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Mapping to prosody

Not all parentheticals are alike

Abstract: This study investigates the prosody of different types of sentence-medial parentheticals in Turkish. The results of a production experiment show that clausal parentheticals exhibit cues similar to intonation phrase-level cues such as pre-boundary lengthening of the final syllable, longer pauses, and higher final rise. Phrasal parentheticals, on the other hand, exhibit cues similar to phonological phrase-level cues on both edges. From these results, we conclude that clausal parentheticals are prosodically isolated, supporting the theories of syntax-prosody mapping, while XP parentheticals are prosodically integrated, partially supporting syntax-prosody mapping theories. The latter result supports theories that assume XP-to-phonological phrase matching, but not those that predict the prosodic isolation with all parentheticals. In this respect, Turkish marks constituent-to-constituent matching of syntax and prosody more faithfully than the mapping of syntactic isolation. Additionally, mapping of pragmatic information is highly favoured in Turkish. Specifically, pragmatically isolated parentheticals such as vocatives or interjections are prosodically isolated, regardless of their syntactic make-up. We discuss the prosodic structure of Turkish parentheticals and propose a representation that favours the recursion of certain prosodic category types.

Keywords: Sentence-medial parentheticals, prosodic constituency, Turkish, prosodic isolation, boundary cues, recursive prosodic category types, pragmatic isolation, syntax-prosody mapping

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1 Introduction

Prosodic constituency is affected by the input syntactic constituency (Selkirk 1986, Nespor and Vogel 1986, Truckenbrodt 1995). How prosody mirrors syntax is the subject of theories of syntax-prosody mapping, such as the theory of Prosodic Hierarchy (Nespor and Vogel 1986, Selkirk 1986) and Match theory (Selkirk 2009, 2011). According to these theories, syntactic constituents match to corresponding prosodic category types and these types are hierarchically ordered (1). Clauses map to *intonation phrases* (ιs), subclausal constituents (i.e. XPs) map to *phonological phrases* (Φs), and lexical words map to *prosodic words*, (ωs).

(1) Hierarchy of prosodic category types (Selkirk 2009)

Utterance (υ)
|
Intonational Phrase (ι)
|
Phonological Phrase (Φ)
|
Prosodic Word (ω)

In the prosodic hierarchy; an ι is composed of one or more Φs, and a Φ is composed of at least one ω. The category types are usually distinguished from one another by the difference in the strength of boundaries, the level of pitch reset across the adjacent prosodic constituents, and the directionality of the prosodic heads (e.g. left prominent categories vs. right prominent categories). Additionally, just like syntactic structures, prosodic structures may be recursive (cf. Ito and Mester 2009, 2012, Wagner 2005, Elfner 2012, Kawahara 2012).

In the Autosegmental-Metrical Model of Intonational Phonology (AM) (cf. Pierrehumbert 1980, Ladd 1996), prosodic constituents are identified with reference to certain segmental phenomena and metrical cues, such as the presence of boundary tones (e.g. T- for Φ, T% for ι), the use of lexical/post-lexical pitch accents (T*), and/or the presence of down-step on the F0 (!T). For example, in English, among other patterns, an ι may also be marked by 'falling intonation': a low-levelled flat F0 on its right edge (i.e. ι final boundary tone; L%). Such marking is usually an indication of the end of a discourse/turn. An ι may be marked by ‘rising intonation’: a steep rise on its right edge (i.e. ι final boundary tone; H%). Coupled with a pause this is an indication of discourse continuation (cf. Nespor and Vogel 1986, Selkirk 2005).

In this paper, we focus on the distinction between ι and Φ in Turkish. Following AM and Match theory, we investigate whether the prosody of parenthetical structures in Turkish is isomorphic to their syntax. Match theory predicts that parenthetical structures, such as the appositive *en yakın arkadaşım* ‘my best friend’ in (2),[2] are parsed as ιs since they are isolated from the utterance to which they interpolate (hereafter the *host*).[3]

(2) Aynur, *en yakın arkadaş-ım*, ben-i parti-ye davet et-me-di.
Aynur most close friend-1POSS I-ACC party-DAT invite do-NEG-PST
‘Aynur, *my best friend*, did not invite me to the party.’

However, some studies, such as Wichmann (2001), Peters (2006), Dehé (2007), Kaltenböck (2009), Dehé (2009), and Dehé and Wichmann (2010), show that not all cases of parenthetical insertions lead to prosodic isolation from the ι of their host. Depending on various factors, such as the length of the inserted item (Dehé 2007, 2009; Dehé & Kavalova 2007, and Kaltenböck 2009) or the function of the parenthetical (Peters 2006), some parentheticals do not exhibit prosodic isolation cues such as language specific ι-formation cues (e.g. ι-level boundary tone insertion, longer pauses, longer final syllables). The prosodic integration of parentheticals poses problems for the theories of strict syntax-prosody mapping, and demonstrates that other properties of language may override the requirement of mapping syntax into prosody.

By prosodic isolation, we mean the parsing of a prosodic unit as a category above Φ (in this paper it is ι). By prosodic integration, we mean the parsing of a prosodic unit as a category below ι (in this paper it is Φ or potentially ω) (Selkirk 1986, Bolinger 1989, Gussenhoven 2004, Dehé 2007, and Kawahara 2012).

Focusing on the case of Turkish, we address two related issues. First, we examine to what extent the prosodic structure of Turkish validates the predictions of universal syntax-prosody mapping theories, with respect to ι-formation. Second, we aim for a better understanding of the cross-linguistic factors that lead to prosodic isolation/integration of parentheticals.

2 For a syntactic account of such parentheticals in Turkish see Griffiths and Güneş (2014).

3 For syntactic isolation accounts see e.g. Haegeman (2009), Peterson (1999), Burton-Roberts (2006), for semantic isolation accounts see Potts (2005), De Vries (2007), Arnold (2007), and see Selkirk (2005) for a Match Theory based account that predicts the prosodic isolation of parentheticals.

These issues have previously been addressed in Güneş (2014), which discusses the results of a production experiment on two parentheticals of Turkish (*yanılmıyorsam* 'if I am not mistaken', and *bence* 'for me' or 'I think'). The results described therein demonstrate that (i) no significant difference pertains between the final rise of pre-nuclear parentheticals and pre-nuclear arguments, (ii) both post-nuclear arguments and post-nuclear parentheticals exhibit low and flat F0, (iii) parentheticals are pronounced at similar pitch intervals to arguments in corresponding positions, and (iv) boundary tones on the edges of parentheticals and preceding host constituents are Φ-level tones. Based on these results, Güneş concludes that *yanılmıyorsam* and *bence* are parsed as Φs and not ιs, and thus display prosodic integration. From this investigation one can conclude that ι-formation in Turkish is not dependent solely upon syntactic input.

