Paradigmatically conditioned phonetic detail in Hungarian transparent vowels

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Abstract In Hungarian palatal vowel harmony in words in which the last vowel is [+back] take suffixes with back vowels and words with final front vowels almost always take suffixes with [–back] vowels. A handful of words in which the last vowel is transparent ([iː], [i], [eː] or [e]) are followed by suffixes that take back vowels. Some have argued that transparent vowels are phonetically more retracted in words which take suffixes with back vowels than in in words that take suffixes with front vowels. Others have denied such a difference. We conducted a production experiment in which we investigated the properties of transparent vowels in monosyllabic words in order to shed light on question as to the presence of paradigmatically conditioned phonetic detail in Hungarian. This is important, because the presence of paradigmatically conditioned phonetic detail in Hungarian, shows that such effects go beyond those established as a consequence of incomplete neutralization.

On the basis of our findings it is necessary to address the question of the representation of paradigmatically conditioned phonetic detail. We discuss several proposals that have been advanced, but all of them have drawbacks. We propose to represent an entire paradigm as a unit in the mental lexicon as an attribute-value representation in which the phonetic details are the result of a constraint on the relation among values of different attributes.

Keywords: transparent vowels; Hungarian; paradigmatically conditioned phonetic detail; representations; incomplete neutralization

1 Introduction

Phonetics is gradually encroaching on morphophonology. Not only is the realization of segments affected by their morphological affiliation (**hedia2017gemination**; **plag2015homophony**; **plag2007testing**), but paradigm uniformity effects also cause phonetic details in one word form in the paradigm to reflect the phonetics of other word forms. Even though the Dutch words *bed* [bɛt] 'bed' and *pet* [pɛt] 'cap' appear to end in the same consonant, the vowel in [bɛt] is slightly longer than the one in [pɛt], reflecting longer length of the vowel before [d] in the paradigmatically related plural *bedden* [bɛdə] (**warner2003orthography**; **warner2004incomplete**; **warner2006orthographic**). The cases of phonetically conditioned paradigmatic uniformity discussed so far in the literature almost all deal with cues for voicing of adjacent obstruents. It is, therefore, unclear how general paradigmatically conditioned phonetic effects are.

To address this question, we focus on a paradigmatically conditioned phonetic effect in Hungarian vowel harmony. In Hungarian the vowel backness of the suffix is determined by the last vowel in the stem. If the last vowel is back, suffix vowels are also back, and when it is front, suffix vowels are almost always front. We say almost always, because there is a handful of words that end in front, unrounded vowels—so-called transparent vowels—occur in a handful of words that take suffixes with back vowels. (**benus2007articulatory**; **szeredi2016exceptionality**) present data to show that transparent vowels are more retracted phonetically in words that take suffixes with back vowels than in words that take suffixes with front vowels. But others have disputed these facts (**blaho2013hungarian**). We will present new evidence to support earlier findings that this effect exists (**benus2007articulatory**; **szeredi2016exceptionality**). We will focus on uninflected words, since these crucially attest the paradigmatic nature of the phonetic detail.

Transparent vowels occur only in a few words. As one has to know which words with transparent vowels take suffixes with back vowels this knowledge has to be stored in the mental lexicon. If there is any phonetic retraction of transparent vowels in uninflected words in case such words are inflected with suffixes with back vowels then this retraction is the consequence of the word being in a paradigm with suffixes with back vowels. As a result, the phonetic detail present in uninflected forms also has to be stored in the mental lexicon. The extant proposals for such representations are insufficient, because they focus on the representation of pho-

netic details among phonologically contrasting segments (**kirby2010cue**; **van2008incomplete**; **yu2011contrast**). We will propose a representation of an entire paradigm as an attribute-value frame (**bird1995computational**; **bird1994phonological**; **bonami2016role**) in which phonetic details are the result of a constraint on the relation between values of different attributes.

Paradigm uniformity effects In addition to phonological uniformity effects (**albright2008inflectional**; **hall2005paradigm**; **harris1989towards**; **steriade2008pseudo**), there are also paradigm uniformity effects that affect the phonetics of word forms. A well-known example is found in Dutch. Voiced and voiceless obstruents contrast everywhere except word-finally (**booij-pd:95**). The singular *bed* [bɛt] 'bed' which has the plural *bedden* [bɛdə], seems to end in the same obstruent as *pet* [pɛt] 'cap', which has the plural [pɛtə]. Careful study showed that the loss of contrast is not complete (**ernestus2006functionality**; **ernestus2007intraparadigmatic**; **ernestus2007paradigmatic**; **warner2006orthographic**). The vowel in [bɛt] is slightly, but systematically, longer than the vowel in [pɛt]. The difference in length of the vowel in [bɛt] and [pɛt] is strongly reminiscent of the length of vowels before fully voiced and fully voiceless stops; vowels before fully voiced obstruents are longer than before fully voiceless obstruents (**chen1970vowel**). The longer vowel in [bɛt], than, makes this word form more similar to the word form in the plural. The paradigmatically conditioned phonetic detail in the vowel length in [bɛt] can therefore be understood as an instance of paradigm uniformity. In this case, too, it is the form with most contrastive information—the plural which contains the information about the voicing of the stem-final obstruent—that is the basis for other word forms to emulate. Similar effects have been attested in many languages (**braver2011incomplete**; **braver2014imperceptible**; **charles1987reanalysis**; **dinnsen-reexamination-neutr-1985**; **dmitrieva2010phonological**; **ernestus2006functionality**; **ernestus2007intraparadigmatic**; **ernestus2007paradigmatic**; **kleberjohnharrington-incompleteneutralization:appear**; **kleber2011incomplete**; **port1989incomplete**; **port1981neutralization**; **roettger-winter-grawunder-incomplete-neu**
roettgeretal-incomplete; **slowiaczek1985neutralizing**; **warner2006orthographic**).

In the cases reviewed above the phonetic detail could be used to recover a contrast among consonants that would otherwise be lost. There is, however, evidence, to which we will add in this paper, that paradigmatically conditioned phonetic details are also found within different tokens of one segment (or a natural class of segments) depending on morphophonological properties of the paradigm. This is the case in Hungarian to which we will now turn.

Paradigmatically conditioned phonetic effects in Hungarian Paradigmatically conditioned phonetic details have also been controversially reported for vowel harmony in Hungarian (**benus2007articulatory**; **blaho2013hungarian**; **szeredi2016exceptionality**). There is a regular rapport between the backness of the final vowel in a stem in Hungarian and the backness of the vowels in suffixes (**toerkenczy-hvh-2011blackwell**; **torkenczy2016hungarian**). For example, the word *ló* [loː] 'horse' has a back vowel in the stem and its accusative form is [lovɔt] with a back vowel in the accusative suffix; the word *tűz* [tyːz] 'fire' has a front vowel in the stem and its accusative form is [tyzɛt] with a front vowel in the accusative suffix. These facts are illustrated in table **??**.

	Nominative		Accusative		Gloss
iː, i	víz	[viːz]	viz-et	[vizɛt]	water
yː, y	tűz	[tyːz]	tüz-et	[tyzɛt]	fire
uː, u	kút	[kuːt]	kut-at	[kutɔt]	well
øː, ø	kő	[køː]	köv-et	[køvɛt]	stone
oː, o	ló	[loː]	lov-at	[lovɔt]	horse
eː, e	kéz	[keːz]	kez-et	[kɛzɛt]	hand
aː, ɔ	nyár	[ɲaːr]	nyar-at	[ɲɔrɔt]	summer

Table 1: Hungarian vowel harmony.

