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PAPER

THE GRAMMAR OF SHORTENING: EXPLORATIONS IN CORRESPONDENCE[1]

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The shortening of linguistic expressions naturally involves some sort of correspondence between short forms and (some portion of) the respective full forms. Based mostly on data from English and Hebrew this article explores the hypothesis that such correspondence concerns necessary sameness of symbolic form, referring either to graphemic or to a specific level of phonological representation. That level indicates a degree of abstractness defined by language-specific contrastiveness (i.e. "phonemic"). Reference to written form can be shown to be highly systematic in certain contexts, including cases where full forms consist of multiple stems. Specific asymmetries pertaining to the targeting of material by correspondence (e.g. initial vs. non-initial position) appear to be alike for both types of representation, a claim supported by a study based on a nomenclature strictly confined to writing (chemical element symbols).

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Shortening, abstractness, correspondence, phonemic representation, graphemic representation

INTRODUCTION

The shortening of linguistic expressions, whether spoken or written, involves a reduction of structure while still maintaining some link to the full form. The link can be conceived of in terms of correspondence, that is, a required match between specific aspects of structure present in the full form and structure present in the respective shortening. That sort of correspondence is often referred to as OO-CORRESPONDENCE ("output-output correspondence") in Optimality Theory (Benua 1995, 1997), an extension of the previously established notion of IO-CORRESPONDENCE ("input-output"), which relates underlying and surface forms.

The notion of OO-CORRESPONDENCE is similar to the familiar concept of paradigm uniformity, which requires morphologically related words to exhibit matching structure. Assuming a single phenomenon here, I will use the term "correspondence" to express a constraint requiring structural identity in morphologically related words, including base-derivative relations. The notion of correspondence then expresses symmetry, reflected in the mirror image constraints stated in (1), despite the asymmetry inherent in the notion of a base in word formation (i.e. the creation of new words based on already existing words).[2]

(1)a. BD-CORRESPONDENCE "Every part of the representation of the base must have a correspondent in the derived form"
b. DB-CORRESPONDENCE "Every part of the representation of the derived form must have a correspondent in the base"

2 See Potts and Pullum (2002) for discussion of why the notion of OO-CORRESPONDENCE is highly problematic in the framework of Optimality Theory, whereas the notion of paradigm uniformity (which subsumes BD-CORRESPONDENCE) is not.

Whereas BD-CORRESPONDENCE is often satisfied in concatenative morphology**,** it is by definition violated in shortenings. Two approaches to capturing relevant violations are sketched in (2). One involves crucial domination of BD-CORRESPONDENCE by a constraint limiting or even precisely determining the size or shape of the shortened form (see (2a)). The other involves domination of a general constraint *STRUCTURE, which prohibits structure altogether (Prince & Smolensky 1993:25)[3], by a BD-CORRESPONDENCE constraint targeting "salient" structure, as in (2b). The effect is that only certain salient parts of structure, for instance those associated with prominent positions, emerge in the shortened form. (Relevant constraints are stated in (2c).)

(2)a. SIZE/SHAPE >> BD-CORRESPONDENCE
b. BD-CORRESPONDENCE$_{SAL}$ >> *STRUCTURE
c. BD-CORRESPONDENCE$_{SAL}$ "Parts of the representation of the base characterized by salience must have a correspondent in the derived form"
*STRUCTURE "No structure!"

Correspondence naturally presupposes the existence of representations to be compared, including, in case of reference to for instance main stressed syllables, the presence of relevant prosodic structure. Correspondence, understood as requiring *sameness* of structure, moreover presupposes symbolic representation.[4] This point is of considerable theoretical significance as various phonological theories differ strongly regarding the role of representations and, to the extent that they are recognized to begin with, the criteria for determining the choice of symbols. For example, the theory of Generative Phonology is characterized by a focus on non-correspondence in morphologically related words (known as "alternation"), which in that theory motivates the assumption of unique underlying representations. Hence the (phonemic) alternations observed in cognates such as (ˈnɛičəɹ)$_{\omega}$ 'nature', (ˈnæčəɹəl)$_{\omega}$ 'natural', perhaps also (ˈnɛitɪv)$_{\omega}$ 'native',

3 Prince & Smolensky (1993:25) credit Cheryl Zoll for proposing that constraint.
4 Sameness is naturally excluded for physical sound properties.

(ˈnæsənt)$_{\omega}$ 'nascent', are said to motivate a uniform root, perhaps |nāt|, from which all of the surface alternations are derived by successive applications of morphological and phonological rules. The derivations end in representations consisting of segments which are part of the "universal phonetic alphabet", a notion aiming at perceivable and hence potentially grammatically significant sound differences (Chomsky 1964). The model of Generative Phonology then includes two so-called "designated" levels of representation, the "underlying" and the "last" phonetic level, along with any number of "non-designated" intermediate levels consisting of the respective outputs of successive rule applications (Chomsky & Halle 1968, McCarthy 2007).

In sharp contrast to the assumptions made in Generative Phonology, an earlier view known as "autonomous phonemics" bans reference to related words when determining phonological representations. Instead, the decisive criterion is language-specific distinctiveness, which sets relevant structures apart from both "underlying" and "phonetic" representations (Bloomfield 1933:128, 129). The separation between phonemic representation and subphonemic phenomena, referred to as "phonetic implementation" in (3), has been motivated by a dichotomy of antipodal properties (cf. Liberman 1983).[5]

(3)a.	**Phonemic representation**	b. **Phonetic implementation**
	static	dynamic
	discrete	gradient
	finite	infinite
	possible lexical exceptions	no lexical exceptions

Whereas phonemic representation is characterized by a potential for choice and consequent potential for distinguishing meaning, phonetic implementation is

5 In at least one of the theories evolving from Generative Phonology, so-called "Lexical Phonology", a level which roughly corresponds to a "phonemic" level is recognized as a designated level, marking the transition from lexical to post-lexical phonology (Kiparsky 1982, Mohanan 1986). The relevant representation in that theory is then not determined autonomously, but rather is understood as a particular stage in the derivation.

characterized by automaticity, where processes are conditioned entirely by context.[6] Relevant processes are moreover confined to those affecting the timing and magnitude of articulatory gestures, whose targets, characterized by staticness, discreteness, finiteness, associate with the phonemic level. While the latter characteristics go together naturally with the concept of symbolic representation, those attributed to the subphonemic level (dynamicity, gradience, infinity) are arguably antithetical to that concept.

Correspondence phenomena have the potential to shed light on the controversies pertaining to abstractness levels and specifics of symbolic representation. Consider again cognates such as *naturally* and *nature*, assumed to have uniform underlying representations by some, but, due to the contrastiveness of the vowel alternation (cf. (f**æ**t)$_{\omega}$ 'fat' – (f**ɛi**t)$_{\omega}$ 'fate'), associate with distinct phonemic stem structure in the view of others (cf. (4a)). Significantly, "autonomously" determined representations for relevant short forms shown in (4b) differ as well, corresponding perfectly with the phonemic differences established for the full forms:[7]

(4)a.	(ˈ**næč**əɹəli)$_{\omega}$ 'naturally' (ˈ**nɛič**əɹ)$_{\omega}$ 'nature'	b.	(ˈ**næč**)$_{\omega}$ 'natch' (ˈ**nɛič**)$_{\omega}$ 'naitch'[8]

6 Phonetic implementation is subject to universal restrictions in that certain contexts are associated with the potential enhancement of articulatory gestures linked to phonemes, while other contexts are associated with the potential weakening and reduction of such gestures. Enhancement is manifest in the lengthening of vowels in stressed syllables or the aspiration of voiceless plosives in foot-initial position (aspiration involves further widening of the open glottis, where openness is conditioned by the feature [-voice] (Catford 1988)). Weakening can be illustrated by the flapping of plosives in foot-internal position or the reduction of vowels in unstressed syllables (Browman & Goldstein 1995, Krakow 1999).

7 The alveopalatal voiceless affricate is represented with the symbol /č/, rather than the IPA symbol /tʃ/, to highlight the monophonemic status of the relevant sound in English. The same motivation applies to the use of /ǰ/ instead of the IPA symbol /dʒ/, to represent the alveopalatal voiced affricate.

8 While *natch* is a common shortening of *naturally*, the word *nature* lacks a well-known short form. Nonetheless it seems clear that such a form would include the diphthong /ɛi/ of the full form rather than any other vowel. Internet data confirm this claim, in particular, the spelling *Naitch* for *Nature Boy* (https://thesportsrush.com/wwe-news-ive-said-some-sht-youve-said-some-sht-wwe-hall-of-famer-reveals-he-had-heat-with-ric-flair/).

Systematic satisfaction of DB-CORRESPONDENCE as in (4) indicates the existence of the representations in question, thereby supporting the criteria for determining them (i.e. language-specific contrastiveness). Similarly, shortenings can be used as a window on various controversies pertaining to phonemics. Consider the question of how to represent a phonemic contrast in neutralization contexts, either by some sort of "archiphoneme" (i.e. by underspecification, Trubetzkoy 1936) or, alternatively, by identifying the relevant opposition member and fully specifying it. For instance, there is a voicing contrast between /s/ and /z/ in English, as in (bʊs)$_{\omega}$ 'bus' versus (bʊz)$_{\omega}$ 'buzz', but within the phonological word that contrast is suspended to achieve voicing harmony with the phoneme in following onset. Hence voiceless /s/ is banned before voiced onsets (cf. *lesbian* shown in (5a)), while voiced /z/ is banned before voiceless onsets (cf. *sister* in (5b)). Significantly, the respective shortenings in the righthand column show systematic correspondence regarding voice, whether voicing is contrastive as in (5c,d) or not. This indicates that phonemic representations include fully specified /s/ or /z/, regardless of the context in which they occur:

(5)a.	(ˈ**lɛz**biən)$_{\omega}$ 'lesbian'	(ˈ**lɛz**)$_{\omega}$ 'lez'
b.	(ˈ**sɪs**təɹ)$_{\omega}$ 'sister'	(ˈ**sɪs**)$_{\omega}$ 'sis'
c.	(ˈ**spæz**əm)$_{\omega}$ 'spasm'	(ˈ**spæz**)$_{\omega}$ 'spaz'
d.	(ˈ**ɡæsə**‧lin)$_{\omega}$ 'gasoline'	(ˈ**ɡæs**)$_{\omega}$ 'gas'

The data in (4) and (5) then suggest that phonological grammar refers to phonemic representations, consisting of fully specified phonemes determined on the basis of language-specific contrast. Correspondence is evaluated by simply checking absolute sameness of relevant symbolic representations.

This view is complicated by the apparent possibility of reference to graphemic representation, which can be illustrated with the shortening of the adjective *upper-class* in British English shown in (6). (The fish angle brackets mark graphemic structure.)

		Full form	Short form
(6)a.	Phonological representation:	(ɐpəɹ)$_{ω}$(klɑs)$_{ω}$	(iu)$_{ω}$[9]
b.	Graphemic representation:	⟨upper-class⟩	⟨U⟩

A comparison of the phonological representations in (6a) indicates a complete lack of correspondence. The graphemic representations, on the other hand, satisfy DB-CORRESPONDENCE, provided that case-differences, that is, lower- versus upper-case letters, do not hinder the establishment of sameness. A possible general criterion for assessing sameness with respect to graphemes lies in conventions concerning the associations of graphs with the same letter name, such as {⟨u⟩, ⟨U⟩, …} → [iu]$_{N}$, {⟨h⟩, ⟨H⟩, …} → [ɛič]$_{N}$, {⟨g⟩, ⟨ɡ⟩, ⟨G⟩, …} → [ǰi]$_{N}$.[10]

Given the association of both the initial letter in ***u**pper-class* and the letter **U** with the same letter name, correspondence can be established at the graphemic level in (6b). Reference to graphemes in connection with this shortening is unmistakably indicated by its phonological representation, which indicates a mapping of the grapheme to the relevant letter name, which in turn is mapped to a phonological word (i.e. ⟨U⟩ → [iu]$_{N}$ → (iu)$_{ω}$). Assuming then that the original shortening affected the written representation, the formation in (6) is consistent with the hypothesis stated below:

(7) *Correspondence Hypothesis pertaining to Shortenings* (CHS)

> The portions standing in correspondence in the relation between a full form and its respective "proper" shortenings exhibit sameness of symbolic structure, pertaining to phonological representation associated with a specific level of phonological abstractness (i.e. "phonemic") and/or graphemic representation.

9 In English the vowel /i/ regularly forms an onset when followed by /u/, which associates with the nucleus.

10 The question of which graphs belong to a single grapheme, to be associated with a unique letter name, appears to be largely specific to the Roman alphabet. The respective letter names, however, are language-specific. (Compare the English letter names with the bold-faced nouns established in German: {⟨u⟩, ⟨U⟩, …} → [**u**]$_{N}$, {⟨h⟩, ⟨H⟩, …} → [**hɑ**]$_{N}$, {⟨g⟩, ⟨ɡ⟩, ⟨G⟩, …} → [**ɡe**]$_{N}$).

It appears that primary reference to phonological versus graphemic representation is largely determined by properties of the full form: full forms consisting of a single word typically yield truncations featuring contiguous phonological structure, where correspondence predominantly refers to phonological form, whereas full forms consisting of multiple words are typically shortened with reference to (non-contiguous) graphemic form. The hypothesis is that there is no reference to any other sort of structure ("underlying" or "phonetic"), nor are there exceptions to the requirement for sameness (here the restriction to shortenings "proper" is important (see section 1.4)).

The empirical verifiability of the CHS is in many cases straightforward. In particular, reference to written form allows for a clear-cut assessment of correspondence, given the criterion concerning the association of letters with their respective names (i.e. letters mapping to the same name correspond, others do not correspond). Reference to phonological form is far less accessible but here, too, establishing corresspondence is in many cases uncontroversial (e.g. (5c,d)). The sort of regularity seen there then allows for the phonological forms of shortenings to be used as a heuristic for inferring less accessible or controversial aspects of the respective phonological representations of the full form (e.g. the voicing contrast seen in the shortenings in (5a,b)).

Shortening data and the possible empirical adequacy of the hypothesis in (7) are then of particular value in shedding light on the mental representations of words. They arguably support a degree of phonological abstractness based on language-specific contrast, where words are represented as strings of fully specified phonemes associated with prosodic structure (see section 1). Such structures are motivated independently by restrictions pertaining to phonetic implementation and the resulting limits on phonetic variation: a potential for enhancement of phonemically encoded structure only in prosodically strong positions compared to a potential for weakening only in weak

positions (see footnote 6).[11] Shortenings shed light not only on types of representations (phonological, graphemic) and abstractness levels but also on structural peculiarities. Here patterns pertaining to parts of full forms to be "preserved" in the shortening offer additional insight into segmental structure (salience) and prosodic prominence.

The article is organized as follows. Section 1 discusses various issues concerning the claim that shortenings are characterized by complete correspondence pertaining to either phonemic or graphemic representation. Section 2 presents a case study of abbreviations pertaining to a finite nomenclature involving written representations only. Section 3 addresses the role of correspondence in Hebrew shortenings, where both phonological and written representations are involved.

1 CORRESPONDENCE IN SHORTENINGS

This section aims to draw attention to various issues relevant to correspondence mostly illustrated with data from American English.[12] Section 1.1. focuses on phonological abstractness while section 1.2. investigates issues pertaining to written forms. Section 1.3. examines generalizations pertaining to the material in full forms targeted by correspondence. Section 1.4. briefly discusses particular exemptions from the CHS stated in (7), to do with linguistic function (Bühler 1934).

11 This sort of restriction on allophony does not pertain to written forms, where the observable differences in visual shape (e.g. ⟨a⟩, ⟨ɑ⟩, ⟨A⟩) are not derivable from the same abstract unit.

12 The data include a wikipedia website listing common abbreviations in English (https://en.wikipedia.org/wiki/List_of_English_abbreviations_made_by_shortening_words), lists of clippings in a dictionary of American slang (Wentworth & Flexner 1975), and entries in Wells (1990). The use of shortening corpora is hampered by the fact that native speakers often quite vehemently reject various entries listed there. The approach taken here is to include only short forms that are well-established and listed in standard dictionaries (*The American Heritage Dictionary of the English Language*).

1.1 ABSTRACTNESS IN PHONOLOGICAL REPRESENTATION

Correspondence effects in word formation are established by demonstrating regularities indicative of systematic "sameness" in the relation between words. A much-cited example concerns the vowel quality in truncations including the low front vowel /æ/ in certain dialects of American English (Ferguson 1972, Kahn 1976, Benua 1995, 1997). Historically, the pronunciation of that vowel has changed in stressed syllables before certain coda consonants, while being unaffected in other contexts. The outcome of this change, known as "æ-tensing", is represented with capitalized [E] in (8a):

(8)a. before certain coda consonants:	b. before other coda consonants	c. before onset consonants
- fricatives (e.g. [lEf] 'laugh')	[kæč] 'catch'	[bæfəl] 'baffle'
- voiced stops (e.g. [bEd] 'bad')	[bæt] 'bat'	[ɹædɪʃ] 'radish'
- nasals /m/, /n/ (e.g. [hEm] 'ham')	[hæŋ] 'hang'	[hæməɹ] 'hammer'

The relevant correspondence effect concerns truncations of the type shown in (9b), which end in one of the consonants associated with æ-tensing (i.e. fricatives, voiced stops, /m/, /n/). Significantly, the vowel quality in the truncated forms corresponds to that in their base (9a), thereby deviating from the sound in comparable underived words as in (9c):

(9)a.	b.	c.
[ˈǰænəs] 'Janice'	[ˈǰæn] 'Jan'	[ˈb**E**n] 'ban'
[ˌmæsəˈčusəts] 'Massachusetts'	[ˈmæs] 'Mass'	[ˈm**E**s] 'mass'
[ˈpæmələ] 'Pamela'	[ˈpæm] 'Pam'	[ˈh**E**m] 'ham'

While the sort of sameness observed in (9a,b), which involves deviation from regular sound patterns, clearly motivates a constraint requiring correspondence of phonological structure, there is a question of what exactly is targeted by that constraint. As for the effect in (9), it has been suggested that the relevant representations include allophonic structure (Benua 1997:181, footnote 100), which is affected directly by correspondence

constraints. The term "allophony" presupposes recognition of a more abstract level of phonemic structure, with respect to which allophones are defined. The effect can be depicted as in (10), where downward arrows indicate the mapping from the phonemic to the phonetic (allophonic) level. Recall the motivation of that level based on perceptual discrimination, where the distinct phonetic symbols [æ] versus [E] in (9) are intended to capture auditory differences. Correspondence is manifest in the 'transfer' of the phonetic vowel quality from the base *Janice* to the shortening *Jan*, which as a result no longer rhymes with underived words like *ban*. (Relevant material affected by BD-CORRESPONDENCE is boldfaced.)