This paper investigates whether Güneş' conclusions are supported by results from an expanded data set. To achieve this, we conducted a production experiment to examine the prosodic behaviour of a number of sentence-medial, pre-nuclear Turkish parentheticals of different lengths, syntactic forms, and pragmatic functions.

The paper is organized as follows: Section 2 outlines the prosodic constituency of Turkish. Section 3 introduces the methodology of the experiment. Section 4 reports the results. Section 5 discusses the findings and section 6 concludes.

2 Background on the prosody of Turkish Declaratives: Φ and ι

Φ and ι are domains above the ω that are envisaged for Turkish (Kabak and Vogel 2001, Kabak and Revithiodou 2009, Kan 2009, Kamali 2011). Kabak and Vogel (2001), the first study on Turkish that depicts a level higher than ω in terms of Prosodic Structure Theory (cf. Selkirk 1986 *et seq.*, Nespor and Vogel 1986), portray the Φ-level as embodying phrase-level stress (i.e. *head prominence*). They observe that head prominence falls on the leftmost ω of an Φ.[4]

4 Note that they associate the head only with the stress-bearing syllable of the leftmost ω, and not with the entire leftmost ω. By instrumental analysis, Kamali (2011) and Güneş (2013) observe that the overall pitch level of head ω (including the unstressed syllables of that ω) is relatively higher than the overall pitch level of the non-head ω (this is called *relative levelling of pitch register*). Therefore, in our view, the head of a Φ is not only the syllable but the entire ω.

Directionality of head prominence, being specific to Φ-level constituent formation, is considered as a diagnostic for the Φ in Turkish. In the consequent studies (Özge and Bozşahin 2010, Kamali 2011), Φs are also observed to bear phrase accents/edge tones that delimit one Φ from another (e.g. H- for the right edge of Φs). Kan (2009) lists four cues that identify the difference between ιs and Φs in Turkish: (i) boundary tones (H- for Φ level and H% for ι level), (ii) pauses (if there are any, then shorter across Φs and longer across ιs), (iii) head prominence (left prominent Φs and right prominent ιs), and (iv) final lengthening (shorter before Φ boundaries, and longer before ι boundaries). We employ Kan's diagnostics for the identification of prosodic category types of different levels in the prosodic hierarchy here. In addition to these diagnostics, we included the degree of initial lowering (the level of L and L%), which tests for pitch reset on the left edges of parentheticals. This diagnostic is added because a recent study on Japanese parentheticals (Kawahara 2012) observes that a change in the degree of initial tone marks a variation in the organization of prosodic structure.

The presence of accent is lexically contrastive in Turkish (there is only one accent and it is a binary one (Kamali 2011: H*L). Words can be accented and accentless in Turkish.[5/6] We utilize only accentless ωs in our experiment. By doing this, we aim to eliminate acoustic variation that arises due to the existence of an accent. The prosodic constituency structure of Turkish declarative root clauses with accentless ωs is illustrated below.[7]

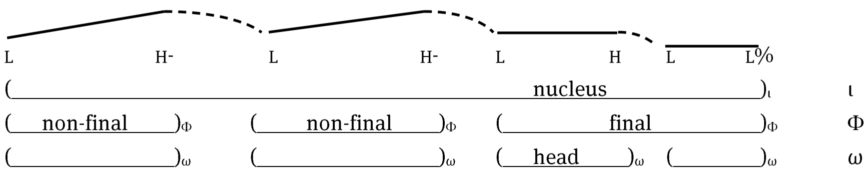
The high-levelled pitch register aligned with the heads of Φs is observed in the data reported here as well.

5 In Turkish most words bear stress on their final syllable (Sezer 1981, Inkelas and Orgun 1998, Kabak and Vogel 2001). The words that bear non-final stress are the words that bear accent, where the pitch accent falls on the stressed syllable. In the case of finally stressed words, the final syllable has *stress accent* but not *pitch accent* (Konrot 1981).

6 That there are accented and accentless words in Turkish has been proposed recently by Kamali (2011), who also suggests that, in this regard, Turkish should be considered as a "pitch accent language". The classification of Turkish in terms of its word melody is beyond the scope of the current study.

7 See Kamali (2011) for a similar representation.

(3) The ι of Turkish declarative root clauses with *accentless* ωs:



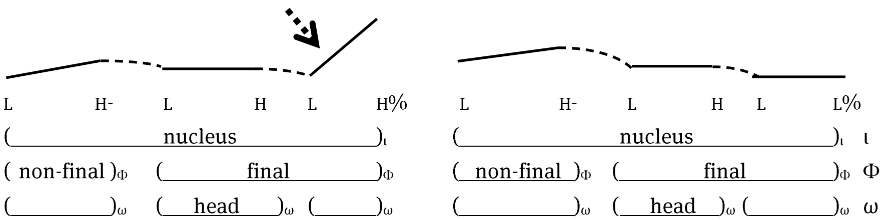
The tonal variation of constituents is highly dependent on their position. The nucleus (the perceptually prominent part of a root clause) is the defining point of the intonational template in declaratives. Any constituent that occurs to the left of the nucleus (pre-nucleus) bears a rising terminal (H-) with an optional lexical accent, and any constituent that occurs to the right of the nucleus (post-nucleus) shows a levelled pitch contour. We refer to the Φ that contains the nucleus as the *final-Φ* and all the Φs that linearly precede the nucleus as *non-final-Φs*. The only difference between non-final-Φs and final-Φs is that final-Φs do not bear H- on their right edge. The high levelling of F0 marks the initial ω of the final-Φ as the head that bears a H on its right edge. The second ω of the final-Φ begins with a low left edge (L), the level of which is scaled lower relative to the L of the first ω in the final-Φ.

Notice that the L of the second ω in the final-Φ is lower than the L on the left edge of the first ω of the final-Φ. This, we believe, is due to the difference in the prosodic category that each L belongs to. What we assume is that L on the left edges of all Φ-initial ωs bear a high levelled low left edge tone (L) marking the left edges of Φs. On the other hand, any non-initial ω in a Φ bears a low levelled low left edge tone (again annotated with a L) that marks the left edges of ωs. In this respect, the phonetic difference between the Φ-level L and the ω-level L is that the former bears relatively higher pitch than the latter. In the present paper, only the Φ-level L is analysed.

The resulting high plateau in the final-Φ is the head of the final-Φ and also the head of the ι: it is the nucleus. In this study nucleus is taken as a prosodic unit.

