Truncation in Message-Oriented Phonology: A case study using Korean vocative truncation*

Abstract

This paper analyzes the vocative truncation pattern in Korean from the viewpoint of Message-Oriented Phonology (MOP: Hall et al. 2016), which capitalizes on the idea that sound patterns are governed by a principle that makes message transfer effective. In the traditional naming pattern, Korean first names consist of a generation marker and a unique portion, and the order between these two elements alternates between generations. To derive vocative forms, the generation marker is truncated, and the suffixal [(j)a] is attached to the unique portion. We argue that MOP naturally predicts this type of truncation. As the generation marker is shared by all the members of the same generation, the generation marker is highly predictable and hence does not reduce uncertainty about the intended message. To achieve effective communication, predictable portions are deleted. To the extent that our analysis is on the right track, it implies that MOP is relevant not only to phonetic implementation patterns, but also to (morpho-)phonological patterns. It also provides support to MOP based on data from a non-Indo-European language. Finally, we aim to integrate insights of MOP with a more formal proposal like Optimality Theory (Prince & Smolensky, 2004), by relating the predictability of a contrast to the ranking of the faithfulness constraint that it protects, following the spirit of the P-map hypothesis (Steriade, 2001/2008).

1 Introduction

This paper has four aims. The first one is to discuss the pattern of Korean vocative truncation, which, as far as we know, has not been discussed in the phonological literature, thereby

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providing a new empirical set of data to the field. Second, the theoretical impetus of the current work is Message-Oriented Phonology (henceforth, MOP: Hall et al. 2016), which capitalizes on the idea that sound patterns are governed by a principle that makes the message transfer—i.e., communication—effective. In MOP, effective communication is defined as "systems [which] trade-off the probability of accurate message transmission and resource cost, adding redundancy when message uncertainty is higher, and reducing it when uncertainty is lower" (Hall et al. 2016, p. 60). While the general theses of MOP, as presented in Hall et al. (2016), seem largely convincing to us, it is not clear whether MOP is solely intended to account for phonetic implementation patterns, or whether it is applicable to (morpho)phonological patterns as well.[1] We argue that MOP offers a straightforward account of Korean vocative truncation in the traditional naming pattern, which is clearly (morpho-)phonological and therefore cannot be relegated to a matter of phonetic implementation. In this sense, we aim to expand the empirical coverage of MOP. Third, our analysis shows that truncation in general may actually follow from one of the fundamental tenets of MOP very naturally, as the effect of information-effort tradeoffs. Message transmission is made more efficient by removing portions that are predictable, and this is precisely what happens in the Korean vocative truncation pattern. Fourth, we aim to integrate our proposal with two other existing proposals, and tentatively propose a theory of "I-map", in which the rankings of faithfulness constraints are projected from the predictability differences of different contrasts. Although this proposal entails a non-trivial departure from the original MOP framework, it constitutes, we hope, a happy marriage (with a little bit of compromise) between MOP and more formal grammatical theories, such as Optimality Theory (Prince & Smolensky, 2004).

Let us expand on the theoretical context of this paper, as well as what this paper intends to add to that theory. The observation that speakers aim for efficient communication is old, and at least goes back to the well-known work by Zipf (1949), who demonstrated that frequent words tend to be short. More recent research has shown that speakers produce linguistic units—segments, syllables or words—longer and more clearly, when they are not predictable; i.e. when they have high surprisal and/or entropy in the sense of Information Theory (Shannon, 1948). On the other hand, predictable linguistic units tend to be reduced. For example, Aylett & Turk (2004, 2006) demonstrate this sort of predictability-driven reduction in English both in terms of duration and vowel quality. Similarly, Cohen-Priva (2015) argues that the duration of [t] in English is shorter when its average predictability (i.e. informativity) is low, and this can ultimately lead to deletion.

[1] Hall et al. (2016) refer to the notion of "phonologization" (Hyman, 1977) or "grammaticalization over time" in several places, so in that sense, MOP is intended to be a theory of phonology. However, the term "phonologization" usually comes with the connotation that a pattern under question is divorced from the original phonetic motivation/precursor of that pattern, and hence can become phonetically unnatural; these cases are sometimes referred to as "crazy rules" (see e.g. Bach & Harms 1972; Barnes 2002; Blevins 2004). Applying the same logic, one could argue that once phonologized, a pattern is no longer governed by the principles that MOP embraces—phonology can develop rules that look "crazy" against the tenets of MOP. Therefore, a question remains as to whether the principle of effective communication synchronically and consistently holds at the level of phonology, even after phonologization.

Rose et al. (2015) demonstrate that the duration of [s] of the English plural suffix correlates with the extent to which semantic plurality is predictable in that context. See Hall et al. (2016) for a comprehensive overview of related research. However, it is not immediately clear from Hall et al. (2016)—or from what the previous research in this tradition has explored—whether this principle of effective communication holds only at the level of phonetic implementation, or also at the level of phonology (see also footnote 1 for further discussion).

