Two tense consonants do not block tensification in Korean: A rejoinder to Kim (2022)*

Abstract

In Korean, the initial lenis obstruent of the second member of a compound can become a tense consonant. A previous study suggests that the likelihood of this tensification is significantly reduced when the first member of a compound contains two tense consonants, instantiating a case of dissimilation prohibiting three occurrences of the same feature. Since such a pattern has been believed not to be possible in human languages and since the presence of this pattern, if true, would bear on the general question of the counting capability of phonological systems, we attempted to replicate this finding with a larger set of stimuli and a larger number of participants. The results of the current experiment did not find evidence for the dissimilatory effect by which two tense consonants in the first member block compound tensification. We conclude that Korean does not instantiate a case of a phonological constraint which counts three segments.

Keywords: Korean, tensification, sai-siot, dissimilation, counting

1 Introduction

1.1 Korean compound tensification

In Korean, the initial plain/lenis obstruent of the second member of a compound can become a tense consonant (e.g. /san/ 'mountain' + /pul/ 'fire' → [sanp'ul] 'wild fire'), a pattern that is sometimes referred to as "sai-siot." The application of this tensification pattern is not obligatory for all lexical stems, and the likelihood of tensification is affected by several factors, such as segmental

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differences as well as lengths, etymological status (Sino-Korean vs. native Korean) and lexical frequencies of the morphemes involved, etc (see especially Ito 2014, Jeon 2023 and Zuraw 2011 among others). Among these factors, the current paper zooms in on a recent claim by Kim (2022) that when the first member of a compound contains two laryngeally marked consonants (tense and aspirated consonants: Gallagher 2011), the probability of tensification significantly decreases.

This claim is based on a report of Kim (2017), which is an online experiment using the Google Docs document, with the data coming from 21 native speakers of Korean. The crucial portion of the results that forms the basis of this claim is reproduced in Table 1. As shown, according to this result, one instance of tense or aspirated consonant does not substantially affect the likelihood of tensification, but two instances do.[1]

Table 1: The part of the results of Kim (2017) that is relevant to the current study. The leftmost column stands for the number of laryngeally marked consonants (tense or aspirated consonants) in the first member of the compounds (Word-A). The data are based on the responses from 21 speakers.

condition	tensification ratio	total N
plain/sonorant	0.58	2,809/4,830
one tense	0.62	521/840
one aspirated	0.56	308/546
two marked Cs	0.04	6/168

If true, this result would constitute a very important finding from the perspective of phonological theory in general, because it would be a counter-example to the thesis that "phonology does not count", a point that we expand upon in the next subsection.

1.2 Dissimilation of three segments?

The claim that the presence of two laryngeally marked consonants reduces the probability of compound tensification in Korean is important for general phonological theorization, because it would constitute a case which has been thought to be impossible in the phonology of natural languages, i.e., dissimilation of three—but not two—tokens of the same feature. Prohibition against two instances of the same feature/segment is very common across languages (see Bennett 2015, Hansson 2001 and Suzuki 1998 for extensive typological studies on dissimilation); however, no languages have been known to prohibit three instances of the same feature, while allowing for two.

[1] Kim (2017) also found a dissimilatory effect by a laryngeally marked consonant that is contained in the second member of a compound (Word-B), but for that case, one token seems to suffice to significantly reduce the likelihood of tensification. This is a familiar case of dissimilation of *two* segments, however. See also Ito (2014) and Zuraw (2011) for a related observation on a laryngeal dissimilatory effect within Word-B.

In fact, such patterns have been believed to be impossible in natural languages. The lack of such patterns was, for instance, quite explicitly noted by Ito & Mester (2003). As a background, within the framework of Optimality Theory (Prince & Smolensky 1993/2004), Ito & Mester proposed to model dissimilatory effects using local self-conjunction of markedness constraints (Smolensky 1995, 1997). According to their proposal, more specifically, a dissimilation constraint against two instances of the structure [A] results from a self-conjoined version of the markedness constraint prohibiting [A] within a specified domain, i.e. *[A]&*[A]$_{domain}$ (Alderete 1997; Blust 2012). Since Ito & Mester (2003) also propose that local conjunction can be recursive, they raise the concern that their mechanisms predict a constraint prohibiting three instances of a particular structure. They deny that this actually happens in the phonology of natural languages, stating that:

> With local conjunction as a recursive operation, ternary (and higher) conjunction such as (No-ϕ&$_\delta$No-ϕ)&$_\delta$No-ϕ = No-ϕ^2&$_\delta$No-ϕ = No-$\phi^3{}_\delta$ are formally derivable. In the example given, the third violation of No-ϕ would be the fatal one. No convincing evidence has been found so far that No-ϕ^3 is ever linguistically operative separate from No-ϕ^2, which tends to support the old idea in generative linguistics (cf. syntactic movement theory) that the genuine contrast in grammars is not "1 vs. 2 vs. 3 vs. 4 vs. . . .", but "1 vs. greater than 1 (p.265)." [NOTE: ϕ is a variable representing a phonological structure and δ is a variable representing a domain]

In other words, Ito & Mester (2003) claim that there is no evidence that natural languages can have a constraint like No-$\phi^3{}_\delta$, which prohibits three instances of a structure (ϕ) within a certain domain (δ). If this thesis is true about natural languages, then there should not be a constraint like No-[+tense]$^3{}_{compound}$ ("no three tense consonants within a compound").

This claim by Ito & Mester (2003) is a specific instantiation of a more general thesis that "phonology does not count" (e.g. Goldsmith 1976; Hewitt & Prince 1989; McCarthy 2003; McCarthy & Prince 1986; Myers 1997; Walker 2001). As McCarthy (2003) puts it, this is "a widely assumed (though often tacit) principle of linguistic metatheory: rules and constraints are local, a requirement often expressed by saying that rules or constraints do not count beyond two in their definitions (p.80)."[2]

While this thesis is well-known and widely accepted, we think that it is important to make clear what the scope of this claim is. Paster (2019) for example argues that there are phonological processes whose structural descriptions need to count the number of moras, e.g. a process in Kuria

[2]As is clear from the quotes from Ito & Mester (2003) and McCarthy (2003), syntactic systems are also believed not to count (e.g. Chomsky 1965 and Haspelmath 2014). The examples that Chomsky (1965) uses to illustrate this point are the lack of syntactic rules such as "interchange of the $(2n-1)$-th word with the $2n$-th word throughout a string of arbitrary length, or insertion of a symbol in the middle of a string of even length" (pp.55-56).

which associates a floating H-tone with the *fourth* mora from the left edge the stem. However, she makes it clear that such "counting" behavior is limited to suprasegmental patterns, and no such patterns are found at the segmental level: "we have not identified any segmental counting rules — our examples have all involved tone or stress" (p.35). We will thus limit our focus on segmental patterns.

Kim (2022), in addition to the case of Korean that is reassessed in this paper, argues that two nasal consonants can block the compound voicing pattern (a.k.a. rendaku) in Japanese, suggesting that there is a dissimilatory force that can be characterized as *[N...N...D]. Such a constraint appears to prohibit three instances of the [+voice] feature, a constraint whose description violates the generalization stated by McCarthy (2003) quoted above. However, a later study by Kawahara & Kumagai (2023) demonstrates that the lexical evidence that Kim (2022) uses is weak at best, there being only one lexical item that unambiguously supports this claim. Furthermore, a nonce-word experiment designed to specifically address this claim actually shows that Japanese speakers do not exhibit evidence for a constraint like *[N...N...D].

To the best of our knowledge, therefore, evidence is yet to be found that phonological systems of human languages can prohibit three instances of the same feature/segment, perhaps because phonological (or general linguistic) systems lack the general capability to count, at least at the segmental level.

1.3 The need for reassessment

With this general theoretical issue in mind, we found it important to attempt to replicate the results of Kim (2017), further analyzed by Kim (2022). There were indeed some concerns about the design of this experiment. First, the results were based on the responses from 21 speakers, whose N is not very large. See Chambers (2017), Vasishth & Gelman (2021) and Winter (2019) for issues related to the lack of statistical power in linguistics and other experimental research. Second, the participants were all undergraduate or graduate students, and it is not clear whether they were naive to the purpose of the experiment.

