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Prosodic and Analogical Effects in Phonetic Realization in Turkish Noun-Noun Compounds

Türkçede Ad-Ad Bileşiklerinin Sesbilgisel Görünümlerine ilişkin Bürünsel ve Analojik Etkiler

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Abstract

Previous studies on phonetic realization of compounds in Turkish have typically examined prosodic accounts of lexical stress; however, evidence for phonetic features is relatively sparse. This study investigates phonetic implementation of lexical stress in Turkish noun-noun compounds by measuring acoustic correlates of compounds vs. phrases and existing vs. novel compounds. In Experiment 1, noun-noun compounds and their phrasal contrasts (e.g., [da.ná.bur.nu] '*mole cricket*' vs. [[da.ná][bur.nú]] '*nose of a calf*'), in Experiment 2, existing and novel compounds were acoustically measured by using existing vs. novel pairs (e.g., [da.ná.bur.nu] vs. [ke.dí.bur.nu]). Results for Experiment 1 showed a clear phonetic tendency that distinguished compounds from their phrasal counterparts. The model revealed significant main effects for intensity, duration, pitch values, and a strong interaction between position (left vs. right) and prosodic type (compound vs phrase). In Experiment 2, even though novel compounds are not lexicalized parts of a language, results from novel compounds revealed a similar stress assignment on the pitch, intensity, and duration of existing compounds. Significant interaction effects were observed for acoustic correlates between position (left vs. right) and compound type (existing vs. novel). Findings obtained from this research might contribute to revealing the basic phonetic aspects of the compound stress in Turkish, and results may lay the groundwork for future research.
Keywords: Compound, phrase, existing, novel, phonetics, stress.

Öz

Türkçede bileşiklerin sesbilgisel özellikleri üzerine yapılan bürünsel araştırmalar tipik olarak sözlüksel vurgunun bürünsel tanımlarını incelemiştir, ancak sesbilgisel özelliklere ilişkin bulgular görece daha az sayıdadır. Bu çalışmada, Türkçede bileşik-öbek ile varolan-uydurma bileşiklerin akustik özelliklerini ölçülerek, Türkçede ad-ad bileşiklerindeki sözlüksel vurgunun sesbilgisel görünümleri araştırılmaktadır. Deney 1'de ad-ad bileşikleri ve öbeksel karşıtlıkları ([da.ná.bur.nu] ve [[da.ná][bur.nú]]) kullanılmış, Deney 2'de varolan ve uydurma bileşikler ([da.ná.bur.nu] ve [ke.dí.bur.nu]) akustik olarak ölçülmüştür. Bulgular, Deney 1 için bileşikleri öbeksel karşıtlarından ayıran belirgin bir sesbilgisel eğilim göstermiştir. Model yoğunluk, süre, perde değerleri, konum (sol ve sağ) ve bürünsel tür (bileşik ve öbek) arasında güçlü bir etkileşim ortaya koymuştur. Deney 2'de uydurma bileşikler dilin sözlüksel bir parçası olmamasına karşın, uydurma bileşiklerden elde edilen bulgular, varolan bileşiklerin perde, yoğunluk ve sürelerinin varolan bileşiklere benzer vurgu atamasını taşıdığını ortaya koymuştur. Konum (sol ve sağ) ve sözcük türü (varolan ve uydurma) etkenlerinin akustik özelliklerine ilişkin benzer etkileşim etkileri gözlenmiştir. Elde edilen bulgular,

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Türkçede bileşik vurgusunun sesbilgisel görünümlerinin ortaya konulmasına katkı sağlayabilmekte ve ileri araştırmalara zemin hazırlamaktadır.
Anahtar sözcükler: Bileşik, öbek, sözlüksel, uydurma, sesbilgisi, vurgu

Introduction

The stress patterns of compound words differ from the stress patterns of their phrasal counterparts. Compounds like "greenhouse" with this prosodic structure are often described as bearing primary stress on the first syllable, whereas its phrasal counterpart "green house" tends to have a secondary stress pattern. The left-prominent stress pattern of compounds is widely considered in early phonological studies (see Chomsky & Halle, 1968; Liberman & Prince, 1977, among others). As well as reported in the so-called Nuclear Stress Rule (NSR) and Compound Stress Rule (CSR) of Chomsky and Halle determining the primary stress for the leftmost item, compounds tend to be stressed phrase-finally. Although there have been significant phonological analyses on the stress patterns in compounds (Chomsky & Halle; Nespor & Vogel, 1986; Ladd, 1996), little empirical research has been conducted on the phonetic implementation of compound stress. Phonetic studies on compound stress (Giegerich, 2009; Nguyên & Ingram, 2007; Plag et al., 2007; Kunter, 2011) have noted that phonetic patterns differ not just in stress patterns but also in the phrasal counterparts specific to nominal compounds.

The current study investigates the acoustic correlates of lexical stress in compounds through two production experiments where participants produced compound vs. phrasal stress and existing vs. novel compounds. Results of Linear mixed-effects model (LMMs) for Experiment 1 shows a clear phonetic tendency that distinguishes compounds from their phrasal counterparts. In Experiment 2, even though novel compounds are not lexicalized parts of a language, preliminary results for novel compounds reveal a similar stress assignment to existing compounds for noun-noun (NN-type) constructions. Even though there are limitations to the methodology, the current preliminary study might contribute to basic phonetic features for compound stress for future studies in Turkish.

The following sections will provide background on compounds, summarize the experiment, and explain its relevance to investigating the acoustic correlates of compounds.

Prosody of compounds

Many studies of metrical structure have focused on the phonological difference between compounds and phrases. Chomsky and Halle (1968) proposed the CSR, which assigns primary stress to the leftmost sonority peak in the string under consideration. By following Liberman and Prince (1977) and Chomsky and Halle's theories, Halle and Vergnaud (1987) developed a claim on compound stress and proposed a prominence is marked by phonetics. According to Liberman and Prince (1977, p. 257), "in a configuration of [CA BC], […] NSR: if C is a phrasal category, B is strong., […] CSR: if C is a lexical category, B is strong if it branches". Liberman and Vergnaud asserted the strong-weak pattern for compounds. According to their analyses, if the left part of a compound becomes 'strong', then the right part is accepted as 'weak'.

Although a great number of compounds typically exhibit the strong-weak pattern, there are different patterns of compound stress that can also be observed, in NN-type of compounds such as Madison Ávenue in English (Ladd, 1984). An additional distinction becomes visible for other types of nominal compounds such as noun-verb (NV) compounds such as hünkarbeğendí ('pot roast lamb with eggplant puree') in Turkish (Swift, 1963). Plag proposed a considerable number of different assignments in English where stress is prominent on the right edge of the metrical structure (e.g., silk tíe). These assumptions show us the different nature of compound stress where they exhibit variability in stress assignment. The current research focuses only on a typical stress pattern for the 'strong-weak' type of nominal compounds to investigate basic roles of phonetic implementation of NN compounds in Turkish.

On the compound and phrase distinction, Giegerich (1992) follows the approach of initial stress to be more prominent on the first constituent and non-initial stress to be more prominent on the second constituent of a compound. He developed the Phrasal Prominence Rule (PPR) and Compound Prominence Rule (CPR) under the basis of NSR (Chomsky & Halle, 1968) and CSR (Liberman & Prince, 1977). According to Giegerich's analyses on compound and phrase distinction (1992:256-257), "the Phrasal Prominence Rule [...] invariably makes the phrase-final word the most prominent one, while [...] the [Compound Prominence Rule] never assigns an S[(=strong)] to the final word in a compound"(ibid.). His points summarize PPR where the phrase-final word is accepted as prominent; however, CPR does not assign as strong to the word in a compound. Within this theoretical framework, in general, he claims a similar approach to complement-head constructions in English. According to Giegerich (2004), if a left item bears an initial stress, it becomes lexical; however, if a right constituent bears a non-initial stress, then it is syntactic.

Prosodic accounts in Turkish

Compounding is a productive word-formation process in structural, semantic, frequential, and phonological factors in Turkish. Basic previous accounts (Demircan, 1975; Inkelas & Orgun, 1998; Kabak & Vogel, 2001; Charette et al., 2007; Göksel & Haznedar, 2007; Kabak & Revithiadou, 2007; Kunduracı, 2013; Johanson, 2021) generally accept prosodic classification for compound stress in regular form for left-edge stress position (generally for nominal compounds) and unusual form for the right edge stress position.