This regular phonological connection between the vowels in the stem and the vowels in the suffix is disrupted by front, unrounded vowels [iː, i, eː, e], which are commonly known as transparent vowels **torkenczy2016hungarian**; **toerkenczy-hvh-2011blackwell** In a small set of words in which the last vowel is transparent, the vowel in a following suffixes is back rather than front. For example, the word *híd* [hiːd] 'bridge' takes the accusative [hidɔt] with a back vowel (**benus2007articulatory**; **blaho2013hungarian**; **hayes2006spk**; **szeredi2016exceptionality**; **torkenczy2016hungarian**; **toerkenczy-hvh-2011blackwell**).[1] In table **??** an example is given of one word with a transparent vowel that combines with a suffix with a front vowel and one word with a transparent vowel that combines with a suffix with a back vowel.

As the pronunciation of a vowel is affected by a preceding vowel even across intervening consonants (**ohman1966coarticulation**), it may be the case that transparent vowels have a different articulation depending on the

[1] The stem vowel shortens in open syllables, for details see **toerkenczy-hvh-2011blackwell**; **torkenczy2016hungarian** This effect is irrelevant for our concerns.

Nominative		Dative		Gloss
víz	[viːz]	víznek	[viːznɛk]	water
híd	[hiːd]	hídnak	[hiːdnɔk]	bridge

Table 2: Transparent vowels combine with front and back suffixes.

vowel in the suffix. This possibility was investigated by **benus2007articulatory** who performed an articulatory study in which they measured the position of the tongue in transparent vowels in words that take either suffixes with back vowels or suffixes with front vowels. They conducted an Electromagnetic midsaggital articulometry (EMMA) in which small receivers are attached to the the articulators in order to track the movements and position of the tongue. In addition, **benus2007articulatory** performed an ultrasound study.

Three speakers of Budapest Hungarian participated in the study, and they read aloud 44 polysyllabic target words (7 pairs with [iː], 8 pairs with [i] and 7 pairs with [eː]) and 16 monosyllabic target words (5 pairs with [iː], 1 pair with [i] and 2 pairs with [eː]) in a carrier sentence. **benus2007articulatory** found that in polysyllabic words transparent vowels surrounded by back vowels are slightly, but statistically significantly retracted. In these words the retraction ranged from 0.23 millimeters to 1.4 millimeters. In monosyllabic words the same effect is found: The receivers indicate that the tongue is further back in words with transparent vowels that take suffixes with back vowels than in words with transparent vowels that take suffixes with front vowels.

benus2007articulatory conclude that transparent vowels are further back if they are surrounded by back vowels. This can be explained as a consequence of coarticulation. It is noteworthy, though, that transparent vowels in monosyllabic uninflected words are also further back when their inflected forms take suffixes with back vowels. This effect is more difficult to analyze as coarticulation, since the vowel that would cause such coarticulation is not present in the target word.

This interesting work sparked research to validate its findings, especially since the behavior of transparent vowels had previously been analyzed as completely lexical and categorical **blaho2013hungarian** They criticized **benus2007articulatory** methodologically, since their conclusions are based on data of only three speakers.

blaho2013hungarian addressed the methodological issue of having too few participants and questioned whether the articulatory retraction is large

enough to have any acoustic consequences, something **benus2007articulatory** doubted. **blaho2013hungarian** did an acoustic analysis of antiharmonic transparent vowels pronounced by 12 native speakers of different dialect areas in Hungary; Budapest Hungarian and Párkány Hungarian, a town in the north of Hungary at the Slovakian border.

They asked native speakers to produce words with harmonic and words with antiharmonic vowels in a carrier sentence, and analyzed the formants of the target vowels at their mid point. They found that the quality of the vowel in the suffix does not correlate with the phonetic realization of the transperent vowel. In other words the F2 value of the vowel in *his* [his] 'believe 3sg', which is harmonic is the same as the F2 value of the vowel in *nyit* [ɲit] 'open 3sg.', which is antiharmonic. They conclude that, even if there is articulatory fronting of transparent vowels (**benus2007articulatory**), the amount of fronting has no acoustic effects.

szeredi2016exceptionality addresses the contradiction between the findings of **benus2007articulatory** and **blaho2013hungarian** He investigated the antiharmonic and transparent vowels [iː] and [i]. He did not measure the properties of [ɛ], since there are only a handful of pertinent stems. He acoustically analyzed the transparent vowels of 48 stems in 3 conditions as produced in a reading experiment by 16 participants. **szeredi2016exceptionality** measured the mid points of the target vowels. The effects in all conditions were very similar, but one condition will be directly comparable to our work, and so we report this condition first.

In one condition the stems were uninflected, but embedded in a carrier sentence. In this condition he found that antiharmonic [i] has an F2 that is on average 20 Hz lower than harmonic [i]. This difference is not significant, however. The difference between the F2 of antiharmonic and harmonic [iː] is 11.4 Hz; a small difference that is not significant. It is interesting that the size of the effect was larger in [i] than in [iː]. This chimes with results reported by **mady2008hungarian**; **mady2007quantity** on variation among the realization of Hungarian vowels. Their measurements were based on vowels that were included in words embedded in carrier sentences, as were the measurements of **szeredi2016exceptionality** They found that there was a greater amount of variation with realzations of [i] than among tokens of [iː] or [eː]. This greater range for [i] may have been exploited by the speakers, and is reflected by a greater difference among F2 values in the different contexts in the results of **szeredi2016exceptionality**

In the other two conditions—words in isolation and in inflected words—the effects were similar. Transparent vowels in words that take suffixes with

back vowels have a lower F2—are more retracted—than those in words that take suffixes with front vowels.

szeredi2016exceptionality ran a rating study with inflected nonsense words to investigate whether Hungarian native speakers use small phonetic differences in the degree of retraction of transparent vowels to predict the type of suffix. He manipulated vowels to create tokens of each type of transparent vowel and made sure that within each vowel type tokens differed with respect to F2. One group of tokens within each vowel type had an F2 that was 250 Hz lower than a second group of the same type. He based the formant values of the vowels on the results of a classification study of vowels that he had run separately. It turns out that nonsense words with artificially retracted vowels do not prompt more choices of suffixes with back vowels than suffixes with front vowels. He concludes that even though native speakers appear to systematically produce more retracted transparent vowels if they occur in words that take suffixes with back vowels, they do not use vowel retraction to choose a suffix type.

However, the literature offers an alternative to a generalization of the effect to novel items. **ernestus2003pui** investigated whether Dutch native speakers extend the voicing neutralization found in words to nonsense words. They asked native speakers to inflect nonsense words. They found the inflection of nonsense words depended on their segmental make up. If the segmental make up of the nonsense word resembled the segmental make up of many existing words that all had a voicing neutralization, the nonsense words were more likely to exhibit a voicing neutralization. We may therefore expect that if the nonsense words have a segmental make up that resembles exiting words, the existing words will be used as analogues to the inflection of the resembling nonsense words.

These studies leave us with contradictory results. Even though **benus2007articulatory** found a small, but systematic articulatory retraction effect for transparent vowels in the context of back vowels, and **szeredi2016exceptionality** found an acoustic effect of tongue retraction, **blaho2013hungarian** failed to find an acoustic correlate of their retraction. One goal of this study, then, is to increase our confidence in the existence or the non-existence of acoustic correlates of the retraction of transparent vowels in the context of back vowels. This will assist us in assessing the theoretical status of the retraction. A secondary goal is to assess whether any difference in retraction of transparent vowels in existing words is generalized to novel words.