Third, neither Kim (2017) nor Kim (2022) report the list of the actual stimuli, so it is impossible to replicate this result. More importantly, guessing from the numbers in Table 1, only eight Word-A/Word-B combinations (=168/21) were included for the condition which contained two laryngeally marked consonants. Moreover, among these eight combinations, it is not clear how many items were used as Word-A in this condition—at most eight items if there was only one Word-B type, four items if there were two Word-B types, etc. It is implied in Kim (2017) that the number of the relevant items in this condition was not very large, as it is stated in the paper that "it is inappropriate to make a generalization in the present study due to the small sample size" (p.5), although this pattern was analyzed by Kim (2022) to propose a specific mechanism associated with

MaxEnt Harmonic Grammar (e.g. Hayes 2022). In short, it is not clear how generalizable Kim's (2017) finding is. See Winter & Grice (2021) and Yarkoni (2020) for the issue of generalizability.

Furthermore, in this experiment, each participant was asked to make a judgment about tensification for 304 items. This is a very large number of items to judge for an online experiment, and it is not clear whether the participants were able to keep focusing on the task. Neither is it clear if the order of these 304 items was randomized—and if so, how—so that this result could have been arisen from the order effect. As discussed in the previous sub-section, the claim by Kim (2017) has important implications for phonological theorization, and as such, it should be established with care. With this in mind, the current experiment reported below is intended to improve upon Kim (2017) .

2 Method

The experimental materials, the raw response data, analytical files and Bayesian posterior samples of the current experiment are all available at Open Science Framework (osf) repository at `https://osf.io/9wyjs/?view_only=dc93bea1ad1d4350bb2e418fe5451e75`. For the sake of replicability, the online experiment can be viewed at `https://hje3unnmcv.cognition.run/`.

2.1 Stimuli

The current experiment varied the number of tense consonants contained in the first member (Word-A) of a compound from 0 to 2. In order to keep the experiment to be of decent size, the current experiment focused on the effects of tense consonants, as they are more likely to interact with tensification than aspirated consonants,[3] although we acknowledge that exploring the effects of aspirated consonant is an interesting and important topic for future exploration. We used nonce words for Word-A but real words for the second member (Word-B), because using nonce words for both Word-A and Word-B would be cognitively too challenging for linguistically-naive participants.

For each condition (0 tense C, 1 tense C, 2 tense Cs), we prepared five items, as listed in Table 2. These stimuli were minimally different in terms of whether the first/second consonants were tense or not. All the nonce words were disyllabic with CV syllables, so that they do not sound like loanwords.

Each of these items was combined with five real Word-Bs, [param] 'wind', [tari] 'leg', [kiɾɯm] 'oil', [soɾi] 'sound' and [tɕaɾi] 'seat', each starting with a different type of a voiceless obstruent.

[3] Zuraw (2011) for example only analyzes the effects of tense consonants, not those of aspirated consonants.

Table 2: The list of stimuli used for Word-A.

0 tense C	1 tense C	2 tense Cs
[sidʑa]	[s'idʑa]	[s'itɕ'a]
[padu]	[p'adu]	[p'at'u]
[tʌsi]	[t'ʌsi]	[t'ʌs'i]
[tugo]	[t'ugo]	[t'uk'o]
[kʌbo]	[k'ʌbo]	[k'ʌp'o]

The experiment thus had a total of 75 stimuli (15 Word-A $\times$ 5 Word-B).

The auditory stimuli were produced by the first author, who is a native speaker of Korean. The RMS amplitude of all the stimuli was automatically adjusted to be 60 dB using Praat (Boersma 2001). The auditory stimuli are available at the above-mentioned osf repository.

2.2 Procedure

The experiment was run online using the `congnition` platform. The participants were first presented with a consent form, and in the instructions, they were asked to use a headphone or an earphone in order to participate in the experiment. They were then presented with a recording of a Korean sentence and were asked to adjust the volume so that they can hear the sounds clearly. All of these were presented to the participants in the standard Korean orthography.

Within each main trial, the participants were presented with one nonce word from Table 2 and one real word. The nonce words were presented as "native words that are specific to the Jeju Island dialect", so that the participants would treat them as (unknown) native Korean words rather than recent loanwords (see Vance 1980 and Zuraw 2010 for similar techniques used for Japanese and Tagalog, respectively). The entire compounds were thus presented as expressions describing a specific scene of the Jeju Island. Two possible pronunciations of the resulting compound—one with tensification and one without tensification—were auditory presented to the participants, and the participants were asked to choose which option is closer to how they would produce each novel compound.