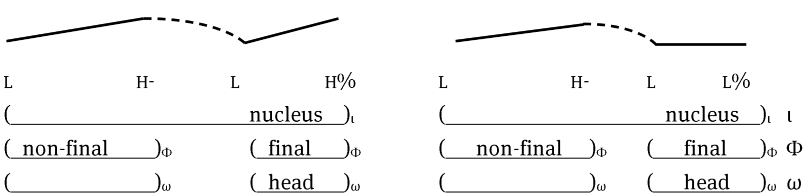
Note that (3) bears a L% right edge ι-level boundary. The leftmost ι in (4) illustrates an utterance with comma intonation (a right-edge rise that is higher than the rise of the non-final Φs): H%.

(4) Two consequent ιs with comma intonation (H%) with accentless ωs



In a declarative utterance with comma intonation, the right edge (final syllable) of the ι is marked with a steep rise. Note that the steepness of the rise in (4) is also due to post-nuclear levelling. Specifically, since the final-Φ is composed of more than one ω, there is post-nuclear lowering of the pitch register in the area after the head of the final-Φ. The post-nuclear area bears the lowest F0 register in Turkish declarative utterances (Özge and Bozşahin 2010). Therefore, any H tone that follows this area is expected to be steeper than the rest of the post-nuclear area, and the rest of that ι. If there is no item following the nucleus, the rise is expected to be less abrupt. (5) illustrates a case where the ι ends with the nucleus (i.e. where the final-Φ bears only one ω).

(5) Two consequent ιs with comma intonation (H%) with accentless ωs and single-ω final-Φ



The right edge boundary tone of the first utterance does not bear a steep rise. However, the boundary is still interpreted as stronger than the Φ-level and is marked with an ι-level boundary tone (H%). This is due to the existence of other ι-level edge properties; i.e. lengthening of the final syllable and a following pause. In the experiment reported in this paper, we considered this variation and controlled the data accordingly.

3 Method

In this experiment, the prosodic properties of parentheticals and the surrounding host (non-)constituents were compared to corresponding Φ and ι boundaries within and across root clauses that do not contain parentheticals. Preboundary lengthening of syllables, F0 values on the constituent edges (boundary tones), and the distribution of the pauses were investigated.

3.1 Stimuli

Stimuli were drawn from two sets: the control and test utterances. The control contained two sub-sets: one for Φ boundaries and the other for ι boundaries. All target utterances exclusively contained accentless words. To the highest possible degree, these words were also devoid of obstruents, especially in the areas targeted in our analysis (i.e. the edges of the analysed items). The total number of sentences processed was 704 (176 sentences x 4 speakers).

3.1.1 Control set

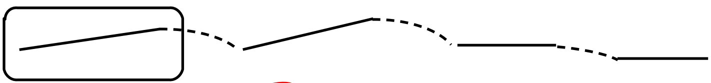
There were two groups in the control set: the Φ-boundary group and the ι-boundary group. For the Φ boundary, there were 48 target utterances in total (VP-adverbial case: 14, argument case: 34). For the ι boundary, there were 45 cases in total (single-ω final-Φ: 21, multi-ω final-Φ: 24). In total, there were 372 boundaries present in the control set (93 boundaries x 4 speakers).

3.1.1.1 Φ boundaries in the control

Only those elements that were parsed as non-final-Φs were included for Φ-boundaries in the control. Because the non-final-Φ that immediately precedes the nucleus bears a higher H- then the preceding non-final-Φs (Günes 2014; İpek and Jun 2013), we included in the control only those non-final-Φs that are non-adjacent to the final-Φ in our analysis. We did this in order to eliminate unnecessary variation for the statistical analysis.

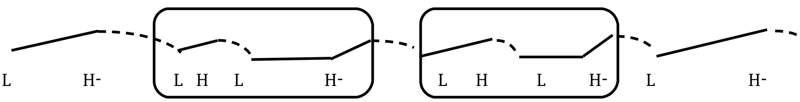
For the F0 analysis of the pre-nuclear final rise, we employed two kinds of non-final-Φs: (i) Φs with single word, and (ii) Φs with two or more words. Unlike the single-ω Φs (6a), multi-ω Φs display a 'head vs. non-head' distinction (6b). Heads of Φs in Turkish are marked by a higher pitch register, and a H tone on the right edge, while the non-head bears F0 lowering (cf. Kamali 2011, Güneş 2013).

(6) a. Control set for Φ boundaries (single-ω argument) (Φ-ar) [8]

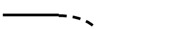


L H- L H- L H L L%
(Dallama-lar)$_{\text{non-f-}\Phi}$ (yalan-lar-ı)$_{\text{non-f-}\Phi}$ (ilgili-ler-e duyur-uyor)$_{\text{f-}\Phi}$
jerk-PL lie-PL-ACC associate-PL-DAT give.out-PROG
'The jerks give out some lies to the officers.'

b. Control set for Φ boundaries (multi-ω arguments) (Φ-ar)



L H- L H L H- L H L H- L H-
(Genelde)$_{\text{non-f-}\Phi}$ (yeni görevli-ler)$_{\text{non-f-}\Phi}$ (yarım marul-lar-ı)$_{\text{non-f-}\Phi}$ (yayla-lar-a)$_{\text{non-f-}\Phi}$
Usually new staff-PL half lettuce-PL-ACC field-PL-DAT



L H L L%
(iade ed-iyor)$_{\text{f-}\Phi}$
return make-PROG
'Usually, the new staff sends the half lettuces back to the fields.'

Parentheticals are frequently analysed as syntactically adjoined to their host (Corver & Thiersch 2001, Potts 2005, De Vries 2006, Van Maastricht 2011, and Griffiths this volume).[9] Bearing this in mind, VP-adverbs such as in (7) were also included in the control, as instances of regular adjunction.

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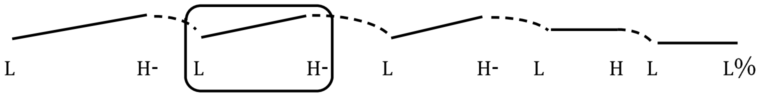
8 Rounded rectangles mark the analysed constituents.

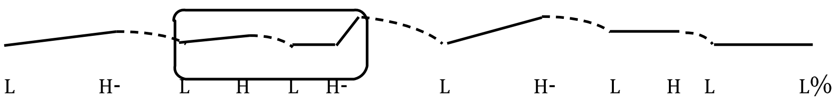
9 To ensure semantic isolation pertains between the adjoined parenthetical and its host, a *sui generis* adjunction mechanism must typically be posited (cf. De Vries 2008, 2012).