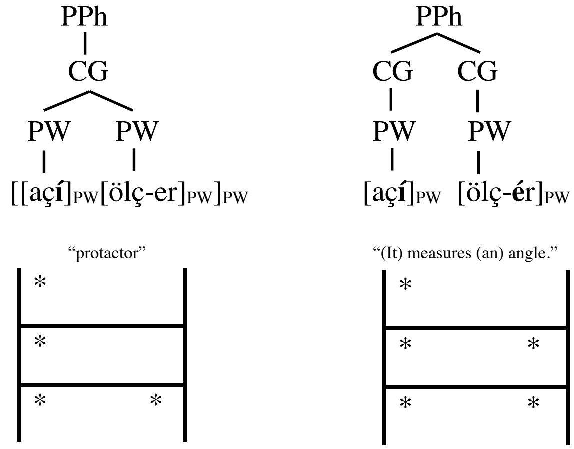
Three major prosodic analyses have been formulated to address compound stress in Turkish. One is the Leftmost Wins approach of Inkelas and Orgun (1998), where compounds are accepted as a left-prominent constituent. According to this analysis, the first member of relevant compound receives an application of default stress. In this co-phonology approach, both compound stresses and final stress are morphologically the same but have different co-phonologies, and each of these words corresponds to a lexical entry.

Two critical prosodic accounts generated from Leftmost Wins. First approach is related to nominal compounds and phrase distinction under syntactic bases in Turkish. Kamali and İkizoğlu (2012) state that compound stress is not related to its lexical entry; it is directly related to its morphosyntactic makeup, so compounds are in fact syntactic phrases. They point out that productive compounds with compound stress are syntactic phrases. Second approach comes from Clitic Group (CG) claim of Kabak and Vogel (2001) formulate under Selkirk's (1984) prosodic hierarchy. They argue prosodic accounts of CSR on the differences between compound and phrase stress as displayed in below (Kabak & Vogel, 2001:337):

> CSR IN TURKISH
> Assign main stress to the leftmost syllable bearing prosodic word [PW] stress and has the effect of retaining only a single primary word stress, and substantially reduce or possibly eliminate the prominence of all other stresses at least perceptually.

Compound stress is an instance of the CG in the prosodic hierarchy according to Kabak and Vogel (2001). They differ in lower categories of prosodic hierarchy from Inkelas and Orgun (1998)'s claim for PW for compounds with final and non-final stress. Kabak and Vogel prefer to bring an explanation to compound stress with CG for compounds with non-final stress. According to their point, prosodic domain for compound stress is the CG. Compounds are stressed with a left-edge prominence according to their approach. This means that each word assumes to begin with a PW, and compound stress moves to a higher level in the hierarchy to CG as presented in below sample (1) in Kabak and Vogel (2001:341).

(1) a) Compound Structure b) Phrasal Structure



Kabak and Vogel (2001) put forth a well-designed metrical point for Turkish stress domain. They refer this nominal compound analysis as to promote stress of first item in CG. By this way, the prominence of any other stresses is decreased. This analysis shares a single CG and assigns a single grid mark (*); however, since phrasal stress shares two CGs, phrasal structure becomes separate, they assign two grid marks (**) on the mid-level designed for CGs. Kabak and Revithiadou (2007) later assert a non-derivational approach to CG, which is larger than PW and smaller than Prosodic Phrase (PPh). According to non-derivational approach, regular compound stress is generally assigned on the final syllable of the first item, which constitutes compounds such as in "kuru kayısı" ('dry apricot'):[[kurú]$_{PW}$[kayısı]$_{PW}$] vs. [kurú]$_{PW}$[kayısí]$_{PW}$. This regular stress indicates the prosodic word of leftmost constituent of CG with a stress on generally its left edge position. Kunduracı (2013) also suggests that Turkish NN-type of compounds exhibit phrasal stress at the Phonological Phrase (PPh) level which is accepted as the primary stress of this level. In the current study, we follow the prosodic analysis for nominal compounds in the line of Kabak and Vogel (2001) and Kunduracı (2013) in Turkish.

Prosody of existing and novel compounds

There are four main prosodic hypotheses on theoretical and empirical analyses of existing and novel compounds in different languages. Prosodic hypotheses put a general remark on the difference between initial and non-initial stress patterns of compounds. The first hypothesis is the Giegerich's (1992, 2004) structural analyses. Giegerich's previous analyses argue that lexical constructions might carry initial and non-initial stress. Giegerich gives a strong discussion on lexicalization in English for the left-stressed "truck driver", and the right-stressed "steel bridge". Following Cinque (1993), Giegerich discusses the head position of English NN-type of compounds on the sample of "toy factory". According to his points, when "toy" is a modifier or specifier of "factory", then "factory" is stressed ("a factory that is a toy"). However, when "toy" is the complement of the "factory", then "toy" is stressed ("a factory producing toys").

Plag (2006) brings a different claim for the initial stress analysis of Giegerich (2004) for English modifier-head compounds. In his analogical hypothesis, novel compounds provide contrast evidence against Giegerich. Plag's reading study investigates stress assignment of novel modifier-head compounds pronounced by English native speakers. The empirical findings show that since novel compounds are not lexicalized, the initial stress of a modifier-head compound is not directly based on lexicalization. The idea of analogical influence on compounds is first developed by Schmerling (1971), and recently investigated by Plag and colleagues (for more details, see Plag, 2006, 2010; Plag & Kunter, 2010; Bell & Plag, 2013; Schlücker & Plag, 2011). Plag (2006: 244) explains the analogical process for novel compounds in a simple context. According to his points, analogy in existing (i.e., lexicalized) compounds may influence new (i.e., non-lexicalized) compounds which lead to staying in a similar shape. Kunduracı (2017; 2019) hasremarkable paradigmatic and formal analyses on novel compound formations in Turkish within the scope of theoretical morphology on -(*s*)*I* compound marker in NN-constructions.

Next hypothesis is generated from semantic effects on prosody for compounds. Olsen (2000) states that prosodic features of English nominal compounds can vary according to their meaning context. Olsen asserts that initial stress in a primary compound becomes significant when semantic interaction between compound families can be derived from the meaning of one constituent such as in her example of "space scientists" where the semantic relation of "study" is derived from the constituent "scientist".

Bell and Plag (2012, 2013) later put forth another hypothesis for English NN-compounds on the relation between informativity and (non-)initial stress where they discuss informativity of individual compound members. They refer to Ladd's (1984) analysis of complex English names such as "Street" with initial stress and "Avenue" with non-initial stress. Their informativity analysis for the initial stressed element "Street" depends on the degree of preciseness and markedness of this item. According to this view, combinations bearing "Street" is not stressed on the head position since "Street" represents the item with the lowest degree of preciseness and markedness. This brings a more crucial role in bearing stress to non-head combinations than head combinations.

So far, four different types of hypotheses are described for NN-combinations: Structural aspects, analogical influences, semantic factors, and informativity. All these approaches have common points in the explanations of stress patterns of NN-constructions when some compounds have initial, and others have non-initial stress. They generally state that novels are derived without being used in any compound before. Therefore, analogical effects on compound stress probably influence the stress pattern of compound. Our current study adopts an analogical hypothesis of Plag and colleagues' studies and theoretical points of Kunduracı (2017, 2019) for novel formations on Turkish NN constructions. From this motivation, novel NN-type of compounds are questioned for whether their prosody behave similarly to existing, or not.

Acoustic correlates of stress and Turkish

Acoustic cues generally used to identify word stress are the duration of phonation, pitch, and intensity. Previous studies (Fry, 1958; Beckman, 1986; Harrington et al., 1998) on acoustic correlates of word stress have indicated that variations between stressed and unstressed syllables in many languages. These differences have been illustrated as fundamental frequency (F0) or pitch, duration, intensity, vowel quality, and spectral slice. Fry (1958) has differentiated between these phonetic cues on the relation to stress where pitch is accepted as the most prominent acoustic cue for perception, followed by intensity and duration.

There are two prosodic levels of stress in Turkish. The first level is the word stress, which is related to syllables in a word-formation (Sezer, 1983; Kabak & Vogel, 2001). As a stress-accent language (Lees, 1961; Lewis, 1967), Turkish typically has words stressed on their final syllable such as in [év>house], [ev-lér>house-PL], [ev-ler-í>houses-PL-ACC]. Stress in irregularly-stressed words can be attributed to either a lexically stressed syllable or to the use of a lexically stressed root or Sezer's root in Turkish. Compared to non-final stress, pitch difference is the primary correlate of prominence in Turkish stress patterns, according to empirical studies comparing metrical properties of the final and non-final stresses (Konrot, 1981; Levi, 2005; Öztürk, 2005). In Levi's acoustic study, which investigates the acoustic correlates of F0, duration, and intensity in Turkish word stress. She finds that duration and intensity are cues of stressed syllables; however, they are prominent as F0 peaks. She asserts that duration and intensity do not correlate well with final stress in Turkish. In contrast to previous studies on acoustic correlates of word stress in Turkish, Öztürk (2005) finds that vowel and syllable durations do not vary significantly between lexically stressed and un-stressed syllables. For lexical stress level, Turkish bears differences between acoustic correlates of final and non-final stress, and non-final stress triggers F0. Next, an acoustic study by Konrot (1981) confirms a distinction between pitch and stress accent in Turkish where final syllable bears stress accent but does not bear pitch accent. Pitch movements in that study indicates F0 peaks, which are accepted as the most prominent correlate of word stress in Turkish.