This question is important to address for the following reason. Most if not all phonologists distinguish phonology and phonetics as different modules of grammar (see Anderson 1981 and Keating 1988 for classic arguments). One could go so far as to say that phonetics is about performance, not competence (though see Kingston & Diehl 1994; Keating 1988 for critical discussion of this view). If there is a clear separation between phonology and phonetics, and if the principle of effective communication is solely about phonetics, MOP would not be a theory of phonology. As Shaw (2016) points out, in SPE (Chomsky & Halle, 1968), there is one passage that refers to the effects of (information-theoretic) predictability, and SPE attributes such effects as a performance factor (p.110). Is MOP—or more generally put, the effects of predictability on sound patterns—solely about phonetics, which can arguably be about performance? One reason that makes us think that this is an important question to address is because Chomsky constantly asserts that language is not a tool for communication (e.g. Chomsky 1966)—therefore, in generative linguistics, communication is often taken to be a matter of performance (see Piantadosi et al. 2012 for relevant discussion). We suspect that MOP can be viewed by some practicing phonologists as a matter of performance as well, since MOP attempts to derive sound patterns from a principle of effective communication.

Proponents of MOP could argue that the distinction between phonology and phonetics is not very clear-cut, or does not even exist (e.g. Browman & Goldstein 1989; Flemming 2001; Steriade 2000), so that MOP is a general theory of phonology after all. However, this debate—how (in)dependent phonetics and phonology are from one another—is highly controversial. There is a possibility that MOP can be dismissed as a theory of phonetics, which has no relevance to phonology, which we think is not desirable. Our aim therefore is to directly address whether the principle of effective communication is operative *at the level of phonology*, regardless of the theory of the phonetics-phonology interface that one embraces. To that end, we take an approach that is slightly different from the research that led to the development of MOP; we take the case of a clearly (morpho-)phonological pattern, and show that the principle of effective communication lies behind that pattern. In this respect, we are heavily inspired by Mahowald et al. (2013) and Shaw et al. (2014) who show that predictability plays a fundamental role in shaping compound truncation patterns in English and Chinese, respectively.

One extra bonus of this project is that most if not all work related to MOP is based on English and other Indo-European languages. In order for MOP to be a useful framework for phonetic and phonological analyses in general, it is ideal to conduct case studies in typologically different languages, such as Korean (see Kawahara 2016 and Shaw & Kawahara 2017 for case studies in Japanese, and Shaw et al. 2014 for a case study in Chinese)

2 The data

In the classic, traditional naming pattern, Korean first names consist of two parts: one part is shared by the same generation of siblings and cousins (henceforth, "the generation marker"), and the other part is unique to each person (henceforth, "the unique portion"). What makes this dataset interesting is the fact that the order between these two elements alternates from one generation to the next (Table 1). In the first generation, for example, the generation marker "hui" [hi] comes at the end, whereas in the next generation, the generation marker "jae" [ʧe] comes at the beginning.

Table 1: The structure of first names in Korean in the traditional naming patterns. Based on the second author's family's names (examples added). The IPA transcriptions are given in [ ].

Generation I		Generation II		Generation III		...
hong+hui	[hoŋ.hi]	jae+eun	[ʧe.ɨn]	min+su	[min.su]	
dong+hui	[doŋ.hi]	jae+young	[ʧe.jɤŋ]	in+su	[in.su]	
seok+hui	[sɤk.hi]	jae+hun	[ʧe.hun]	hui+su	[hi.su]	
yang+hui	[jaŋ.hi]	jae+hun	[ʧe.ʤun]	...		
ja+hui	[ʧa.hi]	jae+u	[ʧe.u]			

What happens in vocative truncation is that the unique part of the name is taken and [(j)a] is added to it (Table 2).[2] [j] appears when the unique portion ends with a vowel. The glide insertion occurs to avoid hiatus (see Jun 2014 for independent evidence that Korean avoids hiatus). It is unlikely that anybody would argue that the word formation process in Table 2 is a matter of phonetic implementation, as it is a morphological derivational process.

Before moving on to the analysis, let us highlight two aspects of the Korean vocative formation which shows that the pattern is a grammatical, phonological process, rather than "a non-linguistic social convention" or "a matter that can somehow be relegated to performance". First, as shown in Table 2, vowel sequences are resolved by inserting a glide, [j]. This avoidance of vowel sequences shows that the truncation pattern is as phonological as other hiatus resolution patterns found in

[2]Not all contemporary Korean first names consist of a generation marker and a unique portion, especially those in new generations. Hyun-Kyung Hwang (p.c.) reported to us that some Seoul and Busan speakers prefer to take the second morphemes in truncation, when the presence of the generation marker is not apparent. We will come back to this pattern in the discussion section.

Table 2: The vocative forms.

