Output-Output Correspondence via Agreement by Projection*

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1. Introduction

This paper proposes unifying the independently developed models of Output-Output Correspondence (OO-Corr) for morphophonology and Agreement by Projection (ABP) for phonology, both of which formalize the insight that linguistic units which are similar are intimately connected, a connection which fosters further similarity. I refer to this as OO-Corr via ABP. Agreement by Projection is a recent proposal in Hansson (2014) coming out of the Agreement by Correspondence literature, which states that constraints can enforce agreement of a feature across a 'projection' of segments. The central innovation of this paper is that I extend this notion of 'projection' to sets of outputs (e.g. outputs of a paradigm) over which agreement is enforced (e.g. with respect to root shape, word shape, etc.). I illustrate the OO-Corr via ABP model for different types of output-to-output similarity, including paradigmatic and transparadigmatic OO-Corr types involving networks of output forms. Finally, I argue that OO-Corr via ABP unites two distinct cases in the paradigm uniformity literature: 'majority rules effects' seen in McCarthy's (2005) work on Optimal Paradigms, and 'least marked effects' seen in Steriade's (1999, 2008) work on 'lexical conservatism'.

In total, I make the following claims. First, OO-Corr is split into two types of outputs: matrix outputs which correspond to the primary input-output mapping that is being derived, and base outputs. Second, base outputs derive from base input-output mappings which I refer to as 'basemaps', and exist in a 'base pool'. Third, a matrix output can be in agreement with more than one base in the base pool, supporting previous work on multiple bases (Burzio 1998, Steriade 1999, Kager 2000, Stanton 2015, a.o.). Finally, agreement between matrix and base outputs is enforced via projection constraints of the shape $[\text{Agreement}]_{[\text{Projection}]}$; the projection picks out the relevant influencing bases.

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2. Output-Output Correspondence (OO-Corr)

It has long been observed that morphologically related word forms can display similarity that is unexpected given the larger phonological grammar, dating back at least to pre-generative works such as Kuryłowicz (1945). One current theory capturing such effects is Output-Output Correspondence, hereafter called OO-Corr[1]. Under OO-Corr, an output candidate is both in correspondence with an input and with another output, called the base. Faithfulness constraints can be evaluated along either of these correspondence relations. Consider the English minimal pair from Davis (2005):

(1) *English minimal pair – pre-tonic aspiration vs. flapping*

a. <militaristic> mìli**[tʰ]**arístic (compare míli**[tʰ]**àry <military>)

b. <capitalistic> càpi**[ɾ]**alístic (compare cápi**[ɾ]**al <capital>)

The /t/ in the word <militaristic> is aspirated in (1)a., which is the expected phonological output in pre-tonic position (e.g. Mèdi[tʰ]erránean) and also matches the realization of /t/ in míli[tʰ]àry. We can contrast this to b. where the /t/ in <capitalistic> is realized as a flap [ɾ] rather than the expected [tʰ]. Davis attributes this discrepancy to an OO-Corr relationship between <capitalistic> and its morphologically related form <capital> whose /t/ is realized as a flap [ɾ], expected in this position.

A number of different subtypes of OO-Corr can be identified based on the relationship between the output forms shown in (2) (laid out further in Rolle 2018). I use the term 'matrix output' (M_O) to differentiate it from the corresponding base, the 'base output' (B_O). In (1)b. above, the M_O is <capitalistic> and the B_O is <capital>.

(2) *Types of Output-Output Correspondence*

	Type of OO-Corr	Matrix Output (M_O)		Base Output (B_O)
a.	Classic	X-Y e.g. [ROOT]-AFX	↔	X ROOT
b.	Paradigmatic	X-$Y_{[+F]}$ e.g. [ROOT]-$AFX_{1[+F]}$	↔	X-$Z_{[+F]}$ [ROOT]-$AFX_{2[+F]}$
c.	Transparadigmatic	X-Z-Y e.g. [ROOT-AFX_2]-AFX_1	↔	X-Y [ROOT]-AFX_1

The first type I refer to as 'Classic OO-Corr'. This involves a correspondence relation between a matrix output (candidate) X-Y (e.g. a [ROOT]-AFX construction) and a base output X (e.g. a ROOT). Here, the base output is a subconstituent entirely contained within the matrix output, and is equivalent to the morphological stem. Classic OO-Corr adheres to a conservative definition of a potential base, e.g. Kager's (1999:282) criteria that a base be a freestanding word and that it contain a subset of the grammatical features of the

[1] Some seminal works include Benua (1997), Kenstowicz (1996), Burzio (1998, 2003, a.o.), Kager (1999, 2000), Steriade (1999, 2008, a.o.), Alderete (2001), Downing et al.'s (2005) collection (e.g. McCarthy 2005), among much recent work. Note that I use the term 'correspondence' here for convenience sake; in section 3 I begin to use the term 'projection'.

matrix output. The English example in (1)b. constitutes an example of Classic OO-Corr, where the B_O <capital> is entirely contained within the M_O <capitalistic>.