The order of the choices was randomized by the first author; for 37 items, the tensified token was presented first, while for the other remaining 38 items the non-tensified token was presented first. The participants were allowed to listen to the two options as many times as they liked by pressing a button that says "listen again". The participants were asked to produce each option themselves before they register their response.

The participants went through two practice trials—/togɛ+tɕaru/ 'NONCE+bag' and /tigo+pori/ 'NONCE+barley'—so that they could familiarize themselves with the task. In the main session,

the order of the stimuli for the main trials was randomized for each participant. Once they register their response, they were not allowed to go back to previous questions.

2.3 Participants

A total of 74 speakers completed the online experiment. Among those, 25 speakers participated through Prolific, a platform that is designed to get participants for online experiments. The qualification conditions for participation in this experiment through Prolific were as follows: they were monolingual speakers of Korean, they could participate in the experiment through a pc, and they have typical hearing ability. The first pre-requisite was necessary, because the main pool of participants for Prolific come from English-speaking communities. The data from the other participants were collected by word-of-mouth. The call-for-participants were written in Korean, and only those participants who identified themselves as native Korean speakers were invited to participate.

2.4 Statistics

We fit a Bayesian logistic mixed-effects model, in which the dependent variable was whether the tensified token was chosen (=1) or not (=0) (for an accessible introductory tutorial on Bayesian analyses, see e.g. Kruschke & Liddell 2018 and Franke & Roettger 2019). The main independent variable was the number of tensed consonants in Word-A; so that we could make a pair-wise comparison between one tense condition and two tense consonant condition, we set the baseline for this condition to be one tense consonant condition. We included a random intercept for items and a random intercept and slope for participants for this fixed effect. For prior specifications, we used a Normal(0, 1) weakly informative prior for the intercept (Lemoine 2019) and a Cauchy prior with scale of 2.5 for the slope (Gelman et al. 2018).

Four chains, each with 4,000 iterations, were run, and 1,000 iterations from each chain were disregarded as warm-ups. The $\hat{R}$-values for the fixed effect was 1.00 and no divergent transitions were detected. See the R markdown file available at the osf repository for further details.

3 Results

The results of the current experiment are illustrated in Figure 1, which is a violin plot representing the distribution of tensified responses for each number of tense consonants contained in Word-A. The red diamonds stand for the overall averages for each condition. Transparent blue circles represent the average for each condition by participant. The grand average tensification ratio was 0.19, 0.19 and 0.21 from left to right. This result shows that two tense consonants in Word-A do

not reduce the probability of tensification; if anything, it very slightly increases the tensification rate, compared to the other two conditions.

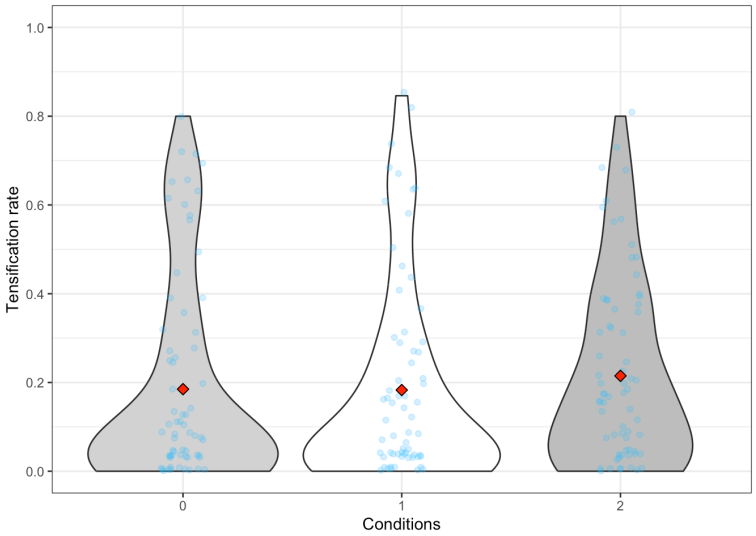

Figure 1: The tensified response ratios for the three conditions.