Generation I		Generation II		Generation III		...
hong+a	[hoŋ.a]	eun+a	[ɨn.a]	min+a	[mi.na]	
dong+a	[doŋ.a]	young+a	[jʌŋ.a]	in+a	[i.na]	
seok+a	[sʌk.ga]	hun+a	[hu.na]	hui+a	[hi.ja]	
ja+ya	[ʧa.ja]	u+a	[u.ja]	...		

many different languages (e.g. Casali 1996, see also Jun 2014 for other hiatus resolution patterns within Korean). Second, in this vocative formation pattern, when a Korean speaker meets a new person, and does not know which part of the name is the unique portion, truncation is impossible. This blockage of truncation is very similar to the blockage of derivational morphology found in other languages, sometimes known as "M-Parse Effect" (Prince & Smolensky, 2004). Many instances of a similar type of blocking of derivational morphology have been reported, for example, in Rice (2007): Norwegian imperative formation, Turkish suffixation, Swedish neuter adjectives, Hungarian CCik verbs, Mandarin Chinese reduplication, Hebrew plural formation, Tagalog infixation, and English schm-reduplication (see Rice & Blaho 2010 for many other cases). In short, the Korean truncation pattern shows two properties—hiatus avoidance and M-Parse effect—that are shared by many other phonological processes.

3 Analysis

The vocative truncation pattern in Korean in fact very naturally follows from MOP. The intuitive idea is as follows: since vocative forms are used by family members, the unique portion of the name, rather than the generation marker, is more effective in distinguishing who is being referred to by that particular phonetic signal. As a result, the unique portion is worth investing the resources to produce it, as compared to producing the generation marker. More formally, let $P(message|signal, context)$ be the probability of the listener retrieving the correct message given its signal and context. For effective communication, this probability needs to be kept high (Hall et al., 2016). To illustrate, let the context—or more formally, the choice space at the conversational setting—be the "hui" generation group in Table 1. Let us further suppose that the intended message is /honghui/. Then:

$$P(\text{/honghui/}|\text{/hui/},\text{“hui”}) = 1/5 = 0.2 \quad (1)$$

$$P(\text{/honghui/}|\text{/hong/}, \text{“hui”}) = 1 \quad (2)$$

Since there are five people with "hui" in Table 1, the probability of retrieving the right message

(/honghui/) given the signal /hui/ is 1/5 (assuming that each person is called with equal a priori probability—ultimately, this assumption does not need to hold, as the probability in (2) is always higher than the probability in (1)). On the other hand, since there is only one person who is denoted by the signal /hong/, P(/honghui/|/hong/, "hui") is 1.

We can also cast the differences in terms of Shannon entropy (Shannon, 1948), which is averaged log predictability. Given the "hui" family, the entropies of the generation markers and the unique portions can be calculated as follows:[3]

$$\begin{aligned} P(\text{generation marker}|\text{“hui”}) &= 1 \\ \text{entropy} = \sum_{x_i \in gen}^{n} p(x_i) \times -\log_2 p(x_i) &= 1 \times -log_2(1) = 0 \text{ bits} \end{aligned} \tag{3}$$

$$\begin{aligned} P(\text{unique portion}|\text{“hui”}) &= 0.2 \\ \text{entropy} = \sum_{x_i \in unique}^{n} p(x_i) \times -\log_2 p(x_i) = \sum_{x_i \in unique}^{n} 0.2 \times -log_2(0.2) &= 2.3 \text{ bits} \end{aligned} \tag{4}$$

This difference in entropy shows that the unique portions resolve more uncertainty in the discourse than do the generation markers.

In short, /hong/ has higher $P(message|signal, context)$ and higher entropy than /hui/, which, we propose, is why it survives truncation in Korean vocative formation.[4] This analysis is in the same spirit as the analysis of Chinese compound truncation by Shaw et al. (2014), who show that what survives in compound truncation is those segments that are less predictable; i.e. those elements that allow listeners to retrieve what the original words were.

This analysis also applies to an observation that holds more generally; namely, that we usually use our first names rather than last names within a family. Within a family, all members share the same last name, so the last name is highly predictable. This tendency is again not (solely) a matter of social convention. In fact, in Icelandic, people use first names everywhere, even in public phonebooks, because their last names indicate their father's first name.[5] Considering the case of Icelandic, the use of names seems to be governed by the effective communication principle in general; it is not *a priori* given which part of the name we use in which situation. We instead use portions of names that are useful in deciphering who is being referred to.

[3] Again, the calculation in (4) assumes the equal probability of each outcome. This entropy value is the theoretical maximum of entropy, given $N = 5$. If the outcomes are not equiprobable, then the entropy decreases, but it never goes below 0 bits.

[4] One line of research that may be worth pursuing, given the proposed role of $P(message|signal, context)$ in phonological patterns, are the effects of ambiguity avoidance (within a morphological paradigm), which in some theories, play a fundamental role in phonological organization (e.g. Flemming 1995; Ito & Mester 2004; Lubowicz 2003; Padgett 2009). Another obvious line of research is to extend our current analysis to other truncation patterns in Korean, and other languages.