The second type is 'Paradigmatic OO-Corr' (Par-OO-C), involving correspondence between a matrix output X-$Y_{[+F]}$ (e.g. [ROOT]-$AFX_{1[+F]}$) and a base output X-$Z_{[+F]}$ (e.g. [ROOT]-$AFX_{2[+F]}$). The outputs share a root and the affixes Y and Z share a morpho-syntactic feature [+F], which thereby places them together in a paradigm. Unlike Classic OO-C, the base output is not necessarily strictly contained within the matrix output. Hall & Scott (2007) illustrate Par-OO-C in dialectal German. In several dialects, /s/ becomes [ʃ] before {t/p} (e.g. <post> 'mail' rendered [poʃt]), dubbed '*s*-dissimilation'. Falkenberg German illustrates that *s*-dissimilation is blocked in certain morphological paradigms (Hall & Scott 2007:173). One such context of the underapplication of *s*-dissimilation is the third singular inflected form of the verb <essen> 'eat', which surfaces as [ɛs-t] rather than the expected ^{x}[ɛʃ-t]. Hall & Scott attribute this to an identity relation with morphologically related words in its paradigm, e.g. the INFINITIVE, 1SG, and IMP.SG forms in (3) whose root shape is [ɛs].

(3) *Par-OO-C in Falkenberg German*

[+INFL]:	INFINITIVE	1SG	2SG	**3SG**	IMP.SG	PST.PART
Form:	[ɛs-ən]	[ɛs-ən]	[ɛ-ʃt]	**[ɛs-t] (^{x}[ɛʃ-t])**	[ɛs]	[gəsas]

The third type is 'Transparadigmatic OO-Corr' (Tr-OO-C). This involves correspondence between a matrix output X-Z-Y (e.g. [ROOT-AFX_2]-AFX_1) and a base output X-Y (e.g. [ROOT]-AFX_1). Here, the outputs share the same root as well as the same outer morphology (i.e. AFX_1). However, there are distinct stems: the matrix output has different inner morphology by virtue of having an additional affix, while the base output does not. Tr-OO-C is like Classic OO-C in that the base output is a subset of the matrix output, albeit one which is not a contiguous constituent. Further, Tr-OO-C is like Par-OO-C in that it involves morphological similarity measured based on the outer morphology, albeit one where there is complete identity and not just featural overlap.

Tr-OO-C was proposed in Rolle (2018) to account for anomalous stress patterns in complex verbs in the Bolivian language Ese Ejja, with important precursors in Burzio (1998) and Pariente (2012). Ese Ejja stress patterns can be divided into two groups (Vuillermet 2012, Rolle 2017, Rolle & Vuillermet *in press*, as well as extensive fieldnotes, recordings, and corpora made available by Vuillermet). The first group involves complex verbs consisting of [ROOT + INFLECTION], where the surface position of primary stress is predictable based on [1] root transitivity, [2] idiosyncratic properties of the inflectional affix, and [3] a left edge 3σ window within which primary stress must fall. Inflectional forms are shown below in (4) in the leftmost columns with various roots and affixes. Obligatory inflection includes tense/mood affixes (1-4 in Column A) and 3rd person agreement/indexation *–ka* (found intermittently in column B). Inflectional affixes fall into distinct groups depending on their prosodic properties which include: [1] whether they assign a phonological accent to the initial, ultima, or penult of the stem, [2] whether they are dominant, recessive, or rightmost-preserving, [3] and whether they trigger iambic or trochaic iterative feet. The grammar maps phonological accent to a position of primary stress which always falls within the left-edge 3σ window. The surface form is the one given in column B. See the references above for more information.

(4) *Tr-OO-C in Ese Ejja complex verb stress patterns*

Inflectional		Derivational	
[ROOT-INFL_1-INFL_2]		[ROOT-DER_1-INFL_1-DER_2-INFL_2-DER_3]	
A	B	C	D
Affix	Primary stress	Attested	Predicted
1	[ˈ**kwya**-me]	[ˈ**mo**-hya-me]	^{x}[mo-ˈ**hya**-me]
◌◌́)-me	[baˈ**na**-me]	[siˈ**po**-hya-me]	^{x}[sipo-ˈ**hya**-me]
POTENT1	[pa-ˈ**ka**-me]	[hya-ˈ**ka**-’yo-me]	^{x}[hya-ka-ˈ**’yo**-me]
	[besa-ˈ**ka**-me]	[sipo-ˈ**hya**-ka-me]	^{x}[siˈ**po**-hya-ka-me]
2	[ˈ**be**sa-nahe]	[ˈ**be**sa-’yo-nahe]	^{x}[beˈ**sa**-’yo-nahe]
(◌́◌-nahe	[baˈ**na**-nahe]	[baˈ**na**-’yo-nahe]	✓
PAST	[ˈ**be**sa-ka-nahe]	[ˈ**si**po-hya-ka-nahe]	✓
3	[ˈ**pa**-kyae]	[ˈ**hyo**-hyo-kyae]	^{x}[hyo-ˈ**hyo**-kyae]
◌(◌́-kyae	[baˈ**na**-kyae]	[woˈ**o**-hya-kyae]	^{x}[ˈ**wo**o-hya-kyae]
POTENT2	[ˈ**ba**na-ka-kyae]	[ˈ**i**jya-ka-’yo-kyae]	✓
4	[ˈ**pa**-he]	[ˈ**pwa**-he-’yo]	✓
(◌́◌-he	[ˈ**be**sa-he]	[ˈ**kwa**kwa-kwakwa-he]	✓
FUTURE	[beˈ**sa**-ka-he]	[oˈ**ja**-hya-ka-he]	^{x}[ˈ**o**ja-hya-ka-he]

What is important to take away thus far is that the forms in column B have predictable though quite complex stress patterns, and only contain inflectional affixes.