Consequences of paradigmatically conditioned phonetic detail for representations The discovery of paradigmatically conditioned phonetic detail in cases of incomplete neutralization prompted **port2005against** to an-

nounce the demise of phonological theory. They argued that paradigmatically conditioned phonetic detail cannot be analyzed with the available categorical phonological tools. A fundamental tenet of phonological theory, according to **port2005against** is that categories are categorical and not continuous. The incomplete neutralization facts show that there is a systematic, but continuous contrast between word-final obstruents. The consistency of the effect makes an account in phonological theory necessary, but the categorical nature of phonology precludes such an account.

van2008incomplete took issue with this proposition and showed that it is very well possible to provide an analysis of incomplete neutralization using the categorical tools of formal phonology. The starting point of **van2008incomplete**'s analysis is a basic assumption within the framework of Optimality Theory (**princesmolensky:otcigg-93**): The underlying form must be contained in the surface form, and nothing from the underlying representation can be destroyed. The underlying form of an incompletely neutralized word-final obstruent is specified by the feature [VOICE]. This feature stands in an abstract, structural relation to the segment in the surface form to which it belongs. There is also another relation, the pronunciation relation, which holds between the segment in the surface form and its underlying features. This relation mediates the pronunciation of the structure. However, in languages with final devoicing the pronunciation relation between the word-final segment and the underlying feature [VOICE] violates a constraint against pronouncing the feature [VOICE] in a word final obstruent. Since there is no pronunciation relation between the segment and the feature [VOICE] the feature is not pronounced, but since the underlying feature cannot be destroyed, it remains there and this unpronounced feature is interpreted by the phonetic module.

van2008incomplete's proposal works in the technical formal sense; it distinguishes between truly voiceless final obstruents and devoiced final obstruents. But it is contradictory and therefore unsatisfactory: The feature [VOICE] is phonologically present, but not pronounced, since that would violate a constraint against pronouncing voiced codas. This phonologically unpronounced feature at some point emerges as phonetic detail; in other words, it is pronounced.

Even if were possible to iron out this contradiction, it remains to be seen whether this analysis can be extended to other cases of morphologically conditioned phonetic detail. For example, in the Hungarian cases a stem vowel with the feature [–BACK] is phonetically more back if it is surrounded by other vowels that are [+BACK]. Even if an argument can be made that

the feature [–BACK] is not pronounced, it is not clear how this would result in making the vowel phonetically more back.

flemming-phonology2001; **flemming2013auditory** proposed to include phonetic detail in order to represent differences in contrastiveness. The phonetic cues to the feature [VOICE] are less salient at the end of a word in comparison to the beginning of a word. **flemming-phonology2001**; **flemming2013auditory** represents this by using phonetic dimensions of a feature that are different in different positions. Extensions of this approach have been proposed by **kirby2010cue** and **yu2011contrast**

The proposals of **flemming-phonology2001**; **flemming2013auditory**; **kirby2010cue** and **yu2011contrast** to include phonetic detail in phonological representations fail to address our problem, though. They all deal with details that depend on a phonological contrast, whereas in the phonetic detail in the realization of transparent vowels in Hungarian we deal with phonetic detail within a a vowel.

What is needed then is a representation that captures the fact that the phonetic details in questions are conditioned by morphophonology and are the consequence of relations among vowels in a paradigm. We will propose an attribute-value matrix as such a representation (**bird1994phonological**; **bonami2016role**), in which the relation between values of the suffix vowel and the final vowel in the stem is constrained so as to reflect the phonetic details.

Our experiment We will address the uncertainty regarding the presence of paradigmatically conditioned phonetic detail in Hungarian by means of a production experiment. We focus on the phonetic properties of transparent vowels in monosyllabic, uninflected words. If there is paradigmatically conditioned phonetic detail then we expect to find that transparent vowels in monosyllabic words that take suffixes with back vowels are more retracted—they have a lower F2—than transparent vowels in words that take front suffixes. It will turn out that we do indeed find such an effect. We will use both words and nonsense words in order to assess whether the retraction is generalized to new items.

We also address the representation of paradigmatically conditioned phonetic detail. On the basis of our results we will propose an attribute-value structure of paradigms, in which relations among values are constrained in such a way that it reflects the presence of phonetic details.

2 Method

We wanted to investigate the hypothesis that the degree of retractedness of transparent vowels varies with their choice of suffix vowels; transparent vowels in monosyllables that take suffixes with back vowels are more retracted than transparent vowels that take suffixes with front vowels. This is because the inflected forms contain information not available in the uninflected form (**albright2008inflectional**; **hayes1999phonological**). In particular it is argued that inflected forms provide reasons to add phonetic detail to the uninflected form. This makes the paradigm more uniform (**downinghallraffelsiefen-pipt3:05**; **malouf2010paradigms**; **downinghallraffelsiefen-pipt10**; **sturgeon2003paradigm**) and the uninflected form more predictable from the inflected form (**roettgeretal-incomplete**).

To test this hypothesis we used a production experiment we asked our participants to *silently* read a sentence in which a word or a nonce was inflected **roettgeretal-incomplete** This gave the participant the information about the frontness of the backness of the vowel in the suffix. The participants were then asked to read *aloud* the uninflected variant of the word which appeared in a gap in the next sentence. We recorded the sentences used the recording to analyze the formants (see section **??**.)

We used 30 existing monosyllabic stems with a transparent vowel that take front suffixes (15 nouns and 15 verbs) and 30 existing monosyllabic stems with a transparent vowel that take back suffixes (15 nouns and 15 verbs). In addition, for each monosyllabic stem we created a corresponding nonsense word, which differed from the existing word only in the onset. The nouns were inflected with the dative suffix (the nɔk, nɛk allomorphs) and the verbs were inflected with the third person plural allomorphs (also nɔk and nɛk).

Examples of sentences with words (in bold) are given below: All sentences are given in the Appendix.

> ɔtɛstɛn a **t͡ʃi:knɔk** pirosa:kɛl va:lɲa. hɔa **t͡ʃi:k** nem si:nezø:dik ɛl, a tɛst nem e:rve:ɲɛs.
> *The **band** on the test should turn red. If the **band** is not colored, the test is not valid.*

> peciɛk **hisnɛk** a føldønki:vyliɛk le:teze:ʃe:bɛn. ɔz ɛmberɛk tøb:ʃe:ge pɛrse nem **his** ɔz iʎɛʃmibɛn.
> *Peti and his friends **believe** in the existence of aliens. The majority of people do not **believe** in such things.*

We tested twenty-one monolingual native speakers of Hungarian, fourteen of them women, at the phonetics lab at the Heinrich-Heine-Universität in Düsseldorf. They were paid 10 Euro's for their participation.

3 Results

We used Praat (**boersmaweenink2008praat**) to measure the formants of the target vowels. First we isolated the vowels in the words and we measured the formants at their midpoint. We looked for 5 formants in a range up to 5500 Hz for women and in a range up to 5000 Hz for men with a time step of 0.01 seconds.

In order to asses the location in the vowel space of the vowels produced in our experiment we plotted the F1 and F2 values in figure **??**. We did this because **mady2007quantity**; **mady2008hungarian** found that the length distinction in Hungarian vowels is gradually being replaced by quality distinction. They reported that the quality of [i] shows a great deal of variabilty, such that it overlaps with the quality of both [i:] and [e:]. In addition, **szeredi2016exceptionality** reports that in a classification study Hungarian listeners are better able to distinguish between tokens of [i] that differ in F2, than between tokens of [i:].

In agreement with the findings of **mady2007quantity**; **mady2008hungarian** the distribution in vowel space of the vowels produced in our experiment shows that the difference between [i:] and [i] is a difference in quality.[2] Short [i] is lower and more retracted than [i:]. Moreover, the distribution of [i] is located in between [i:] and [e:]. This is illustrated in figure **??**.