(7) a. Control set for Φ boundaries (single-ω VP-adverb) (Φ-app)



(Amir-ler)$_{\text{non-f-Φ}}$ (ileri-ler-de)$_{\text{non-f-Φ}}$ (ağa-lar-ı)$_{\text{non-f-Φ}}$ (<u>ön-e</u> al-ıyor)$_{\text{f-Φ}}$
chief-PL ahead-PL-LOC landlord-PL-ACC front-DAT take-PROG
'Ahead of us, the chiefs let the landlords join the cue from the front.'

b. Control set for Φ boundaries (multi-ω VP-adverb) (Φ-app)

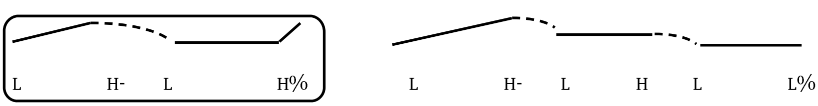


(Yuva-lar)$_{\text{non-f-Φ}}$ (öğle-ye doğru)$_{\text{non-f-Φ}}$ (yavru-lar-ı)$_{\text{non-f-Φ}}$ (<u>uyku-ya</u> yatır-ıyor)$_{\text{f-Φ}}$
nursery-PL noon-DAT towards baby-PL-ACC sleep-DAT lie-PROG
'Around noon, the nurseries put the babies to sleep.'

3.1.1.2 ι boundaries in the control

We utilized strings of consecutive clauses for ι boundaries in the control. Only clauses that bear continuation intonation (comma rise; H%) were included. To analyse the F0 values of the right edge boundaries and control the amount of the final rise, a setting similar to that in (6) and (7) was employed. In this case, the final-Φ of each non-final clause was either single-ω (i.e. the nucleus alone) or multi-ω (i.e. the nucleus and a following low-levelled F0). Single-ω and multi-ω final-Φs enjoyed equal representation in the control. The two conditions are illustrated in (8).

(8) a. Control set for ι (ι-n) boundaries (single-ω final-Φ)



[(Münire)$_{\text{non-f-Φ}}$ (<u>menemen-e</u>)$_{\text{f-Φ}}$]$_{ι}$ [(Neriman)$_{\text{non-f-Φ}}$ (<u>yağlama-ya</u> dadan-ıyor)$_{\text{f-Φ}}$]$_{ι}$
Münire omelet-DAT, Neriman yağlama-DAT pick.at-PROG
'Münire has been picking at the omelet; Neriman the pancake.'

b. Control set for ι (ι-pn) boundaries (multi-ω final-Φ)

L	H-	L	H	L	H%	L	H-	L	H	L	H%

[(Emine)$_{\text{non-f-}\Phi}$ (<u>yavru-yu</u> göm-dü)$_{\text{f-}\Phi}$]$_\iota$ [(Miraye)$_{\text{non-f-}\Phi}$ (<u>yer-ler-i</u> ovala-dı)$_{\text{f-}\Phi}$]$_\iota$
Emine puppy-ACC bury-PST Miraye floor-PL-ACC scrub-PST

L	H-	L	H	L	L%

[(Neriman)$_{\text{non-f-}\Phi}$ (<u>helva-yı</u> yoğur-du)$_{\text{f-}\Phi}$]$_\iota$
Neriman halvah-ACC knead-PST
'Emine buried the puppy. Miraye scrubbed the floor. Neriman kneaded the halvah.'

3.1.2 Test set

The test set was split into *verbal* and *XP* parentheticals.[10] The test set was composed solely of sentence-medial pre-nuclear parentheticals that were not in the immediately pre-nuclear position. *Single-ω* parentheticals and *multi-ω* parentheticals were equally represented.

3.1.2.1 Verbal parentheticals

Verbal parentheticals are clausal parentheticals that contain a finite verb. This test set comprised 31 parentheticals. It contains four subsets, each containing at least 5 utterances. These subsets are:

(9) a. *Comment clauses (com) (8 utterances)*
Bünyamin, *büyük oranla doğrudur*, yeğenini <u>Meray'a</u> ayarlıyormuş.
Bünyamin, *it is probably true*, matches his cousin up with Meray.

b. *Finite non-restrictive relative clauses (finnon) (5 utterances)*
Maymunlar, *ki yabanidirler*, liderlerine <u>boyun</u> eğerler.
Monkeys, *and they are wild*, obey their leaders.

10 Originally, the test set contained a third group of parentheticals: '*in-between*' parentheticals. This group consisted of *amalgamations*, i.e. those constructions like *John is going to I think it is Chicago on Sunday* (Kluck 2011). Since it is unclear where the syntactic and prosodic boundaries lie in such structures, they were not included in the analysis. They were instead used as fillers. Prosodic phrasing of these forms requires future inquiry.

c. *Finite adverb-like parentheticals (adfin) (13 utterances)*
Maymunlar, *yıllar ilerler*, yavruları yuvalara gömerler.
Monkeys, *(and) the years pass by*, bury the infants in their dens.

d. *Interruptions (inter) (5 utterances)*
Mamayı, *yana doğru eğilin*, bebeğe biberonla veriyorlar.
They give the food, *lay down on your side*, to the baby in a nursing bottle.

In (9), verbal parentheticals are divided according to their surface structure. Verbal parentheticals can also be split across another dimension, viz. their *pragmatic function*. This split is binary – either verbal parentheticals are *pragmatically integrated* into their host (9a-c), or they are pragmatically *isolated* from their host (9d). Unlike pragmatically integrated parentheticals, which contribute to the discourse structure containing their host, pragmatically isolated parentheticals contribute only to the situational context in which the host is uttered. To illustrate, consider (9d), where the speaker is a doctor, the addressee is a patient in the setting of a hospital. Here, the interruption is relevant to the situation (i.e. the doctor's examination of the patient) but not to the topic of conversation (i.e. how to feed a baby). Among pragmatically integrated parentheticals, comment clauses, e.g. (9a), exhibit a different semantic-pragmatic relation when compared to other pragmatically integrated clausal parentheticals, e.g. (9b) and (9c). They are even more integrated than the other parentheticals (Reis 2000, Asher 2000, Dehé and Wichmann 2010 and Dehé to 2014). This difference is due to the fact that comment clauses present the speaker's mental disposition about the truth validity of the host proposition. In this sense, their "communicative value is roughly equivalent to an adverbial…" (Reis 2000:9). "A true integrated reading (= Reinhart's 'speaker-oriented' reading)" (ibid.: 12) of comment clauses results in prosodic integration across languages (Reis 2000 for German, Reinhart 1983, Dehé and Wichmann 2010, and Dehé 2014 for English).