(10)	phonemic level:	(ˈǰænɪs)$_{\omega}$	(ˈǰæn)$_{\omega}$	(ˈbæn)$_{\omega}$
		↓	↓	↓
	phonetic level:	[ǰæ̃nɪs]	[ǰæ̃n]	[bẼn]
		'Janice'	'Jan'	'ban'

The claim that correspondence affects allophonic sound properties directly is of major theoretical significance as it motivates the recognition of a subphonemic level of representation in accordance with the view of Generative Phonology. That level includes all distinctions typically represented in narrow phonetic transcriptions, including regressive nasalization of vowels in American English. Assuming such a level of phonetic representation the data in (9) could be captured by the grammar in (11), where BD-CORRESPONDENCE dominates the markedness constraint *æ/æ̃$_{\text{CONTEXT}i}$ (No lax low front vowel in CONTEXT$_i$ (i.e. a stressed syllable closed by a voiced stop, fricative, or /m/, /n/)).

(11) phonetic level: BD-CORRESPONDENCE >> *æ/æ̃$_{\text{CONTEXT}i}$

Inspection of further data indicates that BD-CORRESPONDENCE is violable at the relevant level of representation. For instance, the postvocalic consonants in words like *Kitty* versus *fit* are typically distinguished in phonetic transcriptions in American English, represented as a voiced flap in foot-internal intervocalic position versus a glottalized voiceless plosive in word-final position.[13] Yet there is no relevant correspondence effect in the relation between *Kitty* and its short form *Kit*, which instead rhymes perfectly with non-derived words like *fit*.

(12) phonetic level: [kʰɪɾi] [kʰɪtˀ] [fɪtˀ]
'Kitty' 'Kit' 'fit'

The differences in correspondence observed here could be captured in terms of constraint ranking as in (13), where the markedness constraints *ɾ/-# ("No flap in word-final position") and *tˀ/V-V ("No glottalized stop in foot-internal intervocalic position") dominate the correspondence constraint, while *æ/ãæ$_{\text{CONTEXTi}}$ ranks below:

(13) Phonetic level: *ɾ/-#, *tˀ/V-V >> BD-CORRESPONDENCE >> *æ/ãæ$_{\text{CONTEXTi}}$

While capturing correspondence patterns pertaining to vowel quality, the grammar in (13) fails to capture the regularity of the alternation between the sounds [ɾ] and [tˀ]. That regularity is indicative of correspondence also, albeit at a level defined by contrastiveness. That is, the phonetic qualities and specific distribution among the sounds [ɾ] and [tˀ] indicates the same phonemic target /t/, that is, /t/ being weakened to a flap intervocalically before an unstressed vowel while glottalized when no vowel follows.

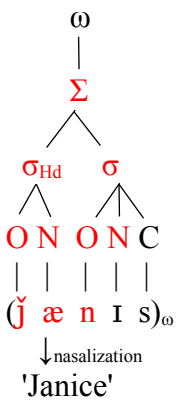
13 Kahn (1976:79) describes the pronunciation of the glottalized plosive as involving a "simultaneous closure of the glottis and placement of the tip of the tongue at the alveolar ridge." The flap is described as a "one-tap trill" (1976:152).

(14)	phonemic level:	(ˈkɪ**t**i)ω	(ˈkɪ**t**)ω	(ˈfɪt)ω
		↓	↓	↓
	phonetic level:	[k^{h}ɪɾi]	[k^{h}ɪt^{ʔ}]	[fɪt^{ʔ}]
		'Kitty'	'Kit'	'fit'

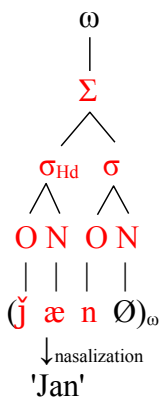
A possible upshot of these observations is that BD-CORRESPONDENCE applies at different abstractness levels, where certain sound properties are characterized by correspondence at the phonetic level while others refer to the phonemic level. There are, however, alternative accounts with correspondence referring to a single level of abstractness. Consider the prosodic trees for *Janice* in (15a) and *ban* in (15c) indicating the regular unmarked prosodic organization of phonemes: vowels form nuclei, single consonants preceding a vowel form onsets whereas other consonants form codas.[14] Given these trees, BD-CORRESPONDENCE could yield a shortened form with two open syllables as is shown in (15b), by targeting contiguous prosodic structure (structure affected by correspondence is marked in red). The distribution of the vowel qualities could then again be treated as a subphonemic phenomenon, captured with reference to syllable structure alone (open in (15a) and (15b) versus closed in (15c)).[15] Subphonemic properties are indicated informally by the downward arrows marked for types of processes (e.g. nasalization, flapping)), rather than being represented symbolically.

14 The trees in (15) are in accordance with assumptions in Prosodic Phonology (Nespor & Vogel 2007). The association of phonemic strings with syllable structure, despite the determination of the latter by the former, is motivated by the dependency of phonotactics on syllable structure (to be expressed in terms of language-specific rankings among phonological markedness constraints referring to syllable structure and correspondence constraints).

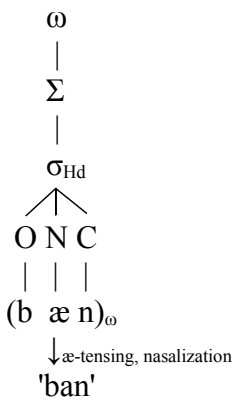
15 The distribution of the flap versus the glottalized alveolar stop is determined by the segmental environment (whether or not a vowel follows) along with stress.

(15)a. 

'Janice'

b. 

'Jan'

c. 

'ban'

The assumptions that correspondence may affect contiguous parts of prosodic trees (s. the structure marked in red in (15a,b)) and that word-final syllables can have an empty nucleus (s. Harris and Gussman 2002)[16] allow for allegedly subphonemic correspondence effects to be analysed with reference to phonological structure. The examples in (16) illustrate well-known cases of truncation in Icelandic (Orešnik 1978) and Norwegian (Kristofferson 1991:247), where words are formed from verbs by "deleting" the final vowel. The phonology of the base verbs is entirely regular in that an intervocalic cluster with a sonority increase forms a complex onset, causing the preceding vowel to be located in an open syllable and therefore affected by phonetic lengthening. Significantly, the apparent "transfer" of vowel lengthening in (16a) to (16b) could be captured by correspondence of the relevant syllable structures, including the second nucleus, in the derived forms (cf. the similar effect in (15a,b)). This would also account for the phonotactic peculiarity of the derived forms, which end in clusters not found in non-truncated words.[17]

16 Harris & Gussman (2002) claim that all word-final consonants form onsets of empty syllables. By contrast, I assume a constraint *N/Ø ("No empty nuclei"), which is violated only under domination by higher-ranking constraints, such as the required correspondence of syllable nodes affecting (15b), but not (15c). Other constraints forcing word-final empty nuclei include phonological markedness constraints banning phonemes in the nucleus of closed syllables or constraints banning phoneme clusters in coda position (s. (36) below, also Raffelsiefen (in press)).

17 The cases of correspondence illustrated in (15) and (16) differ regarding the status of the phonetic processes in question. Whereas vowel lengthening is a natural type of strengthening applying to all

(16)	Icelandic	a.	sø.tra 'to slurp'	b.	sø.trØ 'slurp'
			↓lengthening		↓lengthening
	Norwegian		o.pnə 'to open'		o.pnØ 'open!'
			↓lengthening		↓lengthening

Assuming that putative correspondence effects pertaining to subphonemic properties lend themselves to a reanalysis of correspondence pertaining to prosodic structure, the dichotomy shown in (3) can be tentatively amended as follows:[18]

(17)a.	Phonemic representation (including prosodic organization) ➤ subject to CORRESPONDENCE	b. Phonetic implementation ➤ not affected by CORRESPONDENCE

1.2 REFERENCE TO WRITTEN FORMS

Unlike the cases considered so far, there are also shortenings whose phonological form clearly does not correspond to that of the full form. The data in (18) are presented with standard phonetic transcriptions representing allophony (e.g. [l] = "clear /l/" versus [ɫ] = "dark /l/", whose distribution is conditioned by syllable position in English).

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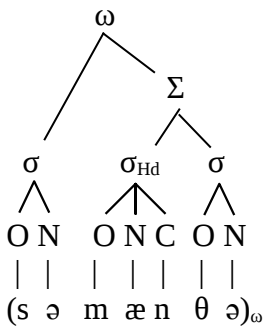
phonemes located in the nuclei of stressed open syllables in Icelandic and Norwegian, the process of æ-tensing is rather idiosyncratic, pertaining only to a single vowel in a highly specific segmental context. Moreover, that process involves quality changes concerning vowel height and/or tenseness, which are often contrastive in English. Indeed there is evidence that the difference between [æ] and the vowel sound resulting from æ-tensing has been historically reanalysed as a phonemic contrast in American English (Trager 1940, Ferguson 1972, who cites minimal pairs such as [sæd] 'sad' - [bEd] 'bad' (1972:259)). Under the assumption of a phonemic vowel contrast /æ/ vs. /E/, the correspondence effect in (9) is altogether unproblematic for the correspondence hypothesis in (7).

18 See also Pater (2000:270), who suggests an analysis of alleged subphonemic paradigm uniformity effects seen in connection with flapping in American English in terms of correspondence affecting foot structure. The proposal is adopted by Davis (2005). For further discussion see Torres-Tamarit's comments and my reply below.

(18) [səˈmæ̃nθə] 'Samantha' - [ˈsẼm] 'Sam'
[məˈlɪsə] 'Melissa' - [ˈmɛɬ] 'Mel'
[ləˈɹɪsə] 'Larissa' - [ˈlɑɹ] 'Lar'

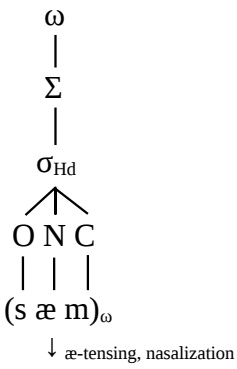
None of the subphonemic properties in (18) are affected by correspondence, which fails even at the phonemic level, given the status of schwa as a separate phoneme in English.[19] The relation between the full forms and the respective shortenings is moreover marked by differences in the prosodic organization. The foot boundaries fail to correspond and so does the syllable organization of the final nasal, which forms a coda in the shortening (s. the application of æ-tensing in *Sam*) while its correspondent forms an onset in foot-initial position in the full form (s. the lack of nasalization in the preceding vowel).

(19)a.



'Samantha'

b.



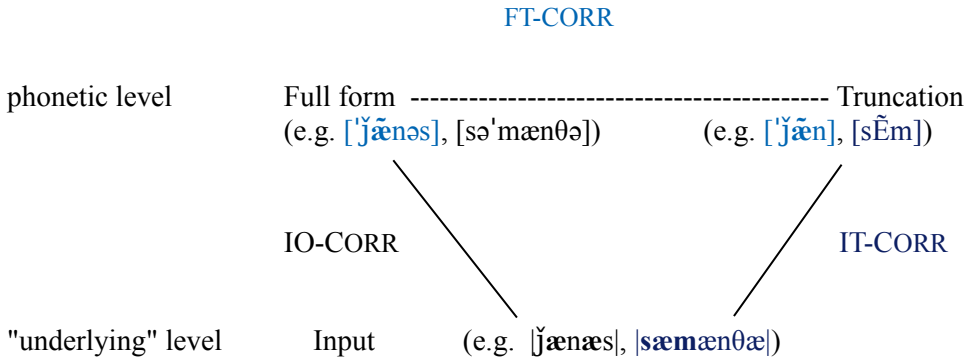
'Sam'

To reconcile the patterns in (18) with those in (9) Zadok (2002:57) invokes an analysis of reduplication patterns by McCarthy & Prince (1995), who argue that both BD-CORRESPONDENCE ("base-reduplicant identity") and IO-CORRESPONDENCE ("input-output faithfulness") play a role in morphophonology. A similar argument is made with respect to truncation and other morphology by Benua (1995, 1997). Zadok argues for a

19 Schwa contrasts with full vowels (e.g. (ˈsəufə)ω 'sofa' vs. (ˈsəufi)ω 'Sophie') as well as with nothing (e.g. (ˈtɪkət)ω 'ticket' vs. (ˈstɹɪkt)ω 'strict', (ˈɡæləp)ω 'gallop' vs. (ˈælp)ω 'alp').

model as in (20), where the BD-CORRESPONDENCE constraint FT-CORR ("full form-truncated form correspondence") accounts for phonetic effects such as the occurrence of lax [æ] in the shortening *Jan*, whereas IT-CORR ("input-truncation correspondence") accounts for the presence of [Ẽ], rather than [ə] in the shortening *Sam*. (Unlike BD-CORRESPONDENCE, which requires actual identity of (symbolic) phonological structure, input-output constraints are meant to ensure some sort of match, where output structure exhibits the effects of phonetic implementation.)

(20)



Zadok asserts then the need to recognize all three types of correspondence constraints in (20), whereas Benua (1995, 1997), who does not discuss the type of data in (18), claims that only IO-CORR and "output-output correspondence" such as FT-CORR are motivated. Zadok's argument, that "without any correspondence between input and truncated form, the vowels [in cases like (18) R.R.] cannot be retrieved" (2002:57) raises the question of how learners infer the vowels in the putative underlying forms to begin with. An alternative approach is sketched in (21), where reference to graphemic representations yields intermediate representations, characterized by complete BD-CORRESPONDENCE indicated by the boldface grapheme structure in (21a). Those representations are then mapped to phonological outputs (s. (21b)).

(21)a. ⟨**Sam**antha⟩ ➜ ⟨**Sam**⟩ b. ⟨Sam⟩ ➪ ('sæm)$_{\omega}$
⟨**Mel**issa⟩ ➜ ⟨**Mel**⟩ ⟨Mel⟩ ➪ ('mɛl)$_{\omega}$
⟨**Lar**issa⟩ ➜ ⟨**Lar**⟩ ⟨Lar⟩ ➪ ('lɑɹ)$_{\omega}$

Grapheme-phoneme correspondence in shortenings is fairly complex (cf. the possible mappings to letter names as in (6)), a topic which will be addressed further below (s. section 3). In the case of English clippings, that type of correspondence appears to be based on analogy with existing words exhibiting similar spellings of the relevant rhymes:

(22) ⟨Sam⟩ ➪ ('sæm)$_{\omega}$ cf. existing ⟨ham⟩ ⇦ ('hæm)$_{\omega}$, ⟨jam⟩ ⇦ ('ǰæm)$_{\omega}$, ...

The proposal is then to replace the model in (20) with that outlined in (23), where full forms consist of two types of representation, phonological and graphemic. Phonological outputs, whether determined directly by BD-CORRESPONDENCE referring to phonological form as in (23a), or involving grapheme-phoneme correspondence as in (23b), are then subject to phonetic implementation. (Relevant correspondence is marked in red.)

(23) Input: Full form Output: Truncation

a. ('ǰæ.nəs)$_{\omega}$ ⟨Janice⟩ ----------BD-CORR-PHON----------('ǰæ.n Ø)$_{\omega}$ ⟨Jan⟩
↓nasalization

b. (sə'mænθə)$_{\omega}$ ⟨Samantha⟩----BD-CORR-GRAPH----⟨Sam⟩----GP-CORR----(sæm)$_{\omega}$ ⟨Sam⟩
↓nasalization, æ-tensing

The model in (23) differs from both Benua's and Zadok's account in that the grammar of shortening, indeed word-formation in general, refers to one phonological abstractness level. That level is here assumed to be phonemic, associated with prosodic organization and (by literate speakers) with a parallel graphemic representation. There is no reference to any type of "underlying" nor to "phonetic" representation.

The interaction between the constraints referred to in (23) for English clippings is tentatively modeled in (24), where inputs as well as candidates consist of ordered pairs comprising both a phonological and a written representation. The constraint *PHON serves here as a collective term covering markedness constraints known to be inviolable in English (e.g. A stressed syllable needs a full vowel in the rhyme.[20] A phonological word cannot end in a lax vowel {/æ/, /ɛ/, /ɐ/, /ɪ/, /ʊ/}). Tableau (24) illustrates the elimination of all shortened candidates which satisfy BD-CORR$_{PHON}$ (i.e. (24 a-c)) due to violations of higher-ranking *PHON. The choice among the remaining candidates is determined with reference to written form. The examples in (24e,f) illustrate the evaluation of candidates which include the postvocalic consonant /z/. Candidate (24e) violates GP-CORR, here assumed to be a symmetrical constraint which evaluates candidates based on their internal structure (i.e. the relation among the two members of the ordered pair), with no reference to input forms: final voiced /z/ in non-inflected content words does not correspond to the grapheme ⟨s⟩ or ⟨ss⟩ in English. GP-CORR is satisfied in (24f) (cf. (ˈǰæz)$_{ω}$ ⇔ ⟨jazz⟩), but that candidate violates BD-CORR$_{GRAPH}$, due to the non-matching graphemes in the shortening versus the input form. As a result candidate (24g) consisting of a single open syllable wins (cf. (spɑ)$_{ω}$ ⇔ ⟨spa⟩).

(24)	(bɹəˈzɪɹ)$_{ω}$, ⟨brassiere⟩	*PHON	BD-CORR$_{PHON}$	GP-CORR	BD-CORR$_{GRAPH}$
a.	(bɹə)$_{ω}$, ⟨...⟩	*			
b.	(bɹəz)$_{ω}$, ⟨...⟩	*			
c.	(bɹəˈzɪ)$_{ω}$, ⟨...⟩	*			
e.	(bɹæz)$_{ω}$, ⟨brass⟩		*	*	
f.	(bɹæz)$_{ω}$, ⟨brazz⟩		*		*
g.	☞ (bɹɑ)$_{ω}$, ⟨bra⟩		*		

20 The formulation is meant to account for stressed syllables such as (təu)$_{ω}$ 'toe', assuming that /ə/ associates with the nucleus and /u/ forms a coda (s. Raffelsiefen & Geumann 2018). In all other cases the nucleus of a stressed syllable is occupied by a full vowel in English.