[5] See, for example, `https://en.wikipedia.org/wiki/Icelandic_name`.

An anonymous reviewer points out that there is further evidence for this view from Korean. When there are a few students in the same classroom with the same given name, other students often call them with “family name + first syllable of given name”. For example, when Kim Chaeyeon, Park Chaeyeon, and Song Chaeyeon are in the same class, then they may be called as “Kimchae”, “Parkchae”, and “Songchae”. This naming convention can be also viewed as maintaining $P(message|signal, context)$ high, because “Chaeyeon” itself does not have high $P(message|signal, context)$ in this situation.

Let us now return to MOP. In Hall et al’s (2016), units that are more predictable—in their terms, those units that cause little information change in a particular context—are predicted to undergo reduction, whereas those units that are less predictable should be robustly implemented. Consider their Figure 5, which is reproduced here as Figure 1. ΔH represents “a change in uncertainty” (measured in terms of Shannon entropy—recall entropy calculation is averaged log predictability, as exemplified in (3)). The y-axis represents “resource cost”, which would influence how the element under question would be implemented phonologically and phonetically. The generation marker has small ΔH, and should hence reduce. The unique portion has large ΔH, and hence should remain stable.

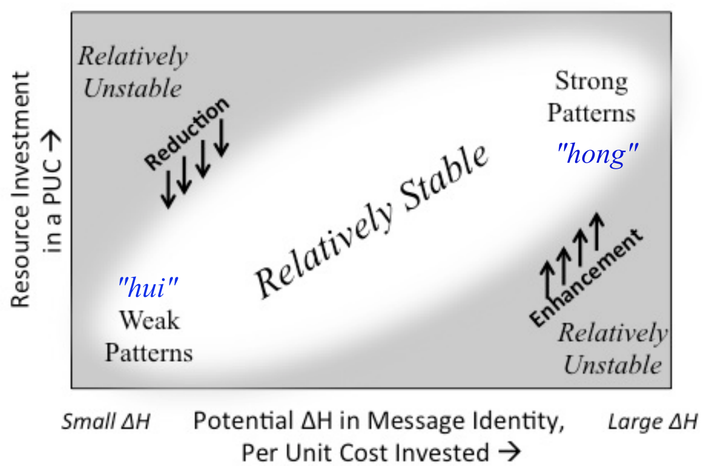

Figure 1: The predicted relationships between the predictability of a phonological unit and its phonological/phonetic behavior (manifested through “cost investment”). Taken from Hall et al. (2016), their Figure 5. The locations of “hong” and “hui” are added by us.

Therefore, the Korean vocative truncation pattern is exactly what is predicted under MOP—those elements that are predictable (/hui/ in equation (3))—should undergo deletion, which is the extreme form of reduction. In other words, /hui/ is not worth “the cost” to produce,[6] given that the

[6]One outstanding challenge to the current theorization of MOP is how to define the “cost”, which is extremely hard to define. What is nice about Korean vocative truncation is that MOP predicts deletion no matter how we define

context makes /hui/ predictable. For related observations, see Mahowald et al. (2013) for the observation that given a pair like *math* and *mathematics*, a shorter form is used in a more predictable context, and see Kurumada & Jaeger (2015) who show that case marker drop in Japanese is more likely to be observed in more predictable contexts.

Let us now briefly compare MOP and Optimality Theory (OT: Prince & Smolensky 2004) in how they account for truncation patterns (see also Blevins 2005 for a related comparison). In OT, truncation occurs in order to satisfy a prosodic templatic markedness requirement (McCarthy & Prince, 1993, 1994, 1995); i.e. it is the emergence of the unmarked. In our view, in MOP, truncation occurs when some portions are not worth producing, given the predictability of those elements in conveying a particular message. OT remains silent about which circumstances truncation occurs. For example, OT provides no answers as to why truncation is so common in nickname formation—this sort of question is probably considered to be a matter of performance in OT. MOP, on the other hand, can attribute deletion to the high predictability of the deleted portions, given a particular context (see again Mahowald et al. 2013 for relevant discussion).

However, one difference between MOP and OT is that MOP may not straightforwardly explain why the outcome of truncation is usually prosodically defined (e.g. "one heavy syllable" or "two moras": McCarthy & Prince 1986, though see Gafos 1998). An anonymous reviewer (p.c.) pointed out that it can be the case that prosodically-defined outcomes of prosodic morphological patterns can be "the most expected or predicted shape" in that particular morphological context of that language. The most predicted shapes require *least effort*, which the anonymous reviewer proposes to define "in terms of the greater/less facility that a speaker has in producing a familiar and less familiar structure". This is an empirically testable prediction of MOP; quantitatively testing whether the outcomes of prosodic morphology can indeed be defined as "the most predicted shape" (either defined segmentally or prosodically) would be an important to topic for a future research in MOP.