The second level of stress in Turkish is generally called as phrasal stress, where stress falls on the first word in a phrase (Inkelas & Orgun, 2003). Phrasal stress marks prosodic prominence of a word located within a phrasal structure. Kornfilt (1997) refers to phrasal stress as phrase-final or preverbal stress in Turkish. A comparison between compound and phrasal structures indicates prosodic level of phrase-final stress. Inkelas and Orgun state that Turkish compounds bears the main stress on the first item; however, phrasal stress typically has its main stress on the final word or immediately preverbal focus position.

Even there seems different points to identify prominence in acoustic correlates of stress in Turkish, experimental studies mentioned above have met on common ground in explaining phonetic implementation of stress. Accordingly, phonetic correlates of compound and phrasal structures generally interact with the acoustic cues of word stress.

Phonetic realization of compounds and phrases

Previous acoustic studies have marked a prosodic distinction between compounds and their phrasal counterparts (Farnetani et al., 1988; Giegerich, 2004, 2009; Nguyên & Ingram, 2007; Plag, 2006; Kunter & Plag, 2007; Plag et al., 2007; Kunter, 2011; Morrill, 2012; Schlechtweg, 2018). In American English, Plag (2006) conducted an experiment on existing and novel modifier-head compounds. Speakers were asked to pronounce novel compounds with initial and non-initial stress patterns. Plag inferred a specific interaction between compound stress and their pitch realizations. Another well-designed study by Morrill (2012) in American English asserted a phonetic implementation of adjective-noun (AN) compounds by measuring acoustic correlates of different intonation patterns of stress between prosodic positions as “greenhouse” and “green house”. Morrill found a distinctive analysis for pitch patterns and an interaction between the intonational and prosodic environments in terms of phonetic cues. One of the first acoustic study on compound-phrase distinction, Farnetari et al. (1988) found an acoustic contribution to stress difference. Five speakers of either American/British English produced only three pairs of compounds and phrases. According to their findings, duration, intensity, and F0 peaks contribute to an acoustic difference between compounds and phrases. From these three acoustic cues, the most prominent cue is described as the duration in both compounds and phrases.

In contrast to American/British English, compound and phrasal structure distinctions do not contribute to stress differences which does not bear word stress. Previous studies indicate that French does not contribute any prosodic difference between compounds and phrases (Arnaud & Renner, 2014; van Goethem, 2009) since this language does not carry a regular lexical stress. However, in English which is the most investigated stress-accent language, compound-phrase distinction contributes to stress differences (Giegerich, 1992, 2004; Vogel & Raimy, 2002; Plag, 2006). Similar to English, previous works on German show that AN type carries initial stress on the first item of a compound, but the phrases carry stress on the non-initial position, so NN-types generally prefer initial stress (Berg, 2012; Neef, 2009; Schlücker, 2013). In a study for a different type of language, Nguyên and Ingram (2007) investigated acoustic and perceptual cues of compound-phrase distinction in Vietnamese. They found that speakers used a phrase-level disambiguation strategy for prosody and asymmetric prominence for coordinative compounds.

When we turn to novel compounds, they are generally accepted as non-lexicalized parts of language; however, they are interpreted using knowledge of existing compounds (Gagné & Spalding, 2006; Plag, 2006, 2009). There are limited number of experimental studies on the prosody of novels. Plag (2006) discusses compound prosody on the basis of three hypotheses of semantic, structural, and analogical approaches for existing and novels. Plag compared novel and existing compounds by using a reading experiment on nine native English speakers to test the productivity and lexicalization of stress assignment. He showed a robust effect of the right constituent on the stress assignment of a given compound. According to this finding, compounds including “symphony” as a right constituent of the compound displayed prosodic differences from the compounds including “sonata” and “opera” as of right constituents. Plag suggests that semantic, structural, and analogical hypotheses for stress assignment are relevant, even though they share different prosodic levels of degrees.

To our knowledge using existing and novel compounds, phonetic features of word stress and compounding have so far been used in a limited number of studies mentioned above to investigate the prosodic accounts by measuring prominence and prosodic alignment. From these empirical motivations, the current study aimed to investigate the acoustic correlates of nominal compound-phrase distinction and their productivity of stress assignment for existing and novel compounds.

Present Study

Previous studies on acoustic correlates of compounds in Turkish have typically examined prosodic accounts of lexical stress (Inkelas & Orgun, 1998; Kabak & Vogel, 2001; among others); however, evidence for phonetic features on compounds and word stress are still relatively sparse (Athanasopoulou et al., 2017; Levi, 2005). The present study examines phonetic characteristics of compounding for lexical stress where stress patterns of existing and novel constructions are acoustically measured in Turkish. Our study tests two main hypotheses with two production experiments. In Experiment 1, to address the lack of acoustic correlates of compounds in Turkish, we predict a phonetic tendency and specific lexical stress cues between compounds-phrase distinction. From this motivation, we focused on basic acoustic roles of duration, pitch, and intensity. Duration and pitch might be the strongest phonetic cues to identify stress patterns of NN-type of compound in Turkish.

Our second question includes the phonetic tendency of stress assignment in nominal novel compounds. In Experiment 2, for NN existing and novel compounds, we asked whether NN-combinations share similar stress positions both for existing and novel. Even if we predict similar stress cues since novels are not lexicalized, they might not share similar stress cues to existing.

To sum up, our main hypothesis is to focus on the acoustic roles and specific stress cues of Turkish nominal compounds. This preliminary study is one of the first experimental studies measuring the phonetic tendency of NN-compounds in Turkish. In accordance with the previous analyses, novels are expected to share the productivity of stress assignment in Turkish NN-type. Even if novels are not lexicalized parts of language, they might represent similar stress assignments to existing compounds for NN-constructions. Although there are limitations to the methodology, our current study might contribute to basic phonetic properties of stress assignment of Turkish compounds. It is considered that there can be prosodic commonalities for NN-types in Turkish between the stress assignment of existing and novel compounds.

Materials

Speakers

Forty-six native speakers of Turkish (25F, mean=22.82, SD=3.46, SE=0.64; 21M, mean=23.68, SD=3.46, SE=0.73) were included to production experiments. All speakers were balanced for selection by gender, and they had no neurological, hearing, or language impairments. Production experiment was approved by Ethical Board {*Decision No:385*}. This research was supported in part by a postdoctoral fellowship from Tübitak-Bideb-2219.

Experimental Design and Stimuli

To address the lack of acoustic correlates of nominal compounds in Turkish, two production experiments were conducted and divided into two parts: (1) compound-phrase distinction, (2) existing vs. novel compounds. All syllables were dissyllabic, and syllable structures were balanced according to the left position and right positions of compounds. All compounds were left-edge prominent. Ten pairs of prosodic type and compound type of existing and novels were formed from NN compounds in Table 1.

Table 1: An experimental sample of Prosodic Type and Compound Type

Prosodic Type	Sample	Prominence	Tones
compound	$[[\text{da.ná}]_{PW}[\text{bur.nu}]_{PW}]_{PW}$ *"a mole cricket"*	left-prominent	[L+H*]
phrase	$[\text{da.ná}]_{PW}[\text{bur.nú}]_{PW}$ "*a nose of a calf*"	left- and right-prominent	[L+H*],[L+H*]
Compound Type	**Sample**	**Prominence**	**Tones**
existing	$[[\text{da.ná}]_{PW}[\text{bur.nu}]_{PW}]_{PW}$ *"a mole cricket"*	left-prominent	[L+H*]
novel	$[[\text{ke.dí}]_{PW}[\text{bur.nu}]_{PW}]_{PW}$ "*a nose of cat*"	left-prominent	[L+H*]

Abbreviations: L+H: Low+High Tone, PW: Prosodic Word.