3.1.2.2 XP parentheticals

Different types of subclausal constituents comprised the test set of XP parentheticals (or *phrasal parentheticals*). 26 XP parentheticals were used for this test set. This set contains four subsets, with each subset containing at least 5 utterances. These subsets are:

(10) a. *Mitigative adverbials (admit) (5 utterances)*
Memurlar, *anladığım kadarıyla*, alanlarda bela arıyor.
'The officers, *to my understanding*, look for a trouble in the arenas.'

b. *Nominal appositives (appo) (6 utterances)*
Emir'i, *yeğenimi*, arabayla oyuna götürüyorlar.
'They always take Emir, *my cousin*, to the play by car.'

c. *Post-positional (peripheral) adverbials (adper) (10 utterances)*
Alevler, *alınan önlemlere rağmen*, yalılıları dumana boğdu.
'The flames, *despite the precautions taken*, have smothered the residents in fog.'

d. *Vocatives (voca) (5 utterances)*
Koyunları, *değerli yöremizin yerlileri*, ağıllarına yenilerle yollarız.
'We send the cows, *(you) dear locals of our region*, to the barns with the new ones.'

Similarly to (9), XP parentheticals can split according to their level of pragmatic integration. (10a-c) are pragmatically integrated, while the vocatives such as the one in (10d) are isolated.

3.2 Data elicitation

Target utterances were presented to the participants as MS PowerPoint slides on a screen. Each slide contained three sections. First was the context section, where an imaginary context was described so that the participant could draw on her knowledge of information structure to produce the target utterance in a more natural manner. Second was the elicitation question, which fixed the position of the nucleus in the target utterance. Third was the target utterance. All the standard orthographic conventions of the Turkish language were employed in the context section, the eliciting question, and the target utterance. The utterances were elicited by means of a role-playing game. The subjects read the context, the question and the target answer (not out loud). Then, the experimenter (the first author) read aloud the eliciting question. The subjects then employed the target sentence as an answer to the experimenter's question. This procedure was repeated throughout the experiment to elicit the same target whenever necessary (in cases of extraneous interruption, etc.).

3.3 Speakers and the recording procedure

Four female speakers of standard Turkish participated in the experiment. All speakers were university graduates. At the time of the recording, the speakers were aged 32, 32, 37, and 55 respectively from speaker one to four. All speakers except the first were monolingual speakers of Turkish. The first speaker was recorded in a sound-proof audio studio with an external microphone using the software program Adobe Audition 3.01, at the University of Groningen. The other three speakers were recorded with an Olympus digital voice recorder (WS-812). The recordings of the last three speakers took place in rooms with minimal background noise. At the time of recording, only the experimenter and the participant occupied the room. Before the experiment began, four sets of training slides were presented to ensure that the participants were familiar with the experimental procedure. The training material was repeated multiple times if necessary. The experiment lasted approximately 45 minutes.

3.4 Data processing and measurement

The sound files of each speaker were processed using Adobe Audition 3.01. The amplitude values of the sound were normalized and the background noise was eliminated (via 'noise reduction') to filter out any potential non-speech sound interference. After the noise reduction, each target utterance was extracted and transferred to PRAAT 5.3.02 (Boersma & Weenink 2011). Using PRAAT, all octave jumps were eliminated. For all speakers, the pitch interval was kept constant (ceiling 400Hz, floor 75Hz). In the statistical analysis of the F0, only the semitone values were used (semitones re 100Hz). All utterances were parsed to their syllable, word and sentence boundaries. The parsing procedure was carried out in three steps: first all syllable, word, and utterance boundaries were manually parsed in PRAAT by a non-Turkish speaker, and then verified by a native speaker of Turkish (the first author). The detailed control of the syllable boundaries was undertaken with close reference to the spectrograms, formant values, and waveforms. All word and sentence boundaries were then manually re-aligned with the corresponding syllable boundaries, two weeks after the second step. Pauses (if any) were also parsed.

3.5 Statistical analyses

Duration and F0 values of all utterances were analysed in R (R Development Core Team 1993-2011). We used linear mixed-effect models for analysing the data. All analyses were performed using lme4 package (Bates et al. 2013). In the presentation of the analyses that follow we present fixed effect parameters of each model with associated standard error (SE) and t-statistic. All models we report are zero-intercept models. As a result the estimates of the model parameters correspond to the expected value of the response variable for the respective group of the explanatory variable. Depending on the model, we also include one or more random effects to account for the variation due to factors such as speaker, relevant syllable type and the length of the item.

Speaker variation is a commonly observed source of variation in the results. Therefore, *speaker* is included as a random effect in all the reported models. Another potential source of variation is the *length* of the items tested (the number of syllables per item). *Length* is also included as a random effect in all models reported here to avoid the length-related variation in the results. In all results reported below, we use a five-level categorical variable representing the length of the phrase where items with one, two, and three syllables form the first three category, and items with four to six (inclusive) syllables and items with seven or more syllables form the last two categories. The category decision was based on inspection of effect of the length on syllable durations in the entire data set.

Finally, dissimilarity in duration persists between open and closed syllables. To avoid any effect of the syllable type, we include *syllable type* as a random effect in all models whereby the response is the syllable duration (i.e. the cases of final lengthening).

For all cues, we only report results from 'intercept-only' random effect.[11] We report standard errors and t-scores for the fixed effects, and the estimated standard deviation of the random effects. We also present point estimates of cue values (e.g. final syllable duration) and plus and minus one standard error interval around the estimate for each category graphically.

11 In our experiments inclusion of random slopes neither improved the model fit nor affected the parameter estimates substantially. Hence, we present the intercept-only random effects for the sake of simplicity and consistency.

4 Results

4.1 Final Lengthening

Segmental makeup of syllables may have an effect on the results when we generate the estimates of final syllable durations. Particularly, open (in our data .CV) and closed (in our data .CVC) syllable values may be consistently different across different prosodic category types. The results show that this is indeed the case when we compare the mean values of the open and closed final syllables of ιs and Φs in the control. Accordingly, the mean duration of ι-final open syllables is 181ms, while the mean duration of Φ-final open syllables is 123ms. Similarly, the mean duration of ι-final closed syllables is found to be 242ms, while the mean duration of Φ-final closed syllables is 206ms. As a result, although there is a consistent difference between the duration of open and closed syllables (where the former is shorter than the latter), the categorical variation persists: i.e. ι-final syllables are longer than Φ-final syllables, regardless of the syllable type. Particularly, open ι-final syllables are shorter than open Φ-final syllables and closed ι-final syllables are shorter than closed Φ-final syllables. When designing the stimuli, the segmental properties and the syllable type distribution of the final syllables are not controlled, and in the analysis, syllable type is included as a random factor.

4.1.1 Parenthetical vs. Φ and ι

Final syllable duration of the parentheticals is compared to the final syllable duration of the Φ and ι in the control. Figure 1 presents the final syllable duration averages for all types. The solid horizontal line denotes the mean word-final syllable duration for all words, both in control and target sentences. The dashed horizontal line represents the overall mean of all syllable durations. Shading indicates the type of the phrase: white is ι, darker grey is Φ, darkest grey is verbal parenthetical, and light grey is XP parenthetical.