The 95% credible interval for the difference between the 0 tense consonant condition and the one tense consonant condition was [-0.39, 0.44] with its central coefficient estimate being 0.02, suggesting that this difference was not very credible. More importantly, the 95% credible interval for the difference between the one tense consonant condition and the two tense consonant condition was [-0.01, 1.02] with its central coefficient estimate being 0.51. Although this 95% credible interval includes 0, the posterior distribution is heavily skewed toward positive values—the probability of this coefficient being positive ($p(\beta_1 > 0)$) was 0.97. This result suggests that two tense consonants actually increased, rather than decreased, the tensification response.

4 Discussion

The main purpose of the current experiment was to re-examine the previous claim that two tense consonants in Word-A can reduce the tensification likelihood in Korean compound formation (Kim 2017, 2022). This claim was important to re-examine, because it would constitute a pattern that has been thought to be impossible in natural languages, namely, dissimilation triggered by the third token (Ito & Mester 2003). The presence of such a pattern has implications for the general question regarding whether or not phonological systems can count (e.g. Goldsmith 1976; Hewitt & Prince 1989; Ito & Mester 2003; McCarthy 2003; McCarthy & Prince 1986; Myers 1997).

To that end, we sought to explore this purported dissimilatory effect with a larger number

of items and participants. The results show that the difference between the one tense consonant condition and the two tense consonant condition is very small (2% difference), and if anything, two tense consonants in Word-A increased—rather than decreased—the likelihood of tensification.

It is not clear how substantive this increase is, but it reminds us of a "double-trigger" vowel harmony pattern, in which the presence of two vowels trigger harmony (Walker 2001)—on this note, we would like to point out that Ito (2014) found that at least in Yanbian Korean, words with tense consonants are overpresented, rather than underrepresented, and thus, there is a sense in which Korean may show a long-distance assimilation of tense consonants. We reiterate, however, that the magnitude of the increase in tensification ratio is very small (2%), although the Bayesian analysis deemed this to be a reliable effect.

There are two topics that can be explored in future research: one is the effect of aspirated consonants. Recall Kim (2017, 2022) treats tense consonants and aspirated consonants as a natural class (Gallagher 2011), and hence the behavior of aspirated effects remains to be a topic of some interest. Second, examining the effects of two tense—or aspirated—consonants in Word-B may also be informative, although Kim (2017) shows that for that case, one instance of a laryngeally marked consonant can block tensification to a significant degree.

All in all, it seems safe to conclude that Korean does not prohibit three tense consonants within a compound, when two of them are contained in Word-A. In this sense, Korean phonology does not show evidence for a phonological constraint that counts three instances of tense consonants, at least when two of them are contained in Word-A.

References

Alderete, John. 1997. Dissimilation as local conjunction. In Kiyomi Kusumoto (ed.), *Proceedings of the North East Linguistics Society 27*, 17–31. Amherst: GLSA.

Bennett, Wm. G. 2015. *The phonology of consonants*. Cambrige: Cambridge University Press.

Blust, Robert. 2012. One mark per word? Some patterns of dissimilation in Austronesian and Australian languages. *Phonology* 29(3). 355–381.

Boersma, Paul. 2001. Praat, a system for doing phonetics by computer. *Glot International* 5(9/10). 341–345.

Chambers, Chris. 2017. *The 7 deadly sins of psychology*. Princeton: Princeton University Press.

Chomsky, Noam. 1965. *Aspects of the theory of syntax*. Cambridge: MIT Press.

Franke, Michael & Timo B. Roettger. 2019. Bayesian regression modeling (for factorial designs): A tutorial. Ms. `https://doi.org/10.31234/osf.io/cdxv3`.

Gallagher, Gillian. 2011. Auditory features in phonology—the case for [long VOT]. *The Linguistic Review* 28. 281–313.

Gelman, Andrew, Aleks Jakulin, Maria Grazia Pittau & Yu-Sung Su. 2018. A weakly informative default prior distribution for logistic and other regression models. *Annual Applied Statistics* 2(4). 1360–1383.

Goldsmith, John. 1976. *Autosegmental phonology*: MIT Doctoral dissertation.