The effect seen in (24), that is reference to graphemic form when all candidates violate *PHON or BD-CORR$_{PHON}$, is illustrated further in (25) (cf. (bæn)$_{\omega}$ ⇔ ⟨ban⟩).[21]

(25)

(fəˈnætɪk)$_{\omega}$,⟨fanatic⟩	*PHON	BD-CORR$_{PHON}$	GP-CORR	BD-CORR$_{GRAPH}$
(fən)$_{\omega}$ ⟨fan⟩	*			
(fɐn)$_{\omega}$ ⟨fan⟩		*	*	
(fɐn)$_{\omega}$ ⟨fun⟩		*		*
☞ (fæn)$_{\omega}$ ⟨fan⟩		*		

Evidence for the specific ranking among the correspondence constraints in (25) comes from cases where truncation conflicts with spelling conventions. Such cases are typically resolved by violating BD-CORR$_{GRAPH}$, in that the shortening chosen on the basis of phonological correspondence is associated with a novel spelling in accordance with GP-CORR (s. (26)):

(26)

(ˈnæčəɹəli)$_{\omega}$,⟨naturally⟩	*PHON	BD-CORR$_{PHON}$	GP-CORR	BD-CORR$_{GRAPH}$
(ˈnæt)$_{\omega}$ ⟨nat⟩		*		
(ˈnæč)$_{\omega}$ ⟨nat⟩			*	
(ˈnæč)$_{\omega}$ ⟨natu⟩			*	
☞ (ˈnæč)$_{\omega}$ ⟨natch⟩				*

Additional cases illustrating the effect modeled in (26) are listed below:

(27)

(ˈsɑɹ̆ənt)$_{\omega}$ ⟨sergeant⟩	(ˈsɑɹ̆)$_{\omega}$ ⟨sarge⟩
(ˈpæʃən)$_{\omega}$ ⟨passion⟩	(ˈpæʃ)$_{\omega}$ ⟨pash⟩
(kəuˈkɛin)$_{\omega}$ ⟨cocaine⟩	(ˈkəuk)$_{\omega}$ ⟨coke⟩
(ˈkɐzən)$_{\omega}$ ⟨cousin⟩	(ˈkɐz)$_{\omega}$ ⟨cuz⟩
(ˈkiu,kɐmbəɹ)$_{\omega}$ ⟨cucumber⟩	(ˈkiuk)$_{\omega}$ ⟨cuke⟩
(ˈfɛivəɹət)$_{\omega}$ ⟨favorite⟩	(ˈfɛiv)$_{\omega}$ ⟨fave⟩

21 Here I assume that in tableau (25) the additional candidate (fɑ)$_{\omega}$ ⟨fa⟩ would be eliminated by a markedness constraint requiring minimal structure. That constraint is satisfied by the branching onset in the winning candidate *bra* in (24) and by the branching rhyme in clippings like *ad* (from *advertisement*).

There may be limits on the graphemic adjustments in shortenings, indicated by the spellings of the shortenings in (28) with final ⟨g⟩ rather than the three-letter cluster ⟨dge⟩ (cf. regular (ˈɛǰ)$_{\omega}$ ⇔ ⟨edge⟩, (ˈhɛǰ)$_{\omega}$ ⇔ ⟨hedge⟩).

(28)a.	(ˈvɛǰəˌtɛit)$_{\omega}$ ⟨vegetate⟩	b.	(ˈvɛǰ)$_{\omega}$ ⟨veg⟩
	(ɹɛǰəsˈtɹɛiʃən)$_{\omega}$ ⟨registration⟩		(ˈɹɛǰ)$_{\omega}$ ⟨reg⟩

Significantly, such limits appear to be consistent with the CHS hypothesis in (7). In fact the formations in (28) satisfy both BD-CORR$_{PHON}$ and BD-CORR$_{GRAPH}$.

1.3 CONSTRAINTS AFFECTING THE SELECTION OF MATERIAL FROM FULL FORMS

Apart from shedding light on the nature of representations of words in the mental lexicon (level of abstractness, phonological versus orthographic forms) correspondence patterns seen in shortenings also provide a window on asymmetries pertaining to such representations. Consider the English clippings in (29), which differ from those examined so far in that they do not include the initial symbol in the representation of the full form:

(29) a.	(ɹəˈfɹɪǰəˌɹɛitəɹ)$_{\omega}$ ⟨refrigerator⟩	(ˈfɹɪǰ)$_{\omega}$ ⟨fridge⟩
	(ˌɪnfluˈɛnzə)$_{\omega}$ ⟨influenza⟩	(ˈflu)$_{\omega}$ ⟨flu⟩
b.	(kɹəˈsænθəməm)$_{\omega}$ ⟨chrysanthemum⟩	(ˈmɐm)$_{\omega}$ ⟨mum⟩
	(ˈsɐˌbɹbz)$_{\omega}$ 'suburbs'	(ˈbɹbz)$_{\omega}$ ⟨burbs⟩

The rareness of such cases indicates a constraint often referred to as ANCHOR-LEFT, stated in (30) (cf. McCarthy & Prince 1994, 1995).

(30) ANCHOR-LEFT "The left edge of the base and the left edge of the derived form are in correspondence"

The constraint as stated in (30) will not be adopted here for two reasons. First, it is superfluous because of independently motivated asymmetries linked to prominent positions (cf. the concept of “positional faithfulness” (Beckman 1998), also known as "Relevanzstellung" (Trubetzkoy 1936)). Initial positions are consistently among those, including the initial position in morphological constituents such as words or stems. Assuming that positional prominence can also affect BD-CORRESPONDENCE (rather than just IO-CORRESPONDENCE), the restriction in question can be captured by the constraint BD-$\text{CORR}_{\text{INIT}}$ stated in (31).

(31) BD-$\text{CORR}_{\text{INIT}}$ "The symbol occurring in the initial position in relevant base constituents must have a correspondent in the derived (short) form"

The second reason for adopting the constraint in (31), instead of ANCHOR-LEFT, concerns the attribute *initial*, which could refer to either a local or a temporal order, instead of *left*, which refers to a specific body relative direction. Significantly, the relevance of the first symbol, and also the asymmetry between the first and the last, is also seen in languages which are written from right to left such as Hebrew.[22] Instead of assuming different rankings favoring left-anchoring over right-anchoring or vice versa, reference to the constraint in (31) allows for a universal ranking of BD-$\text{CORR}_{\text{INIT}}$ over BD-$\text{CORR}_{\text{LAST}}$ ("The symbol occurring in the last position of the base must have a correspondent in the derived (short) form").

Returning to the data in (29) it appears that the exceptional clippings include either a stem-initial symbol, assuming that *re-* and *in-* are prefixes in (29a), or the final symbol of the base (cf. (29b)).[23] Moreover, these exceptions indicate a possible

22 A case of specific reference to the leftmost position in Hebrew spelling concerns the special allographs associated with some letters when occurring in word-final, rather than word-initial, position.

23 Lists of "right-anchored" truncations often include cases where compounds are reduced to their righthand constituent, such as *tub* for *bathtub*, *pipe* for *stovepipe*, *goat* for *scapegoat* (Wentworth & Flexner 1975:644). The fact that these are much more common than other cases such as *mum* for *chrysanthemum* (see (29b)), where the truncation does not correspond to a separate stem, indicates that

sensitivity of correspondence to segmental salience, specifically a tendency to target non-alveolar consonants. The correspondence constraint stated in (32) is a special case of BD-CORR$_{SAL}$ mentioned in (2c).

(32) BD-CORR$_{SAL\text{-}PLACE}$ "Phonemes associated with a salient place of articulation in the base have a correspondent in the derived form"

It is then conceivable that correspondence targets the stem-initial or base-final phonemes in (29) because of their salient places of articulation, instead of selecting the phoneme in the initial position of the base.[24] The association with a salient place of articulation may also play a role in the presence of final /k/ in the shortenings in (33):

(33)a.	(ˈbɑɪsəkəl)$_{\omega}$ ⟨bicycle⟩	(ˈbɑɪk)$_{\omega}$ ⟨bike⟩
b.	(ˌspɛsəfɪˈkɛiʃən)$_{\omega}$ ⟨specification⟩	(ˈspɛk)$_{\omega}$ ⟨spec⟩

The truncations in (33) stand out in that the corresponding symbols do not form a contiguous phonological string in the base,[25] thereby violating the correspondence constraint CONTIGUITY stated in (34a). The data considered so far indicate that CONTIGUITY and BD-CORR$_{INIT}$ are sporadically violated to satisfy BD-CORR$_{SAL\text{-}PLACE}$. By contrast, the correspondence constraint LINEARITY stated in (34b) appears to be inviolable in English shortenings proper (see section 1.4.). CONTIGUITY and LINEARITY were proposed by McCarthy & Prince (1994).

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these are distinct phenomena.

24 While *chrysanthemum* also starts with a velar, the truncation of the final syllable yields a syllable where both margins are occupied by salient phonemes.

25 The shortening in (33b) does match a contiguous portion of the base with reference to the written form, which could also account for the phonological form (ˈspɛk)$_{\omega}$ via grapheme-phoneme correspondence. It is unclear whether or not the presence of final /k/ in that shortening is motivated by phonological salience or with reference to the written form or both.

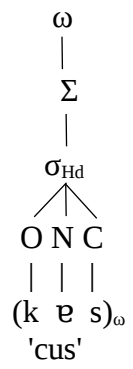
(34)a.	CONTIGUITY	"The portion of the base standing in correspondence forms a contiguous string, as does the correspondent portion of the derived form"
b.	LINEARITY	"Precedence relations among symbols in the short forms must match those of the corresponding symbols in the full form and vice versa"

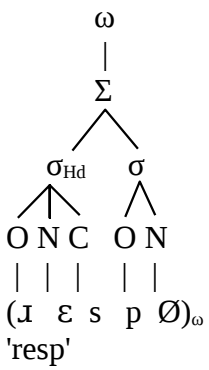
The strongest evidence for BD-CORR$_{\text{SAL-PLACE}}$ in English concerns cases where CONTIGUITY and BD-CORR$_{\text{INIT}}$ are satisfied and the resulting truncation contains only one syllabic vowel. The exact conditions are illustrated in (35), where the onset of the second syllable in the base is included when it is occupied by a salient (non-alveolar) phoneme (35b), not otherwise (35a).[26]

(35)a.	(ˈkʊs**t**əməɹ)$_{\omega}$ 'customer' - (ˈkʊs)$_{\omega}$ 'cus'	b.	(ˈɹɛs**p**əɹəˌtɔɹi)$_{\omega}$ 'respiratory' - (ˈɹɛsp)$_{\omega}$ 'resp'
	(ˈdɑk**t**əɹ)$_{\omega}$ 'doctor' - (ˈdɑk)$_{\omega}$ 'doc'		(ˈʊmˌ**p**ɑiɹ)$_{\omega}$ 'umpire' - (ˈʊmp)$_{\omega}$ 'ump'
	(ˈfɛn**t**əˌnɪl)$_{\omega}$ 'fentanyl' - (ˈfɛn)$_{\omega}$ 'fen'		(ˈmɛs**k**əˌlɪn)$_{\omega}$ 'mescaline' - (ˈmɛsk)$_{\omega}$ 'mesc'
	(ˈkæp**s**əl)$_{\omega}$ 'capsule' - (ˈkæp)$_{\omega}$ 'cap'		(ˈdɔɹ**m**əˌtɔɹi)$_{\omega}$ 'dormitory' - (ˈdɔɹm)$_{\omega}$ 'dorm'
	(ˈtɹʊu**z**əɹz)$_{\omega}$ 'trousers' - (ˈtɹʊu)$_{\omega}$ 'trou'		(ˈgænǰ**ə**)$_{\omega}$ 'ganja' - (ˈgænǰ)$_{\omega}$ 'ganj'

The relevant representations are compared below, where the clipping *cus* from *customer* as in (36a) demonstrates the regular shape of a truncated form in English, namely a single closed syllable. The additional inclusion of a non-alveolar phoneme occupying the next onset illustrated in (35b) is represented by the clipping in (36b). The patterns indicate then an active role of the constraint BD-CORR$_{\text{SAL-PLACE}}$, which dominates *N/Ø ("No empty nuclei").

26 A tendency not to retain final "coronals" in consonant clusters is noted by Lappe (2007:143) but the observation is not explored nor linked to other salience phenomena. Reference to alveolars, rather than coronals, is motivated by the retention of (non-alveolar but coronal) /θ/ or /ǰ/ in cases like (sɪnθ)$_{\omega}$ 'synth' (< *synthesizer*) or (ˈgænǰ)$_{\omega}$'ganj' (< *ganja*).

(36)a. 

b. 

The typical restriction to a single syllabic vowel in English clippings is often violated when the initial syllable of the base is unstressed as is shown by the data in (37):

(37)a.	(dəˈlɪʃəs)ω 'delicious'	(dəˈlɪʃ)ω 'delish'
	(əgˈzɛkiətɪv)ω 'executive'	(əgˈzɛk)ω 'exec'
	(səˈlɛbɹəti)ω 'celebrity'	(səˈlɛb)ω 'celeb'
	(əˌfiʃəˈnɑdəu)ω 'aficionado'	(əˈfiʃ)ω 'afish'
	(ləˈǰɪtəmət)ω 'legitimate'	(ləˈǰɪt)ω 'legit'
	(ɹəˈdɪkiələs)ω 'ridiculous'	(ɹəˈdɪk)ω 'ridic'
b.	(əˈlɐmnəs)ω 'alumnus'	(əˈlɐm)ω 'alum'
	(əgˌzæməˈnɛɪʃən)ω 'examination'	(əgˈzæm)ω 'exam'
	(əˈɹæŋəˌtæn)ω 'orangutan'	(əˈɹæŋ)ω 'orang'
	(fəˈnɑmənən)ω 'phenomenon'	(fəˈnɑm)ω 'phenom'

The dependency of the truncation patterns on stress indicates another type of correspondence constraint requiring the "preservation" of phoneme strings associated with salient prosody (i.e. stress). The relevant constraint is stated in (38).

(38) BD-CORR$_{SAL\text{-}PROS}$ "Stressed syllables in the base must have a correspondent in the derived form"

The disyllabic clippings with final stress emerge then due to the joint effects of BD-CORR$_{SAL\text{-}PROS}$, BD-CORR$_{INIT}$, and CONTIGUITY, yielding perfect correspondence between the shortened form and the relevant part of the phonological structure of the base. The

shape of the truncations in (39b), despite the main stress on the second syllable of their base, indicates then the presence of (secondary) stress on the respective initial syllables of the base, which satisfies BD-CORR$_{\text{SAL-PROS}}$. The stress on the initial syllable is also supported by the occurrence of full vowels in those syllables, as opposed to the presence of schwa in (37).[27]

(39)a.	(ˌǰɪmˈnɛisiəm)$_{\omega}$ 'gymnasium'	b.	(ˈǰɪm)$_{\omega}$ ⟨gym⟩
	(ˌhɑiˈpɹbəli)$_{\omega}$ 'hyperbole'		(ˈhɑip)$_{\omega}$ ⟨hype⟩

The disyllabic truncations in (37) indicate phonological restrictions on the second syllable, which must end in a coda occupied by an obstruent (s. (37a)) or by a salient (non-alveolar) consonant (s. (37b)). When the relevant syllable in the base does not exhibit the right kind of phoneme (see the boldfaced phonemes in the left column in (40)) shortening needs to refer to written forms.[28] Here we find more idiosyncrasies, including the cases exhibiting correspondence to the last grapheme in the base (40a). The shortening consisting of the two initial graphemes in (40b), mapped to the respective letter names to be organized as a copulative compound, is peculiar but the formation does satisfy BD-CORR$_{\text{INIT}}$ and CONTIGUITY (⟨identification⟩ → ⟨ID⟩).[29]

(40)a.	(əsˈpæ**ɹ**əgəs)$_{\omega}$ ⟨asparagus⟩	(ˈgɐs)$_{\omega}$ ⟨gus⟩
	(kɹəˈsæ**n**θəməm)$_{\omega}$ ⟨chrysanthemum⟩	(ˈmɐm)$_{\omega}$ ⟨mum⟩
b.	(ɑiˌdɛ**n**təfɪˈkɛiʃən)$_{\omega}$ ⟨identification⟩	((ˈɑi)$_{\omega}$(ˈdi)$_{\omega\text{Hd}}$)$_{\text{COP-COM}}$ ⟨ID⟩

27 The phoneme schwa is often implemented with some raising of the tongue before [+high] consonants such as velars, hence the variant phonetic transcription of (əgˈzɛkiətɪv)$_{\omega}$ 'executive' also with initial [ɪg] in Wells (1990).

28 The fact that (ɹəˈfɹɪǰəˌɹɛitəɹ)$_{\omega}$ ⟨refrigerator⟩ is shortened not to *(ɹəˈfɹɪǰ)$_{\omega}$, but to (ˈfɹɪǰ)$_{\omega}$ ⟨fridge⟩, may also be due to the special requirements for unmarked final syllables in the disyllabic shortenings, which would be violated by the complex onset /fɹ/. The fact that *fanatic* and *professor* are shortened with reference to their graphemic representation, rather than forming disyllabic shortenings *(fəˈnæt)$_{\omega}$, *(pɹəˈfɛs)$_{\omega}$, may be due to the fact that the latter shortenings correspond exactly to stems inferred by stripping productive suffixes off the base words.

29 ⟨ID⟩ could also stem from *identification document*. A clearer example of the sort of shortening in question is ⟨OP⟩ for *Operation* 'operation' in German.

Exclusive reference to written forms, where an individual grapheme is mapped to its letter name, is also seen in (41), a rare type of shortening perhaps motivated by the intention to conceal the base word (cf. also (6)). Here, too, BD-CORR$_{INIT}$ is satisfied.

(41)a.	⟨piss⟩ → ⟨p⟩		b.	⟨p⟩ → (ˈpi)$_{ω}$ ⟨pee⟩
	⟨kilo⟩ → ⟨k⟩			⟨k⟩ → (ˈkɛi)$_{ω}$ ⟨K⟩ ('thousand dollars')

While rare for full forms consisting of a single word as in (41), the reduction to initial graphemes mapped to letter names is very common for full forms consisting of two or more words (stems). Sequences of letter names are organized as copulative compounds,[30] whose last member constitutes the prosodic head and receives main stress (see also *ID* in (40b)):

(42)	compact disc	⟨CD⟩	((ˈsi)$_{ω}$(ˈdi)$_{Hd}$)$_{COP-COM}$
	International Phonetic Alphabet	⟨IPA⟩	((ˈɑi)$_{ω}$(ˈpi)$_{ω}$(ˈɛi)$_{ωHd}$)$_{COP-COM}$
	United States Air Force	⟨USAF⟩	((ˈiu)$_{ω}$(ˈɛs)$_{ω}$(ˈɛi)$_{ω}$(ˈɛf)$_{ωHd}$)$_{COP-COM}$

For some letter names consisting of three or more symbols, there is an alternative to the organization as a compound, as they lend themselves to some sort of spelling pronunciation (cf. the discussion of grapheme - phoneme correspondence above). In that case the shortenings are mapped to single phonological words as shown in (43):

(43)	⟨Sudden Infant Death Syndrome⟩	⟨SIDS⟩	(ˈsɪdz)$_{ω}$
	⟨Bay Area Rapid Transit⟩	⟨BART⟩	(ˈbɑɹt)$_{ω}$
	⟨European Free Trade Association⟩	⟨EFTA⟩	(ˈɛftə)$_{ω}$
	⟨What you see is what you get⟩	⟨WYSIWYG⟩	(ˈwɪzɪˌwɪɡ)$_{ω}$

30 Grapheme sequences such as ⟨CD⟩ are first mapped to the respective sequence of letter names (i.e. [si]$_{N}$[di]$_{N}$), which are then mapped to the prosodic compounds shown in (42).

The basic shortening pattern in both (42) and (43) appears to indicate the same ranking of constraints. This is illustrated in (44), where constraint evaluations refer exclusively to the graphemic representations marked in red. The constraint DB-CORRESPONDENCE, which requires every grapheme in the short form to have a correspondent in the full form, is always satisfied. So is the constraint BD-$\text{CORR}_{\text{INIT}}$, which requires the respective initial graphemes in the full form to have correspondents in the short form. CONTIGUITY is violated under domination of *STRUCTURE.