In contrast are the derivational forms in columns C-D which contain both derivational and inflectional affixes. These constitute the second group of stress patterns. Derivational affixes are boxed, and are interleaved with inflectional affixes. If we follow the stress algorithm for the inflectional forms, we predict the forms in D, which are not the actual output forms, indicated with a superscript ^{x}. The actual attested output forms are in column C, which cannot be generated from the previous algorithm.

The key generalization to this anomaly is that the position of primary stress in the derivational forms (C) matches that of its equivalent inflectional form (B), whether it be on the first, second, or third syllable.[2] This is true in all cells of the paradigm (see Rolle 2018). Note that the position of primary stress need not fall on equivalent morphemes: in the first row, compare the inflectional form [besa-ˈ**ka**-me] in column B with stress on *–ka* to the derivational form [sipo-ˈ**hya**-ka-me] in C with stress on *–hya*, both on the 3^{rd} σ.

These data therefore illustrate Tr-OO-C. Schematically, the derivational forms are of the shape [ROOT-DERIV]-INFL (X-Z-Y) which act as the matrix output, and inflectional forms are of the shape [ROOT]-INFL (X-Y) which act as the base output. These forms are in correspondence by virtue of sharing the same root and inflection, a consequence of which is that the position of primary stress of the base is mirrored in the matrix output.

Tr-OO-C is supported theoretically and empirically in several places in the literature (Buzio 1998, 2003; Pariente 2012 "[there are] correspondence relations between forms of the same Morphological Structure (Italian participles) and even between words sharing a

[2] Note that due corpus restrictions, not all forms match perfectly for the same root. What is given in many case are roots with the same syllable count and transitivity, which are equivalent for our purposes. There are a handful of exceptional roots (of high frequency often), not part of this analysis (see Vuillermet 2012).

suffix"). As argued in Rolle (2018), one case I consider to be Tr-OO-C is overapplication of /l/-to-[i]-vocalization in Brazilian Portuguese, a frequently cited example (Benua 1997:237-240, Bachrach & Nevins 2008). In (5) below, the /l/ in *jornal* 'newspaper' becomes [i] in plural *jorna*[i]*s* before [s]. This root may appear with the diminutive derivational morph *–zinho*, resulting in *jornalzinho*. When this derivational form appears with inflectional *–s*, *l*-vocalization overapplies in the resulting *jorna*[i]*zinhos*, even though /l/ is not before [s]. Schematically, this is also a case where the matrix output is [ROOT-DERIV]-INFL and the base is [ROOT]-INFL, and therefore constitutes Tr-OO-C. The difference is that it is the root shape which is being preserved, rather than primary stress. See Rolle (2018) for discussion of other cases of Tr-OO-C.

(5) *Tr-OO-C in overapplication of Brazilian Portuguese /l/-to-[i]-vocalization*

Ø	*-s* PL	*-zinho* DIM	*-zinho* DIM + *-s* PL
jornal	*jorna*[i]*-s*	*jornal-zinho*	*jorna*[i]*-zinho-s*

3. Agreement by Correspondence (ABC) and Agreement by Projection (ABP)

Agreement by Correspondence (hereafter ABC) is a theory in which [1] segments are assessed as to their similarity along some phonological dimension, [2] sufficiently similar segments are said to be in correspondence (CORR constraints), and [3] those segments which are in correspondence must also be in 'agreement' along some other dimension (IDENT-CC constraints). ABC was originally conceived of for long distance consonant agreement (Rose & Walker 2004), but has since been extended to numerous other phenomena.[3] The basic ABC configuration is in (6), illustrating two consonants in a correspondence relation (C_x) which consequently enter an agreement relationship along some dimension ([$_{\alpha}$F]). A data point from Kikongo exemplifies this configuration (Rose & Walker 2004:510). Here, alveolar sonorants are in correspondence and must consequently agree in nasality, resulting in deviation from the input form.

(6) *Basic ABC configuration*

Correspondence:	C_x V	C_x V	e.g.	/nik -ulu/	[$n_x$ik -un$_x$u]
	|	|			| |
Agreement:	[$_{\alpha}$F]	[$_{\alpha}$F]			[$_{\alpha}$NAS] [$_{\alpha}$NAS]

In the Kikongo configuration, Rose & Walker propose a correspondence constraint CORR-N↔L and an agreement constraint ID-C_LC_R(NAS), ranked above a faithfulness constraint IDENT-OI(NAS). Adapting terminology from Hansson (2014), we can call the standing similarity between two or more segments the 'similarity condition' (here, features [CORONAL,+SONORANT]) and the similarity enforced by agreement the 'similarity imperative' (here, [$_{\alpha}$NASALITY]).