Of the existing compounds, there were ten pairs of NN-type compound-phrase distinctions, e.g. $[[\text{da.ná}]_{PW}[\text{bur.nu}]_{PW}]$ *"a mole cricket*" vs. $[\text{da.ná}]_{PW}[\text{bur.nú}]_{PW}$ *"a nose of a calf*" and ten pairs of novels, e.g. $[[\text{ke.dí}]_{PW}[\text{bur.nu}]_{PW}]$ *"a nose of a cat"*. They shared same prominence in their left edge position and same binary tones (L+H*). Existing compounds are selected by NN compounds bear stress on the first members where they carry only binary L+H* tone. As a non-lexicalized compound, novels are considered to bear similar prosodic prominence to existings, therefore they share same tones (L+H*). Since the phrasal counterparts of both existing and novel have two prosodic members, they bear two binary L+H* tones for each member of the phrasal structure.

The production stimuli were sampled from Turkish National Corpus (Aksan et al., 2017). There were (10×2×3) 60 combinations for NN-type existing and phrasal contrasts and (10×2×3) 60 combinations for NN-type novel compounds with three repetitions of each speaker. A full list of 40 target words for NN-constructions for both experiments is shown below in Table 2.

Table 2: Stimuli of Prosodic Type and Compound Type used in the production experiments

Experiment 1: Prosodic Type			
Compound		Phrase	
aslanağzı	*'snapdragon'*	aslan ağzı	*'mouth of a lion'*
danaburnu	*'mole cricket'*	dana burnu	*'nose of a calf'*
tavşankanı	*'bright red'*	tavşan kanı	*'blood of a rabbit'*
yavruağzı	*'light pink'*	yavru ağzı	*'mouth of a baby'*
balıkgözü	*'eyelet'*	balık gözü	*'eye of a fish'*
tavukgöğsü	*'white pudding'*	tavuk göğsü	*'breast of a chicken'*
samanyolu	*'Milky Way'*	saman yolu	*'hayloft'*
kedidili	*'lady finger'*	kedi dili	*'tongue of a cat'*
koltukaltı	*'armpit'*	koltuk altı	*'under sofa'*
gecekuşu	*'night person'*	gece kuşu	*'night bird'*
Experiment 2: Compound Type			
Existing		Novel	
aslanağzı	*'snapdragon'*	insanağzı	*'mouth of a human'*
danáburnu	*'mole cricket'*	kediburnu	*'tongue of a cat'*
tavşankanı	*'bright red'*	devekanı	*'blood of a camel'*
yavruağzı	*'light pink'*	şişeağzı	*'tubulure of a bottle'*
balıkgözü	*'eyelet'*	ahşapgözü	*'eye of a wood'*
tavukgöğsü	*'white pudding'*	hindigöğsü	*'breast of a turkey'*
samanyolu	*'Milky Way'*	koşuyolu	*'running way'*
kedidili	*'lady finger'*	kadındili	*'language of a woman'*
koltukaltı	*'armpit'*	yatakaltı	*'under a bed'*
gecekuşu	*'night person'*	denizkuşu	*'sea bird'*

Procedure

The spoken data were recorded in a sound-proof booth in AUBRC Phonetics Laboratory using a dynamic microphone via Praat 6.0.40 (Boersma & Weenink, 2022). To control the speakers' hearing levels, an audiometer system of Interacoustics AS608e was used before the experiments (see Figure 1).

Speakers were seated approximately 18 inches from the microphone which was stabilized on a boom in the booth. A consent form and instructions were provided to all speakers in Turkish. They were asked to train reading instructions to have comfortable speaking with the equipment. To prevent mistakes during producing sentences, all speakers were instructed to sound the experiment sentences three times. Before the main session was begun, a trial experiment was conducted to prepare speakers for the main experiments. In trials, speakers were asked to produce similar sentences to the main sentences. Each speaker was informed in the practice session to ensure that speakers comprehended the instructions to read out the target sentences three times carefully and naturally.

Experimental sentences were presented in the center of a light grey screen and one sentence was visible at a time. Stimuli were presented to speakers on a laptop screen with the target compound pairs embedded in carrier sentences. Accented pronunciations were elicited by having speakers read out a sentence with a related word in the preverbal focus position in Turkish such as in [Kadın danáburnu dedi] > [The woman mole cricket say-PAST].

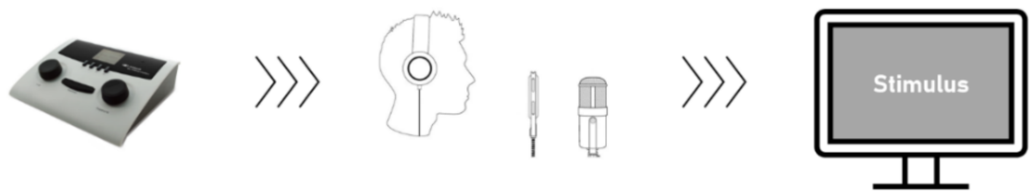


Figure 1. Procedure

Speakers read through a list of target sentences in careful speech. They were not informed about any specific errors and only read sentences with three repetitions. There were four main sessions of experiments and three breaks after each session. The whole session lasted one hour including practice, production, and breaks.

Data Analysis

Acoustic characteristics of NN-type of compounds for both experiments were measured using speech analysis software Praat by the following parameters presented in Table 3. In each target word, the syllables with primary (left edge stressed) were manually determined, and the sonorant of the rime of each target syllable was annotated as the acoustic measurement interval.

Table 3: Acoustic parameters

Acoustic Parameters	Units	Description
duration	Ms	Word duration excluding any silence before or after word
meanF0	Hz	Mean F0 of entire word and stressed syllable
maxF0	Hz	Maximum F0 value across entire word and stressed syllable
minF0	Hz	Minimum F0 across entire word and stressed syllables
meanIntensity	dB	Mean intensity of word and stressed syllable

All data were manually prepared by splitting sentences from rawdata according to acoustic annotations. Before annotations, tokens with recording problems such as microphone artifacts, unexpected noise, or clipping were removed from the rawdata analysis. After data renaming, following articulation errors and different syllable types were eliminated from further analysis: (a) an unexpected pause/hesitation before or after target word, (b) replacements/errors in reading one or more of the words in carrier sentence, (c) non-fluently pronounced tokens.

There were 4968 (108 combinations×46 speakers) sentences in total were included in annotation and rawdata analysis. Acoustic annotation of compound-phrase distinction was conducted in Praat using TextGrids. Sentences were enumerated and labeled according to their compound type, sentence, word, syllable, and sound-level of characteristics. Gridmaker (Ryan, 2005) script running under Praat was used to annotate the TextGrids. Seven levels were created during the annotation: Transcription, tokens, syllables, structures, phonemes, stressed syllables, and compound types as in Table 4. A following sample of annotated data is presented in Figure 2:

Table 4: Overview of annotation scheme

#Tiername	Labels	Explanation
transcription	transcription names	Carrier sentences
tokens	token names	Each word in a separated form
syllables	syllable names	Syllable labels
structures	CV, CVC	Syllables types
phonemes	consonants, glides, and vowels	Labels of consonants, glides, and vowels
stressed syllables	*, x	If syllable is on the left-edge: ***,** If syllable is on the right-edge: x
breaks	–	Breaks between phrases and existing/novel compounds
compound type	s, 01, f, m, nn, comp, nov, phr	Speaker, speaker number, female, male, NN-type, compound, novel, phrasal counterpart
comment		Comments on speakers' articulation, voice quality, artefacts, breakpoints in milliseconds (ms)

Abbreviations. *: stressed syllable, x: non-stressed syllable, –: prosodic break.

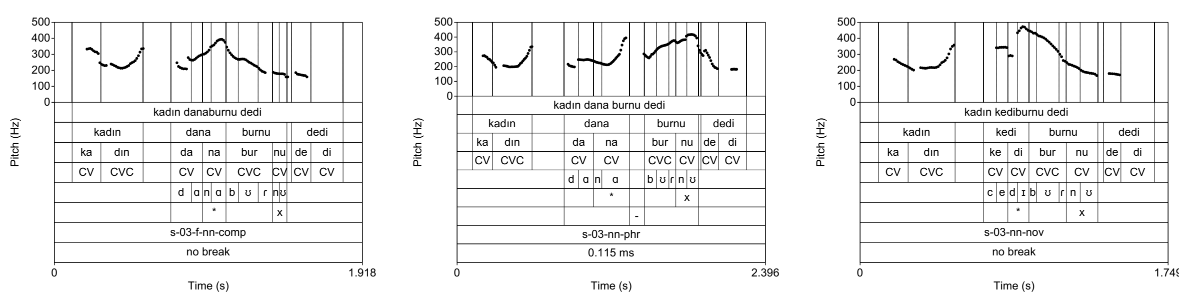


Figure 2: Representative annotations of tokens used in two experiments. *Compound vs. phrasal contrast:[danáburnu](left)–[daná burnú](middle) and novel compound [kedíburnu](right)*

For statistical analysis of annotated data, a Praat script ProsodyPro (Xu, 2013) was used to extract and analyze F0 contours, intensity, and duration (see Table 3). All segmental boundaries were labelled and controlled in manually with visual inspection and listening to the validation.