Hansson, Gunnar Olafur. 2001. *Theoretical and typological issues in consonant harmony*: University of California, Berkeley Doctoral dissertation.
Haspelmath, Martin. 2014. Comparative syntax. In *The Routledge handbook of syntax*, 490–508. Routledge.
Hayes, Bruce. 2022. Deriving the wug-shaped curve: A criterion for assessing formal theories of linguistic variation. *Annual Review of Linguistics* 8. 473–494.
Hewitt, Mark & Alan Prince. 1989. OCP, locality and linking: The N. Karanga verb. In E. J. Fee & K. Hunt (eds.), *Proceedings of West Coast Conference on Formal Linguistics 8*, 176–191. Stanford: Stanford Linguistic Association.
Ito, Chiyuki. 2014. Compound tensification and laryngeal co-occurrence restrictions in Yanbian Korean. *Phonology* 31(3). 349–398.
Ito, Junko & Armin Mester. 2003. *Japanese morphophonemics*. Cambridge: MIT Press.
Jeon, H-S. 2023. Exploring variability in compound tensification in Seoul Korean. *Language and Speech* 66(1). 214–245.
Kawahara, Shigeto & Gakuji Kumagai. 2023. Rendaku is not blocked by two nasal consonants: A reply to Kim (2022). *Glossa* .
Kim, Seoyoung. 2017. Phonological trends in Seoul Korean compound tensification. *Proceedings of the Annual Meetings on Phonology* .
Kim, Seoyoung. 2022. A maxent learner for super-additive counting cumulativity. *Glossa* 7(1).
Kruschke, John K. & Torrin M. Liddell. 2018. The Bayesian new statistics: Hypothesis testing, estimation, meta-analysis, and power analysis from a Bayesian perspective. *Psychological Bulletin and Review* 25. 178–206.
Lemoine, Nathan P. 2019. Moving beyond noninformative priors: Why and how to choose weakly informative priors in Bayesian analyses. *Oikos* 128. 912–928.
McCarthy, John J. 2003. OT constraints are categorical. *Phonology* 20(1). 75–138.
McCarthy, John J. & Alan Prince. 1986. Prosodic morphology. Ms., University of Massachusetts and Rutgers University.
Myers, Scott. 1997. OCP effects in Optimality Theory. *Natural Language and Linguistic Theory* 15(4). 847–892.
Paster, Mary. 2019. Phonology counts. *Radical* 1. 1–61.
Prince, Alan & Paul Smolensky. 1993/2004. *Optimality Theory: Constraint interaction in generative grammar*. Malden and Oxford: Blackwell.
Smolensky, Paul. 1995. On the internal structure of the constraint component CON of UG. Talk presented at the University of California, Los Angeles (ROA-86).
Smolensky, Paul. 1997. Constraint interaction in generative grammar II: Local conjunction, or random rules in universal grammar. Handout of talk given at Hopkins Optimality Theory Workshop/Maryland Mayfest, Baltimore.
Suzuki, Keiichiro. 1998. *A typological investigation of dissimilation*: University of Arizona Doctoral dissertation.
Vance, Timothy. 1980. The psychological status of a constraint on Japanese consonant alternation. *Linguistics* 18. 245–267.
Vasishth, Shravan & Andrew Gelman. 2021. How to embrace variation and accept uncertainty in linguistic and psycholinguistic data analysis. *Linguistics* 59(5). 1311–1342.
Walker, Rachel. 2001. Round licensing, harmony, and bisyllabic triggers in Altaic. *Natural Language and Linguistic Theory* 19. 827–878.

Winter, Bodo. 2019. *Statistics for linguists*. New York: Taylor & Francis Ltd.
Winter, Bodo & Martine Grice. 2021. Independence and generalizability in linguistics. *Linguistics* 59(5). 1251–1277.
Yarkoni, Tal. 2020. The generalizability crisis. *Behavioral and Brain Sciences* 45(e1).
Zuraw, Kie. 2010. A model of lexical variation and the grammar with application to Tagalog nasal substitution. *Natural language and Linguistic Theory* 28(2). 417–472.
Zuraw, Kie. 2011. Predicting korean sai-siot: phonological and non-phonological factors. Talk given at.