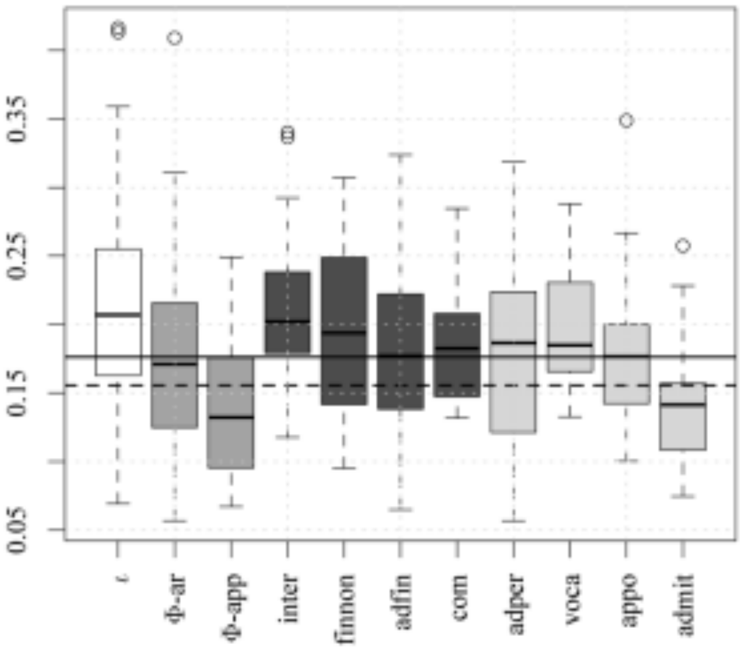


Fig.1: Final syllable duration of the parentheticals, Φ and ι boundaries

As Figure 1 shows, the averages of the final syllable duration for some parentheticals are closer to ι, the final syllable duration of which is higher than average word-final syllable duration. While Φ-final syllable duration values are around average, Φ-*app* (low adverbs) exhibits markedly shorter final syllables.[12] A similar variation is observed in parenthetical type *admit* (mitigative adverbials).

12 The results of other tests, which are reported in the current paper, indicate that low adverbs in the Φ-control group are different from the arguments of the same group. We observed that, in all cues, the Φ-app cases show weaker boundaries than the Φ-ar cases. That Turkish prosodic structure marks low adverbs differently from the arguments is a very interesting observation. Yet, a more elaborate investigation that specifically focuses on this distinction is essential for comprehensive conclusions.

Figure 1 also indicates a difference between verbal and XP parentheticals (the former having longer final syllables). Among the verbal parenthetical group, *inter* (interjections) bears substantially longer final syllables; more than the ι-final syllable duration. Among the XP parenthetical group, *voca* (vocatives) exhibits the longest final syllables, with an equal (if not higher) ι-final syllable duration.[13]

Figure 2 and Table 1 present the parameter estimates of a linear mixed-effect model fit with random intercepts for *length* (as the total number of syllables of each chunk), *speaker* and *syllable type*, whereby the predictor is the general phrase types 'parenthetical', 'intonational phrase' and 'phonological phrase'.

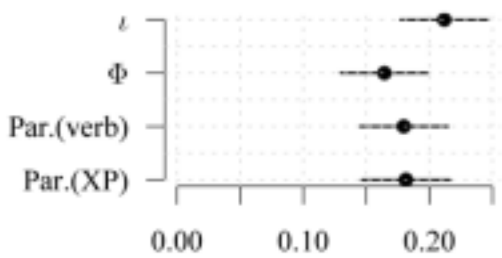


Fig. 2: Estimates of the final syllable durations (in seconds) of ι, Φ, verbal parenthetical and XP parenthetical

13 As reported here and in the following sub-sections, the groups *voca* and *inter* behave differently in comparison to their group-mates. Particularly, the box-plots for all cues report that *voca* is substantially different from the other XP parentheticals and *inter* is substantially different from the verbal parentheticals. This variation could be a source of misleading results for linear mixed-effect models, as all estimates are calculated relatively. For this reason, the tokens of *voca* and *inter* were not included in any of the linear mixed-effect models.

For all cues, the cases of *voca* and *inter* are only discussed based on the average values reported in box-plots.

			Estimate	SE	t value
Fixed effects					
	ι		0.216	0.034	6.281
	Φ		0.164	0.034	4.776
	Par.(verbal)		0.184	0.035	5.331
	Par.(XP)		0.183	0.035	5.290
Random effects s.d.					
	Length	Intercept	0.0024		
	Speaker	Intercept	0.0082		
	Syl. Type	Intercept	0.0480		

Table 1: Estimates of the final syllable durations (in seconds) of ι, Φ, verbal and XP parenthetical

Intonational phrases show the longest final syllables. Phonological phrases exhibit the shortest final syllables, and two groups of parentheticals are in-between, being slightly closer to Φ than ι. There does not seem to be a difference in the final syllable length values of the verbal and XP parentheticals – both exhibit Φ-like durations.

Figure 3 and Table 2 present a model fit to the same data with a more detailed grouping of the parentheticals and phonological phrases, which reveals some differences between the verbal and XP parentheticals.

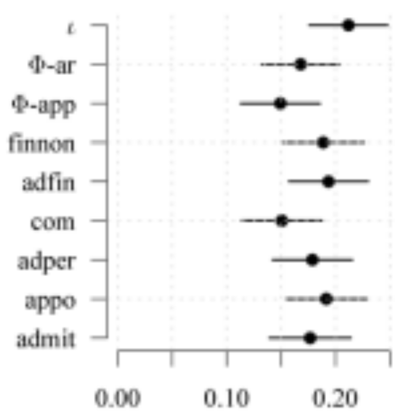


Fig. 3: Estimates of the final syllable durations with all parenthetical types

			Estimate	SE	t value
Fixed effects					
	ι		0.218	0.035	6.216
	Φ-ar		0.168	0.035	4.801
	Φ-app		0.147	0.035	4.171
	Finnon		0.204	0.037	5.542
	Adfin		0.190	0.036	5.348
	Com		0.159	0.036	4.408
	Adper		0.180	0.036	5.060
	Appo		0.191	0.036	5.283
	Admit		0.179	0.037	4.866
Random effects s.d.					
	Length	Intercept	0.0046		
	Speaker	Intercept	0.0082		
	Syl. Type	Intercept	0.0487		

Table 2: Estimates of the final syllable durations with all parenthetical types

With respect to the control, a large difference pertains between ι-final and Φ-final syllable durations. ι-final syllables are *long* and Φ-final syllables are *short*. The final syllables of some parentheticals are dissimilar in duration to both ι-final and Φ-final syllables: they are neither long nor short (*finnon* and *adfin* among the verbal parentheticals, and *appo* among the XP parentheticals). Among the XP parentheticals, the final syllable durations of *adper* and *admit* is very close to the Φ category, as well as *com*, which is in the group of verbal parentheticals. Nevertheless, the final syllable of verbal parentheticals endures for slightly longer than its XP parenthetical counterpart.
Thus, the ordering of the tested items in terms of their final syllable duration is as follows:

(11) ι > verbal parenthetical ≈ XP parenthetical > Φ

4.1.2 Pre-parenthetical host boundary vs. Φ and ι

To see if the part of the host that linearly precedes the parenthetical insertion is isolated or not, the final syllable duration of the pre-parenthetical host item is compared to the final syllable duration of the Φ and ι in the control data. Figure 4 compares pre-parenthetical host-final syllable duration classified for each parenthetical type with the last syllables of Φ and ι.