Intervals and duration measurements

Compounds and phrases were labeled according to following intervals and duration: Tokens, vowel intervals, stressed syllables, and syllable structures. While glides and soft <g> were included in the vowel lengths, voice onset time and aspiration were considered for consonants. . They were labeled as intervals on phonemes to identify the pitch contours. Durations of phonemes, words, and stressed syllables of the targets were included into analysis.

Pitch measurements

Using ProsodyPro, which is a large-scale analysis of continuous prosodic events, allowed us to systematically process the annotated data with high precision for F0 tracks in minimum, mean, and maximum levels in a selected segment and label intervals. As to eliminate unexpected pitch-tracking problems in an automated method of getting accurate F0 tracks in min, mean, and max levels were controlled manually after the extraction of each stimulus. Pitch values for the beginning and ending points of selected intervals were set at 0.01 seconds after the start, and 0.015 seconds (see measurement methods in Morrill, 2012) to decrease undefined F0 tracking, which occurs at the beginning and ending points of vowels. Following Plag et al. (2011), pitch settings were arranged to 75-300 Hertz (Hz) for males and 100-500 Hz for females. Since semitones display any possible change in vowel productions, linear Hz data are converted into 1 Hz semitones. Automatic measurements provided the semitones in excursion size, maximum, and final velocities which are indicators of target slope. MaxF0 location in ms was measured automatically as the duration of the F0 peak relative to the onset of an interval in ms. The maxF0 location ratio was extracted automatically as the related location of the F0 peak as a proportion for the duration of intervals.

Intensity measurements

Speakers were asked to seat in a stable position during experiments due to calibrating of microphone as to measure the intensity (dB) accurately. Intensity values were extracted automatically at the point of mean intensity in each vowel.

Statistical analysis

Analyses were conducted using R statistical language (version 4.0.3; R Core Team, 2022) using the packages *lme4* (version 1.1.26; Bates et al., 2015), *ggpubr* (version 0.4.0; Kassambara, 2020), *ggplot2* (version 3.3.5; Wickham, 2016), *lmerTest* (version 3.1.3; Kuznetsova, Brockhoff, & Christensen, 2017). Linear mixed-effects model (LMMs) was used to investigate effects of multiple random effects with *lme4*. Fixed factors in LMMs were AcousticMeasure (minF0, meanF0, maxF0, duration, and meanIntensity), ProsodicType (compound and phrase), CompoundType (existing and novel). Random factors were Item, Gender, and Speaker following Baayen (2008). Random factors were included to control individual differences between speech rates and speaker specific variabilities. The significance of fixed effects was evaluated by performing likelihood t-tests using Satterthwaite approximants to degrees of freedom.

Random intercepts (i.e., (1|Speaker)) were added to an empty model, then the fixed factors (i.e., Position, ProsodicType, CompoundType) and random slopes for predictors were included (i.e., (1+Position * ProsodicType|Speaker)). The differences in least-squares mean and confidence intervals for fixed factors of LMMs were compared for experiments. Post-doc formulas for pairwise comparisons using *lsmeans* package (Lenth, 2016) are *difflsmeans (lme.model, test.effs="Position:ProsodicType")* for Experiment 1, *difflsmeans (lme.model, test.effs="Position:CompoundType")* for Experiment 2. Final LMMs for Experiment 1, where the effects of Position and ProsodicType were calculated up to acoustic measurements, was a model with two-way interaction terms among fixed factors: *AcousticMeasure~Position* ProsodicType+(1|Speaker)+(1|Item)+(1|Gender)*. LMMs for Experiment 2 where two-way interaction effects of Position and CompoundType were calculated according to acoustic measurements among fixed factors: *AcousticMeasure~Position * CompoundType+(1|Speaker)+(1|Item)+(1|Gender)*.

Results

The statistical analyses for duration, mean intensity, and pitch were performed separately on the second syllables of compounds and phrases. While the effects of interest are Position and ProsodicType (compound vs. phrase) in Experiment 1, they are Position and CompoundType (existing vs. novel) in Experiment 2 according to the relevant acoustic measurements.

Duration (ms)

In durational results, Figure 3 (left) shows the second syllable duration differences between Position (left-right) and ProsodicType (compound-phrase). As expected, phrases are longer than compounds both in gender and position. This means that both the left and right positions of a phrase are longer than the left and right positions of a compound. LMMs analysis for Experiment 1 reveals significant main effects of Position (β=–17.53, SE=2.57, z=–6.18, p<0.001) and ProsodicType (β=73.203, SE=3.15, z=23.18, p<0.001), and the interaction of Position and ProsodicType (β=38.119, SE=2.13, z=–14.18, p<0.001). Post-hoc comparison tests indicate significantly high performances for Position (left-right) and ProsodicType (compound-phrase). Comparisons are significant for Left position compared to Right position (β=36.63, SE=2.23, z=16.40, p<0.001) and for Compound compared to Phrase (β=54.14, SE=2.23, z=–24.24, p<0.001).

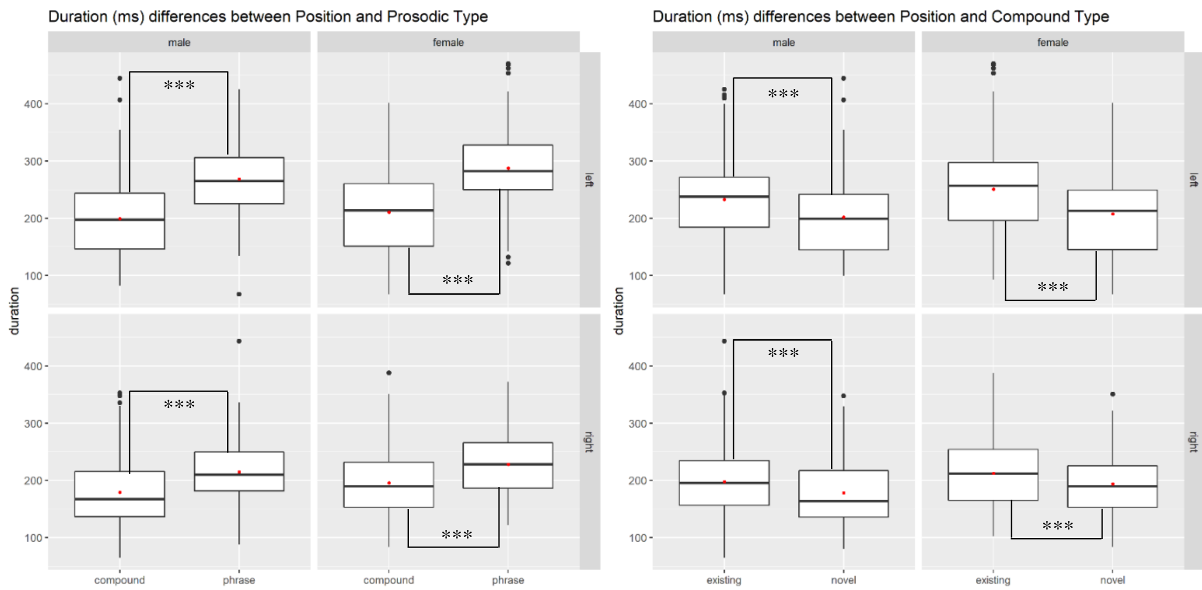


Figure 3: Durational (ms) differences between Position and ProsodicType (left), and Position and CompoundType (right)

In Figure 3 (right), the second syllable duration differences between Position (left-right) and CompoundType (existing-novel) are compared according to gender. Existing compounds are longer than novels as expected for gender and positions; however, the difference becomes bigger in the left position for female speakers. Similar to Experiment 1, LMMs analysis for Experiment 2 reveals a significant main effect of Position (β=–36.30, SE=2.82, z=–12.86, p<0.001) and CompoundType (β=–37.70, SE=3.45, z=–10.90, p<0.001), and the interaction of Position and CompoundType (β=18.06, SE=4.89, z=3.69, p<0.001). Post-hoc comparison tests indicate significantly high performances for Position (left-right) and CompoundType (existing-novel). Post-hoc comparisons are significant for Left position compared to Right position (β=27.26, SE=2.44, z=11.15, p<0.001) and for Existing compared to Novel (β=28.67, SE=2.44, z=11.72, p<0.001), but not significant in left existing compared to right novel (β=55.94, SE=3.45, z=16.17, p=0.6844).