Hansson (2014) proposes a modification to the ABC architecture which he calls 'Agreement by Projection' (hereafter ABP). Hansson's central innovation is to 'conflate

[3] A bibliography of ABC has been compiled here by Stephanie Shih & Sharon Inkelas: http://linguistics.berkeley.edu/~inkelas/ABCBibliography.html

the work of (high-ranked) Corr constraints and CC-Ident[F] into a single constraint' (p. 17). Important to this idea is the concept of 'projection'[4]:

(7) "Any well-defined **class** of segments defines (**projects**) a **subsequence** of the output string, consisting of all and only the segments belonging to that class , e.g. the subsequence of a string *S* which results from 'removing' all **non**-members of the natural class [+F, –G, +H] from *S* " (Hansson 2014:15, bolding his)

For example, Hansson shows several projections of the word <choosiness> /tʃuzinɛs/: [$_{\alpha}$PLACE] tʃ…z…n…s, [+STRIDENT, $_{\alpha}$CONT] …z…s, *etc*. Using projections, the basic ABP configuration is in (8). The agreement and projection relation exists in a single constraint of the type [Agreement]$_{\text{[Projection]}}$, e.g. Hansson's schematic example *[-F][+F]$_{[\alpha G,\beta H]}$ which should be read as 'the projection picked out by [αG,βH] must not disagree for feature [F]'. For the Kikongo example above, the correspondence constraint CORR-N↔L and the agreement constraint ID-C_LC_R(NAS) would be conflated as a single ABP constraint [$_{\alpha}$NAS]$_{\text{[COR,+SON]}}$. Note here that I deviate from Hansson in representing the agreement relation in alpha notation rather than as a co-occurrence restriction.

(8) *Basic ABP configuration*
a. [Agreement]$_{\text{[Projection]}}$ b. *[-F][+F]$_{[\alpha G,\beta H]}$ c. [$_{\alpha}$NAS]$_{\text{[COR,+SON]}}$

By replacing correspondence with projections, Hansson argues this avoids shortcomings of modified versions of transitive or intransitive correspondence, and avoids the 'agreement by proxy' pathology (Hansson 2014:43):

(9) *'Agreement by proxy' pathology:*
Agreement (or dissimilation) between C_x and C_y that is parasitic on the presence of a co-occurring "proxy" segment (C_z)

Under ABC, the consonants in a sequence [saga] are not sufficiently similar along certain phonological dimensions, e.g. place, voicing, continuousness. They therefore are not in correspondence and do not show agreement. In contrast, in a sequence /sagaxa/ the /s/ and /g/ *are* in correspondence by virtue of a proxy segment /x/ which partially shares features with each (continuousness/voicing and place, respectively). As such, the output [z_xag_xax_xa] is optimal where all consonants are in correspondence and consequently can show agreement along some dimension. Under ABP, this pathology does not arise as the projections are each assessed by separate constraints, e.g. [$_{\alpha}$VOICE]$_{\text{[-SON},\alpha\text{PLACE]}}$.

4. Output-Output Correspondence via Agreement by Projection

In this section, I propose to unify the independently developed models of Output-Output Correspondence (OO-Corr) for morphophonology and Agreement by Projection (ABP) for phonology. Both of these models formalize the insight that linguistic units which are

[4] Hansson relates projections to the notion of 'tier' in the Tier-based Strictly Local class in formal language theory (Heinz et al. 2011). Note that Rose & Walker (2004:514-516) originally provided arguments against tier-based approaches within ABC.

similar are connected, a connection which fosters further similarity. There has been some recognition of similarities between OO-Corr and ABC (Hansson 2007:405, fn 8), but no implementation to my knowledge. Whether ABC or ABP has the best coverage is still an open question, as is which best integrates with OO-Corr.

4.1 Core components

The core components of OO-Corr implemented via ABP is shown in (10).

(10) *Components of OO-corr via ABP*

	ABP		OO-Corr via ABP	
Domain:	word	<choosiness> [tʃuzinɛs]	set of derivations	{M_I: /capital-ist-ic/ M_O: [capitalistic], B_I: /capital/ B_O: [capital], …}
Unit:	segments	{tʃ,u,z…}	set of outputs	{[capitalistic], [capital],…}
Asymmetry:	none		M_O vs. B_O(s)	
Projection: (similarity condition)	phono-logical feature	[+STRIDENT]	morpho-syntactic feature	[ROOT],[AFX$_{[+F]}$]
Agreement: (similarity imperative)	phono-logical feature	[$_{\alpha}$ANTERIOR]	phono-logical shape	[. x .] [σ σ σ]
Constraint:	[$_{\alpha}$ANTERIOR]$_{[+\text{STRIDENT}]}$		[. x .] [σ σ σ]$_{[\text{ROOT}],[\text{AFX}[+F]]}$	

The first component is the domain, which for standard ABP is a word (or some such phonological constituent), e.g. <choosiness> [tʃuzinɛs] as above. In OO-Corr via ABP, this is a set of derivations consisting of a set of input-output mappings, minimally consisting of a matrix input-output (M) and one or more base input-output mappings (B). I refer to these latter cases as 'basemaps'. Next, the units over which similarity is assessed and imposed for ABP is the segment (or conceivably any phonological unit of contrast), while for OO-Corr it is the output. Further, in ABP there is no inherent 'asymmetry' between the units (although contextually, those in prominent positions have a greater influence). In contrast in OO-Corr, asymmetry comes 'built in' by virtue of the fact that the matrix I-O mapping is distinct from the basemaps: it is the matrix mapping which is fed from the syntax (or whichever previous module have you) and feeds the phonetic implementation (i.e. articulatory targets), and is part of the communicative intent of the speaker. The base(s) can influence the matrix, but not vice versa.