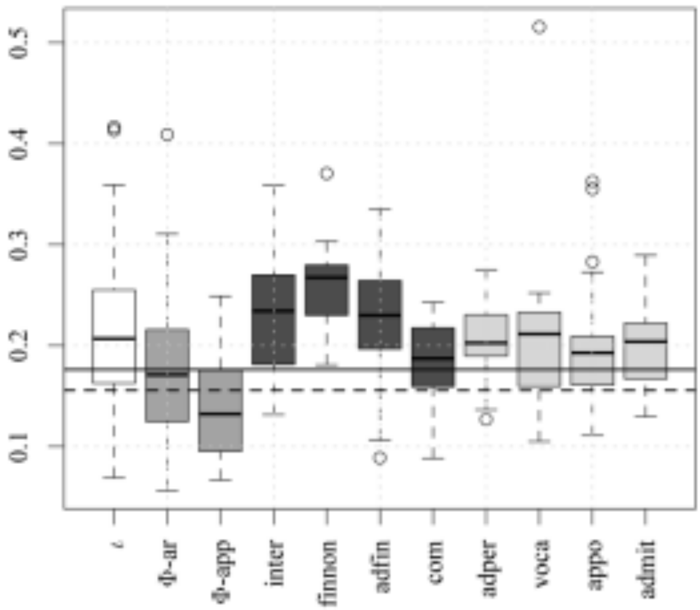


Fig. 4: Final syllable duration of Φ and ι boundaries and the pre-parenthetical host-clause part for all parenthetical types

The pre-parenthetical final syllable duration is as long as or longer than ι boundaries in the case of verbal parentheticals. The host part that precedes XP parentheticals is shorter than the overall duration of verbal parenthetical cases and closer to Φ-final syllables. As before, speaker and syllable type and the length of the analysed item cause systematic variation in the results presented in Figure 4. Therefore, we create a model where length, speaker and syllable type are included as random effects. Figure 5 and Table 3 present the results.

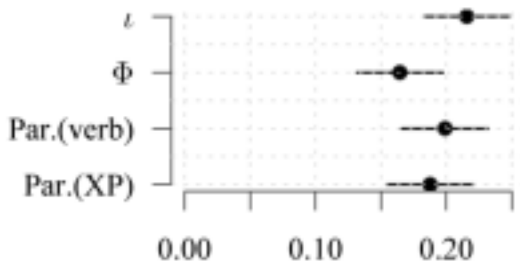


Fig. 5: Estimates of the final syllable durations of ι, Φ, and pre-parenthetical host syllable durations before verbal parenthetical and XP parenthetical

			Estimate	SE	t value
Fixed effects					
	ι		0.216	0.033	6.548
	Φ		0.164	0.033	5.010
	Par.(verbal)		0.199	0.033	6.018
	Par.(XP)		0.188	0.033	5.664
Random effects s.d.					
	Length	Intercept	0.0000		
	Speaker	Intercept	0.0059		
	Syl. Type	Intercept	0.0461		

Table 3: Estimates of the final syllable durations of ι, Φ, and pre-parenthetical host syllable durations before verbal parenthetical and XP parenthetical

Figure 5 and Table 3 provide results closer to those observed with final syllable duration. The duration of pre-parenthetical syllables lies between the duration of the final syllables of Φ and ι. Again, a difference in duration between verbal and XP parentheticals is observed – this time in a more pronounced way. Pre-verbal parenthetical host-final syllable duration is closer to ι-final syllable duration, while pre-XP parenthetical host-final syllable duration is closer to the Φ-final syllable duration.

The parameter estimates of the detailed model including all the sub-groups of the control and the test are presented in Figure 6 and Table 4.

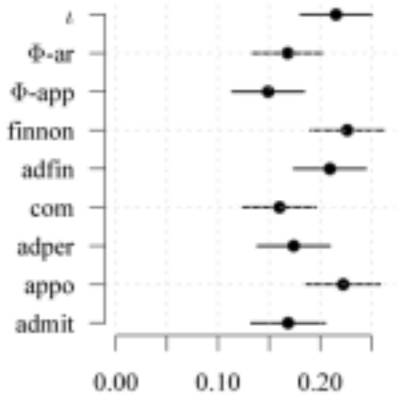


Fig. 6: Estimates of the final syllable durations of ι, Φ and pre-parenthetical host syllable durations for detailed parenthetical types

			Estimate	SE	t value
Fixed effects					
	ι		0.216	0.035	6.180
	Φ-ar		0.168	0.035	4.831
	Φ-app		0.149	0.035	4.231
	finnon		0.226	0.036	6.253
	adfin		0.209	0.035	5.939
	com		0.160	0.036	4.494
	Adper		0.174	0.035	4.904
	Appo		0.223	0.036	6.191
	Admit		0.169	0.036	4.655
Random effects s.d.					
	Length	Intercept	0.0004		
	Speaker	Intercept	0.0060		
	Syl. type	Intercept	0.0489		

Table 4: Estimates of the final syllable durations of ι, Φ and pre-parenthetical host syllable durations for detailed parenthetical types

The results of the detailed model in Figure 6 and Table 4 support the earlier model's conclusions with some exceptions. Although pre-verbal parenthetical syllable duration is longer than pre-XP parenthetical duration, and closer to ι-final syllable duration, the host part that immediately precedes *com* has the shortest difference, being closer to XP parenthetical and Φ-final syllable duration. A similar behaviour is observed for the host part that precedes XP-parenthetical *appo*, which is, this time, closer to ι-final syllable duration.