Intensity (dB)

The Figure 4 (left) indicates intensity differences between Position and ProsodicType in second syllable constituents according to gender variation. Phrases are produced higher in the right position of the second syllable items both in males and females; however, intensity of compounds in the left position are higher for females compared to right position. Additionally, there seems to be not many particular differences for males in the left when compared to the right position. LMMs analysis for Experiment 1 indicates significant main effects of Position (β=–5.83, SE=0.17, z=–34.33, p<0.001) and ProsodicType (β=–5.85, SE=0.20, z=–7.34, p<0.001), and the interaction of Position and ProsodicType (β=3.47, SE=0.20, z=11.77, p<0.001). Post-hoc comparison tests show significantly high performances for Position, but not for ProsodicType. Post-hoc comparisons are significant for Left position compared to Right position (β=4.11, SE=0.14 z=27.88, p<0.001); however, results are not significant for Compound compared to Phrase (β=–0.20, SE=0.14, z=–1.38, p=0.1659).

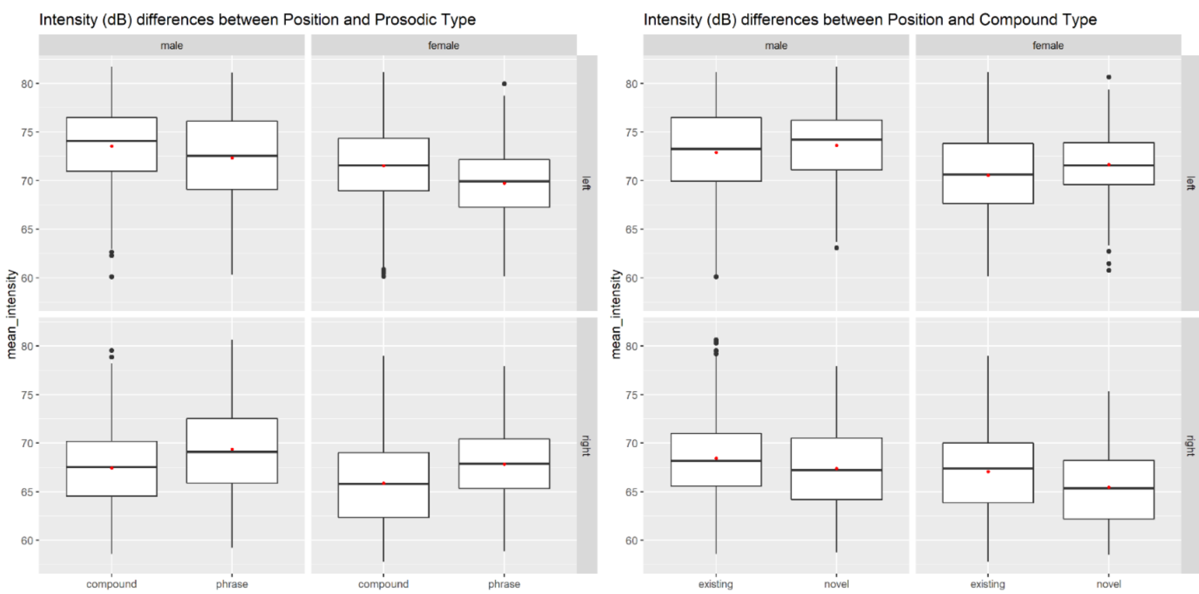


Figure 4: Intensity (dB) differences between Position and ProsodicType (left) and Position and CompoundType (right)

Figure 4 (right) shows the intensity (dB) values differences between Position (left-right) and CompoundType (existing-novel) for the second syllable items for males and females. Intensity values in the left position are higher than right position for both speakers, as expected. While the mean intensity values in the left position are approximately around 70-75 dB, it is around 65-70 dB in the right position for both speakers. LMMs analysis for Experiment 2 also reveals significant main effects of Position (β=–3.92, SE=0.17, z=–22.71, p<0.001) and CompoundType (β=0.92, SE=0.21, z=4.37, p<0.001), and the interaction between Position and CompoundType (β=–2.28, SE=0.29, z=–7.62, p<0.001). Similar to Experiment 1, pairwise comparisons indicate significantly important performances for the Position, but not for CompoundType. Post-hoc comparisons are significant for the Left position when it is compared to the Right position (β=5.07, SE=0.14, z=33.83, p<0.001). As expected in our second hypothesis, pairwise comparisons for existing and novel compounds (β=0.21, SE=0.14, z=1.44, p=0.15) on CompoundType share similarities between their intensity (dB) values.

Pitch results

The pitch values in Hz are calculated for min, mean, and maxF0. Results obtained from the three types of F0 contours for the second syllable constituents of compounds and phrases show that there are remarkably high significances between Position and ProsodicType for Experiment 1. However, pitch values are not significantly high in all acoustic cues between Position and CompoundType, as expected for Experiment 2. The main difference and interaction values for CompoundType in pitch results implicate similar results to duration and intensity values mentioned in previous sections.

Mean F0 (Hz)

Figure 5 (left) shows meanF0 values for Position (left-right) and ProsodicType (compound and phrase) in the second syllable constituents between male and female speakers. Phrases are produced higher in the right positions of second syllable items both in males and females; however, meanF0 of compounds in the left position is higher for females compared to the right position. Additionally, there seem to be not many particular differences for males on the left position when compared to the right position. LMMs analysis for Experiment 1 reveals significant main effects of Position (β=–56.46, SE=1.35, z=–41.73, p<0.001) and ProsodicType (β=4.74, SE=1.65, z=0.04, p<0.005). The two-way interaction between Position and ProsodicType (β=19.88, SE=2.34, z=8.48, p<0.001) are also significant. Post-hoc comparison tests indicate significantly high performances for Position (left-right) and ProsodicType (compound and phrase). Post-hoc comparisons are also significant for Left position compared to Right position (β=46.52, SE=1.17, z=39.71, p<0.001) and Compound compared to Phrase (β=–14.69, SE=1.17, z=–12.54, p<0.001).

The pairwise comparisons between Compound and Phrase (β=–4.74, SE=1.65, z=–2.86, p<0.005) are significant when they are both positioned on the left. MeanF0 values in Figure 5 (right) show remarkable differences between the Position and CompoundType according to gender variation. Similar to intensity values, meanF0 is higher in the left position when it is compared to the right position for males and females, confirming the expected pattern for left-edge compounds.

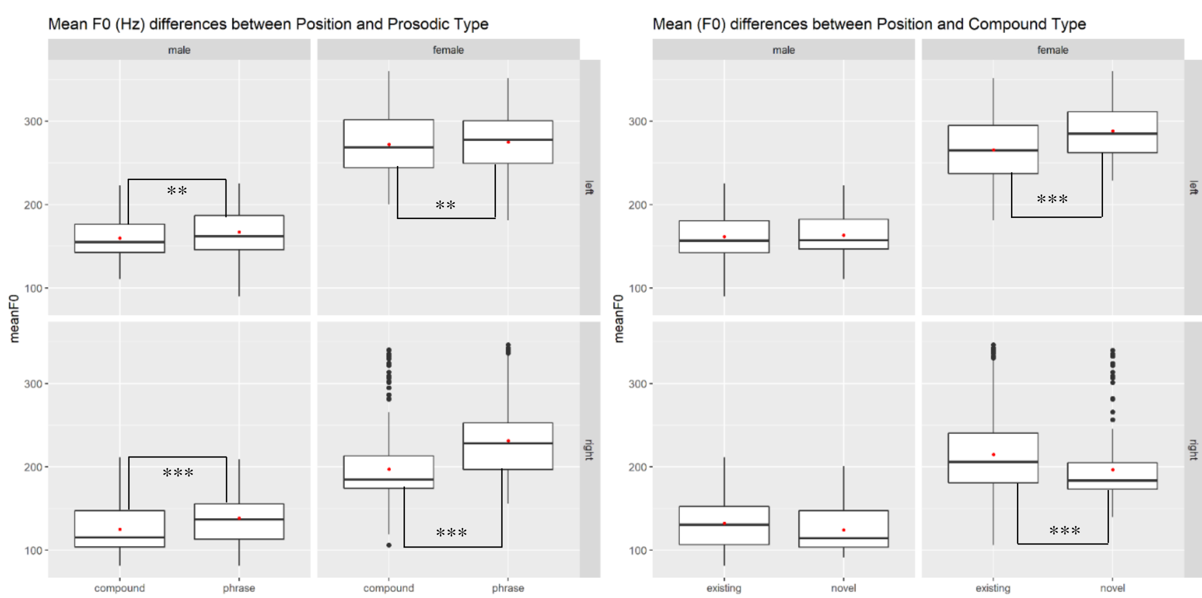


Figure 5: MeanF0 (Hz) differences between Position and ProsodicType (left) and Position and CompoundType (right)

Significant main effects of Position and CompoundType are observed. LMMs analysis reveals significant main effects of Position (β=–40.89, SE=1.37, z=–29.64, p<0.001) and CompoundType (β=13.30, SE=1.69, z=7.89, p<0.001), and the interaction between Position and CompoundType (β=–26.86, SE=2.39, z=–11.23, p<0.001). The pairwise comparisons indicate significantly higher performances for the Position when it is compared to the CompoundType. Post-hoc results are also significantly important for the Left position compared to the Right position (β=54.32, SE=1.19, z=45.44, p<0.001). However, the pairwise comparisons for existing and novel compounds (β=0.12, SE=1.19, z=0.10, p=0.9151) are not significant, as expected.