Finally, we would like to entertain one possible alternative analysis of the Korean vocative formation. One could argue that the unique portions of the names are *morphological heads*, and hence survive truncation (see Revithiadou 1999 for head-specific faithfulness constraints). As far as we are aware of, there is no independent evidence that the unique portions of the Korean first names are the morphological heads, and the generation markers are non-heads (recall that the linear order between the unique portion and the generation marker alternates between generations). One could argue that the unique portions are morphological heads, because they are more "content-full"

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the cost, because the generation markers are perfectly predictable and hence carry zero information (= 0 bit entropy). However, this analysis raises a non-trivial question as well: why is it that languages do not delete every segment after the "uniqueness point", where the target word is distinguished from others? As Shannon (1948) shows, some redundancy is necessary for effective message transfer given a noisy channel; however, in the case of natural languages, how should we quantify this "necessary redundancy" in the context of language? In the words of Pierce (1980), what is "the right sort of redundancy"? See Hall et al. 2016, section 4.1 for relevant discussion.

or "conveys more meaning"—however, that postulation is very similar to our proposal. Ultimately, this theory admits that what lies behind the survival of truncation is predictability.

4 Faithfulness and predictability: I-map

In this final section, we would like to entertain the possibility of combining the insights of MOP and a more formal framework of phonology, like Optimality Theory (Prince & Smolensky, 2004).[7] The fundamental observation of this paper is that units with higher information—which can be defined in terms of Shannon entropy—are less likely to delete. In Optimality Theory, this observation can be expressed as a ranking relationship of the anti-deletion faithfulness constraint MAX (McCarthy & Prince, 1995): MAX(high entropy) $\gg$ MAX(low entropy) (see Cohen-Priva 2015 for a similar proposal).

In order to illustrate how this ranking helps to model the Korean truncation pattern, let us assume that there is a general prosodic requirement that vocative forms be disyllabic, a requirement which we express as DISYLL. Since the vocative suffix [(j)a] always surfaces, we use a constraint REALIZEMORPHEME (RM) that requires this morpheme to receive some phonological exponent (Kurisu 2001). These two constraints coerce truncation. What survives in truncation is determined by the constraint ranking between two MAX constraints, MAX(UNIQUE) $\gg$ MAX(GENMARK), whose ranking is determined by their entropy differences.

Table 3: An OT analysis of the Korean truncation pattern

/hong-hui-a/	DISYLL	RM	MAX(UNIQUE)	MAX(GENMARK)
(a) [hong-hui-a]	*!			
(b) [hong-hui]		*!		
(c) [hui-a]			*!	
(d) → [hong-a]				*

To generalize this analysis, there are two other proposals/observations in which the effects of informativity can be captured as the ranking of faithfulness constraints, dictated by predictability differences. First, Hume & Mailhot (2013) argue that the vowels that are inserted as epenthetic vowels in English and French are those that have lowest entropy, which can be expressed as DEP(high entropy) $\gg$ DEP(low entropy).

[7]This combination entails a non-trivial departure from the original formulation of MOP, in which phonology is shaped by pressures on "meaning-bearing units", whereas OT is "sound-centric". We are not ready to reconcile this challenge, but as we argue in this section, we believe that there are merits in combining a formalistic framework like OT and insights of MOP.

Also, our proposal here can be implemented in other related constraint-based theories of phonology, as long as they acknowledge the existence of faithfulness constraints in their model. Faithfulness constraints are those that prohibit change from one level of representation to another level of representation.

Second, Kawahara (2016) argues that Japanese has the ranking IDENT(VOICE)(high entropy) ≫ IDENT(VOICE)(low entropy). In Japanese loanwords, voiced obstruents can devoice when there is another voiced obstruent, whereas singleton obstruents cannot, as shown in (1) (Kawahara, 2006, 2015). This difference in devoicability shows that Japanese has the ranking IDENT(VOI-SING) ≫ IDENT(VOI-GEM).

(1) Patterns of devoicing in Japanese loanwords

a. /**bedd**o/ → [**bett**o] 'bed'; /**d**o**gg**u/ → [**d**o**kk**u] 'dog'

b. /ba**d**o/ → *[ba**t**o] 'badominton'; /ba**g**u/ → *[ba**k**u] 'bug'

Kawahara (2016) furthermore shows that in the Japanese lexicon, the voicing contrast in singletons is much more informative than the voicing contrast in geminates; for example, the entropy for the contrast between [t] and [d] is 0.93 bits, whereas the entropy for the contrast between [tt] and [dd] is only 0.06 bits (the frequency calculations are based on the Corpus of Spontaneous Japanese: Maekawa 2003). Kawahara (2016) therefore argues that this difference in entropy may be responsible for the ranking in Japanese IDENT(VOI-SING) ≫ IDENT(VOI-GEM) (see Rice 2006 for a similar idea).