Furthermore, the projection in ABP is defined by phonological features such as [+STRIDENT]. Informally, the projection captures the 'similarity condition' which is the independent similarity between the units. In OO-Corr, the projection is defined by morphosyntactic features, e.g. sharing [ROOT],[AFX$_{[+F]}$], etc. Note that, conceptually, the projection here need not be exclusively morphosyntactic features. Moving down, agreement in ABP is also defined by phonological features. Informally, this captures the 'similarity imperative' which is the dependent similarity enforced between the units in the projection. In OO-Corr, agreement is defined with respect to the phonological shape of some constituent. Again, conceivably this could be defined morphosyntactically or by lower-level phonological features. Together, these form $[\text{Agreement}]_{[\text{Projection}]}$ constraints, e.g. $[_{\alpha}\text{ANTERIOR}]_{[+\text{STRIDENT}]}$ for ABP and $[\sigma\acute{\sigma}\sigma]_{[\text{ROOT}],[\text{AFX}[+\text{F}]]}$ for OO-Corr.

A central tenet that I adopt is that OO-Corr involves a set of derivations and a set of outputs, meaning that a single matrix mapping can have multiple bases, i.e. the projection targets multiple basemaps. Multiple bases (or 'split base formations') are overtly argued for in Burzio (1998), Steriade (1999), Kager (2000:126), Stanton & Steriade (2014), Stanton (2015), a.o. Specially, Steriade (1999) argues that word properties are 'computed by consulting the entire paradigm of the stem, not a unique base form', recently reaffirmed in Stanton & Steriade's (2014) strong claim that 'all words which are lexically related to it are potential bases'. This latter work promotes a distinction between 'local' and 'remote' bases to account for influence from non-immediate subconstituents, e.g. the secondary stress *apòstolícity* attributable to a remote base *apóstle* (cf. local *àpostólic*).

I refer to the set of derivations acting as potential bases as the 'base pool'. Each matrix input-output mapping has a set of derivations which it is connected to within the base pool, e.g. *capitalistic* has a base pool consisting of words related by root {*capitalist, capital, capitals, capitalism, capitalize*, etc.} but also by affix {*militaristic, materialistic, impressionistic, artistic,* etc.}. Conceivably, this could be any linguistic similarity along any dimension. The role of the projection is to 'pick out' one (or more) of these characteristics, and agreement ensures the proscribed similarity. For our purposes, the base pool corresponds to Steriade's (2008:325) 'derived lexicon'.

4.2 OO-Corr types

Classic OO-Corr is represented by the *capitalistic* case, shown as the first example in (11) below. Here, the constraint $[_{\alpha}\text{Root\_Shape}]_{[\surd\text{ROOT}]}$ is highly ranked, resulting in those outputs which share the same root to 'project', and subsequently agree in root shape (e.g. same footing and realization /t/ as [ɾ]). The relevant projection plane selected by the constraint is highlighted as glowing text. This constraint does not pick out a projection based on the affix, and therefore the word *militaristic* does not impose any influence.

The next example involves Par-OO-C from the dialectal German data from (3). Here, the constraint $[_{\alpha}\text{Root\_Shape}]_{[\surd\text{ROOT}][+\text{INFL}]}$ results in outputs which share both the same root and share an inflectional feature. The exact feature is left unspecified here; I use a placeholder [+INFL]. Like with the English example, uniform root shape is enforced along this projection, resulting in the underapplication of *s*-dissimilation.

The final two examples in (11) below involve Tr-OO-C where a [ROOT-INFL] form exerts influence on a [ROOT-DERIV-INFL] form. The first case involves Ese Ejja data from (4), where a constraint $[_{\alpha}\text{Stress\_Melody}]_{[\surd\text{ROOT}][\alpha\text{INFL}]}$ assesses uniformity of the stress melody (i.e. position of primary stress as defined from the left edge of the word) within the projection. Here, the second output in the base pool is not part of the projection as it contains an inflectional affix *–nahe* PAST not found in the other outputs; it therefore does not influence the position of stress. The constraint requires inflection be exactly identical.