Minimum and Maximum F0 (Hz)

MinF0 values show similar results to meanF0 for Experiment 1. The Figure 6 (left) shows the minimum values for Position (left-right) and ProsodicType (compound-phrase) in the second syllable constituents. While the minF0 of males has a common ground in ProsodicType, mean values of the compounds and phrases are altered up to Position for females. Accordingly, females produce compounds with a higher minimum pitch than phrases in the left position, but less in the right position. Outliers in the right position are observed much farther from the mean values in females when they are compared to males. LMMs analysis for Experiment 1 reveals significant main effects of Position (β=–46.06, SE=0.98, z=–46.59, p<0.001) and ProsodicType (β=–12.71, SE=1.21, z=–10.50, p<0.001). The two-way interaction between Position and ProsodicType (β=27.50, SE=1.71, z=16.06, p<0.001) is significant. Post-hoc comparison tests show significant performances for Position (left-right) and ProsodicType (compound-phrase). Post-hoc comparisons are significant for Left position compared to Right position (β=31.31, SE=0.85, z=37.75, p<0.001), but not significant for Compound compared to Phrase (β=–1.03, SE=0.85, z=–1.20, p=0.2283).

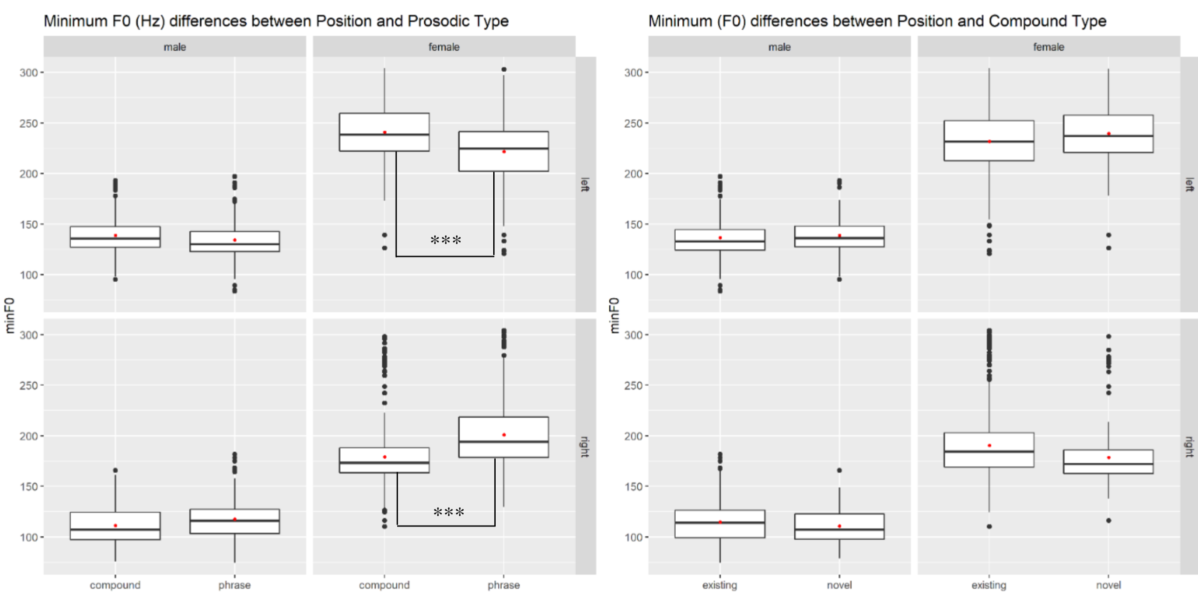


Figure 6: MinF0 (Hz) differences between Position and ProsodicType (left) and Position and CompoundType (right)

Figure 6 (right) shows minF0 values for Position (left-right) and CompoundType (existing-novel) conditions according to gender variation. MinF0 values indicate differences in Position and CompoundType and outliers are more visible in female speakers compared to male speakers. The LMMs analysis for Experiment 2 presents the significant main effects of Position (β=–32.44, SE=1.01, z=–31.88, p<0.001) and CompoundType (β=5.36, SE=1.24, z=4.30, p<0.001), and the interaction between Position and

CompoundType (β=–13.66, SE=1.78, z=–7.67, p<0.001). Pairwise comparisons indicate significantly higher performances for the Position when compared to the CompoundType. Post-hoc results are significant for the Left position when it is compared to the Right position (β=39.22, SE=0.88, z=44.47, p<0.001). However, pairwise comparisons for existing and novel compounds (β=1.40, SE=0.88, z=1.59, p=0.1102) are not significant.

Results for maxF0 for the second syllable items in Figure 7 (left) represent the Position and ProsodicType conditions between genders. Similar to meanF0 and minF0 findings, phrases are produced higher both in the left and right positions in males and females. LMMs analysis for Experiment 1 reveals significant main effects of Position (β=–64.91, SE=1.84, z=–35.11, p<0.001) and ProsodicType (β=14.79, SE=2.26, z=6.53, p<0.001). The two-way interactions between Position and ProsodicType (β=15.65, SE=3.20, z=4.88, p<0.001) is also significant. Post-hoc comparison tests indicate significantly high performances for Position and ProsodicType. Post-hoc comparisons are significant for Left position compared to Right position (β=57.08, SE=1.60, z=35.66, p<0.001) and Compound compared to Phrase (β=–22.61, SE=1.60, z=–14.13, p<0.001).

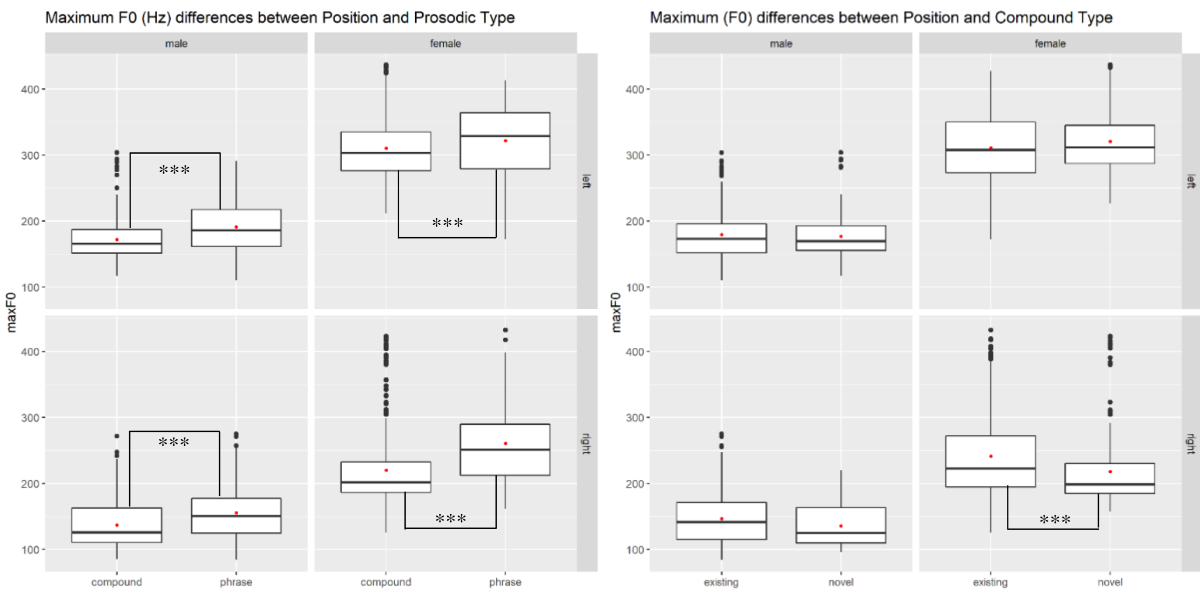


Figure 7: MaxF0 (Hz) differences between Position and ProsodicType (left) and Position and CompoundType (right)

For Experiment 2, the maxF0 values in Figure 7 (right) show differences between the Position and CompoundType conditions according to gender variation. The difference becomes higher between existing and novel compounds when they are located in the right positions. LMMs analysis for Experiment 2 reveals the significant main effects of Position (β=–52.38, SE=1.90, z=–27.47, p<0.001), but not for the CompoundType (β=3.90, SE=2.33, z=1.67, p=0.0945). Even the main effect of CompoundType is not significant, the interaction between Position and CompoundType (β=–21.94, SE=3.30, z=–6.64, p<0.001) is significant. The pairwise comparisons indicate significantly higher performances specifically for Position when they are compared to CompoundType. The post-hoc results are significant for the Left position when it is compared to the Right position (β=63.36, SE=1.66, z=38.44, p<0.001), and the Existing and Novel conditions (β=7.06, SE=1.65, z=4.27, p<0.001). Pairwise differences are also remarkably high between right positions for existing and novel compounds (β=18.03, SE=2.33, z=7.71, p<0.001); however, they are not significant when they are located in the left position (β=–3.90, SE=2.33, z=–1.67, p<0.001).