Table 4: An OT analysis of the Japanese devoicing pattern

/bado/	IDENT(VOI-SING) (= high entropy)	OCP(voi)	IDENT(VOI-GEM) (= low entropy)
→ (a) [bado]		*	
(b) [bato]	*!		
/beddo/	IDENT(VOI-SING)	OCP(voi)	IDENT(VOI-GEM)
(a) [beddo]		*	
→ (b) [betto]			*

Therefore, for the three types of phonological patterns reviewed here (deletion, epenthesis, and featural neutralization), we observe a consistent pattern in which those units with lower entropy undergo phonological changes. Schematically, we can thus formalize this observation as: FAITH(contrast A) ≫ FAITH(contrast B) if Entropy(contrast A) > Entropy(contrast B). This formalization predicts that a contrast that has higher entropy is less likely to be neutralized. This formalization is inspired by the "P-map" theory of Steriade (2001/2008), in which changes that involve smaller perceptual changes—arguably defined by language-specific phonetic implementation patterns (Kawahara, 2006)—are more likely to occur. Hence we call this hypothesis "I-map" (for "Information-map").

Teasing apart the P-map theory and I-map theory is not as easy as it first may appear, because according to Hall (2009), a contrast that is less informative is perceived to be more similar (see also Boomershine et al. 2008; Hume & Johnson 2003 for similar results). Therefore, it could be the case that a contrast that differentiates a small number of items is perceived to be similar, which eventually affects the P-map of a particular language; i.e. it could be that I-map influences P-map, which in turn affects phonological grammars by dictating the ranking of faithfulness constraints.

Although fully developing the idea of I-map, and considering its interaction with P-map, is beyond the scope of this paper, we believe that combining MOP and OT, or other related formal theories, in this way seems promising (cf. "Neo-Grounded Phonology": Barnes 2002). One reason that makes us believe so is the observation that there are likely to be phonological principles that cannot be reduced to effective communication; e.g. templatic effects discussed in section 3.[8] Another empirical advantage of using a formal model with violable constraints has been offered by Kawahara (2016): we need to account for the fact that Japanese geminate devoicing is not context-free. Geminate devoicing can occur in response to OCP(voice)—prohibition against two voiced obstruents within the same morpheme (Ito & Mester, 1986), but not in response to a context-free prohibition against voiced geminates (e.g. **/beddo/** → [**bett**o] 'bed'; but **/heddo/** → *[**hett**o] 'head'). In other words, just because a voicing contrast is highly predictable in geminates, it does not mean that it is neutralized everywhere—a grammatical pressure like OCP(voice) is necessary to cause devoicing. OT with rankable constraints is well-suited to model this sort of interaction.

Third, it is sometimes the case that the predictability consideration can be overridden. Hyun-Kyung Hwang (p.c.) informed us that one Busan speaker told her that her relatives always took the last syllable of a first name regardless of the position of a generation marker, even when all her relatives are in the same place. In this case, the pressure to preserve portions with higher entropy can potentially be overridden by the requirement to keep the last syllable. OT, with rankable constraints, is suited to model this sort of language/dialectal variation.

Fourth, phonological patterns are stable; e.g., we do not change our phonology in response to noise that exists between the speaker and the hearer (see also Barnes 2002). Let us take the case of assimilation, as discussed in Hall et al. (2016) (section 5.1.3.), which should increase redundancy of the trigger. We know of no languages in which assimilation occurs only in noisy environments—if a pressure on message transmission directly dictates phonological patterns, it predicts that there could be suchs phonological patterns, because in noisy environments, the redundancy of the trigger may need to be increased. Nor are we aware of a language in which assimilation stops occurring in extremely quiet environments—assimilation which is often deployed to increase redundancy can be deemed unnecessary when the channel is not noisy. One could postulate that a pressure on effi-

[8] In formulating Uniform Density Hypothesis, which is related to MOP, Jaeger (2010) starts with a conditional phrase, "Within the bounds defined by grammar" (p.25). In this theory, therefore, grammar first provides choice space, and informativity allows speakers to choose from the choices provided by the grammar. In this view, then, grammar and the effects of informativity are separate forces that shape our linguistic patterns.

cient message transmission works on phonetic implementation patterns, and that phonetic patterns need to be *phonologized* after these phonetic patterns recur certain times. This postulation amounts to saying, however, that phonology itself is not shaped by pressures on message transmission. This conclusion, however is not compatible with the general conclusion of this paper.

5 Summary

To summarize, Message-Oriented Phonology (MOP) capitalizes on the role of effective communication in shaping sound patterns. For successful communication, it is important that the speaker's intention is conveyed accurately to the listener, and also that predictable portions are reduced. We analyzed the Korean vocative truncation patterns from this perspective in this paper, and showed that the pattern follows naturally from MOP. To the extent that our analysis is successful, it provides support to MOP from a morphophonological perspective (a la Shaw et al. 2014). We also suggested that it may be possible—or even desirable—to combine MOP with a more formalistic framework like OT, which seems promising on several grounds.

References

Anderson, Stephen (1981) Why phonology isn't "natural". *Linguistic Inquiry* **12**(4): 493–539.