The second Tr-OO-C case involves the Brazilian Portuguese data from (5). Here the projection is the same, but what is being enforced is root shape identity, resulting in the overapplication of /l/-to-[i] vocalization. As in the other Tr-OO-C case, the [ROOT-DER] or [ROOT] forms do not exert influence on root shape, as they do not share inflection.[5]

(11) *Exemplification of OO-Corr via ABP (projection = glowing text)*

Type	**Matrix**	**Base pool** (condensed)		
Classic OO-C	*capitalistic* [(kæ̀.pɪ.ɾə).(lɪ́.stɪk)]	*capital* [(kǽ.pɪ.ɾəl)]		*militaristic* [(mɪ̀.lɪ).{tʰə(ɹɪ́.stɪk)}]
Ex. (1)	Constraint: $[_{\alpha}\text{Root\_Shape}]_{[\sqrt{\text{ROOT}}]}$			
Par-OO-C	ROOT-3SG [ɛs-t]	ROOT-INF [ɛs-ən]	ROOT-1SG [ɛs-ən]	ROOT[IMP.SG] [ɛs]
Ex. (3)	Constraint: $[_{\alpha}\text{Root\_Shape}]_{[\sqrt{\text{ROOT}}][+\text{INFL}]}$			
Tr-OO-C	ROOT-DER-INFL$_1$-INFL$_2$ [sipo-ˈhya-ka-me]	ROOT-INFL$_1$-INFL$_2$ [sipo-ˈka-me]		ROOT-DER-INFL$_1$-**INFL$_3$** [ˈsipo-hya-ka-nahe]
Ex. (4)	Constraint: $[_{\alpha}\text{Stress\_Melody}]_{[\sqrt{\text{ROOT}}][\alpha\text{INFL}]}$			
Tr-OO-C	ROOT-DER-INFL *jorna*[i]*-zinho-s*	ROOT *jornal*	ROOT-DER *jornal-zinho*	ROOT-INFL *jorna*[i]*-s*
Ex. (5)	Constraint: $[_{\alpha}\text{Root\_Shape}]_{[\sqrt{\text{ROOT}}][\alpha\text{INFL}]}$			

Three of these ABP constraints involve agreement in root shape, but it is also possible to involve agreement in the shapes of other morphemes or of the stem shape. Consider Kenstowicz's (2005) discussion of paradigm uniformity in Spanish diminutives (2005:147-150). The diminutive has two allomorphs: /–sit/ if the word ends in {r,n} (12)a., and /–it/ if it ends in a vowel (12)b. This phonological requirement can be 'overridden' if two diminutive forms are paradigmatically related, as in c. In our terms, the matrix output [raton-sit-a] (f.) agrees in stem shape with a base [raton-sit-o] (m.).

(12) *Spanish stem shape agreement*

a. limón > limon-**sit**-o 'lemon (dim)'

b. koron-a > koron-**it**-a 'crown (dim)'

c. ratón > raton-**sit**-o 'mouse (dim)' (m.)
raton-a > raton-**sit**-a 'mouse (dim)' (f.)

4.3 Majority rules effects and lexical conservatism

Deriving OO-Corr via ABP can also unite two distinct cases in the paradigm uniformity literature: majority rules effects and lexical conservatism. Majority rules effects are presented in McCarthy (2005:202-206) for Moroccan Arabic, whereby 'the pattern that is most common in a paradigm acts as an attractor to other paradigm members'. $C_1C_2C_3$ sequences are broken up by a schwa, whose distribution in nouns is determined by the

[5] Another example of Tr-OO-C which could be modeled with ABP is Pariente's (2012) 'grammatical paradigm uniformity' in Modern Hebrew pharyngeal vocalization.

sonority conditions. If $C_2 > C_3$ in sonority, then the output is [C_1əC_2C_3], e.g. /klb/ [kəlb] ‘dog’ (cf. /ktf/ [ktəf] ‘shoulder’). Unlike nouns, however, with verbs only the [C_1C_2əC_3] pattern is available regardless of sonority, e.g. the minimal pair /ʃrb/ [ʃərb] ‘drinking, love of alcoholic drink’ (n.) vs. [ʃrəb] ‘he drank’ (v.).

McCarthy takes this as evidence for ‘optimal paradigms’ in which candidates consist of ‘entire inflectional paradigms’. These paradigm candidates are evaluated against the constraint set (with violations accumulated) and each paradigm member is in correspondence with every other member. The perfective paradigm with ‘drink’ is in (13), where candidate a. consists of the form [ʃrəb] for ‘he drank’, while candidate b. consists of the form [ʃərb]. Candidate a. is optimal because it incurs the fewest violations of the optimal paradigms constraint OP-Max-V, which essentially means that it has a more uniform paradigm (5 of the 7 forms have the shape [ʃrəb]). This can be understood as a type of Par-OO-C. In contrast, candidate b. incurs more violations here (now 4 of 7 forms have [ʃrəb]) and is eliminated, even though it does not incur violations of the lower ranked sonority condition. Note that absolute paradigm uniformity for root shape is not possible due to markedness constraints against schwa in open syllables *ə]$_σ$ and *CCC.