Discussion

This study investigated the phonetic implementation of word stress in Turkish NN-type compounds by measuring the acoustic correlates of compound-phrase distinction and existing-novel compound pairs. Two experiments were reported here was designed to examine the acoustic characteristics of pitch, intensity, and duration in a fixed carrier sentence. Our first aim was to address the lack of phonetic realizations of Turkish NN-type compounds. Previous studies have typically examined the prosodic accounts of word stress in Turkish (Inkelas & Orgun, 1998; Kabak & Vogel, 2001; among others); however, evidence for phonetic implementation on compounds and word stress are still sparse (Athanasopoulou et al., 2017; Levi, 2005). Following this motivation, our results from the first experiment revealed a phonetic tendency and specific lexical stress cues between NN-type compounds and their phrasal counterparts. The linear model showed us a clear significance patterns for the main effects of intensity, duration, and pitch values, and for the interaction between Position (left vs. right) and ProsodicType (compound vs phrase). Intensity and duration were the most significant acoustic cues distinguishing compounds from their phrases in Turkish.

A general assumption from a series of production experiments on phonetic implementation of compound and phrase distinction (Giegerich, 2009; Nguyên & Ingram, 2007) put forth that duration is one of the most consistent correlates displaying acoustic differences in word level, and intensity ranks as the second (Fry, 1958). Our results showed remarkable differences between compounds and phrases both in duration and intensity values, but the overall results for pitch were less significant for the left and right positions compared to duration and intensity values. A summary of the results for Experiment 1 (compound vs. phrase) are found in Table 5.

Table 5: Summary of results with experimental samples for ProsodicType and Position

			Duration	Intensity	Pitch
ProsodicType	compound	[da.ná.bur.nu]	(✓)	(x)	(x)
	phrase	[[da.ná] [bur.nú]]	(✓)	(x)	(x)
Position	left	[Syl_1+**Syl_2**] [Syl_1+Syl_2]	(✓)	(✓)	(✓)
	right	[Syl_1+Syl_2] [Syl_1+**Syl_2**]	(✓)	(✓)	(✓)

Abbreviations. Syl1: syllable 1, Syl2: syllable 2, (✓): significant, (✓): not-significant

Pitch values emerged as reliable acoustic cues for minF0, meanF0, and maxF0 for Position condition; however, the results for meanF0 showed less significance for ProsodicType differences on the left positioned compounds and phrases when compared to the right position. The compounds used in the first experiment bear a left-prominent stress pattern, which has been proposed to present the NN-type compounds. Even though the expected pitch differences were found for the interaction between left and right positions, the pairwise differences were less significant for meanF0 in the left positions for compound and phrase distinction.

As well known, there is a general assertation on compound and phrase distinction (Giegerich, 1992, 2004, 2005, 2009; Nguyên & Ingram, 2007) that the initial stress is more prominent on the left position and non-initial stress is more prominent on the right position of a compound. Kabak and Vogel (2001) support this idea, and they refer to the stress of the right position as reduced regardless of interacting this rule with any acoustic correlate of stress. As we recall Kabak and Vogel's CSR in Turkish, the main stress to the leftmost syllable bearing a prosodic word stress, it may reduce the prominence effect of any other stress(es) in the prosodic environment. Our results for F0 of initial stressed constituents might indicate less difference compared to non-initial stress constituents due to the strength of stress in the left positions of compounds and their phrasal counterparts when compared to their right positions.

Since phrases appear to be stressed similarly to compounds in Turkish, pitch values reveal less significance for the left positions, as expected. However, the acoustic differences between the right positions of compounds and their phrasal counterparts showed us a more distinctive stress pattern compared to the left. While the primary stress pattern in the compounds is on the left positions, phrases have two primary stress patterns placed in the left and right positions. Therefore, the differences revealed in pitch, duration, and intensity for right positions of compounds are phrases showed us a clear acoustic cue for distinct stress rules for NN-type compounds in Turkish. Our results for the position differences for compound and phrase distinction are compatible with previous theoretical literature in Turkish (Kabak & Vogel, 2001, 2005; Kamali, & İkizoğlu, 2012; Kunduracı, 2013). Our findings are also in the same line with Levi's (2005) previous accounts where she investigated the acoustic correlates of Turkish word stress. She inferred that duration and intensity are the acoustic correlates of stressed syllables, and they are prominent as F0 peaks.

Our second aim was to investigate the phonetic tendency of stress assignment in novel compound for NN-type compounds in Turkish. We asked whether NN-type combinations share similar stress prominence both for existing and novel compounds. Plag (2006) found a robust effect for the right edge prominent stress for the novel compounds in English; however, Plag et al. (2006) criticize this claim that Plag does not consider many other potential semantic relations of compounds which might play important roles for analogy. Plag et al. put forth that existing (lexicalized) compounds affect novel (non-lexicalized or newly invented) compounds to behave similarly. From this motivation, we examined the acoustic correlates of NN-type compounds with left-prominent stress in Turkish. The phonetic realization of novel compounds shared similarity with existing compounds since the pairwise comparisons for existing and novel compounds were not significantly important for intensity and pitch, but significant for the duration results. These findings for intensity and pitch values supported the Plag et al.'s claims for left prominent stress pattern for NN-type novel compounds. Duration did not exhibit significantly important findings for existing compounds on the left position and novel compound on the right positions. Additionally, our results obtained from Position effect for the comparison of left and right positions also shared similar acoustic patterns with existing compounds for intensity and pitch values, but not for the duration. A summary of results of Experiment 2 are found in Table 6.

Table 6: Summary of results with experimental samples for CompoundType and Position

			Duration	Intensity	Pitch
CompoundType	existing	[da.ná.bur.nu]	(✓)	(x)	(x)
	novel	[ke.dí.bur.nu]	(✓)	(x)	(x)
Position	left	[Syl_1+**Syl_2**] [Syl_1+Syl_2]	(✓)	(✓)	(✓)
	right	[Syl_1+Syl_2] [Syl_1+**Syl_2**]	(✓)	(✓)	(✓)

Abbreviations.Syl1: syllable 1, Syl2: syllable 2, (✓): significant, (✓): not-significant

To sum up, our findings for the main hypothesis showed remarkable acoustic differences between left edge compounds and their phrases, which seem to be compatible with the previous accounts on NN-type of compound-phrase distinction (Inkelas & Orgun, 1998; Kabak & Vogel, 2001; Kunduracı, 2013, among others) and word stress (Levi, 2005) in Turkish. Our results also revealed remarkable acoustic differences between compounds and phrases both in duration and intensity values, but the overall results for pitch were less significant for the left and right positions compared to duration and intensity values for the first experiment. Our findings from the second experiment, which described the phonetic similarities and differences between existing and novel compounds in Turkish, showed a clear similarity for duration both in their word type and position. In accordance with the previous hypotheses on lexicalized and newly invented compounds for different languages (Plag, 2006, 2009; Plag et al., 2006), NN-type of novel compounds shared similar productivity of stress assignment in Turkish. Our findings supported the claim for the left prominent stressed novel compounds (initial stress) behaved similar stress assignments to existing compounds. However, this claim needs to be constricted with the acoustic findings obtained from left-prominent stressed NN-type compounds since our experiments did not include right-prominent stressed NN-type compounds in Turkish.

To our knowledge, future work needs to be done as to investigate the non-initial stress assignments for a comparison of existing and novel compounds as to discuss the further assumptions for right edge prominent stressed compounds in Plag and Plag et al.'s studies. Even though our study had limitations for the methodology, the current findings might contribute to basic phonetic implementations for compound-phrase distinction and similar behaviors of left prominent stress assignment of novel and existing NN-type of compounds in Turkish.

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