Aylett, Matthew & Alice Turk (2004) The smooth signal redundancy hypothesis: A functional explanation for relationships between redundancy, prosodic prominence, and duration in spontaneous speech. *Language and Speech* **47**(1): 31–56.

Aylett, Matthew & Alice Turk (2006) Language redundancy predicts syllabic duration and the spectral characteristics of vocalic syllable nuclei. *Journal of the Acoustical Society of America* **119**(5): 3048–3059.

Bach, Emmon & Robert Harms (1972) How do languages get crazy rules? In *Linguistic Change and Generative Theory*, R. Stockwell & R. Macaulay, eds., Bloomington: Indiana University Press, 1–21.

Barnes, Jonathan (2002) *Positional Neutralization: A Phonologization Approach to Typological Patterns*. Doctoral dissertation, University of California, Berkeley.

Blevins, Juliette (2004) *Evolutionary Phonology: The Emergence of Sound Patterns*. Cambridge: Cambridge University Press.

Blevins, Juliette (2005) The role of phonological predictability in sound change: Previleged reduction in Oceanic reduplicated substraings. *Oceanic Linguistics* **44**(2): 517–526.

Boomershine, Amanda, Kathleen Currie Hall, Elizabeth Hume, & Keith Johnson (2008) The impact of allophony vs. contrast on speech perception. In *Contrast in phonology: Perception and acquisition*, Peter Avery, Elan Dresher, & Keren Rice, eds., New York: Mouton de Gruyter, 143–172.

Browman, Catherine & Louis Goldstein (1989) Articulatory gestures as phonological units. *Phonology* **6**: 201–251.

Casali, Roderic (1996) *Resolving Hiatus*. Doctoral dissertation, University of California, Los Angeles.

Chomsky, Noam (1966) *Cartesian Linguistics*. New York: Harper and Row.

Chomsky, Noam & Moris Halle (1968) *The Sound Pattern of English*. New York: Harper and Row.

Cohen-Priva, Uriel (2015) Informativity affects consonant duration and deletion rates. *Journal of Laboratory Phonology* **6**(2): 243–278.

Flemming, Edward (1995) *Auditory Representations in Phonology*. Doctoral dissertation, University of California, Los Angeles.

Flemming, Edward (2001) Scalar and categorical phenomena in a unified model of phonetics and phonology. *Phonology* **18**(1): 7–44.

Gafos, Adamantios (1998) A-templatic reduplication. *Linguistic Inquiry* **29**: 515–527.

Hall, Kathleen Currie (2009) *A Probabilistic Model of Phonological Relationships from Contrast to Allophony*. Doctoral dissertation, Ohio State University.

Hall, Kathleen Currie, Elizabeth Hume, Florian T Jaeger, & Andrew Wedel (2016) The message shapes phonology. Ms.

Hume, Elizabeth (2008) Markedness and the language user. *Phonological Studies* **11**: 83–98.

Hume, Elizabeth (2016) Phonological markedness and its relation to the uncertainty of words. *Phonological Studies* **19**: 107–116.

Hume, Elizabeth & Keith Johnson (2003) The impact of partial phonological contrast on speech perception. *Proceedings of ICPhS 2003* **XV**: 2385–2388.

Hume, Elizabeth & Frédéric Mailhot (2013) The role of entropy and surprisal in phonologization and language change. In *Origins of Sound Patterns: Approaches to Phonologization*, Alan C. L. Yu, ed., Oxford: Oxford University Press, 29–47.

Hyman, Larry (1977) Phonologization. In *Linguistic Studies offered to Joseph Greenberg*, A. Juilland, ed., Saratoga: Alama Libri, 407–418.

Ito, Junko & Armin Mester (1986) The phonology of voicing in Japanese: Theoretical consequences for morphological accessibility. *Linguistic Inquiry* **17**: 49–73.

Ito, Junko & Armin Mester (2004) Morphological contrast and merger: Ranuki in Japanese. *Journal of Japanese Linguistics* **20**: 1–19.

Jaeger, Florian T (2010) Redundancy and reduction: Speakers manage syntactic information density. *Cognitive Psychology* **61**(1): 23–62.

Jun, Jongho (2014) Hiatus resolution and opacity in Seoul Korean verbal paradigm. *Studies in Phonetics, Phonology and Morphology* **20**(3): 379–401.

Kawahara, Shigeto (2006) A faithfulness ranking projected from a perceptibility scale: The case of [+voice] in Japanese. *Language* **82**(3): 536–574.

Kawahara, Shigeto (2008) Phonetic naturalness and unnaturalness in Japanese loanword phonology. *Journal of East Asian Linguistics* **17**(4): 317–330.

Kawahara, Shigeto (2015) Geminate devoicing in Japanese loanwords: Theoretical and experimental investigations. *Language and Linguistic Compass* **9**(4): 168–182.

Kawahara, Shigeto (2016) Japanese geminate devoicing once again: Insights from Information Theory. *Proceedings of Formal Approaches to Japanese Linguistics* **8**: 43–62.