(44)	(('kɑm,pækt)$_{\omega\text{Hd}}$('dɪsk)$_{\omega}$)$_{\text{COMP}}$ ⟨compact disc⟩	BD-$\text{CORR}_{\text{INIT}}$	*STRUCTURE	CONTIGUITY
a.	(('kɑm)$_{\omega\text{Hd}}$('dɪs)$_{\omega}$)$_{\text{COMP}}$ ⟨com-dis⟩		******!	
b.	(si)$_{\omega}$ ⟨C⟩	*!	*	
c.	☞ (('si)$_{\omega}$('di)$_{\omega\text{Hd}}$)$_{\text{COP-COM}}$ ⟨CD⟩		**	*

The grammar in (44) does not yet take into account the impact of constraints pertaining to the phonological organization of shortenings. Recall that full forms consisting of single words are typically not reduced to their initials but rather are truncated with primary reference to their phonological form. The examples in (45) indicate that the shortening of full forms consisting of two polysyllabic stems may also undergo truncation, unlike the example in (44). Reference to primarily phonological versus graphemic form then follows the patterns examined above: the presence of a stressed initial syllable as in ('hæzəɹdəs)$_{\omega}$ allows for reference to phonological form while the presence of an initial schwa syllable as in (mə'tɪɹiəl)$_{\omega}$ conditions reference to the graphemic form. (Ambiguous references are marked with dotted lines.) Note that the short forms consist of regular left-headed compounds, regardless of the prosodic structure of the full forms: there are no correspondence effects referring to the given prominence relations.[31]

31 The truncations in the compound clippings differ from simple clippings in that they contain only single closed syllables ending in a simple coda, with no catalectic syllables (e.g. no structures as in (36b)). This

(45)	Full form	Short forms
a.	(('fɔ̟ɹ̟miələ)$_{\omega Hd}$ (ˌt̟ɹ̟æn̟z'lɛiʃən)$_{\omega}$)$_{COMP}$	((fɔɹ)$_{\omega Hd}$(tɹæn)$_{\omega}$)$_{COMP}$
	⟨fo̟rmula t̟ra̟nslation⟩	⟨FORTRAN⟩
b.	(('hæz̟ɹ̟dəs)$_{\omega}$(mə'tɪɹiəl)$_{\omega Hd}$)$_{PHRASE}$	((hæz)$_{\omega Hd}$(mæt)$_{\omega}$)$_{COMP}$
	⟨ha̟z̟ardous mat̟erial⟩	⟨hazmat⟩
c.	(('bɪznəs)$_{\omega Hd}$(əd‚mɪnɪs'tɹɛiʃən)$_{\omega}$)$_{COMP}$	((bɪz)$_{\omega Hd}$(æd)$_{\omega}$)$_{COMP}$
	⟨business administration⟩	⟨biz ad⟩
d.	(('lɛ̆əs‚lɛitɪv)$_{\omega Hd}$('kɐunsəl)$_{\omega}$)$_{COMP}$	((lɛ̆)$_{\omega Hd}$(kəu)$_{\omega}$)$_{COMP}$
	⟨Legislative Council⟩	⟨LegCo⟩

The example in (45d) indicates a tendency in this particular shortening pattern in English (compounds consisting of two truncations) to target the phonological form in the first word of the full form and the written form of the second. This tendency is manifest in various shortening patterns, including the creation of rhyming compounds in (46):

(46)	Full forms	Short forms
	(('sɑ̟iəns)$_{\omega}$('fɪkʃən)$_{\omega Hd}$)$_{COMP}$	((sɑi)$_{\omega Hd}$(fɑi)$_{\omega}$)$_{COMP}$
	⟨science fiction⟩	⟨sci-fi⟩
	(('wɑ̟iɹ)$_{\omega}$ləs)$_{AG}$[32](fə'dɛləti)$_{\omega Hd}$)$_{COMP}$	((wɑi)$_{\omega Hd}$(fɑi)$_{\omega}$)$_{COMP}$
	⟨wireless fidelity⟩	⟨wi-fi⟩
	(('p̠əust)$_{\omega}$('mɑdəɹn)$_{\omega Hd}$)$_{COMP}$	((pəu)$_{\omega Hd}$(məu)$_{\omega}$)$_{COMP}$
	⟨post-modern⟩	⟨po-mo⟩

The formations in (46) indicate a cluster of particular conditions, including a full form with an initial stressed syllable containing a diphthong and a written representation where that diphthong is represented by a single grapheme. That grapheme has an exact correspondent in the written form of the second constituent which, by grapheme-

restriction is somewhat similar to that seen in the disyllabic clippings in (37) as compounds, too, are already marked due to their complex prosodic structure. In both cases, markedness is not to be exacerbated by the presence of empty nuclei. Such effects are easily captured in terms of local constraint conjunction (Smolensky 1997), further supporting that concept.

32 AG stands for "adjunct group", referring to a prosodic constituent dominating a phonological word together with a smaller constituent such as foot or syllable.

phoneme correspondence, licenses phonological forms which include the relevant diphthong (cf. existing words such as ⟨pi⟩ ⇔ (ˈpɑi)$_{ω}$, ⟨go⟩ ⇔ (ˈɡəu)$_{ω}$). Note that while these formations do not exhibit regular selection patterns, which would have resulted in compounds ending in (ˈfɪk)$_{ω}$, (ˈfɪd)$_{ω}$, (ˈmɑd)$_{ω}$, respectively, they are perfectly consistent with the CHS stated in (7).

In general it holds that apparent irregularities and deviations from phonological correspondence in English shortenings can be shown to conform to the CHS once written forms are taken into account. A rather common type of shortening to illustrate this claim is shown in (47), where the relation among the phonological full form and respective shortening exhibits numerous violations of phonemic correspondence, marked in boldface

(47)a.	(ˈmɛiəˌnɛiz)$_{ω}$ - (ˈmɛiə**u**)$_{ω}$	b.	⟨may**o**nnaise⟩ ➜ ⟨may**o**⟩ ➪ (ˈmɛiəu)$_{ω}$
	(ˈlɪməˌzin)$_{ω}$ - (ˈlɪmə**u**)$_{ω}$		⟨lim**o**usine⟩ ➜ ⟨lim**o**⟩ ➪ (ˈlɪməu)$_{ω}$
	(ˌɪnfəɹˈmɛiʃən)$_{ω}$ - (ˈɪnfə**u**)$_{ω}$		⟨inf**o**rmation⟩ ➜ ⟨inf**o**⟩ ➪ (ˈɪnfəu)$_{ω}$
	(ɹɑiˈn**ɑ**səɹəs)$_{ω}$ - (ˈɹɑinə**u**)$_{ω}$		⟨rhin**o**ceros⟩ ➜ ⟨rhin**o**⟩ ➪ (ˈɹɑinəu)$_{ω}$
	(pɔɹˈn**ɑ**ɡɹəfi)$_{ω}$ - (ˈpɔɹnə**u**)$_{ω}$		⟨porn**o**graphy⟩ ➜ ⟨porn**o**⟩ ➪ (ˈpɔɹnəu)$_{ω}$
	(pɹəˈməuʃən)$_{ω}$ - (ˈprə**u**məu)$_{ω}$		⟨prom**o**tion⟩ ➜ ⟨prom**o**⟩ ➪ (ˈprəuməu)$_{ω}$
	(l**ɪ**ˈnəuliəm)$_{ω}$ - (ˈl**ɑi**nəu)$_{ω}$		⟨lin**o**leum⟩ ➜ ⟨lin**o**⟩ ➪ (ˈlɑinəu)$_{ω}$

The shortenings moreover deviate from regular truncations in that they are all disyllabic, consistently forming trochees regardless of the foot structure of the full form. The key to these anomalies is seen in the written representations in (47b), which satisfy all relevant correspondence constraints (BD-CORR$_{INIT}$, CONTIGUITY). What sets these shortenings apart is arguably the presence of the grapheme ⟨o⟩ as the second vowel grapheme in the full forms in (47b), which may trigger reference to written forms when creating the short form, perhaps due to the association of that grapheme with the suffix *-o* in formations like *weirdo, aggro* (based on *aggression*). Reference to written form almost suffices to account for the shortenings in (47), except for the cases exhibiting corresponding foot structures (the top 3 examples in (47)). This is because, for instance,

⟨mayo⟩ could also be mapped to (ˈmɑiəu)$_{ω}$ (cf. (ˈmɑiə)$_{ω}$ 'Maya')), ⟨limo⟩ could also be mapped to (ˈliməu)$_{ω}$ (cf. (ˈpɹimə)$_{ω}$ 'prima')), indicating that the actual mappings are determined by correspondence with the phonological base forms. By contrast, the phonological forms of the "stress-shifting" cases in (47) is determined by grapheme-phoneme correspondence alone, with no reference to the phonological input forms (e.g. the grapheme string ⟨CinV⟩ corresponds typically to (CɑinV)$_{ω}$ as in ⟨minus⟩ (mɑinəs)$_{ω}$, ⟨tiny⟩ (tɑini)$_{ω}$, hence the mapping ⟨lin**o**⟩ ➪ (ˈlɑinəu)$_{ω}$).

To summarize, it appears that the creation of short forms in English is consistent with regular correspondence, including BD-CORR$_{INIT}$ and CONTIGUITY, referring to either phonemic or graphemic representations. Some of the main findings concerning the dependencies between the count and structure of words (or stems) contained in full forms and the shortening types are summarized in (48).

(48)

Full forms	shortening type
single word/stem	almost exclusively clippings, with primary reference to phonological form. Occasional systematic reference to graphemic representation
two words/stems	Grapheme initials or compound clippings, partially depending on the structure of the input forms (exclusively polysyllabic or also including monosyllabic constituents); reference to both phonological and graphemic form in compound clippings
three or more words/stems	Grapheme initials

Investigations of additional data show that the word count in full forms is not necessarily given but may depend on the final mapping of grapheme strings to phonological words. Consider the example in (49a), which illustrates the typical omission of reference to the initials of function words such as *of*. This rule is broken in (49b), to achieve the prosodic organization of the shortening as a simple phonological

word by grapheme-phoneme correspondence, instead of the organization as a letter compound as in the case in (49c). [33]

(49)a.	Organization **of** Petroleum Exporting Countries	⟨OPEC⟩	(ˈəuˌpɛk)$_{ω}$
b.	electronic point **of** sale	⟨EPOS⟩	(ˈiˌpɑs)$_{ω}$
c.	United Parcel Service	⟨UPS⟩	((ˈiu)$_{ω}$(ˈpi)$_{ω}$(ˈɛs)$_{ωHd}$)$_{COP\text{-}COM}$

The preferred organization of shortenings consisting of four or more letters as a single phonological word, rather than a letter compound, is evident in the cases in (50). The strategy seen in (50) is not to violate regular correspondence targeting initials (s. (50a)) but rather to dispense with a uniform approach to GP-CORR. Instead the mapping of contiguous grapheme substrings to phoneme strings forming well-formed syllables is maximized, leaving "troublesome" graphemes to be mapped to individual letter names (s. (50b)). The various phoneme strings are then linearly integrated into single phonological words as is shown in (50c).

(50)a.	Reserve Officers Training Corps		⟨ROTC⟩
	Extended Binary Coded Decimal Interchange Code		⟨EBCDIC⟩
b.	⟨ROT⟩ ➪ /ɹɑt/ + C → [si]$_{N}$	c.	(ˈɹɑtsi)$_{ω}$
	⟨EB⟩ ➪ /ɛb/ + C → [si]$_{N}$ + ⟨DIC⟩ ➪ /dɪk/		(ˈɛbsɪˌdɪk)$_{ω}$

Cases where grapheme strings are mapped to single phonological words are of particular interest to phonologists due to emerging unmarkedness, caused by the absence of prosodic input structure and consequent absence of correspondence effects. For instance, the cases in (51a) indicate the unmarked organization of two syllables with initial main stress in English. Trisyllabic words also have initial main stress when they

33 The forms (ˈɪps)$_{ω}$ ⟨IPS⟩ or (ˈɐps)$_{ω}$ ⟨UPS⟩ would be possible words in English (cf. (kɔɹps)$_{ω}$ *corpse*), but such marked syllable structures are typically avoided in shortenings based on initials. In fact, English differs from German in generally favoring letter compounds as long as they consist of maximally three members (e.g. English ((ˈɑi)$_{ω}$(ˈpi)$_{ω}$(ˈɛi)$_{ωHd}$)$_{COP\text{-}COM}$ ⟨IPA⟩ (< *International Phonetic Alphabet*), compared to German (ˈipɑ)$_{ω}$ ⟨IPA⟩.

end in a closed syllable.[34] Final main stress found in regular words (e.g. (ɹuˈpi)$_{ω}$ 'rupee', (həˈləu)$_{ω}$ 'hello') is then ruled out in the relevant mappings:

(51)a. ⟨EFTA⟩ ➪ (ˈɛftə)$_{ω}$
⟨lino⟩ ➪ (ˈlɑinəu)$_{ω}$
⟨ROTC⟩ ➪ (ˈɹɑtsi)$_{ω}$

b. ⟨WYSIWYG⟩ ➪ (ˈwɪzɪˌwɪg)$_{ω}$
⟨EBCDIC⟩ ➪ (ˈɛbsɪˌdɪk)$_{ω}$

The significance of mappings from graphemic to phonological representations for gaining insight into phonological grammar and markedness was first explored by Bat-El (1994) based on Hebrew data, where such mappings are always possible, due to epenthesis. The main relevance of these findings for the present article concerns the fact that possible violations of the DB-CORRESPONDENCE or CONTIGUITY (due to epenthesis) do not concern shortening proper, but only the mapping of shortened (graphemic) forms to phonological representations (see section 3).

1.4 RESTRICTIONS ON CORRESPONDENCE IN CONNECTION WITH LINGUISTIC FUNCTION

While the shortenings considered so far appear to conform to the CHS stated in (7) along with various correspondence constraints such as LINEARITY, there are some types of shortenings, including hypocoristics and the coinage of trademarks, which can be found to violate those constraints. I will briefly discuss these in turn, arguing that the violations are due to the particular linguistic functions associated with these formations, motivating their exclusion from the class of shortenings proper.

34 Very similar TETU-effects (*The Emergence of the Unmarked*) are seen in short forms in German. (S. Raffelsiefen (2021:84ff) for explanations of the respective unmarked organizations; differences between English and German pertaining to the stress in disyllabic shortenings are also treated there (s. (2021:73)).

1.4.1 Violations of correspondence in hypocoristics

While many nicknames conform to the correspondence constraints characteristic of shortenings (e.g. *Jan, Pam, Sam*) they may also exhibit more or less drastic violations. The examples in (52a) indicate deviations resulting in more unmarked formations, at the expense of violating correspondence. Special asymmetries manifest in that BD-CORR$_{\text{INIT}}$ appears to be more important than CONTIGUITY and correspondence involving consonants matters more than correspondence involving vowels. Violations of LINEARITY are exceedingly rare even here, pertaining only to full forms lacking an onset, a position then filled by the word-final consonant (s. (52b)).

(52)a.	(ˈɑizək)$_{\omega}$ ⟨Isaac⟩	(ˈɑik)$_{\omega}$ ⟨Ike⟩
	(təˈɹisə)$_{\omega}$ ⟨Theresa⟩	(ˈtɛs)$_{\omega}$ ⟨Tess⟩
	(ˈdɑɹəθi)$_{\omega}$ ⟨Dorothy⟩	(ˈdɑt)$_{\omega}$ ⟨Dot⟩, (ˈdi)$_{\omega}$ ⟨Dee⟩
	(ˈθiəˌdɔɹ)$_{\omega}$ ⟨Theodor⟩	(ˈtɛd)$_{\omega}$ ⟨Ted⟩
	(ˈǰɛimz)$_{\omega}$ ⟨James⟩	(ˈǰɪm)$_{\omega}$ ⟨Jim⟩
b.	(ˈɛlən)$_{\omega}$ ⟨Ellen⟩	(ˈnɛl)$_{\omega}$ ⟨Nell⟩
	(ˈɛdwɪn)$_{\omega}$ ⟨Edwin⟩	(ˈnɛd)$_{\omega}$ ⟨Ned⟩

Nicknames differ from regular shortenings not only in their tolerance for alternations and variation but also in that base relations are sometimes indeterminable. It appears that nicknames are not necessarily "derived" from base words but may exist independently, associated because of certain similarities. For instance, the nickname *Ned* associates not only with *Edwin* but with other names starting with (ˈɛd)$_{\omega}$ ⟨Ed⟩, whether or not they contain the phoneme /n/ (e.g. (ˈ**ɛd**wəɹd)$_{\omega}$ ⟨**Ed**ward⟩, (ˈ**ɛd**gəɹ)$_{\omega}$ ⟨**Ed**gar⟩). *Ike* associates not only with *Isaac*, but with other names spelled with initial ⟨Is⟩ ((ɑiˈzɑiə)$_{\omega}$ ⟨**Is**aiah⟩, (ˈɪzəˌdɔɹ)$_{\omega}$ ⟨**Is**idore⟩), again regardless of the remaining phonemic structure. Well-known cases of nickname selection are shown in (53), where

correspondence between the initials (or initial onsets) and the relatively unmarked shape of the "novel" nickname apparently suffices.[35]

(53) (ˈ**ǰ**ɑn)$_{ω}$ ⟨John⟩ - (ˈ**ǰ**æk)$_{ω}$ ⟨Jack⟩ (< French *Jacques* ('male name'))
(ˈ**č**ɑɹlz)$_{ω}$ ⟨Charles⟩ - (ˈ**č**ɐk)$_{ω}$ ⟨Chuck⟩ (? (ˈ**č**ɐk)$_{ω}$ ⟨chuck⟩ ('term of endearment'))
(ˈ**h**ɛnɹi)$_{ω}$ ⟨Henry⟩ - (ˈ**h**æŋk)$_{ω}$ ⟨Hank⟩ (< Dutch *Henk*[36] ('male name'))
(ˈ**fɹ**ɛdəˌɹɪk)$_{ω}$ ⟨Frederick⟩ - (**fɹ**ɪts)$_{ω}$ ⟨Fritz⟩ (< German *Fritz* ('male name'))

The conditions pertaining to the creation of nicknames differ then significantly from those pertaining to other shortenings, including the possible non-conformity with the CHS stated in (7). In general, the role of correspondence is much reduced in favor of phonologically unmarked shapes, occasionally already established words (see (53)). The lack of restrictedness seen here is manifest in considerable variation, as names are often associated with several distinct nicknames. These characteristics make sense in view of the linguistic function associated with nicknames, namely, to express attitudes and feelings, also to strengthen the bond with the addressee by choosing novel and personal expressions possibly not used by others (cf. Bühler's "expressive function" (Bühler 1934)).[37] To properly limit the domain of systematic correspondence discussed in the preceding sections it is then necessary to delineate "shortenings proper" as follows:

(54) Shortening proper aims at shortening the signifier (phonological or graphemic form) while preserving the association with the signified (concept).