Inspection of the distribution of the formant values showed that they values were not distributed normally, but rather had a logarithmic distribution. We therefore transformed the formant values logarithmically for our analysis. We performed a linear mixed effects regression analysis on our data. We analyzed the results for [i:], [i] and [e:] separately, because these vowels differ inherently in height and backness of the tongue (**mady2007quantity**; **mady2008hungarian**) (see also figure **??**). We did not analyze the items with an [e] as there were no words with such a vowel that take back suffixes in our sample.

We begin with the results of our linear mixed effects model that we calculated with the lme4 package in R (**Rlme4**) for [i:]. Upon inspection of our data for [i:] we noticed that five items were obviously mispronounced.

[2] We also found that short vowels are shorter than long vowels. As this is not crucial we do not dwell on the quantity distinction.

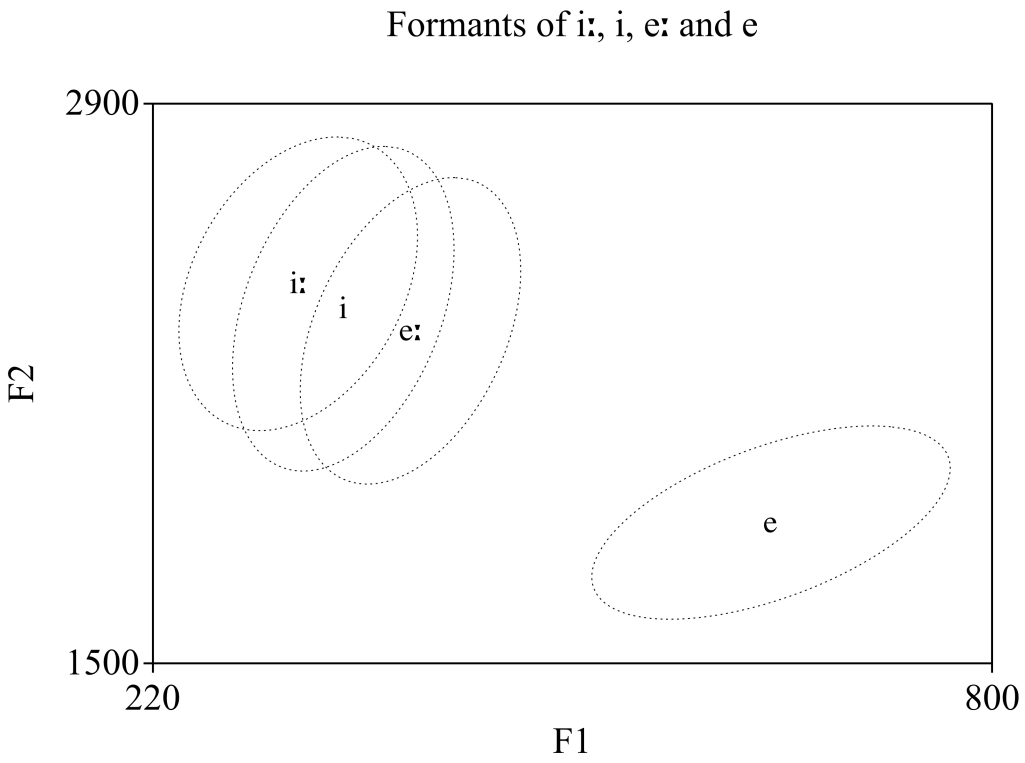

Figure 1: Formants with concentration ellipses. One ellipse covers 39.3% of the data (**boersmaweenink2008praat**). Long [iː] is slightly higher and more front than short [i], which, in turn is more high and more front than [eː]. The range of [i] overlaps with both [iː] and [eː] (**mady2007quantity**; **mady2008hungarian**).

They had F1 values larger than 1000 Hz or F2 values smaller than 750 Hz. We excluded these items, which accounted for 0.5% of the total amount of [iː] tokens.

Speakers were given random intercepts, but not the items or the suffixes, since there is a small closed set of existing words with transparent vowels, and there are two fixed suffixes. Fixed factors were Suffix (-[nɛk] (front vowel), -[nɔk] (back vowel)) and Word (Nonsense word, Word). The log(F2) formant values were used to assess any differences between the fixed factors.

It turns out that [iː] in words has a slightly more front F2 value than in nonces, and there is no significant effect for the factor suffix (see table **??**).

	Est	Std. Er	df	t value	Pr(>|t|)
(Intercept)	7.79	0.02	22.04	361.06	0.00
nek	-0.01	0.01	1090.02	-1.40	0.16
word	0.02	0.01	1090.07	2.10	0.04

Table 3: Linear mixed effects model for the vowel [i:].

We continue with the mixed effects model analysis of the vowel [i]. Visual inspection of the data for [i] revealed that there were five tokens with an F1 higher than 600 Hz. We excluded these items. As for the analysis of [i:], we gave speakers random intercepts and used Suffix and Word as fixed factors. The analysis shows that the transparent vowels [i] in monosyllabic words which take suffixes with front vowels when inflected have a higher F2 value than transparent vowels in monosyllabic words which take suffixes with back vowels when inflected. The vowels in words are lower than the vowels in nonces (see table **??**.)

	Est	Std. Er	df	t value	Pr(>|t|)
(Intercept)	7.76	0.02	36.87	337.05	0.00
nek	0.04	0.02	455.44	2.10	0.04
word	-0.04	0.02	455.97	-2.16	0.03

Table 4: Linear mixed effects model for the vowel [i].

The effect of the type of suffix on the retraction of [i] is illustrated in figure **??**, in which the F2 values and the F1 values of tokens with [i] are depicted. The blue line is for monosyllables that take suffixes with back vowels and the red line is for monosyllables that suffixes that take front vowels. The blue line is lower than the red line, which shows that transparent vowels in monosyllabic words that take suffixes with back vowels are more back than transparent vowels in words that take suffixes with front vowels.

Figure **??** illustrates the word effect. In uninflected words [i] is more retracted than in nonsense words when it occurs with back suffixes when they are inflected.

The same analysis as for the other vowels was carried out for [e:]. It turns out that the F2 values of [e:] vowels are the same, irrespective of kind of vowel in the suffixes of the inflected variants of the words, and also irrespective of whether the item is a word or not (see table **??**.)

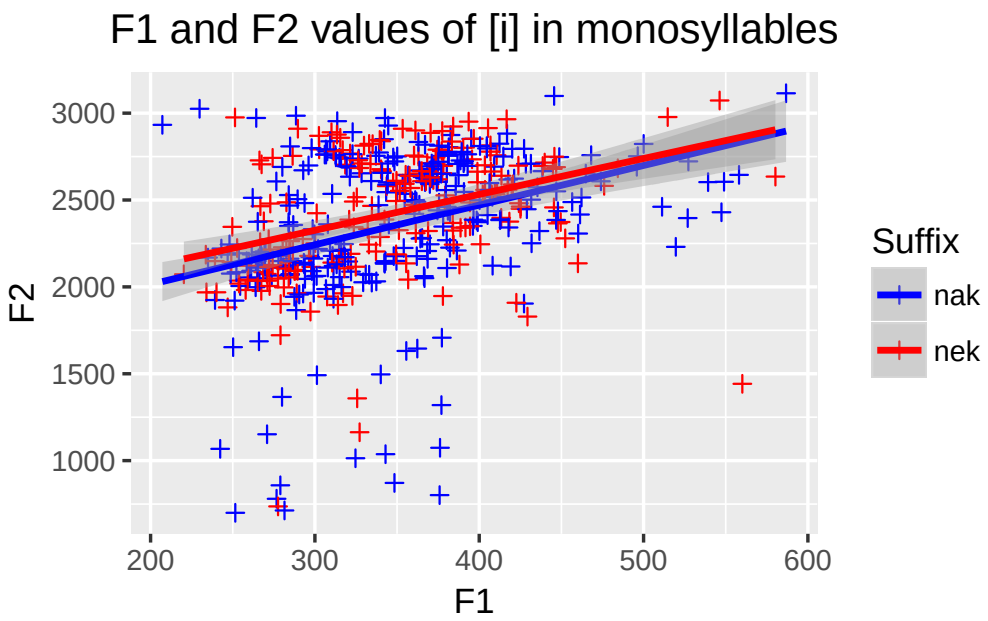

Figure 2: The vowel i is more retracted in monosyllabic words that take suffixes with back vowels (blue) than in monosyllabic words that take suffixes with front vowels (red).