(13) *Tableau illustrating majority rules effects – Optimal Paradigms (OP)*

		/ʃərb/+{Ø,t,ti,ət,na,tu,u}	*ə]$_σ$	*CCC	OP-Max-V	SonCon
a.	☞	<**ʃrəb**, ʃrəbt, ʃrəbti, ʃərbət, ʃrəbna, ʃrəbtu, ʃərbu>			(20)	(1)
b.	~	<**ʃərb**, ʃrəbt, ʃrəbti, ʃərbət, ʃrəbna, ʃrəbtu, ʃərbu>			W (20~24)	L (1~0)

One conceptual issue with optimal paradigms is that the contents of the input and output mark a radical departure from standard practice. Here, it would not be possible to say that this input-output mapping is part of a derivation as normally conceived, e.g. which of the seven forms would be concatenated within a larger utterance? It is further not compatible with the assumption that the input is fed from morphosyntax and subsequently feeds a phonetic implementation, without substantial modification to derivational architecture. I advocate, instead, that the majority rules effects can be equally captured with the OO-Corr via ABP model proposed here.

The tableau in (14) illustrates this reinterpretation of the Moroccan Arabic analysis.

(14) *Tableau illustrating majority rules effects via ABP*

Matrix		ROOT[3.M.SG.PF] /ʃərb/	*ə]$_σ$	*CCC	[$_α$Root_Shape]$_{[\sqrt{ROOT}][+INFL]}$	SonCon
a.	☞	[ʃrəb]			(2)	(1)
b.	~	[ʃərb]			W (2~4)	L (1~0)
Base Pool		ROOT-1.C.SG.PF [ʃrəb-t]	ROOT-2.C.SG.PF [ʃrəb-ti]	ROOT-3.F.SG.PF [ʃərb-ət]		…
		ROOT-1.C.PL.PF [ʃrəb-na]	ROOT-2.C.PL.PF [ʃrəb-tu]	ROOT-3.C.PL.PF [ʃərb-u]		…

The matrix input-output mapping consists of standard, single form output candidates which are evaluated against the constraints. The OP constraint has been replaced with a projection constraint $[_{\alpha}\text{Root\_Shape}]_{[\sqrt{\text{ROOT}}][+\text{INFL}]}$, which requires identical root shapes within the projection. Candidate a. is optimal as its root shape matches 4/6 forms in the base pool (2 violations), compared to candidate b. (4 violations).

This analysis lends support to the literature cited above arguing for multiple bases. However, it is distinct in that there is no dedicated constraint enforcing correspondence to a particular type of base. Compare this to Stanton (2015), in which correspondence to a particular type of base is enforced via CORR constraints, e.g. CORRB_{L} enforces correspondence to a local base (immediate syntactic subconstituent), and CORRB_{R} to a remote base (≈ stem in isolation). The implications of the differences between my analysis and Stanton's are yet to be explored.

Further, minimally adjusting ABP will allow us to account for 'lexical conservatism' effects, as well (Steriade 1999). Lexical conservatism is proposed to account for why languages tend to 'reuse' the same forms of morphemes, and is defined in (15).

(15) *Lexical conservatism*: Property P of a novel form of morpheme μ has a precedent in property P of a listed form of μ

Lexical conservatism accounts for why French uses feminine forms of adjectives with masculine nouns to avoid hiatus (e.g. [nuvɛl ami] 'nouvelle$_{[\text{FEM}]}$ ami$_{[\text{MASC}]}$'), rather than hypothetical repairs that would create new allomorphs, i.e. ^{x}[**nuv** ami] or ^{x}[nuvo-**t**-ami].

A case study involving paradigmatic uniformity from Romanian palatalization is below, from Steriade (2008). Derivational suffixes such as /-ist/ trigger palatalization of stem-final velars on only some roots, e.g. compare /stɨŋg-ist/ [stɨndʒ-ist] 'leftist' to non-palatalized /fok-ist/ [fok-ist] 'locomotive engineer' (lit. 'fire-ist'). The application of palatalization can be predicted on whether the root undergoes palatalization somewhere else within its inflectional paradigm, what Steriade calls 'inflection dependence'. To exemplify, the plural form of /fok/ 'fire' is [fók-uri] while the plural form of /stɨŋg/ 'left (hand)' is [stɨndʒ-i̯]. The former's plural suffix does not trigger palatalization and therefore no palatalization is licensed in the derivational form, while the latter's does trigger palatalization, licensing palatalization more widely.

Steriade presents a constraint $\text{Ident}_{\text{lex}}[\alpha\text{F}]$ to account for these facts:

(16) *Definition of* $\text{Ident}_{lex}[\alpha F]$ *(Steriade 2008:331):*
For any segment s in a sub constituent C of an expression under evaluation, if s is [αF] then s has an [αF] correspondent in a listed allomorph of C

In short, this constraint curtails the use of new allomorphs and captures the 'lexical conservatism' insight. Crucially, this constraint must be ranked higher than the markedness constraint against [VELAR + FRONT VOWEL] sequences, *KE.