The restriction in (54) is in line with Bühler's (1934) "representation function", which is essentially concerned with conveying information.

35 The fact that the novel names typically end in salient consonants may be relevant as well.
36 The choice of /æ/, rather than /ɛ/, in is presumably due to the frequent occurrence of the rhyme /æŋk/ in English (cf. *bank, thank, prank*). Muthmann (1999) lists 23 distinct words ending in /æŋk/, but not a single word ending in /ɛŋk/.
37 This function is typically associated with personal names but can also pertain to other words. For instance, the short form (dɪk)$_{ω}$ 'dick' for (dəˈtɛktɪv)$_{ω}$ 'detective' may also involve the selection of a pre-established word, the common nickname *Dick*, linking it to *detective* based on the corresponding initials.

1.4.2 VIOLATIONS OF CORRESPONDENCE IN TRADEMARKS

A type of shortening blatantly violating the condition stated in (54) concerns the creation of trademarks, illustrated with the examples from German in (55). Here the base expression refers to an individual, often the founder of the company, entirely distinct from the concepts associated with the respective outputs, which refer to products.

(55)

Base (Name of individual)	**Shortening (Trademark)**		**Type of product**
	Written form	**Phonological form**	
⟨Elsa Tesmer⟩	⟨Tesa⟩	(ˈtezɑ)$_{ω}$	sticky tape
⟨Emil Pauly⟩	⟨Milupa⟩	(miˈlupɑ)$_{ω}$	baby food
⟨Robert Weintraud⟩	⟨Rowenta⟩	(ʀoˈvɛntɑ)$_{ω}$	kitchen and household appliances

The formations in (55) indicate preferences for phonologically unmarked expressions, exhibiting simple syllables with full vowels and single occupants in the margins, organized into trochaic feet in word-final position. In view of the main purpose of these formations, to create a suitable name for a novel product necessarily distinct from all established trademarks, and the somewhat arbitrary nature of the chosen base form,[38] their most astonishing property concerns the systematic impact of correspondence. Specifically, we find that DB-CORRESPONDENCE holds with reference to graphemic representations[39] in that all graphemes seen in the trademarks occur in the respective base expressions. Moreover, the constraints BD-CORR$_{INIT}$, CONTIGUITY, and LINEARITY are violated only under domination of markedness constraints pertaining to the respective phonological forms. For instance, the LINEARITY-violation in *Tesa* is caused by a markedness constraint against schwa, as shortenings such as *Elte* or *Sate* would be

38 *Elsa Tesmer* worked as a secretary in the company producing adhesive tape and proposed the trademark *Tesa* based on her name.

39 Reference to graphemic representations is indicated for instance by the presence of the grapheme ⟨e⟩ in *Rowenta*, which corresponds to the phoneme /ɛ/ in the relevant context (closed syllable). The phonological full form (vaintʀaud)$_{ω}$ does not include a correspondent of /ɛ/.

pronounced with final schwa in German, due to grapheme-phoneme correspondence rules referring to the grapheme ⟨e⟩ in word-final position. The CONTIGUITY-violations in *Rowenta* are motivated by a constraint against superheavy rhymes and complex onsets, respectively, which would be violated by the more contiguous phonological form (ʀoˈvaintʀɑ)$_{\omega}$. The observation that relevant correspondence constraints are violated only under domination may seem odd, given the irrelevance of the recoverability of the base expressions in this context. That observation then demonstrates the existence of the relevant correspondence constraints, which will make their force felt whenever there is some sort of base expression, unless they are dominated by conflicting constraints. What sets "shortenings proper" apart is the dominance of correspondence constraints over all markedness constraints (other than size constraints and *STRUCTURE). The case studies in the following sections are accordingly confined to "shortenings proper".

2 ABBREVIATING ELEMENT NAMES

This section presents a case study on abbreviations involving written forms only, to investigate the role of the correspondence constraints introduced above in such a restricted context.

2.1 EVIDENCE FOR GRAPHEME CORRESPONDENCE

The periodic table includes 118 element names, historically abbreviated by using non-linguistic symbols such as "○○" for *arsenic*. Starting in the early 1800s, linguistic symbols were employed as well, referring either to the initial or a maximal sequence of three contiguous symbols, enclosed in a circle (e.g. Ⓛ for *lead*, Ⓐr for *arsenic*, Ⓒob for *cobalt*, alongside non-linguistic symbols such as "⊛" for *magnesium*). In 1814 a standardization was proposed, restricting element symbols to one or two letters of the Roman alphabet abbreviating relevant element names (see below). Element symbols are

not pronounced as phonological words, even when their form matches that of free-standing words (e.g. ⟨As⟩ is never pronounced /æz/ in English, despite the existence of the word /æz/ 'as'). They are also not pronounced as letter compounds, in contrast to expressions involving two or more of such symbols (e.g. $((\varepsilon i\check{c})_{\omega}(tu)_{\omega}(əu)_{\omega})_{\text{COP-COMP}}$ ⟨H_2O⟩) in English. Instead, they are used exclusively in writing.[40]

Assuming that the form of shortenings is determined by correspondence, the respective base expressions must consist of graphemic representations as well, in particular, they must consist of letters of the Roman alphabet. The actual forms of current element symbols suggest that relevant full forms consist not of English words (in contrast to for instance L for *lead* cited above), but rather of a particular inventory of written terms marked by "latinization", typically manifest in the addition of the suffix -(*i*)*um*. The inventory in question, which does not belong to any individual language, has been standardized over the course of centuries. Evidence for consistent reference to that inventory comes from peculiarities characterizing the spelling of relevant terms. Such peculiarities are illustrated in (56), where certain graphemes in loanwords marked in red are compared to their adaptation in the Latinate element names. The data are of interest because of the odd conventions concerning the adaptation of for instance the Greek letter ⟨κ⟩ as ⟨c/C⟩ in the Latinized element names, rather than using the more similarly shaped Roman letter ⟨k/K⟩.[41] Significantly, whatever the varied factors determining the distribution among the letters ⟨c/C⟩ versus ⟨k/K⟩ in the element names, it is precisely those graphemes which have correspondents in the element symbols shown in the righthand column in (56).

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40 They are further restricted to serving as symbols, as they are not associated with syntactic categories and cannot be used in sentences even in writing (e.g. *The demand for *Li/lithium is growing*.)

41 The data in (56a) show that the Greek letter ⟨κ⟩ and the Cyrillic letter ⟨к⟩ were both replaced with ⟨c/C⟩ in the Latinized element names, in accordance with the restriction of Roman ⟨k/K⟩ to special cases like adapting the uvular voiceless plosive represented by ⟨ق⟩ in the Arabic word in (56b). Such cases also include element names ending in the Greek suffix -*on*, where Greek ⟨κ⟩ is adapted as ⟨k/K⟩. In source words represented already in the Roman alphabet, including ⟨Berkeley⟩, the relevant graphemes have exact correspondents in the newly coined Latinized element names as in (56c).

(56)	Source expression	Latinate element name	Element symbol
a.	Greek ⟨ακτίνα⟩ 'ray'	"Neo-Latin" ⟨Actinium⟩	Ac
	Greek ⟨κύπριος⟩ 'Cyprus'	Latin ⟨Cuprum⟩	Cu
	Greek ⟨καδμία⟩ 'zinc ore'	"Neo-Latin" ⟨Cadmium⟩	Cd
	Russian ⟨Москвá⟩ 'Moscow'	"Neo-Latin" ⟨Moscovium⟩	Mc
b.	Arabic ⟨القلي⟩ (*al qalīy*) 'calcined ashes' => Medieval Latin ⟨Alkali⟩	"Neo-Latin" ⟨Kalium⟩	K
	Greek ⟨κρυπτός⟩ 'hidden'	⟨Krypton⟩	Kr
c.	English ⟨Berkeley⟩	"Neo-Latin" ⟨Berkelium⟩	Bk

These data then illustrate the inviolability of the constraint DB-CORR$_{GRAPH}$ in (57a), entailing the conformity of the data with the CHS stated in (7). The relevant mirror image constraint in (57b) is dominated by the size constraint MAX2 defined in (57c). The ranking is stated in (57d).

(57)a.	DB-CORR$_{GRAPH}$	Every grapheme in the derivative (short form) must have a correspondent in the base (full form)
b.	BD-CORR$_{GRAPH}$	Every grapheme in the base (full form) must have a correspondent in the derivative (short form)
c.	MAX2	The short form consists of maximally two graphemes
d.	DB-CORR$_{GRAPH}$, MAX2 >> BD-CORR$_{GRAPH}$	

Before investigating the conditions on the selection of the respective graphemes I will briefly note the fact that individual languages also have an inventory of element names, which are likewise associated with the element symbols illustrated in (56). It is then important to emphasize the aim of the grammar in (57d) to capture the condition on the *creation* of element symbols, not their subsequent status and use. Consider the partial inventories of relevant expressions in French or German in (58), often marked by a coherent morphosyntax (e.g. all masculine nouns in French, all neuter in German). Here

long-established native words block the use of element names chosen by chemists, even in scientific discourse.[42]

(58)	element symbol	element name	French terms	German terms
	Cd	⟨Cadmium⟩ 'cadmium'	⟨cadmium⟩$_{\text{MASC}}$	⟨Kadmium⟩$_{\text{NEUT}}$
	Cu	⟨Cuprum⟩ 'copper'	⟨cuivre⟩$_{\text{MASC}}$	⟨Kupfer⟩$_{\text{NEUT}}$
	Au	⟨Aurum⟩ 'gold'	⟨or⟩$_{\text{MASC}}$	⟨Gold⟩$_{\text{NEUT}}$

Significantly there is no evidence that either the spoken or written form of any such language-specific terms, even when etymologically related to the historical element names, has influenced the form of element symbols. The grammar in (57) then strictly relates historical written element names to written element symbols, where none of these expressions belongs to any spoken language.

2.2 SELECTING MATERIAL FROM SOURCE FORMS: SALIENCE REGARDING POSITION

The selection of material from source forms is drastically restricted by the inviolability of BD-CORR$_{\text{INIT}}$, that is, the systematic correspondence targeting the initial grapheme.[43] The regular occurrence of that grapheme in the initial position of the element symbol indicates the inviolability of LINEARITY as well. Together with the other two inviolable constraints mentioned above, DB-CORR and MAX2, the constraints stated in (59) severely limit candidate sets for element symbols. For instance, for the element name ⟨Phosphorus⟩ only seven candidates remain: {⟨P⟩, ⟨Ph⟩, ⟨Po⟩, ⟨Ps⟩, ⟨Pp⟩, ⟨Pr⟩, ⟨Pu⟩}. The tableau in (59) illustrates some of the evaluations:

42 Terms such as *ferrum, plumbum, kalium*, etc. can be found in unabridged English dictionaries, associated with a syntactic category and a phonological form, but they appear to be rarely used.

43 Targeting the word-initial position due to its prominence is especially motivated when referring to written forms, where that position is highlighted by the typical presence of a preceding empty space. Indeed, there are various conventions for visually enhancing the initial letter in words, sentences, or entire texts (upper rather than lower case, decoration in handwritten manuscripts).

(59)

⟨Phosphorus⟩	DB-CORR	LINEARITY	BD-CORR$_{INIT}$	MAX2	BD-CORR
F	*		*		**********
Pru				*	*******
hP		*			********
P					********
Ph					*********

The selection of the single grapheme ⟨P⟩ as the optimal element symbol motivates the ranking in (60), where *GRAPHEME-violations eliminate all candidates not required to satisfy BD-CORR$_{INIT}$.

(60)

⟨Phosphorus⟩	BD-CORR$_{INIT}$	*GRAPHEME	BD-CORR
Ph		**!	********
P		*	*********

The ranking in (60) calls then for an explanation for all cases where element symbols consist of two symbols. In a few cases, the inclusion of the second grapheme indicates additional relevance of positional prominence, namely reference to an internal stem-initial position. Examples are given in (61), where initial stem boundaries are informally marked by a left bracket.

(61)	element name		element symbol
a.	[Prot**[a**ctin-ium	(cf. ***actinium*)**	Pa
b.	[Hydr[??][ar**g**yr-um	(cf. Latin *hydr* 'water', *argyr* 'silver')	Hg
c.	[Neo**[d**ym-ium	(cf. ***neo***- 'new', *didymos* 'twin')	Nd
d.	[P**r**aseo[??][dym-ium	(cf. Greek *prasinos* 'green', *didymos* 'twin')	Pr
e.	[Darm**[s**tadt-ium	(cf. German *Darmstadt* (town) ***Stadt*** 'city')	Ds
f.	[Ein**[s**tein-ium	(cf. German ***Ein-stein*** 'one stone')	Es
g.	[Wolf[??][ram	(cf. German *Wolf* 'wolf')	W

Etymologically, all of the element names in (61) consist of two stems. The fact that the respective internal stem-initial grapheme has a correspondent in the element symbol only in the cases in (61a,c,e,f), not in (61b,d,g), indicates certain criteria for stem

recognition. Clear motivation for internal stem recognition is seen in the element name *Protactinium*, which is based on the previously established element name *actinium* (compare *actinium* with non-existing *argyrum* in (61b)). Also, it seems plausible that *neo-* is recognized as a familiar and meaningful prefix in *Neodymium*, motivating a following stem boundary, whereas *praseo-* in *Praseodymium* is obscure. The assumption of internal stem boundaries in *Darmstadtium* and *Einsteinium,* but not *Wolfram*, could be motivated with reference to both the meaningfulness of the stem in the relevant source language and/or phonotactics (the clusters *-armst-*, *einst* likely include a stem boundary before *s*.).[44]

Assuming the boldfaced internal stem boundaries in (61), the selection of the second grapheme in the relevant element symbols is captured by the constraint in (62).[45]

(62) $\text{BD-CORR}_{\text{St-INIT}}$ "The material in the initial position of each stem (full form) must have a correspondent in the derived (short) form"

Most element symbols consisting of two graphemes are based on names with no recognizable internal stem structure, indicating additional constraints ranked above *GRAPHEME. The need for a second element is mostly motivated by a special constraint linked to the very purpose of element symbols, namely, to provide unambiguous reference to each of the element names in the given inventory. To satisfy the constraint in question, referred to as DISTINCT here (see (63a)), the function of for instance the grapheme ⟨P⟩ to serve as a symbol for the element name ⟨Phosphorus⟩ preempts its potential use for any of the other element names starting with ⟨P⟩. To ensure

44 The element symbol *Yb* for *Ytterbium*, based on the Swedish town *Ytterby* also likely involves reference to an internal stem-initial position (i.e. the Swedish stem *by* 'village').
45 The constraint in (62) subsumes $\text{BD-CORR}_{\text{INIT}}$, which targets the initial position of the entire base expression. The reason for including both constraints in the grammar in question concerns the apparent inviolability of base-initial grapheme correspondence, compared to the less clear status of word-internal stem boundaries.

unambiguous reference, those must include a second grapheme, again distinct from other second graphemes. Examples are given in (63b):

(63)a. DISTINCT Distinct full forms must correspond to distinct short forms and vice versa

b. ⟨Polonium⟩ ⟨Po⟩; ⟨Praseodymium⟩ ⟨Pr⟩; ⟨Promethium⟩ ⟨Pm⟩; ⟨Plumbum⟩ ⟨Pb⟩; ⟨Platinum⟩ ⟨Pt⟩; ⟨Palladium⟩ ⟨Pd⟩

The evaluation of candidates with respect to the constraint DISTINCT requires reference to the complete set of established element symbols with the respective initial at a given point in historical time.[46] It is therefore not a standard type of OT constraint and in fact appears to play no significant role in natural language shortenings, where homophony abounds (e.g. English *cat* for *catamaran, catalytic converter*, *cam* for *camera, camouflage*, etc.). The aspect of interest here is the question of *how* DISTINCT is satisfied, that is, what the criteria are for choosing a second grapheme. In half of the roughly 100 relevant element symbols (i.e. those with two graphemes based on names including only one stem) the choice satisfies the constraint CONTIGUITY (cf. (34a)). The question of why this number is not higher is in part answered by cases like *promethium*, where all of the CONTIGUITY-satisfying candidates listed in (64) are eliminated by the top three inviolable constraints.

(64)

⟨Promethium⟩	BD-CORR$_{INIT}$	DISTINCT	MAX2	CONTIGUITY
P		* (Phosphorus/P)		
Pr		* (Praseodymium/Pr)		
Pro			*	
ro	*			

The elimination patterns in (64) raise the question of whether the correspondence constraint targeting the initials of internal stems is really motivated. For instance, the

46 This requirement seems unproblematic for a relatively small nomenclature where abbreviations are determined in a highly deliberate manner by panels of experts.

element symbol ⟨Pa⟩ in (61a) does not actually require reference to internal stem structure in *Prot[actinium*, but could be due to inviolable DISTINCT alone (cf. the existence of the element symbols {P, Pr, Po, Pt} in (63b)). Compelling evidence for BD-CORR$_{\text{St-INIT}}$ comes from the fact that ⟨Pa⟩ had in fact also been in use at the time when the element name *Prot[actinium* was first established, serving then as a symbol for the element name *Palladium*. The abrupt reassociation of that symbol with the novel name *Prot[actinium* strongly supports an active role for CORR$_{\text{St-INIT}}$, along with the recognition of internal stem boundaries.[47] Specifically, that abrupt change indicates the domination of a constraint "PRESERVE" whose active role is presupposed by DISTINCT, namely the regular preservation of established associations between element names and element symbols. It is only the dominance of CORR$_{\text{St-INIT}}$, along with inviolable DISTINCT, which force the dissociation of the symbol *Pa* from its base *Palladium*.[48]

To summarize, the formation of element symbols indicates an inviolable constraint BD-CORR$_{\text{INIT}}$ requiring the initial grapheme in the element name to have a correspondent in the element symbol, possibly also an inviolable constraint referring to stem-initial positions. (The latter are harder to establish, due to the uncertainties of when to recognize stem boundaries.) There is evidence for CONTIGUITY, which is necessarily violated under certain conditions, including the joint effect of an inviolable size constraint (MAX2) and an inviolable constraint requiring distinctness from all other element symbols (DISTINCT). The role of CONTIGUITY will be explored further in the next section.

47 The recognition of the internal stem boundary is beyond doubt given the naming of the newly discovered element *protactinium* based on the already established element name *actinium*.

48 Palladium was subsequently associated with *Pd*. The same effect can be observed in connection with the creation of the element name *Darm[stadtium* and the choice of *Ds* as its symbol, despite the established role of that grapheme combination at the time to represent the element *Dysprosium*. Here, too, the dissociated element name *Dysprosium* reassociates with a new element symbol, *Dy* (instead of former *Ds*).

2.3 SELECTING MATERIAL FROM SOURCE FORMS: SALIENCE

While consistent with the data considered so far, the grammar fragments proposed above fail to account for the fact that some graphemes form element symbols by themselves (cf. (65a)) while others are always followed by a second grapheme (cf. (65b)) (∄R = R does not occur by itself as an element symbol). In particular, the gaps in (65b) raise the question of what motivates the seemingly gratuitous violation of *GRAPHEME.