4 Discussion

We conducted our experiment in order to shed light on the question as to the reality of paradigmatically conditioned phonetic detail in Hungarian transparent vowels. In our production experiment Hungarian native speakers silently read a sentence with an inflected word or nonsense word with a transparent vowel, followed by reading out loud of a sentence with its uninflected variant. The formants of these vowels were measured and compared. We found a consistent effect of retraction for the vowel [i] and a generalization of this effect to nonsense words for this vowel.

benus2007articulatory did find very small articulatory effects for two of their three speakers and they surmised that these small effects would have no acoustic consequences; **blaho2013hungarian** found that there is a tendency for transparent vowels to be more front if they occur in words that are inflected with suffixes with front vowels, than if they occur in words that are inflected with suffixes that take back vowels. The tendency was, however, not statistically significant; **szeredi2016exceptionality** found small

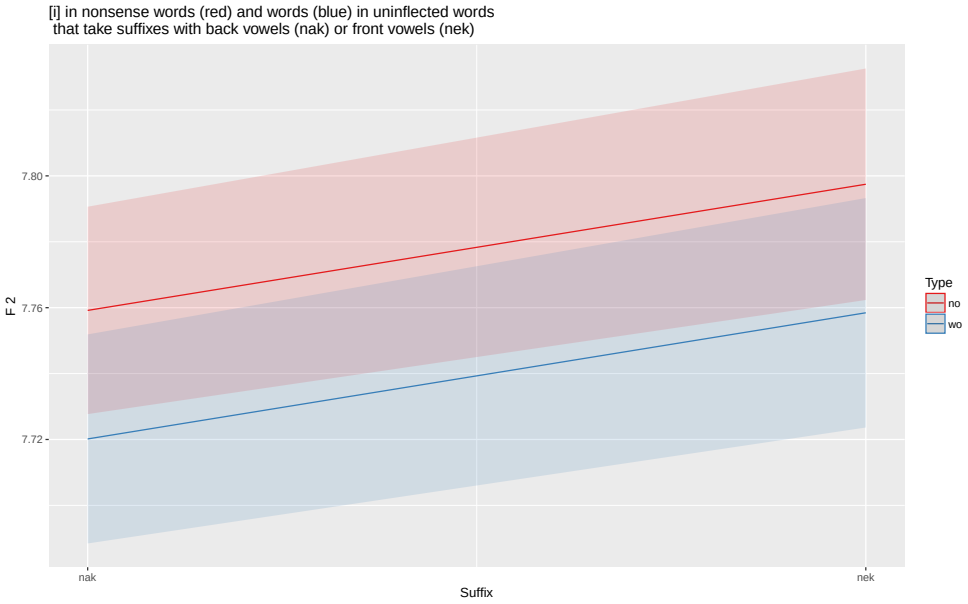

Figure 3: [i] is more retracted in words (wo) and nonces (no) if these take suffixes with back vowels.

	Est	Std. Er	df	t value	Pr(>|t|)
(Intercept)	7.73	0.03	50.85	261.83	0.00
nek	-0.00	0.02	437.04	-0.20	0.85
word	0.03	0.02	437.05	1.63	0.10

Table 5: Linear mixed effects model for the vowel [e:].

differences between antiharmonic and harmonic transparent vowels. Antiharmonic vowels are slightly more back than harmonic vowels, but only in suffixed words the difference was statistically significant.

We found significant retraction for the vowel [i], but not for [i:] or [e:]. In view of previous results on the nature of Hungarian vowels this result is not unexpected. We ascribe the fact that we only found the effect in [i] and not in [i:] or [e:] to the inherent variation of [i], which has been attested independently (**mady2007quantity**; **mady2008hungarian**). Moreover **szeredi2016exceptionality** found that Hungarian are able to distinguish tokens of [i] on the basis of phonetic differences in F2, but not [i:] or [e:]. Figure **??** illustrates that the space for [i] overlaps with both [i:] and [e:]. This makes it harder to pronounce an unambiguous token of [i],

which may make the [i] more susceptible to coarticulatory effects; The effort to keep [i] distinct from [iː] and [eː] may be too great, and it may be better to instead invest articulatory effort into keeping [iː] and [eː] distinct. Our data is furthermore in full agreement with the data presented by **szeredi2016exceptionality** These data also show that the greatest effect in monosyllabic words that were presented in carrier sentences—as in our experiment—is found for [i], and the effect for [iː] is much smaller.

The effect we found for nonsense words, see figure **??**, can be explained by analogy (**ernestus2003pui**). Our nonsense words were based on existing words; we only changed the onset. Native speakers based their inflections of nonsense words on existing words. Therefore, if a nonsense word resembles a word that takes a suffix with a back vowel, the nonsense word also takes a suffix with a back vowel and the vowel of the nonsense word is therefore slightly retracted. The fact that nonsense words are overall pronounced with higher F2 is a consequence of hypo-articulation (**lindblom1990epv**; **tomaschek2018practice**).

Our results fit in with the previous findings in that the effect is infinitesimal. In combination with previous research (**benus2007articulatory**; **szeredi2016exceptional** a picture emerges that shows that the effect is systematic. Even if the tendency does not always reach significance it is (almost) always in the same direction: Antiharmonic transparent vowels are more retracted than harmonic transparent vowels, even in uninflected words in which there is no other [+BACK] vowel that could serve as a coarticulatory target.

Since we have found that there is a paradigmatically conditioned phonetic effect in Hungarian, we can turn to our second objective: To propose a represent the effect. We propose to represent a paradigm as one unit in the mental lexicon. This is achieved by means of an attribute-value structure (**bird1994phonological**; **bonami2016role**). Our proposal is illustrated in figure **??**, in which (part of the) the paradigm of the word *fingk*, [fiŋk] 'fart' is represented. This word has a short [i] and was used in our experiment.

Figure **??** contains the morphological information M-BASE, which stands for the morphological base—in this case the stem. The tag $\boxed{1}$ indicates structure sharing; the structure of the M-BASE is provided by the values of the attributes PHONOLOGY, which has as values the attributes CONSONANT, VOWEL and SKELETON. The values of these attributes are ordered lists, indicated by $<$ and $>$. The vowel of the M-BASE has a further attribute FEATURE, which has as value the feature *[-back]*, which has an attribute ACOUSTICS, which has the value *F2*.

The structure of the M-BASE is shared with the AFFIX, which, in turn, is represented by the attribute PHONOLOGY which has further attributes in the same way as M-BASE has.

The phonetic detail in this representation is given as a constraint on the relation between the value of the attribute VOWEL of the affix and the value of the attribute ACOUSTICS of the M-BASE. The constraints states that if the vowel of the suffix is back, the value of F2 of the vowel of the stem is between 2256 Hz and 2366 Hz. This reflects a bandwidth of 110 Hz around the mean F2 of transparent [i] in words that take suffixes with back vowels. A difference of 110 Hz reflects the just noticeable difference for untrained ears (**kewley2001vowel**; **mermelstein1976difference**). The same bandwidth of F2 for [[i]] in words that take suffixes with front vowels is between 2349 Hz and 2459 Hz.