Updating to our ABP analysis, I use a projection constraint in place of the $\text{Ident}_{\text{lex}}$ constraint. In doing so, however, I modify the ABP constraint $[\text{Agreement}]_{[\text{Projection}]}$. (17)a. below modifies the constraint by saying that the agreement is from a base output to a matrix output candidate, notated with $\text{B}_{\text{O}}\text{M}_{\text{O}}$. Essentially this states that the relevant feature (e.g. root shape) of *every* base in the base pool must also be in the matrix output, resulting in majority rules effects. The constraint used for the Moroccan Arabic data in

(14) can be updated as $B_OM_O[_\alpha\text{Root\_Shape}]_{[\sqrt{\text{ROOT}}][+\text{INFL}]}$, which states that the root shape of every (projected) base must be found in the matrix output. In contrast, (17)b. modifies the constraint with the reverse M_OB_O, stating that agreement is from a matrix output to *at least one* base output. This essentially states that the relevant feature (e.g. root shape) of the matrix output must be found in a base in the base pool, but not necessarily every base.

(17) *ABP constraints (updated)*

a. $B_OM_O[\text{Agreement}]_{[\text{Projection}]}$: Within the projection P, there must be agreement along dimension D between a base output B_O and a matrix output candidate M_O

b. $M_OB_O[\text{Agreement}]_{[\text{Projection}]}$: Within the projection P, there must be agreement along dimension D between the matrix output candidate M_O and at least one base output B_O in the base pool

I illustrate these differences in the tableaux below in (18), using the Romanian data.

(18) *Romanian tableaux*

Matrix		ROOT-DER /fok-ist/	$MB[_\alpha\text{Shape}]_{[\sqrt{\text{ROOT}}]}$	*KE	Ident-IO(velar)	$BM[_\alpha\text{Shape}]_{[\sqrt{\text{ROOT}}]}$
a.	☞	[fok-íst]		(1)		
b.	~	[fotʃ-íst]	W (0~1)	L (1~0)	W (0~1)	W (0~3)

Base Pool	ROOT[SG]	ROOT-PL	DER-ROOT-DER	…
	[fók]	[fók-uri̯]	[ɨn-fok-á]	
	'fire'	'fires'	'fire up'	

Matrix		ROOT-DER /stɨŋg-ist/	$MB[_\alpha\text{Shape}]_{[\sqrt{\text{ROOT}}]}$	*KE	Ident-IO(velar)	$BM[_\alpha\text{Shape}]_{[\sqrt{\text{ROOT}}]}$
a.	☞	[stɨndʒ-íst]			(1)	(2)
b.	~	[stɨŋg-íst]		W (0~1)	L (1~0)	L (2~1)

Base Pool	ROOT-SG	ROOT-PL	ROOT-DER	…
	[stɨ́ŋg-ʌ]	[stɨ́ndʒ-i̯]	[stɨŋg-átʃ]	
	'left (hand)'	'left' (pl.)	'lefty'	

The first tableau from Romanian above derives the [fok-íst] form without palatalization. The constraint $MB[_\alpha\text{Shape}]_{[\sqrt{\text{ROOT}}]}$ enforces that the matrix output be in agreement in root shape with at least one base member, which candidate a. does. In contrast, candidate b. with palatalization does not agree in root shape with a base and therefore violates this constraint, even though it satisfies the *KE markedness constraint. This results in the lexical conservatism effect.

Compare this to the second tableau involving [stɨndʒ-íst]. Both candidates a. and b. agree in root shape with at least one base in the base pool, and therefore the lower ranked

*KE plays a role. This is a 'least-marked effect' in that the base which is agreed with results in the least marked matrix output. As Steriade discusses, we therefore predict that base pools with a large number of allomorphs will result in less marked matrix outputs under ABP, a testable hypothesis given a sufficient typological sample. Note that the second tableau shows that the BM[$_{\alpha}$Shape]$_{[\sqrt{\text{ROOT}}]}$ must be low ranked to avoid a 'majority rules' effect, as [stɨŋg] shape is the most common in the (condensed) base pool.

Modifying the projection constraints as such exploits the already existing asymmetry between matrix outputs and base outputs. These data also reveal a mini ABP typology involving the ranking of M_OB_O[AGR]$_{[\text{PROJECT}]}$ constraints, B_OM_O[AGR]$_{[\text{PROJECT}]}$ constraints, and markedness constraints, deriving paradigm uniformity effects such as majority rules effects and least-marked effects.

(19) *ABP typology*

a. Majority Rules: B_OM_O[AGR]$_{[\text{PROJECT}]}$ >> Mark

b. Least-Marked: M_OB_O[AGR]$_{[\text{PROJECT}]}$ >> Mark >> (B_OM_O[AGR]$_{[\text{PROJECT}]}$)

5. Conclusion

This paper has proposed unifying the independently developed models of Output-Output Correspondence and Agreement by Projection, both of which formalize the insight that linguistic units which are similar are intimately connected, a connection which fosters further similarity. I referred to this as OO-Corr via ABP. This current work is part of a larger discussion of what it means to have 'multiple bases' which influence surface forms, i.e. what is the relevant typology, the limits, and the constraints to derive this influence? What can go into the base pool also will undoubtedly affect the typology, especially with respect to 'majority rules effects', e.g. allowing morphologically distinct but phonologically identical forms (e.g. all forms in the past tense paradigm in English are identical). Furthermore, should the influence of bases be gradient, depending on independent factors such as frequency (Stanton & Steriade 2014) or global similarity across projections? These questions and more should be addressed in future work.

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