(65)a.	P	Phosphorus	b.	∄R	Rh (Rhodium), Ru (Ruthenium), Rb (Rubidium), ...
	F	Fluorine		∄L	Li (Lithium), La (Lanthanum), Lu (Lutetium), ...
	V	Vanadium		∄T	Ti (Titanium), Te (Tellurium), Tc (Technetium), ...
	W	Wolfram		∄D	Dy (Dysprosium), Db (Dubnium), ...
	B	Boron		∄Z	Zn (Zinc), Zr (Zirconium), ...
	K	Kalium			
	C	Carbon			

A possible explanation concerns the association of the graphemes in (65a) with a non-alveolar and therefore salient phoneme. Likewise, the occurrence of the single vowel graphemes in (66a), but not those in (66b), may indicate the relevance of salience, namely vowel phonemes associated with lip rounding [+round] and/or raising of the tongue [+high].[49]

49 There are exceptions in both directions. Two cases of element symbols consisting of a single grapheme associated with an alveolar place of articulation, *N* for *nitrogene* and *S* for *sulfur* concern particularly common element names. The tendency to favor unmarked structure here (fewer violations of *GRAPHEME) makes sense in that high frequency, like correspondence, facilitates recoverability.
The other type of counter-examples, i.e. the fact that the graphemes G, M, and X are not used as element symbols by themselves, despite their association with non-alveolar places of articulation, might be due to historical vagaries. The single graphemes *G* and *M* were historically used as the element symbols for the elements *glucinium* and *muriaticum*, respectively. Both elements were subsequently renamed (*glucinium* to *beryllium*, *muriaticum* to *chlorine*), rendering the symbols *G* and *M* obsolete.

(66)a. I Iodine
U Uranium
Y Yttrium
O Oxygene

b. ♯A Au (Aurum), Al (Aluminium), Ac (Actinium), ...
♯E Eu (Europium), Er (Erbium), ...

The effect in question could be expressed in terms of the constraint in (67):[50]

(67) SALIENCE$_{MIN}$ "Element symbols must associate with minimal phonological salience (one consonant associated with a non-alveolar constriction, or one vowel associated with lip rounding and/or tongue raising, or more than one grapheme):

The effect of SALIENCE$_{MIN}$ is illustrated in (68):

(68)a.

⟨argon⟩	BD-CORR$_{INIT}$	SALIENCE$_{MIN}$	*GRAPHEME
A		*!	
Ar			**
Ag			**
⋮			
b. ⟨yttrium⟩			
Yt			**!
☞ Y			*

The specific restrictions captured in (68) have evolved historically, as is manifest in historical changes. The grapheme *A* was used by itself as a symbol for the element *argon* until 1957, when it was replaced with the more complex symbol *Ar*. The opposite development is seen for the element symbol for *yttrium*, where *Yt* was used until the 1920s, when simple *Y* began to take hold. The grammar in (68) is then motivated in particular by patterns of historical change pertaining to the number of element symbols shown in (69):

50 As for the notion of salience there is no evidence for the relevance of grapheme shapes (e.g. the grapheme ⟨A⟩ appears to be more salient than the grapheme ⟨I⟩) or the acoustic properties of phonemes, but only their articulatory properties. This may support the motor theory of speech perception, which holds that vocal tract gestures involved in speech also play a significant role in the perception (and presumably memorization) of phonological structure (s. Galantucci et al. 2006).

(69)a. Two graphemes to one	b. One grapheme to two
Phosphorus (Ph => P)	Rhodium (R => Rh)
Boron (Bo => B)	Lithium (L => Li)
Fluorine (Fl => F)	Argon (A => Ar)
Kalium (Ka => K)	Erbium (E => Er)
Wolfram (Wo => W)	
Vanadium (Va => V)	
Uranium (Ur => U)	

It appears then that there are at least three separate conditions under which an element symbol includes a second grapheme: to satisfy BD-$\text{CORR}_{\text{St-INIT}}$, to satisfy DISTINCT, or to satisfy $\text{SALIENCE}_{\text{MIN}}$. In the first case the choice of the second grapheme is naturally predetermined (i.e. the correspondent of the initial grapheme occurring in the internal stem (s. (61)), but in the other two cases it is not. The selection patterns are not completely systematic but there are significant differences regarding the distribution of graphemes associating with a vowel versus those associating with a consonant. Here I will briefly mention relevant generalizations.

For element names starting with a consonant grapheme the selection of the second grapheme is influenced by phonological salience. Specifically, initial consonant graphemes which are not salient themselves (i.e. which are linked to an alveolar phoneme or one characterized by no constriction, i.e. /h/) appear to favor the combination with a salient consonant grapheme over the respective contiguous grapheme.[51] The rejected respective CONTIGUITY-satisfying candidates are listed in (70b). (Note that none of them were to violate DISTINCT.) The actual element symbols featuring a salient consonant in second position are shown in (70c). Here an asymmetry

51 Some apparent counter-examples can be explained by examining the timeline of naming the elements and relevant DISTINCT effects (e.g. the association of *Nobelium* with the symbol *No*, rather than *Nb*, which at the time had already been in use to represent *Niobium* or the association of the element name *Fermium* with the symbol *Fm*, rather than *Fe*, which at the time had already been in use to represent *Ferrum*). For the element names *Silicon* and *Dysprosium*, the choice of the contiguous candidates *Si* and *Dy*, respectively, might also be due to DISTINCT effects referring to *Sc/Scandium* and *Dp/Decipium*, the latter being later discarded.

between consonants and vowels manifests, as salience pertaining to vowels (e.g. *Du, Hy*) appears to not satisfy the constraint in question.

(70)a.	Full form	b.	c.	element symbol
	Du**b**n-ium	~~Du~~		Db
	Sa**m**ar-ium	~~Sa~~		Sm
	Ha**f**n-ium	~~Ha~~		Hf
	Hydrar**g**yr-um	~~Hy~~		Hg
	Roent**g**en-ium	~~Ro~~		Rg
	Sti**b**-ium	~~St~~		Sb

By contrast, initials which do associate with a non-alveolar constriction strongly favor the contiguous grapheme in second position (s. the disregard for the non-contiguous salient phoneme marked in boldface in (71a)). This result also obtains when none of the consonant graphemes in the stem associate with salience (cf. (71b)). The restriction to the stem is important as graphemes belonging to the suffix are typically not selected, regardless of their properties.[52]

(71)a.		element symbol	b.		element symbol
	Bro**m**-ine	Br		Tantal-um	Ta
	Kry**p**t-on	Kr		Tellur-ium	Te
	Fran**c**-ium	Fr		Thor-ium	Th
	Flero**v**-ium	Fl		Titan-ium	Ti
	Bis**m**uth	Bi		Hel-ium	He
	Cob**b**alt	Co		Lanthan-um	La
	Ger**m**an-ium	Ge		Lith-ium	Li
	Cup**p**r-um	Cu		Lutet-ium	Lu

The patterns in (71) indicate an active role for CONTIGUITY, violated to ensure the presence of a salient consonant grapheme in the element symbol as in (70). Interestingly, this particular exemption does not concern element names starting with a

52 The rare exceptions to this generalization (*Cm* for *curium*, *Tm* for *thulium*, *Rn* for *Radon*) appear to be largely motivated by the impact of the constraint DISTINCT (e.g. *Curium: Cu/Cuprum, Cr/Chromium*, also the stem-homophony in *Rad-on, Rad-ium*)

vowel. Here a clear preference for the contiguous candidate obtains, regardless of which graphemes follow (s. (72)).[53]

(72)				
	Europ-ium	Eu	Actin-ium	Ac
	Arg-on	Ar	Americ-ium	Am
	Irid-ium	Ir	Oganess-on	Og
	Erb-ium	Er	Ind-ium	In
	Osm-ium	Os	Alumin-ium	Al
	Aur-um	Au		

I will not attempt to further model the generalizations specific to the creation of element symbols observed here but merely note the existence of regularities specific to this particular inventory. Comparable special grammars associate for instance with abbreviations for US state names used by the US post office or abbreviations of city names on license plates for cars in Germany. The remarkable observation concerns the convergence on very similar correspondence constraints in the relevant grammars as well as regular shortening patterns in for instance English. In all of these cases the symbols in the short forms have direct correspondences in the symbolic representation of the full form, such that initials are systematically represented and CONTIGUITY is violated only under domination. To recognize these patterns and to verify the validity of this claim it is indispensable to properly identify the respective representations of the base forms, a consistent focus of the present study.

3 THE GRAMMAR OF SHORTENINGS IN HEBREW

This section explores the role of correspondence in connection with two competing models of shortenings in Hebrew shown in (73a,b), proposed by Bat-El (1994) and

53 Two exceptions concern the omission of ⟨r⟩ in the element symbols *Ag* and *As* for the elements *argentum* and *arsenic*, respectively. The element symbol *Ar* for *Argon* has not played a role here since the ⟨r⟩ was added long after the element symbols *Ag* and *As* had been established (cf. the remarks about *Argon* under (68)).

Zadok (2002), respectively. Bat-El's basic assumption is shown in (73a), where so-called "acronym bases" are shortened to "acronyms" consisting of grapheme strings, which are then mapped to phonological representations. Bat-El's analysis focuses exclusively on the shaded area in (73a), examining generalizations concerning the prosodic organization of acronym words (i.e. syllabification, stress). Zadok argues for the model in (73b) instead, where spoken base forms are mapped to acronym words with no intermediate steps and no reference to written forms.

(73)a.

"acronym base"	➜selection	"acronym" *string of graphemes*	➜organization	"acronym word" *string of phonemes, prosodically organized*

b.

"acronym base" *phonological representations (?prosodically organized)*	➜selection,organization	"acronym word" *string of phonemes, prosodically organized*

In section 3.1. I present Bat-El's arguments for the separate treatment of the shaded area in (73a), followed by a discussion of Zadok's objections and her counter-proposal in section 3.2. There I will argue that considerations of correspondence are largely consistent with Bat-El's model in (73a), while raising problems for Zadok's model in (73b). However, possible reference to phonological structure in acronym bases in the formation of acronym words might require some modification of the model in (73a).

3.1 THE "TWO-STEP MODEL" (BAT-EL 1994) VS THE "ONE-STEP MODEL" (ZADOK 2002)

The phenomenon focused on by Bat-El (1994) concerns certain phonological restrictions on spoken acronyms, distinguishing them from other Hebrew words. For instance, acronym words exhibit only simple syllable onsets and are characterized by a typical restriction to the vowel /a/, as opposed to the occurrence of complex onsets and

various vowels in the ordinary vocabulary. Bat-El notes that the key to capturing these restrictions lies in the relation between the spoken *acronym words*, which consist of prosodically organized phonemes and the corresponding *acronyms*, conceived of as strings of graphemes representing shortenings. The data in (74), including the capitals meant to represent Hebrew letters, are adopted from Bat-El (2000:69).

(74)a.	**acronym**	**acronym word**		b.	**Non-acronym word**	
	KLB	kalab	'close to home'		klavim	'dogs'
	GLC	galac	'the army radio station'		glida	'ice-cream'
	TGM	tagam	'very high frequency'		tguva	'response'

Bat-El's 1994 account of the discrepancies in (74) focuses on the relation between the written acronyms and the phonological acronym words. Specifically, the convention characterizing Hebrew orthography to provide only graphemes corresponding to phonemes potentially associated with the syllable margin results in frequent grapheme strings where no symbol corresponds to a potential nucleus (cf. the leftmost column in (74a)). This particular property of Hebrew grapheme strings allows markedness constraints to dominate the mapping to phonological words, determining both the sites of syllable nuclei and the quality of vowels occupying them.[54] Relevant constraints include standard markedness constraints on syllable structure such as ONSET, NOCODA, *COMPLEX ("No more than one C or V may associate to any syllable position node"), as well as a constraint *N/V$^{[-low]}$, limiting vowels to the most sonorous low vowel /a/ (s. Prince & Smolensky 1993). The shape of the acronym words is then determined by the interaction of those markedness constraints with two constraints on grapheme-phoneme correspondence, here referred to as GP-CORR and *EPEN, respectively. GP-CORR requires every grapheme to have a segmental correspondent in the phonological

54 This TETU effect is seen in acronyms, which form novel words, not when reading established words, where relevant structure is "filled in" based on recognizing those words.

representation and is undominated in Hebrew. *EPEN ("No epenthesis) prohibits the occurrence of segments in the phonology lacking a correspondent in the written form and is violated only under domination. The essence of the grammar proposed by Bat-El (1994) is illustrated in tableau (75), where the top three constraints are undominated and therefore unranked:

(75)

⟨KLB⟩	GP-CORR	ONSET	*COMPLEX	*EPEN	NOCODA	*N/V[-low]
(kal)$_{\omega}$	*			*	*	
(akalab)$_{\omega}$		*		***	*	
(kalb)$_{\omega}$			**	*	*	
☞ (kalab)$_{\omega}$				**	*	
(kalaba)$_{\omega}$				***!		

Strong evidence for the grammar in (75) pertains to a specific subset of graphemes in the Hebrew alphabet, which correspond not only to phonemes organized in the syllable margin, but, depending on context, also to those forming a nucleus (Bat-El 1994:33). Specifically, the graphemes represented by the symbols ⟨H⟩, ⟨ʔ⟩, ⟨Y⟩, and ⟨W⟩ below each correspond to phonemes associating with the onset or the nucleus in acronym words:

(76)

	Graphemes	Phonemic correspondents in acronym words	
		Onset	Nucleus
a.	⟨H⟩ (ה)	/h/ ~ /ʔ/	/a/
b.	⟨ʔ⟩ (א, ע)	/ʔ/	/a/
c.	⟨Y⟩ (י)	/j/ (/i/)	/i/
d.	⟨W⟩ (ו)	/v/	/u/, /o/

Bat-El (1994:32ff) observes that the syllable position and consequent distribution of phonemes in acronym words is determined by the position of the corresponding graphemes in the acronym. The graphemes ⟨H⟩ and ⟨ʔ⟩ correspond to glottal phonemes associated with the syllable onset, unless they occupy the last position in the acronym,

in which case they correspond to syllabic /a/ in the acronym word. The graphemes ⟨Y⟩ and ⟨W⟩ regularly correspond to phonemes forming syllabic nuclei, unless they occupy the initial position in the acronym, in which case they correspond to glides or fricatives in the acronym word.[55] The distribution is thus roughly captured in the grammar illustrated below, where the same grapheme ⟨Y⟩ corresponds to a glide in (77a) but to a nucleus in (77b).[56] The latter syllabification is forced by *EPEN, which ensures the preference of candidates with syllabic correspondents over those with non-syllabic correspondents, as the latter trigger vowel epenthesis (cf. the first two candidates in (77b)). Similar dependencies can be demonstrated for glottals, where again identical graphemes map to distinct phonemes, depending on the position of the grapheme in the acronym.

(77)a.	⟨**Y**XB⟩	GP-CORR	ONSET	*COMP	*EPEN	NOCODA	*N/V[-low]
	(xab)ω	*!					
	(ixab)ω		*!		*		
	(jxab)ω			*!	*		
	☞ (**j**axab)ω				**	*	
b.	⟨X**Y**BH⟩						
	(xajabaha)ω				***		
	(xajaba)ω				**	*	
	☞ (x**i**ba)ω						*

Two conclusions follow from the analysis in (77). First, to the extent that the relation between observable acronyms (represented as grapheme strings) and acronym words can indeed be captured in terms of a ranking among independently motivated markedness and correspondence constraints, this in itself supports the grammar in

55 The grapheme-phoneme mapping properties of the grapheme ⟨Y⟩ are then somewhat similar to those seen in English, where ⟨Y⟩ corresponds to a syllabic vowel (cf. ⟨WYSIWYG⟩ in (43), mapped to (ˈwɪzɪˌwɪg)ω), unless a vowel follows, in which case ⟨Y⟩ corresponds to a glide as in ⟨YOP⟩ (< *Youth Opportunities Program*).

56 A more complex grammar is needed to capture the asymmetry between glides and glottals in word-internal contexts (see Bat-El 1994:33ff for a proposal). The question of how to eliminate the candidate (kalba)ω in (75) likewise merits further discussion, an issue also discussed by Bat-El 1994:30).

question along with the model in (73a). Note that the entire domain of regularity staked out in (77) is ignored in the model in (73b).

Second, and more important in the context of the present article, it holds that the separate treatment of the grapheme to phoneme mapping in (73a) is a prerequisite for capturing relevant correspondences pertaining to the shortenings. Consider the relation between the phonological base forms and the acronym words envisioned in Zadok's model. Here DB-CORRESPONDENCE clearly fails as is illustrated in (78): the glide in the acronym base does not necessarily correspond to a glide in the acronym word and the phoneme /h/ in the acronym base corresponds to the vowel /a/ (rather than /h/). Moreover, CONTIGUITY fails as well even within morphemes as for instance the phonemes /xi/ are contiguous in the acronym word while the corresponding /x/ and /j/ in the base are non-contiguous.

(78)	acronym base	acronym word	
a.	(jexidat)$_{\omega}$(binuy)$_{\omega}$	(jaxab)$_{\omega}$	'construction unit'
b.	(xajalot)$_{\omega}$(beʃerut)$_{\omega}$(hamiʃtara)$_{\omega}$	(xiba)$_{\omega}$	'female police soldiers'

Mismatches as in (78b) do not concern Bat-El's two-step model, where the shortening affects the relation between acronym bases and acronyms, both represented in form of grapheme strings. Here DB-CORRESPONDENCE is satisfied, as is shown in (79). (The diacritic " is regularly included in Hebrew acronyms before the last grapheme, to mark the status of the string as an acronym.) The constraint CONTIGUITY is crucially dominated by BD-CORR$_{\text{INIT}}$ (and some size- or anti-structure constraint), regularly satisfied whenever multiple graphemes belong to one word.

(79)	acronym base	acronym	
a.	יחידת בינוי	יח"ב	'construction unit'
b.	חיילות בשירות המשטרה	חיב"ה	'female police soldiers'

Zadok's model then not only misses the generalizations pertaining to the grapheme-phoneme mapping captured by the grammar in (73a) but moreover ignores the systematic correspondence patterns in (79), which concern the sameness of symbolic representation and appear to be highly systematic for shortenings.[57] The next section briefly addresses Zadok's motivation for positing the model in (73b) along with some suggestions to tackle her concerns, drawing on the phenomena observed in the data presented in the preceding sections.

3.2 CORRESPONDENCE PATTERNS IN HEBREW SHORTENING

Zadok (2002) motivates her proposal of a single model referring to only phonological representations with the predictability of shortening types based on the phonological structure of the full form. In particular she notes that the specifics of selecting material from base expressions depend on the number of stems/words in the full form. For base expressions with three or more stems, only initials are selected (80a), while for those with two stems, additional non-initial material is included (80b). For base forms consisting of a single word two consecutive syllables in the full form are selected (80c). All examples in (80) are from Zadok (2002:70-73).