The representation in figure **??** reflects that the effect only occurs in paradigms: Only vowels of words that take back suffixes can be retracted. The constraint still exerts its effect of only the uninflected word is needed. This can be explained as a consequence of the fact that the word [fiŋk] is often pronounced with its inflection (**bybee2001pal**). The backness of the vowel in the suffix then causes the vowel in the stem to be retracted, and this in turn affects the vowel in the uninflected form. In our representation this is expressed as a constraint. The fact that there is a connection at all between the inflected and the uninflected form is expressed by the fact that the paradigm is represented as one unit in the mental lexicon.

Our proposal solves a problem posed by **van2008incomplete**'s analysis of incomplete neutralization. In his analysis phonetic details are a reflex of unpronounced phonological features that are present in the underlying form. Such features are then interpreted by the phonetic module. In the case of Hungarian it is difficult to imagine why the feature [–back] in the stem would be unpronounced, and, even if it were, why it would cause a retraction of its host. In our approach phonetic detail is the consequence of paradigms being stored as units in the mental lexicon and there being constraints on relations among attributes and their values within a paradigm.

This proposal blurs the lines between lexicon and grammar, but the strict separation between these two has come under scrutiny (**coetzee2006lexically**; **inkelas1997implications**; **pater2005lexically**; **pater2006locus**; **pater2008morpheme**). Exceptions are marked so as to receive a special treatment in grammar. This is very similar to our approach to phonetic detail in Hungarian.

We extend work on the inclusion of phonetic detail in phonological representations **flemming-phonology2001**; **flemming2013auditory**; **kirby2010cue**; **yu2011contrast** by incorporating representations of paradigms into the dis-

$$\left[\begin{array}{l}
\textit{paradigm} \\
\textsc{Affix}\ \boxed{1}\text{+/nɔk/} \\
\left[\begin{array}{ll}
\textsc{Phonology} & \left[\begin{array}{ll}
\textsc{Consonant} & \left\langle \text{n}\ \boxed{x}, \text{k}\ \boxed{z} \right\rangle \\
\textsc{Vowel} & \left[\begin{array}{l}
\left\langle \text{ɔ}\ \boxed{y} \right\rangle \\
\left[\begin{array}{l}
\textsc{Feature}\ \textit{[+back]} \\
\left[\textsc{Acoustics} \left\langle \text{F2} \right\rangle\right]
\end{array}\right]
\end{array}\right] \\
\textsc{Skeleton} & \left\langle \boxed{x}, \boxed{y}, \boxed{z} \right\rangle
\end{array}\right]
\end{array}\right] \\
\textsc{M-Base}\ \boxed{1} \\
\left[\begin{array}{ll}
\textsc{Phonology} & \left[\begin{array}{ll}
\textsc{Consonant} & \left\langle \text{f}\ \boxed{t}, \text{ŋ}\ \boxed{v}, \text{k}\ \boxed{w} \right\rangle \\
\textsc{Vowel} & \left[\begin{array}{l}
\left\langle \text{i}\ \boxed{u} \right\rangle \\
\left[\begin{array}{l}
\textsc{Feature}\ \textit{[−back]} \\
\left[\textsc{Acoustics} \left\langle \text{F2} \right\rangle\right]
\end{array}\right]
\end{array}\right] \\
\textsc{Skeleton} & \left\langle \boxed{t}, \boxed{u}, \boxed{v}, \boxed{w} \right\rangle
\end{array}\right]
\end{array}\right] \\
\textit{constraint: if y is [+ back], then the value of Acoustics of u = F2 = 2256 Hz : 2366 Hz}
\end{array}\right]$$

Figure 4: Attribute-value matrix of (part of the) paradigm of the Hungarian word *fart*, consisting of the DAT affix [nɔk] and the stem [fiŋg]. The second formant (F2), which reflects the backness of the tongue, of the stem vowel is constrained by the phonological value of the vowel in the suffix.

cussion of the representation of phonetic detail in phonology. Their work focuses on the representation of phonetic detail in phonological contrasts. Hungarian shows the it is necessary that such details not only arise among phonological contrasts in different prosodic positions—word-intially versus intervocallically versus word-finally—but also within one category—[i]—if the it occurs in different morphological contexts. As attribute-value representations are also feasible for phonological categories (**bird1995computational**), it is possible to incorporate the phonetic details in phonological categories into such representations. If successful, such an approach would offer a unified theory on the role of phonetic detail in phonology and morphology.

Transparent vowels in Hungarian show paradigmatically conditioned phonetic detail. This adds to existing work in which phonetics encroaches upon phonology **flemming-phonology2001**; **flemming2013auditory**; **kirby2010cue**; **yu2011contrast** and morphology (**hedia2017gemination**; **plag2007testing**; **plag2015homophony**), in ways that go beyond much research documenting the phonetic effects of incomplete neutralization and flapping (**braver2011incomplete**; **braver2014imperceptible**; **charles1987reanalysis**; **dinnsen-reexamination-neutr-1985**; **dmitrieva2010phonological**; **ernestus2006functionality**; **ernestus2007intraparadigmatic**; **ernestus2007paradigmatic**; **port1989incomplete**; **port1981neutralization**; **roettger-winter-grawunder-incomplete-neutr:2011**; **roettgeretal-incomplete**; **slowiaczek1985neutralizing**; **warner2006orthographic**).

5 Conclusion

Transparent vowels in Hungarian show paradigm uniformity effects that cannot be reduced to a neutralized contrast, as our data have shown. This shows that the effect is general and that the categorical and continuous cases should be analyzed in the same way. We have proposed an attribute-value representation of paradigms in which phonetic detail are modeled as a constraint on the relation between values of different attributes.

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Competing Interests

The authors have no competing interests to declare.

Appendix: Hungarian sentences

Minden népnek vannak érdekes szokásai. Néhány ... azonban nagyon szokatlan hagyományokkal rendelkezik.
Sok hírnek nincsen valóságalapja. Ez a ... is nagyon gyanús.
Ennek a helynek különleges hangulata van. A történelem során ez a ... fontos szerepet játszott.
Nézd, Petiék cinganak a játszótéren. Mit csinál Peti? ...
Laci nem igazán örült a dísznek. Feltette a polcra, és a ... ott porosodott hetekig.
Petiék gyakran finganak. Mit csinál Peti? ... Gyümölcsök inganak az ágakon, az egyik gyümölcs azonban alig ... .
Nézd, Petiék gábnak a játszótéren. Mit csinál Peti? ...
Hiába futott 10 km-t, a célba érés után arcán nyoma sem volt a pírnak. A ... néhány perc alatt eltűnt az arcáról.
A gyerekek az óvodában egész délelőtt fantáziaállatokat rajzoltak.
Zsuzsi kétszarvú állatát bilmnek nevezte el. Az állat neve ...
A gyerekek az óvodában egész délelőtt fantáziaállatokat rajzoltak.
Zsuzsi kétszarvú állatát físznek nevezte el. Az állat neve ...
Nézd, Petiék cürnek a játszótéren. Mit csinál Peti? ...
A gyerekek az óvodában egész délelőtt fantáziaállatokat rajzoltak.
Zsuzsi kétszarvú állatát bejnek nevezte el. Az állat neve ...
Nézd, Petiék vúnnak a játszótéren. Mit csinál Peti? ...
Nézd, Petiék vengenek a játszótéren. Mit csinál Peti? ...
Nézd, Petiék diltanak a játszótéren. Mit csinál Peti? ...
Laci nem igazán örült a sípnak. Feltette a polcra, és a ... ott porosodott hetekig.
Nézd, Petiék mestenek a játszótéren. Mit csinál Peti? ...
Petiék gyakran félnek. Mit csinál Peti? ...
Petiék intenek a sofőrnek, hogy álljon meg. Ha senki nem ... a sofőrnek, nem fog megállni.
Petiék gyakran vívnak. Mit csinál Peti? ...
A gyerekek az óvodában egész délelőtt fantáziaállatokat rajzoltak.
Zsuzsi kétszarvú állatát zérnek nevezte el. Az állat neve ...
Nézd, Petiék gednek a játszótéren. Mit csinál Peti? ...