Keating, Patricia A. (1988) The phonology-phonetics interface. In *Linguistics: The Cambridge Survey*, vol. 1, F. J. Newmeyer, ed., Cambridge: Cambridge University Press, 281–302.

Kingston, John & Randy Diehl (1994) Phonetic knowledge. *Language* **70**: 419–454.

Kurisu, Kazutaka (2001) *The Phonology of Morpheme Realization*. Doctoral dissertation, University of California, Santa Cruz.

Kurumada, Chigusa & Florian T. Jaeger (2015) Communicative efficiency in language production: Optional case-marking in Japanese. *Journal of Memory and Language* **83**: 152–178.

Lubowicz, Anna (2003) *Contrast Preservation in Phonological Mappings*. Doctoral dissertation, University of Massachusetts, Amherst.

Maekawa, Kikuo (2003) Corpus of Spontaneous Japanese: Its Design and Evaluation. *Proceedings of ISCA and IEEE Workshop on Spontaneous Speech Processing and Recognition (SSPR2003)* : 7–12.

Mahowald, Kyle, Evelina Fedorenko, Steven T. Piantadosi, & Edward Gibson (2013) Info/information theory: Speakers choose shorter words in predictive contexts. *Cognition* **126**: 313–318.

McCarthy, John J. & Alan Prince (1986) Prosodic morphology. Ms., University of Massachusetts and Rutgers University.

McCarthy, John J. & Alan Prince (1993) Generalized alignment. In *Yearbook of Morphology*, Geert Booij & Jaap van Marle, eds., Dordrecht: Kluwer, 79–153.

McCarthy, John J. & Alan Prince (1994) The emergence of the unmarked: Optimality in prosodic morphology. In *Proceedings of the North East Linguistic Society 24*, Merce Gonzalez, ed., Amherst, Mass.: GLSA Publications, 333–379.

McCarthy, John J. & Alan Prince (1995) Faithfulness and reduplicative identity. In *University of Massachusetts Occasional Papers in Linguistics 18*, Jill Beckman, Laura Walsh Dickey, & Suzanne Urbanczyk, eds., Amherst: GLSA, 249–384.

Padgett, Jaye (2009) Systemic contrasts and Catalan rhotics. *The Linguistic Review* **26**(4): 431–463.

Paster, Mary (2004) Vowel height harmony and blocking in Buchan Scots. *Phonology* **21**(3): 359–407.

Piantadosi, Steven T., Harry Tily, & Edward Gibson (2012) The communicative function of ambiguity in language. *Cognition* **122**: 280–291.

Pierce, John R. (1980) *An introduction to Information Theory: Symbols, signals and noise*. Dover Publications.

Prince, Alan & Paul Smolensky (2004) *Optimality Theory: Constraint Interaction in Generative Grammar*. Malden and Oxford: Blackwell.

Revithiadou, Anthi (1999) *Headmost Accent Wins: Head Dominance and Ideal Prosodic Form in Lexical Accent Systems*. Doctoral dissertation, University of Leiden.

Rice, Curt (2007) Gaps and repairs at the phonology-morphology interface. *Journal of Linguistics* **43**(1).

Rice, Curt & Sylvia Blaho, eds. (2010) *Modeling Ungrammaticality in Optimality Theory*. London: Equinox.

Rice, Keren (2006) On the patterning of voiced stops in loanwords in Japanese. *Toronto Working Papers in Linguistics* **26**: 11–22.

Rose, D.E., Hume Elizabeth, & Jen Hay (2015) Morphological predictability shapes the phonetic realization of morphemes. Talk delivered at the Linguistic Society of New Zealand Conference, University of Otago, Dunedin, New Zealand.

Shannon, Claude (1948) *A mathematical theory of communication*. MA Thesis, MIT.

Shaw, Jason (2016) The role of predictability in shaping human language sound patterns. Talk presented at "The predictability symposium".

Shaw, Jason, Chong Han, & Yuan Ma (2014) Surviving truncation: Informativity at the interface of morphology and phonology. *Morphology* **24**: 407–432.

Shaw, Jason & Shigeto Kawahara (2017) Effects of Surprisal and Entropy on vowel duration in Japanese. Ms. Keio University [Revision submitted to Language and Speech].

Steriade, Donca (2000) Paradigm uniformity and the phonetics-phonology boundary. In *Papers in Laboratory Phonology V: Acquisition and the Lexicon*, Michael B. Broe & Janet B. Pierrehumbert, eds., Cambridge: Cambridge University Press, 313–334.

Steriade, Donca (2001/2008) The phonology of perceptibility effects: The P-map and its consequences for constraint organization. In *The nature of the word*, Kristin Hanson & Sharon Inkelas, eds., Cambridge: MIT Press, 151–179.

Yu, Alan (2007) *A Natural History of Infixation*. Oxford: Oxford University Press.

Zipf, George Kingsley (1949) *Human Behavior and the Principle of Least Effort*. Cambridge, MA: Addison-Wesley Press.