(80)	Full form	Shortened form	
a.	nemal teufa ben gurion	natbag	'Ben Gurion airport'
	cva hagana le-israel	cahal	'Israeli Defence Force'
b.	mate klali	matkal	'general headquarters'
	mefaked basis	mabas	'base commander'
c.	bircinut	birci	'seriously'
	dikaon	diki	'depression'

57 Recall that such correspondence is naturally excluded for grapheme-phoneme relations, due to the distinctness of the symbols in question (graphemes versus phonemes). Shortenings can accordingly not be based on graphemic base forms, yielding phonological forms without any intermediate representation.

Zadok argues that the complementarity seen here, where properties of the full form (word count) determine the mode of shortening, indicates the existence of a single grammar, associated with a single type of input (2002:59) and uniform prosodic restrictions on the output (disyllabicity). She asserts that the relevant inputs need to consist of the phonological representations of the full forms, in accordance with the representations motivated for shortening grammars in other languages (2002:33).

It is apparent that the type in (80c) differs from the other types in being characterized by correspondence to a contiguous phonological string, including the correspondence of the full set of vowel phonemes (apart from the suffix *-i*), much like clippings in English. By contrast, the phonological form of the shortenings in (80a,b) is likely determined by grapheme-phoneme correspondence as described in the preceding section (but see below). The similarity in output shape, namely disyllabicity, is accidental then, resulting from a size constraint (including the suffix *-i*) in the case of clippings, and from the most typical number of graphemes to form an acronym (i.e. three), along with relevant restrictions on vowel epenthesis. The dependency of shortening on the number of stems/words in the input is somewhat similar to that seen in English, indicating similar associations between stem count and representation type (e.g. reference to phonological form primarily when full forms consist of a single stem). Hebrew, too, shows a particular variety of shortening patterns pertaining to base expressions consisting of exactly two stems, which can be shortened to the initial graphemes as in (81a,b), or include an additional non-initial grapheme as in (81c) (cf. the relevant English patterns in (44), (45)). In the former case the graphemes are often mapped to letter compounds as in (81a) (Noam Faust, p.c.), but can also be organized as an acronym word, in accordance with the grammar in (77) (cf. (81b)). When three graphemes are present, acronyms are consistently mapped to acronym words (s. 81c):

(81)	acronym base	acronym	prosodic organization	
a.	⟨מַפקד פְּלוגה⟩	⟨מ"פ⟩	$((mem)_{\omega}(pej)_{\omega})_{COP\text{-}COM}$[58]	'company commander'
b.	⟨חבר כְּנסת⟩	⟨ח"כ⟩	$(xak)_{\omega}$	'parliament member'
c.	⟨יחידת בְּינוי⟩	⟨יח"ב⟩	$(jaxab)_{\omega}$	'construction unit'

The generalization here is that the shortening of full forms consisting of more than one stem typically requires reference to graphemic representation, while those based on a single stem involve truncation referring to phonological form. Complementarity then does not entail a single grammar referring to a single type of representation.

I will end this section by briefly addressing criteria for the selection of graphemes in acronyms, other than the occurrence in stem-initial position. The two criteria indicated by the examples in (79) concern the intention to ensure complete correspondence of the acronym with an independent word (s. the Hebrew word (xiba) 'affection') and a preference for acronyms with three, rather than two, graphemes. The latter case raises the question of how the third letter is chosen when only two stems are present. The case in (79a) indicates CONTIGUITY in written representation as a decisive factor but there are of course two options for satisfying that constraint: the first versus the second word. The selection of the grapheme ⟨ח⟩ associated with the velar fricative rather than ⟨י⟩ associated with a glide or vowel in (79a) suggests that the choice here, too, may have been affected by phonological salience. Such a preference is seen repeatedly in the data provided by Bat-El (1994) and Zadok (2002) but there is also a perhaps independent tendency to avoid graphemes associated with glides or glottals, marked in red in (82):

(82)	acronym base	acronym	
	⟨צִיוד בְּדיקה⟩ $(t^{s}iyud)_{\omega}$ $(bdika)_{\omega}$	⟨צב"ד⟩ $(t^{s}abad)_{\omega}$	'testing equipment'
	⟨חַייל פַּשוט⟩ $(xayal)_{\omega}$ $(paʃut)_{\omega}$	⟨חפ"ש⟩ $(xapaʃ)_{\omega}$	'private' (simple soldier)
	⟨גלי צה"ל⟩ $(ɢaley)_{\omega}$ $(t^{s}ahal)_{\omega}$	⟨גל"צ⟩ $(ɢalat^{s})_{\omega}$	'the army radio station'
	⟨שִיתוף פְּעולה⟩ $(ʃituf)_{\omega}$ $(peula)_{\omega}$	⟨שת"פ⟩ $(ʃatap)_{\omega}$	'collaboration'

58 This letter compound is based on the grapheme to letter name mappings ⟨מ⟩→ $[mem]_{STM}$,⟨פ⟩→$[pej]_{STM}$.

Yet another possible factor indicated by those data concerns the vowel in the respective initial syllable in the acronym word. The data in (83) indicate that the presence of the maximally unmarked vowel /a/, whether located in the first word as in (83a) or in the second word as in (83b), may induce a preference for the following consonant:

(83)	acronym base	acronym	
a.	⟨מטבע חוץ⟩ (matbeʔa)$_{\omega}$ (xut^{s})$_{\omega}$	⟨מט"ח⟩ (matax)$_{\omega}$	'foreign currency'
	⟨מדריך ספורט⟩ (madrix)$_{\omega}$ (sport)$_{\omega}$	⟨מד"ס⟩ (madas)$_{\omega}$	'sports instructor'
b.	⟨מפקד חטיבה⟩ (mefaked)$_{\omega}$ (xativa)$_{\omega}$	⟨מח"ט⟩ (maxat)$_{\omega}$	'brigadeer commander'
	⟨מספר קטלוגי⟩ (mispar)$_{\omega}$ (katalogi)$_{\omega}$	⟨מק"ט⟩ (makat)$_{\omega}$	'catalogue number'

The patterns in (83) make sense from the perspective of the grammar in (77), assuming that "hybrid outputs" are admitted, which combine correspondence to phonemic and to graphemic input representation (cf. the hybrid formations in English in (45), (46)). In that case, the candidate including the closed syllable containing /a/ would beat its rivals consisting of only graphemes as it would cause one less violation of the constraint prohibiting epenthesis. (The restriction to /a/ is motivated by the fact that this is the only vowel satisfying the constraint prohibiting non-low vowels.)

Potential support for this proposal comes from irregularities in the formation of the acronym comprising two stems in (84a). There is a question of why four graphemes are included, instead of the more regular count of three. Moreover, these graphemes include ⟨ת⟩ representing the function word /ha/, which is often omitted when forming shortenings (s. (84b)). A possible explanation for these peculiarities is shown in (84c), where reference to phonological form, specifically the presence of the initial /CaC/-strings in both components, allows for those strings to be concatenated into a single phonological word conforming to regular acronym words. Alternatively, those strings could also be organized as a type of compound, perhaps in part mimicking English shortenings consisting of two truncated closed syllables seen in compounds like ((fɔɹ)$_{\omega Hd}$(tɹæn)$_{\omega}$)$_{COMP}$ 'FORTRAN' (cf. (45)).

(84)a.	acronym base: ⟨אַרְצוֹת הַבְּרִית⟩		acronym: ⟨ארה"ב⟩		'United States'
b.	חֵיל הָרְפוּאָה	xeyl ha-rəfua	חר"פ	$(\text{xarap})_{\omega}$	'medical corps'
	מִשְׁמַר הַגְּבוּל	miʃmar ha-gvul	מג"ב	$(\text{magav})_{\omega}$	'border guard'
c.	ʔarcot ha-brit		$((\text{ʔar})_{\omega}(\text{hab})_{\omega})_{\text{COMP}} \sim (\text{ʔarhab})_{\omega}$		'United States'

The tentative evidence for (exclusive) reference to the phonological representation of the full form in the formation of the acronym word $(\text{ʔarhab})_{\omega}$ contrasts with the clear evidence for reference to graphemic representation in the formation of the acronym word $(\text{xarap})_{\omega}$ in (84b).[59] This is because of the correspondence affecting the grapheme ⟨פ⟩ (rather than the respective phonemes /f/ and /p/), which moreover violates the regular occurrence of the allograph ⟨ף⟩ of the letter *Pe* in word-final position.

The question of whether any of the proposed criteria for selecting stem-internal material in Hebrew acronyms are valid requires further study. Especially evidence for "hybrid formations" would support a model allowing for access to both phonological and written input representations here, too.

CONCLUSION

The examination of shortening patterns presented in this article indicates correspondence constraints requiring the symbols in short forms to have exact matches in the full forms. This requirement typically pertains to phonological representations in the case of truncations of single words but, especially in the case of full forms consisting of multiple words or stems, predominantly refers to written representations. Significantly, in either case there is reference to a single specific level of abstractness, determined by language-specific contrastiveness in the case of phonological

59 I thank Roger Schwarzschild for bringing this acronym to my attention.

representations (i.e. phonemicity), and particular conventions pertaining to the classification of graphemes in the case of written representations (i.e. association with a single grapheme name). As for phonemic representations there is also evidence for reference to specific prosodic organizations concerning both syllable and foot structure. The relevant structures are in accordance with assumptions in Prosodic Phonology (e.g. reference to complex syllable onsets or coda constituents as in (15), (16), cf. Nespor & Vogel 2007).

Why is there reference to these particular types of symbolic representation in shortening grammar to the exclusion of others? Arguably, it is because these are the only types of symbolic representation of words in the mind, referred to not only in shortening grammars but in grammar in general. Hence word formation in general requires reference to phonemic representation, accounting for instance for allomorphy in suffixes to avoid instances of phonemic sameness. Consider the suffix -*al* in (ˈspɑinə**l**)$_{\omega}$ 'spinal', as opposed to -*ar* in (ˈpəulə**ɹ**)$_{\omega}$ 'polar', to avoid the same phonemes flanking the nucleus (e.g. *(ˈpəu**l**ə**l**)$_{\omega}$), even though phonetically the relevant segments differ rather drastically (i.e. "clear" versus "dark" /l/). Word formation is indeed subject to the same type of correspondence constraints requiring phonemic sameness, violated only to satisfy specific constraints imposed by individual affixes (s. Raffelsiefen (in press) for details regarding English) or particular demands concerning distinctness of stems in inflectional morphology. There are also requirements on sameness in inflectional morphology, known as "syncretism", which again refer to phonemic representations (e.g. sameness in comparative and superlative forms as in (bæd)$_{\omega}$ 'bad' (**wɹs**)$_{\omega}$ 'worse' (**wɹs**t)$_{\omega}$ 'worst' in English). Shortenings are of particular interest to studies on correspondence then mainly because they are typically not affected by specific restrictions imposed by affixes nor by requirements to be distinct from other members of the paradigm.

Shortenings shed light not only on the nature of representations in the mental lexicon

but also on particular properties characterizing the structures in question. Relevant evidence comes from the selection of material from full forms to be included in the short forms. Here pervasive preferences manifest, notably the need for the initial symbols to correspond and for strings affected by correspondence to be contiguous. Significantly, these constraints affect phonological and graphemic representations alike. Other constraints concern the need to ensure correspondence of particular types of symbols, associated with salience regarding articulatory gestures encoded in phonemic forms (e.g. non-alveolar). There is some tentative evidence that even here phonological and graphemic representations are affected in similar ways.

A general question raised by the generalizations noted in this article is why they are not widely known or acknowledged in formal grammar. The answer lies in unfortunate vagaries in the history of the field, particularly in the past decades, where reference to graphemic representations is mostly shunned and the concept of phonemic representation is often dismissed lightly.

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DISCUSSION WITH FRANCESC TORRES-TAMARIT
(UNIVERSITAT AUTÒNOMA DE BARCELONA)

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COMMENTS

In this interesting paper, Raffelsiefen investigates the role of correspondence in a variety of shortening phenomena including hypocoristic truncation in American English (AE) and the pronunciation of acronyms in both AE and Modern Hebrew. The author's main claim is that correspondence between bases and truncated forms can make reference to two different abstract levels of representation: (i) a phonological level of representation determined by language-specific contrastiveness, or phonemic representation, and (ii) written representations.

In this reaction I will first concentrate on the claim that correspondence can make reference to a level of "phonemic structure", a Bloomfieldian notion. Then I will comment on size effects in the formation of acronyms and initialisms.

1. Phonemic representations. In contrast to Generative Phonology, which assumes common underlying representations from which different surface representations of morphologically related forms are derived, "autonomous phonemics" claims that phonological representations cannot be determined by reference to related forms but only to phonemic contrastiveness. Therefore, forms like *naturally* or *nature*, which contain a vowel alternation which is phonemic in English (cf. *fat* vs. *fate*), possess their own phonemic structure: /nætʃəɹəli/ and /nɛitʃəɹ/, respectively. According to the author, the fact that *naturally* and *nature* can be truncated to *natch* [ˈnætʃ] and *naitch* [ˈnɛi̯tʃ],

respectively, demonstrates the irrelevance of uniform underlying representations, which in these words would have the same vowel. However, nothing precludes an analysis whereby correspondence operates between output forms in truncation, which is the standard view in OT since Benua (1995) (see also Birgit & Arndt-Lappe 2022 and work cited therein). Therefore, the output of the base [ˈnætʃəɹəli] determines the output of the truncated form [ˈnætʃ], and the output of the base [ˈnɛi̯tʃɚ] determines the output of the truncated form [ˈnɛi̯tʃ].

The author also claims that truncation processes can help resolve issues related to phonemics. In English there is a phonemic contrast between /s/ and /z/, which is neutralized in preconsonantal position: [s] is banned before voiced onsets, and [z] is banned before voiceless onsets. The author claims that truncated forms like *lez* derived from *lesbian* or *sis* derived from *sister* show that phonemic representations must actually include /z/ and /s/ in neutralizing contexts: /lezbiən/ and /sɪstəɹ/. However, reference to the output forms of those bases is again sufficient in determining the feature value specification of the sibilants in the truncated forms. (In this reaction I use the term ‘base’ as a synonym for output of the base.) Are the two mechanisms, reference to phonemic representations and reference to output forms, equivalent? In my opinion, correspondence in terms of phonemic representations is problematic for various reasons, which I will briefly enumerate.

Although the author assumes OT, phonemic representations seem to contradict the Richness of the Base hypothesis. OT has no morpheme-structure constraints and there can be no restrictions on inputs. The constraints themselves are responsible for enforcing any surface patterns. Richness of the Base is simply the ultimate consequence of the basic assumption that the only difference between grammars is constraint ranking. Given Richness of the Base, a truncated form like [ˈlɛz] can only be derived by correspondence to the output form of the base, [ˈlɛzbiən], because the input can either be /lɛzbiən/ or /lɛsbiən/. There is of course debate on the level of abstractness of output

forms in OT, but I think that any OT phonologist would agree that output forms must include at least allophonic properties such as the voicing specification of the preconsonantal sibilant in a form like *lesbian*. In any case, any deviation from Richness of the Base has far-reaching consequences and should be treated with caution. I will not further elaborate on this issue.

To argue in favor of the claim that truncation makes reference to phonemic representations, Raffelsiefen considers two case studies that Benua (1995) used to argue in favor of output-output correspondence in truncation. Phonological processes usually underapply or overapply in truncated forms. Benua (1995) argued that truncatory identity effects are caused by BT-FAITHFULNESS, faithfulness between the output of bases and truncated forms. One case study was illustrated with the form ['dʒæ̃n] (*Jan*) derived from ['dʒæ̃nɪs] (*Janice*). In the truncated form ['dʒæ̃n], æ-tensing underapplies (cf. ['bEn], *ban*). Underapplication of æ-tensing is derived in Benua (1995) by ranking IDENT-BT(tense) above the markedness constraint responsible for æ-tensing, which dominates IDENT-IO(tense). The same metaranking, BT-FAITHFULNESS >> MARKEDNESS, is also responsible for deriving cases of overapplication in truncation. The example used in Benua (1995) was overapplication of vowel lengthening in truncated imperatives in Icelandic. There is open syllable lengthening of stressed vowels in Icelandic, derived by ranking the markedness constraint STRESS-TO-WEIGHT, requiring stressed syllables to be heavy, above a markedness constraint against long vowels, *VV, which dominates the faithfulness constraint IDENT-IO[v-length]. This ranking ensures that only stressed vowels, but not unstressed vowels, surface as long vowels in Icelandic, irrespective of the vowel length specification in the input as mandated by Richness of the Base. The next two tableaux illustrate this fact.

(1) STRESS-TO-WEIGHT >> *VV >> IDENT-IO[v-length] (Benua 1995)

/sötra/	STRESS-TO-WEIGHT	*VV	IDENT-IO[v-length]
a. sö.tra	*!		
b. söö.traa		**!	**
c. ☾ söö.tra		*	*

/söötraa/	STRESS-TO-WEIGHT	*VV	IDENT-IO[v-length]
a. sö.tra	*!		**
b. söö.traa		**!	
c. ☾ söö.tra		*	*

The truncated imperative is derived by deleting the final vowel of the infinitive in Icelandic. The ranking IDENT-BT[v-length] >> *VV is responsible for selecting the candidate with a long vowel. Vowel lengthening in this context is driven not by markedness but by BT-FAITHFULNESS. If the final vowel deletes, the stressed syllable is a closed syllable, and because coda consonants contribute to the weight of syllables in Icelandic, STRESS-TO-WEIGHT, not represented in (3), is satisfied irrespective of vowel length.

(2) IDENT-BT[v-length] >> *VV (Benua 1995)

Base: [söö.tra]	IDENT-BT[v-length]	*VV
a. ☾ söötr		*
b. sötr	*!	

In Raffelsiefen's analysis, overapplication of vowel lengthening in Icelandic is derived differently. She assumes that correspondence may affect contiguous parts of the prosodic trees of phonemic representations and that word-final syllables can have an empty nucleus, allowing for subphonemic (allophonic) correspondence effects (see 15a). The two syllables in the phonemic representation of the imperative /sö.tra/ would stand in correspondence with two syllables in the phonemic representation of the truncated imperative /sö.trØ/, with a final empty nucleus. The final empty nucleus in /sö.trØ/

allows for syllabifying the final cluster of consonants as the onset of the second syllable, and then open syllable lengthening of the stressed vowel applies regularly in phonetic implementation. The same analysis is suggested for the underapplication of æ-tensing in [ˈdʒæ̃n].

Only when phonemic representations are enriched with prosodic structure can one maintain the claim that truncation makes reference to phonemic representations. Such phonemic representations are actually conflating contrastive properties with properties that are constraint-governed. My take on this is that the approach defended by Raffelsiefen compromises not only Richness of the Base, but the standard assumption in OT that the most abstract level of phonological representation does not include prosodic structure because it is always constraint-governed.