A gyerekek az óvodában egész délelőtt fantáziaállatokat rajzoltak.
Zsuzsi kétszarvú állatát mácnak nevezte el. Az állat neve ...
A gyerekek az óvodában egész délelőtt fantáziaállatokat rajzoltak. Zsuzsi kétszarvú állatát raznak nevezte el. Az állat neve ...
Nézd, Petiék bernek a játszótéren. Mit csinál Peti? ...
A gyerekek az óvodában egész délelőtt fantáziaállatokat rajzoltak.
Zsuzsi kétszarvú állatát fépnek nevezte el. Az állat neve ...
Ennek a térnek különleges hangulata van. A történelem során ez a ... fontos szerepet játszott.
Nézd, Petiék lortanak a játszótéren. Mit csinál Peti? ...
Nézd, Petiék bisznek a játszótéren. Mit csinál Peti? ...
Nézd, Petiék vitnak a játszótéren. Mit csinál Peti? ...
Laci nem igazán örült az ingnek. Feltette a polcra, és a ... ott porosodott hetekig.
Néhány sírnak senki sem viseli gondját. Az a ... például teljesen elhanyagolt.
A gyerekek az óvodában egész délelőtt fantáziaállatokat rajzoltak.
Zsuzsi kétszarvú állatát vingnek nevezte el. Az állat neve ...
A gyerekek az óvodában egész délelőtt fantáziaállatokat rajzoltak. Zsuzsi kétszarvú állatát vírnak nevezte el. Az állat neve ...
Nézd, Petiék fórnak a játszótéren. Mit csinál Peti? ...
Nézd, Petiék vütnek a játszótéren. Mit csinál Peti? ...
Nem tesz jót a sebnek, ha koszos lesz. ügyelj rá, hogy a ... mindig tiszta maradjon.
Nézd, Petiék minganak a játszótéren. Mit csinál Peti? ...
A szülők semmit sem tiltanak ok nélkül. Ha anyu valamit ... , annak oka van.
Nézd, Petiék dítanak a játszótéren. Mit csinál Peti? ...
A gyerekek az óvodában egész délelőtt fantáziaállatokat rajzoltak. Zsuzsi kétszarvú állatát fúdnak nevezte el. Az állat neve ...
A gyerekek az óvodában egész délelőtt fantáziaállatokat rajzoltak. Zsuzsi kétszarvú állatát zsíknak nevezte el. Az állat neve ...
Petiék gyakran sírnak. Mit csinál Peti? ...
A gyerekek az óvodában egész délelőtt fantáziaállatokat rajzoltak. Zsuzsi kétszarvú állatát kótnak nevezte el. Az állat neve ...
A gyerekek az óvodában egész délelőtt fantáziaállatokat rajzoltak. Zsuzsi kétszarvú állatát píjnak nevezte el. Az állat neve ...
Az évnek ebben a szakaszában általában hideg van, de persze minden ... más.
A gyerekek az óvodában egész délelőtt fantáziaállatokat rajzoltak. Zsuzsi kétszarvú állatát cavnak nevezte el. Az állat neve ...

Ha két síknak létezik egy közös pontja, akkor a két ... metszi egymást.
Petiék állandóan kérnek valamit. Amikor Peti valamit ... , mindig ideges leszek.
Nézd, Petiék gisznek a játszótéren. Mit csinál Peti? ...
A gyerekek az óvodában egész délelőtt fantáziaállatokat rajzoltak. Zsuzsi kétszarvú állatát űfnek nevezte el. Az állat neve ...
Nézd, Petiék sélnek a játszótéren. Mit csinál Peti? ...
Nézd, Petiék tőfnek a játszótéren. Mit csinál Peti? ...
Laci nem igazán örült a szíjnak. Feltette a polcra, és a ... ott porosodott hetekig.
A célnak mindig a szemed előtt kell lebegnie. Jegyezd meg, a ... a legfontosabb.
Ennek a hídnak nem tetszik a színe. Ha pirosra festenénk, ez a ... sokkal szebb lenne.
Ekkora kínnak nem szabadna senkit sem kitenni. Ekkora ... képes bárkit tönkretenni.
Petiék állandóan szednek valamit. Amikor Peti valamit ... , mindig ideges leszek.
A gyerekek az óvodában egész délelőtt fantáziaállatokat rajzoltak. Zsuzsi kétszarvú állatát sűznek nevezte el. Az állat neve ...
A fahasábok a kandallóban égnek. Az egyik fahasáb azonban valamiért nem ... rendesen.
Ezzel a gyakorlatsorral a zsírnak nincs esélye. Néhány hét alatt a hasi ... teljesen eltűnik.
A gyerekek az óvodában egész délelőtt fantáziaállatokat rajzoltak. Zsuzsi kétszarvú állatát míknak nevezte el. Az állat neve ...
Petiék nagyon türelmesek, sosem szítanak vitákat. Kati viszont állandóan vitát ... .
A gyerekek az óvodában egész délelőtt fantáziaállatokat rajzoltak. Zsuzsi kétszarvú állatát híknak nevezte el. Az állat neve ...
Nézd, Petiék séznek a játszótéren. Mit csinál Peti? ...
Nézd, Petiék rűmnek a játszótéren. Mit csinál Peti? ...
Ennek a filmnek már a címe sem tetszik. Lehet, hogy jobb lenne egy másik ... .
A teszten a csíknak pirossá kell válnia. Ha a ... nem színeződik el, a teszt nem érvényes.
Nézd, Petiék nernek a játszótéren. Mit csinál Peti? ...
Nézd, Petiék fagnak a játszótéren. Mit csinál Peti? ...
Nézd, Petiék zírnak a játszótéren. Mit csinál Peti? ...
Nézd, Petiék tírnak a játszótéren. Mit csinál Peti? ...

Petiék gyakran írnak. Mit csinál Peti? ...
A gyerekek az óvodában egész délelőtt fantáziaállatokat rajzoltak. Zsuzsi kétszarvú állatát húfnak nevezte el. Az állat neve ...
A gyerekek az óvodában egész délelőtt fantáziaállatokat rajzoltak. Zsuzsi kétszarvú állatát jévnek nevezte el. Az állat neve ...
A gyerekek az óvodában egész délelőtt fantáziaállatokat rajzoltak. Zsuzsi kétszarvú állatát gyüfnek nevezte el. Az állat neve ...
A gyerekek az óvodában egész délelőtt fantáziaállatokat rajzoltak. Zsuzsi kétszarvú állatát rűnnek nevezte el. Az állat neve ...
Nézd, Petiék lírnak a játszótéren. Mit csinál Peti? ...
A gyerekek az óvodában egész délelőtt fantáziaállatokat rajzoltak. Zsuzsi kétszarvú állatát dújnak nevezte el. Az állat neve ...
A gyerekek az óvodában egész délelőtt fantáziaállatokat rajzoltak. Zsuzsi kétszarvú állatát rölnek nevezte el. Az állat neve ...
Petiék gyakran festenek. Mit csinál Peti? ...
A gyerekek az óvodában egész délelőtt fantáziaállatokat rajzoltak. Zsuzsi kétszarvú állatát fívnek nevezte el. Az állat neve ...
Nézd, Petiék búdnak a játszótéren. Mit csinál Peti? ...
A gyerekek az óvodában egész délelőtt fantáziaállatokat rajzoltak. Zsuzsi kétszarvú állatát vílnak nevezte el. Az állat neve ...
Nézd, Petiék gáknak a játszótéren. Mit csinál Peti? ...
Nagyon örülnek a bajnoki címnek, a ... megszerzését a hétvégén meg is ünneplik.
A telefonok ma egész nap csengenek. Az egyik még most is ... .
A gyerekek az óvodában egész délelőtt fantáziaállatokat rajzoltak. Zsuzsi kétszarvú állatát hínnek nevezte el. Az állat neve ...
A gyerekek az óvodában egész délelőtt fantáziaállatokat rajzoltak. Zsuzsi kétszarvú állatát méjnak nevezte el. Az állat neve ...
Petiék állandóan visznek valamit. Amikor Peti valamit ... , mindig ideges leszek.
Ennek a széknek nem tetszik a színe. Ha pirosra festenénk, ez a ... sokkal szebb lenne.
A gyerekek az óvodában egész délelőtt fantáziaállatokat rajzoltak. Zsuzsi kétszarvú állatát kírnak nevezte el. Az állat neve ...
Nézd, Petiék bidnak a játszótéren. Mit csinál Peti? ...
A gyerekek az óvodában egész délelőtt fantáziaállatokat rajzoltak. Zsuzsi kétszarvú állatát zővnek nevezte el. Az állat neve ...
Egy izomnak vagy ínnak a meghúzódása komoly fájdalommal járhat. Az izom vagy ... pihentetése ebben az esetben elengedhetetlen.
Petiék gyakran hívnak engem. Amikor Peti engem ... , mindig elszaladok.

Nézd, Petiék lirtanak a játszótéren. Mit csinál Peti? ...
A gyerekek az óvodában egész délelőtt fantáziaállatokat rajzoltak. Zsuzsi kétszarvú állatát pebnek nevezte el. Az állat neve ...
A gyerekek az óvodában egész délelőtt fantáziaállatokat rajzoltak. Zsuzsi kétszarvú állatát rélnak nevezte el. Az állat neve ...
A héjnak nevezett külső réteg nagyon kemény. Ez a ... megvéd a komolyabb sérülésektől.
Nézd, Petiék mírnak a játszótéren. Mit csinál Peti? ...
Petiék gyakran néznek engem. Amikor Peti engem ... , mindig elszaladok.
Nézd, Petiék tívnak a játszótéren. Mit csinál Peti? ...
Nézd, Petiék tinganak a játszótéren. Mit csinál Peti? ...
A gyerekek az óvodában egész délelőtt fantáziaállatokat rajzoltak. Zsuzsi kétszarvú állatát zípnak nevezte el. Az állat neve ...
Első látásra víznek tűnt, aztán kiderült, hogy alkohol. A ... semleges illatú.
A gyerekek az óvodában egész délelőtt fantáziaállatokat rajzoltak. Zsuzsi kétszarvú állatát zejnek nevezte el. Az állat neve ...
Nézd, Petiék pérnek a játszótéren. Mit csinál Peti? ...
A csónakok békésen ringanak a kikötőben. Egy csónak pedig a távolban ... .
Petiék gyakran szidnak engem. Amikor Peti engem ... , mindig elszaladok.
Petiék állandóan szívnak valamit. Amikor Peti valamit ... , mindig ideges leszek.
Nézd, Petiék vognak a játszótéren. Mit csinál Peti? ...
A gyerekek az óvodában egész délelőtt fantáziaállatokat rajzoltak. Zsuzsi kétszarvú állatát vímnek nevezte el. Az állat neve ...
Nézd, Petiék lintenek a játszótéren. Mit csinál Peti? ...
Nézd, Petiék pégnek a játszótéren. Mit csinál Peti? ...
A zsíros ételek árthatnak a szívnek. A ... egészséges működéséhez kevesebb zsírra van szükség.
Petiék nem mernek szembenézni a nehézségekkel. Kati azonban bátor, és szembe ... nézni a nehézségekkel.
Petiék állandóan vesznek valamit. Amikor Peti valamit ... , mindig ideges leszek.
Petiék holnap csótányokat irtanak az épületben. Senki nem lehet az épületben, amikor Peti csótányt ... .
Laci nem igazán örült a nyílnak. Feltette a polcra, és a ... ott porosodott hetekig.
Petiék állandóan mérnek valamit. Amikor Peti valamit ... , mindig ideges leszek.
A bankban új számlát nyitnak nekem. Kata is eljött velem, de ő nem ... új

számlát.
Petiék minden nap korán kelnek. Zsuzsi azonban sosem ... korán. Nézd, Petiék bűrnek a játszótéren. Mit csinál Peti? ...
Katiék nem bírnak a kutyájukkal. Aki nem ... a kutyájával, vigye kutyaiskolába.
Ennek a színnek egyik árnyalata sem tetszik. Melyik másik ... lenne megfelelő?
Nézd, Petiék mörnek a játszótéren. Mit csinál Peti? ...
A gyerekek az óvodában egész délelőtt fantáziaállatokat rajzoltak. Zsuzsi kétszarvú állatát gídnak nevezte el. Az állat neve ...
A gyerekek arról beszélgettek, hogy milyen hangja van egy gyíknak. Kati szerint a ... nem tud hangot kiadni.
Petiék gyakran vernek engem. Amikor Peti engem ... , mindig elszaladok.
A gyerekek az óvodában egész délelőtt fantáziaállatokat rajzoltak. Zsuzsi kétszarvú állatát zírnak nevezte el. Az állat neve ...
Petiék a farmon egész nap birkákat nyírnak. Nagyon óvatosnak kell lenni, amikor valaki birkát ... .
Laci nem igazán örült a díjnak. Feltette a polcra, és a ... ott porosodott hetekig.
A gyerekek az óvodában egész délelőtt fantáziaállatokat rajzoltak. Zsuzsi kétszarvú állatát ríjnak nevezte el. Az állat neve ...
Nézd, Petiék gyívnak a játszótéren. Mit csinál Peti? ...
A gyerekek az óvodában egész délelőtt fantáziaállatokat rajzoltak. Zsuzsi kétszarvú állatát réknek nevezte el. Az állat neve ...
Nézd, Petiék pelnek a játszótéren. Mit csinál Peti? ...
Furcsa íze van a tejnek. Inkább kiöntöm és ... helyett iszom valami mást.
Nézd, Petiék zérnek a játszótéren. Mit csinál Peti? ...
A gyerekek az óvodában egész délelőtt fantáziaállatokat rajzoltak. Zsuzsi kétszarvú állatát szófnak nevezte el. Az állat neve ...
Nézd, Petiék durtanak a játszótéren. Mit csinál Peti? ...
A gyerekek az óvodában egész délelőtt fantáziaállatokat rajzoltak. Zsuzsi kétszarvú állatát fínnak nevezte el. Az állat neve ...
Nézd, Petiék resznek a játszótéren. Mit csinál Peti? ...
A gyerekek az óvodában egész délelőtt fantáziaállatokat rajzoltak. Zsuzsi kétszarvú állatát kúznak nevezte el. Az állat neve ...
Nézd, Petiék gívnak a játszótéren. Mit csinál Peti? ...
Petiék hisznek a földönkívüliek létezésében. Az emberek többsége persze nem ... az ilyesmiben.
A gyerekek az óvodában egész délelőtt fantáziaállatokat rajzoltak. Zsuzsi kétszarvú állatát fírnek nevezte el. Az állat neve ...
A gyerekek az óvodában egész délelőtt fantáziaállatokat rajzoltak. Zsuzsi kétszarvú állatát rínnak nevezte el. Az állat neve ...

A gyerekek az óvodában egész délelőtt fantáziaállatokat rajzoltak. Zsuzsi kétszarvú állatát díznek nevezte el. Az állat neve ...