Raffelsiefen also comments on another interesting truncated hypocoristic from AE: [ˈkʰɪt] (*Kit*), without flapping (cf. [ˈkʰɪ.ɾi] *Kitty* with flapping). The sounds [ɾ] and [tˀ] are derived from the same phonemic target /t/, which is weakened to a flap intervocalically before an unstressed vowel while glottalized when no vowel follows. But what prevents correspondence from targeting prosodic trees? If open syllable vowel lengthening can occur from phonemic representation to phonetic implementation in /sö.trØ/, flapping could also occur before an empty nucleus in a disyllabic phonemic representation like /ˈkɪ.tØ/ as it occurs in /ˈkɪ.ti/. One could say that flapping only occurs before unstressed vowels and not before empty nuclei, but if empty nuclei are available, it is predicted that such a truncated form can be possible in some languages. Both Raffelsiefen's approach and the classic OT approach by Benua could actually derive an unattested form like *[ˈkʰɪɾ]. Whether such forms must be predicted by our finite set of constraints or not is an empirical question, but a reasonable interim hypothesis is that no truncated form includes sound properties from their bases if those properties are non-structure-preserving. This would explain the ungrammaticality of a form like *[ˈkʰɪɾ], with a flap, a non-contrastive sound in English. I think that this hypothesis, if true, can hopefully

shed light on larger questions relating to the basic architecture of grammar. Although flapping is characterized by distinct contexts word-internally and across words (it only applies before stressed vowels across word boundaries), it is usually regarded as a postlexical process because it has no lexical exceptions, is not structure-preserving, and has a clear phonetic motivation. I think that an analysis framed within Stratal OT can actually block *[ˈkʰɪɾ] from being selected as the most optimal candidate if BT-FAITHFULNESS is undominated. At the word-level stratum, IO-FAITHFULNESS must outrank the markedness constraint *ɾ/-#, *tˀ/V_V, which governs the distribution of [ɾ] and [tˀ]. If flapping is not a lexical process, faithfulness must outrank markedness at the word-level stratum. If IO-FAITHFULNESS dominates *ɾ/-#, *tˀ/V_V, the output of the base does not contain the flap and the optimal candidate is [ˈkʰɪ.ti]. I assume that truncation is a word-level process, so BT-FAITHFULNESS (unranked in this particular case) ensures that the output of the truncated form is [ˈkʰɪtˀ] at the word-level phonology. At the postlexical stratum, the reverse ranking *ɾ/-#, *tˀ/V_V >> IO-FAITHFULNESS is responsible for mapping [ˈkʰɪ.ti] onto [ˈkʰɪ.ɾi], and [ˈkʰɪtˀ] onto faithful [ˈkʰɪtˀ]. Importantly, we must assume that no output form derived at the postlexical stratum can enter into a new BT-correspondence relation. Why would that be the case? One possible answer is that truncation is strictly a lexical process, and BT-correspondence cannot be altered in the postlexical stratum. Therefore, the output of the base at the postlexical stratum must remain the output of the base derived at the lexical stratum (i.e., [ˈkʰɪ.ti], not [ˈkʰɪ.ɾi]). Then, BT-FAITHFULNESS, ranked above *ɾ/-#, *tˀ/V_V, is responsible for selecting [ˈkʰɪtˀ]. It seems that Stratal OT is able to block the presumably unattested emergence of non-structure-preserving properties in truncated forms if BT-correspondence is only established at the word-level stratum.

2. Size effects. I would like to elaborate on the idea that acronym and initialism formation is partly determined by size constraints, which is not the author's focus of

interest. Consider, for instance, the acronym forms ((ˈwɪzɪ)$_{Ft}$(ˌwɪg)$_{Ft}$)$_{ω}$ (*WYSIWYG*) and ((ˈɛbsɪ)$_{Ft}$(ˌdɪk)$_{Ft}$)$_{ω}$ (*EBCDIC*). These forms cannot be considered minimal words as they contain more than one foot, but may show instead *how big small words can be*, that is, an effect of a maximality constraint on minimal words, which in English could mean having a maximum of two feet and no unparsed syllables. Therefore, the length of an acronym like *WYSIGYG* is probably not solely a function of the full form "**W**hat **y**ou **s**ee **i**s **w**hat **y**ou **g**et", which happens to have seven initials that, when put together, allow for the creation of three syllables.

Similarly, in German trademarks, which resemble acronyms, two trisyllabic forms with a single stress are illustrated in the paper: (miˈlupɑ)$_{ω}$ (*Milupa*) and (ʀoˈvɛntɑ)$_{ω}$ (*Rowenta*). These trisyllabic forms have only one stress. Is word minimality at play in the creation of trisyllabic acronyms? Is PARSE-SYLLABLE violated in these forms? It has been proposed for Spanish that trisyllabic truncated forms actually contain a layered foot, e.g. (*σ(ˈσσ)*$_{Ft}$)$_{Ft}$ (Martínez-Paricio & Torres-Tamarit 2019), so the general assumption that truncated forms minimally correspond to the size of a single metrical foot is maintained.

With respect to initialisms, the author assumes that each grapheme maps onto its own prosodic word in AE: (ˈɑi̯)$_{ω}$(ˈdi)$_{ω}$ (*ID*), (ˈɑi̯)$_{ω}$(ˈpi)$_{ω}$(ˈɛi̯)$_{ω}$ (*IPA*). I asked one American and one Canadian phonologist about their judgments on the pronunciation of the following initialisms: *ID*, *IPA*, *USAF*, *biz ad* and *sci-fi*. Although one phonologist accepted the parse in which each grapheme maps onto its own prosodic word, the other speaker preferred alternative parses. Both agreed that (ˈɑi̯)$_{ω}$(ˈdi)$_{ω}$ is pronounced as two separate prosodic words because the second one carries the most prominent stress. For three-grapheme initialisms, one of the phonologists said that they sounded to her like one unit, which would be closest to either (ˈɑi̯ˌpi)$_{ω}$(ˈɛi̯)$_{ω}$, with two prosodic words, or (ˌɑi̯piˈɛi̯)$_{ω}$, with one prosodic word (in both parses, the most prominent stress falls on the last syllable). A prosodification with a single prosodic word is also suggested for

(ˈbɪzˌæd)$_{ω}$ and (ˈsɑi̯ˌfɑi̯)$_{ω}$, with initial main stress. What is interesting from these examples is that size effects can also be observed in initialisms, in that they tend to avoid building more than two prosodic words. The prosodic structure of both acronyms and initialisms, but also ideophones like *jingle-jangle* or *higgledy-piggledy* (McCarthy & Prince 1986), which are often disregarded in metrical investigations of prosodic morphology, are therefore worth further investigation.

Alber, B. & S. **Arndt-Lappe**. 2022. 'Anchoring in truncation: A typological analysis'. *Natural Language and Linguistic Theory*. https://doi.org/10.1007/s11049-021-09523-x. **Benua**, L. 2015. 'Identity effects in morphological truncation'. In J. Beckman, L. Walsh-Dickey & S. Urbanczyk (eds), *University of Massachusetts occasional papers in linguistics 18: papers in Optimality Theory*. Amherst, MA, GLSA: 77-136. **Martínez-Paricio**, V. & F. **Torres-Tamarit**. 2019. Trisyllabic hypocoristics in Spanish and layered feet. *Natural Language and Linguistic Theory* 37(2): 659-691. **McCarthy**, J. & A. **Prince**. 1986. Prosodic Morphology. Technical report, Rutgers University Center for Cognitive Science, New Brunswick, NJ.

REPLY

I appreciate the opportunity to publicly react to the comments by Torres-Tamarit. I will focus on various points where I disagree with the way my views are represented or object to the alternative analyses proposed there. I follow the sections given in the review, discussing the issue of representation first, followed by comments on the prosody of shortenings.

I have argued that the relation between full forms and respective shortened forms indicates complete correspondence (sameness of structure occurring in the shortened form compared to that in the full form) referring to two types of representation: either "phonemic" (i.e. based on language-specific contrast), where phoneme strings are associated with prosodic organization, or graphemic. (Torres-Tamarit writes that my claim concerns bases and truncated forms. That is both too broad, as I have argued that hypocoristic truncation is not necessarily restricted by complete correspondence (s.

section 1.4.1), and also too narrow, as my claim concerns all sorts of shortenings, not just truncations.) Relevant evidence pertains both to comparisons with putative more abstract representation, motivated by neutralization and/or the idea that alternations require a uniform underlying representation, and also with more concrete "phonetic" representations, motivated by perceptual discriminability. The former case is illustrated with neutralization data from English in (5) (p.106), where the distribution between /s/ and /z/ in truncated forms corresponds to that in the full forms, whether relevant fricatives occur in a position where voicing is contrastive (s. (5b,c)) or determined by markedness (s. (5a)). The data in (5a) are repeated in (1), where "→" marks the representations indicated by correspondence, exhibiting fully specified phonemes rather than the archiphoneme |S| (Trubetzkoy 1936).

(1)a. → (ˈsɪstəɹ)ѡ, *(ˈsɪ|S|təɹ)ѡ 'sister'
→ (ˈlɛzbiən)ѡ, *(ˈlɛ|S|biən)ѡ 'lesbian'

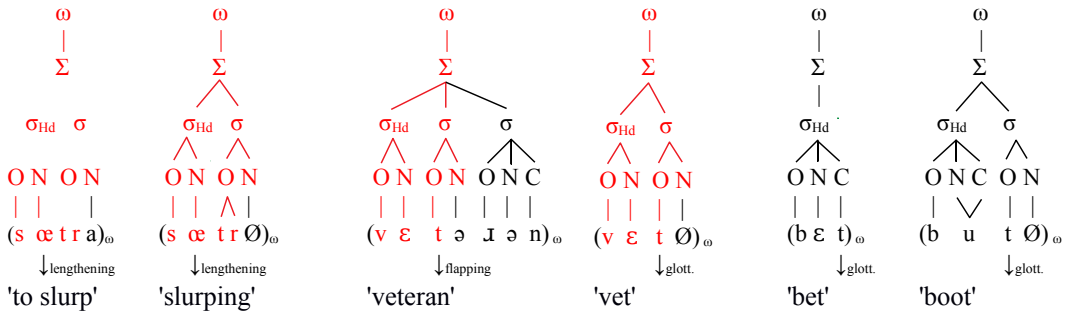
b. (ˈsɪs)ѡ 'sis'
(ˈlɛz)ѡ 'lez'

Torres-Tamarit errs in referring to the neutralization of the voicing contrast in (1a) as “allophonic” but is of course correct in assuming the presence of the relevant voicing differences at the phonetic level as well. Reference to those would indeed suffice to capture the shortening data above. However, I never asserted the absence of individual shortening patterns consistent with multiple abstraction levels but rather claim that *all* shortening patterns are consistent with *exclusive* reference to phonemic and/or graphemic structure. To falsify this claim it must be shown that there are shortenings which *require* reference to either subphonemic or abstract representation. A relevant case is shown in (2), as regressive place assimilation marked in square brackets - unlike voicing harmony in (1a) - results in allophonic differences. Crucially, the truncated forms in (2b) do not "copy" any of those: the sameness of the final nasals indicates reference to phonemic structure then.

(2)a.	→ ('fɛntəˌnɪl)ω, ('fɛ[n]təˌnɪl)ω 'fentanyl'	b.	('fɛ[n])ω 'fen'
	→ (sɪn'θɛtɪk)ω, (sɪ[n̪]'θɛtɪk)ω 'synthetic'		('sɪ[n])ω 'syn'
	→ ('kɑnfədəns)ω, ('kɑ[ɱ]fədəns)ω 'confidence'		('kɑ[n])ω 'con'

The generalization that there is no reference to subphonemic properties in the formation of shortenings appears to be contradicted by the vowel length in Icelandic truncations such as (s[œ:]tr)ω mentioned by Torres-Tamarit. Vowel length is clearly allophonic in Icelandic, conditioned by the position of a vowel in a stressed open syllable, itself determined by the sonority profile of the following consonant cluster (Orešnik & Pétursson 1977). I have argued that such cases are consistent with exclusive reference to phonemic structure by allowing for correspondence constraints to target contiguous prosodic organization, indicated by the red marking in (3a). The vowel /œ/ were then to occur in an open head syllable in both words, in each case satisfying the condition for phonetic lengthening.

(3)a Full form Truncation b Full form Truncation c



Torres-Tamarit objects to the assumption that phonemic representation contains syllable structure, although that assumption is widely held (cf. the review by Haugen (1956)).[60]

60 There is ample evidence that syllable structure affects potential contrast. For instance, tense versus lax vowels in English contrast before clusters with increasing sonority (e.g. /d**u**plɛks/ 'duplex', /d**ʊ**blɪn/ 'Dublin') while only lax vowels may precede certain clusters with decreasing sonority (e.g. /p**ʊ**lpɪt/ 'pulpit' */p**u**lpɪt/). These restrictions appear to follow directly from constraints on syllable structure, the possible syllabification of clusters with a sharp sonority increase as a complex onset, allowing for a branching preceding rhyme, as opposed to the necessary heterosyllabic organization of clusters exhibiting a decrease in sonority, which imposes a restriction to preceding lax monophthongs (Raffelsiefen (in press: section

Also there is a consensus that the representation in Lexical Phonology most akin to the phonemic level, namely the "output of the lexical component", is associated with syllable structure.

Torres-Tamarit further argues that correspondence of prosodic structure as in (3a) wrongly predicts flapping in the truncation shown in (3b). However, the cases differ in that lengthening is a type of phonetic implementation conditioned entirely by prosodic position, whereas flapping requires an additional segmental context, namely the presence of a following vowel (this condition obtains in both contexts where flapping applies: foot-internally as in *veteran*, but also in word-final position where the initial vowel of the following word can be stressed (*hit Al*) or unstressed (*hit a boy*) (Kahn 1976)). When no vowel follows in the relevant prosodic contexts, /t/ is implemented with glottalization, whether it occurs after a lax vowel in coda position as in *bet* or after a high tense vowel as in *boot*, where /t/ arguably forms the onset of a catalectic syllable (see (3c)). Glottalization of /t/ in the truncation *vet* in (3b) is then expected, regardless of its syllabic organization.

The assumption of mental representations consisting of (prosodically organized) phonemic structure, which condition, but do not include, phonetic implementation, predicts that subphonemic sound properties cannot be affected by correspondence directly. Rather, such properties can appear in truncated forms only when the relevant conditioning phonemic (including prosodic) context is affected by correspondence. Thus the absence of the postnasal fricatives in the truncated forms in (2) predicts the absence of relevant allophony, as does the absence of the vowel following /t/ in (3b). Torres-Tamarit invokes the notion of "structure preservation" to account for the absence of relevant sound properties but it is unclear how this principle will account for the occurrence of the clearly allophonic vowel length in the truncated forms in Icelandic. The proposal to resort to *Stratal Optimality Theory* invokes a more complex

2.2)).

architecture with unclear predictions regarding the question of which allophonic properties potentially manifest in truncations. (The concept of "structure preservation" has in fact been altogether abandoned in that framework (Bermúdez-Otero 2018 and references there)).

Torres-Tamarit's claim that the approach to Optimality Theory advocated here, which aims at well-formed phonemic representation, is at odds with *Richness of the Base* is bewildering: ROTB simply calls for a grammar to determine an output for any conceivable input (e.g. |ffgrtx|) and is equally consistent with outputs consisting of phonetic and of phonemic form. The criticism seems even less relevant in the context of my article, which concerns word formation, an area of grammar often conceived of in terms of relations among existing words (bases) and possible derived forms.

I will end my reply to the topic of representation with a more general reflection on the status of abstractness levels. I object to Torres-Tamarit's description of phonemic structure as a "Bloomfieldian notion". The idea that symbolic representation of natural language ought to reflect language-specific contrast is far older, explored for instance in the so-called "First Grammatical Treatise", a 12th-century work on the phonology of Old Icelandic (s. Benediktsson 1972). Indeed alphabetic writing systems appear to be generally grounded in language-specific contrast. Phonetic transcription, on the other hand, aiming at perceptual discriminability, appears to be a more novel idea, whose vagueness is betrayed by notions like "(extremely) narrow transcription".[61] The view of phonetic representation as more well-defined than phonemic representation begs for an explanation.

Turning now to the second section Torres-Tamarit's review, various types of shortenings are subsumed under the label "initialism" there which I have treated distinctly in my article. His statement that I assume "that each grapheme maps onto its

61 Bloomfield comments as follows on phonetic transcription: "The extent of observation is haphazard, its accuracy doubtful, and the terms in which it is reported are vague. Practical phonetics is a skill, for the student of languages often a very useful skill, but it has little scientific value." (1933:127).

own prosodic word in American English" calls for the following clarification. Acronyms consisting of initials can be mapped to spoken forms either by associating the individual graphemes with the relevant letter names, that is sequences of stems mapped to separate phonological words which form copulative compounds, or they can be mapped to a single phonological word. In most cases the latter option is not available, due to phonotactic constraints (cf. the initial cluster */fb/ in (4a)), but in many cases both options exist in principle. The question of which option is chosen is easily recognizable: letter compounds exhibit the segmental material associated with the respective language-specific letter names (e.g. English A = $[\varepsilon i]_N$, B = $[bi]_N$, ...) and are moreover characterized by final main stress. This is due to the fact that all letter compounds are copulative, the final member forming the prosodic head.

(4)a.	Federal Bureau of Investigation	FBI	$(('\varepsilon f)_\omega('bi)_\omega('\alpha i)_{\omega Hd})_{COP\text{-}COMP}$
b.	Environmental Protection Agency	EPA	$(('i)_\omega('pi)_\omega('\varepsilon i)_{\omega Hd})_{COP\text{-}COMP}$
c.	Individual Savings account	ISA	$('\alpha isə)_\omega$

Torres-Tamarit questions my claim that the pronunciation of IPA as /ɑipi'ɛi/ reflects the organization of that acronym as a letter compound. I believe that such organization is clearly indicated by the presence of the second /i/, the final diphthong /ɛi/ and the stress pattern with final main stress (cf. *EPA* in (4b)): the organization of IPA as a single phonological word ought to have resulted in something like $('\alpha ipə)_\omega$ (cf. ISA in (4c)). It is true that letter compounds may fuse into a single phonological word, due to diachronic change (similar to the fusion of other compounds such as *breakfast, necklace, cupboard*) or fusion may be playfully intended (cf. the spelling of the name of the French cartoonist (ɛʀ'ʒe) 'Hergé', based on the letter sequence RG). However, there is no indication for fusion in the case of IPA. I object to Torres-Tamarit's suggestion that phonological word boundaries and prosodic organization are best determined by the intuitions of native speakers. Instead such boundaries are determined by correlating linguistic diagnostics, to be established by linguists. This also concerns the shortenings

bis ad and *sci-fi*, subsumed under initialisms forming a single phonological word by Torres-Tamarit, although they are compounds, consisting of two truncations each (see (45), (46) in my article). It is true that such compounds are quite similar to sequences of monosyllabic feet forming a single phonological word (cf. *bis ad* versus *nomad*), but there is a potential for a juncture effect in *bis ad* (due to the organization of /z/ as a coda), not in *nomad,* where /m/ forms an exclusive onset (cf. similar phenomena observed in *night rate* vs. *nitrate*). This juncture effect clearly indicates the presence of a phonological word boundary.

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