In sum, on average, the final syllable duration values before parentheticals are in between ι-final and Φ-final syllable durations. The ordering of the tested items in terms of their final syllable duration is shown below:

(12) ι ≈ pre-verbal-par. host > pre-XP-par. host > Φ

4.2 Pauses

Number and duration of the pauses before and after the parentheticals are compared to the number and duration of the pauses before and after Φs and ιs in the control. Figure 4 presents a logarithm of the duration of the pauses before (left) and after (right) the indicated phrase types. The graph only presents the durations where a pause occurred. The rate of pauses after indicated types is analysed and presented separately.

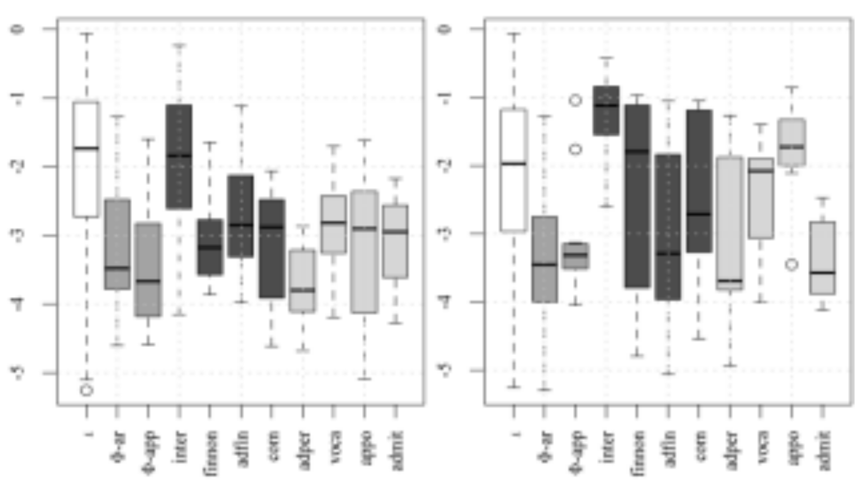


Fig. 7: Duration (in log scale) of the pauses before (left) and after (right) each type

The first impression we get from Figure 7 is that pauses occur both before and after all phrases of interest. For all parentheticals, the general tendency is that the pauses before the tested items are shorter than the pauses that come after. The pauses that occur before and after the interjections are the longest in duration. The pauses that come after the appositives are the longest among XP parentheticals. Pauses surrounding ιs are considerably longer than the pauses that surround Φ types.

Pause duration results are in line with the final syllable duration values; ι > parenthetical > Φ. Parenthetical types show a large internal variation. Within parentheticals there is a verbal parenthetical > XP parenthetical ordering, especially in the cases of pauses that follow the parentheticals. Excluding the set of *inter*, the pauses that come before the parentheticals seem to be closer in duration to the pauses that come before Φ types.

We fit two more models as before, this time predicting the pauses on the sides from the phrase types. We include *speaker* and the item *length* as the random variables. The model in Figure 8 and Table 5 estimates the pause durations in the occurrences before the four main groups.

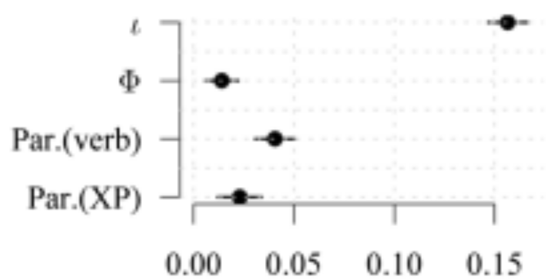


Fig. 8: Estimates of the duration of the pauses that occur before ι, Φ, verbal and XP parenthetical

		Estimate	SE	t value
Fixed effects				
ι		0.139	0.011	12.583
Φ		0.013	0.009	1.423
Par.(verbal)		0.038	0.011	3.399
Par.(XP)		0.020	0.012	1.695
Random effects s.d.				
Length	Intercept	0.0051		
Speaker	Intercept	0.0089		

Table 5: Estimates of the duration of the pauses that occur before ι, Φ, verbal and XP parenthetical

The model fit on the pauses that are observed before the phrases show that pauses that follow ι are remarkably longer than the others. Pre-ι pause duration is followed by pre-verbal parenthetical pause duration, which is followed by the duration of pauses that come before XP parentheticals. Pre-Φ pause duration is the shortest.

The model presented in Figure 9 and Table 6 below estimates of pause duration in the occurrences after ι, Φ, verbal parenthetical and XP parenthetical.

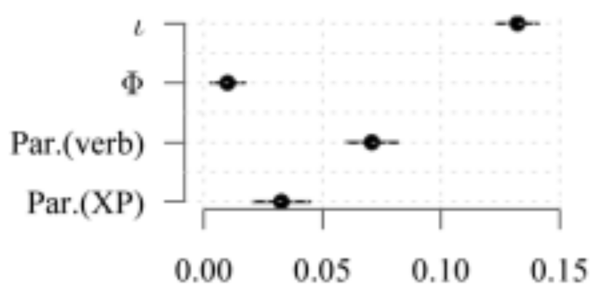


Fig. 9: Estimates of the duration of the pauses that occur after ι, Φ, verbal and XP parenthetical

		Estimate	SE	t value
Fixed effects				
ι		0.140	0.009	15.382
Φ		0.010	0.007	1.420
Par.(verbal)		0.068	0.012	5.636
Par.(XP)		0.036	0.013	2.867
Random effects s.d.				
Length	Intercept	0.0000		
Speaker	Intercept	0.0066		

Table 6: Estimates of the duration of the pauses that occur after ι, Φ, verbal and XP parenthetical

Pauses that occur on the right edge of the analysed items support the previously attested order, i.e. ι > verbal parenthetical > XP parenthetical > Φ. This time the differences are clearer, and the estimates of the parameters are more certain. The results of this model show that pauses that occur after the parentheticals tested are longer than the pauses that occur before them. For the sake of completion, Figure 10 and Table 7 present estimates of detailed model parameters for pause durations before and after the phrase types.

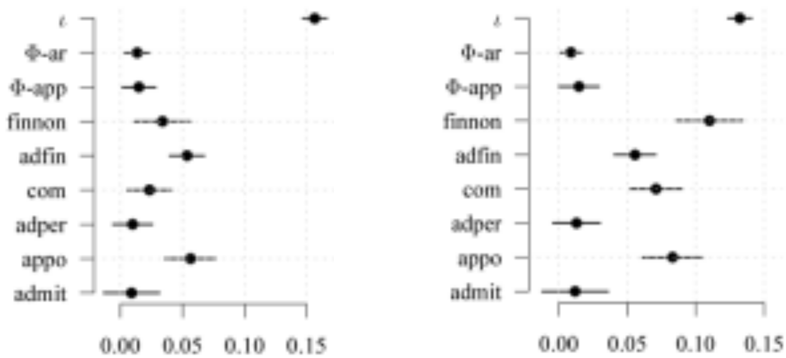


Fig. 10 Estimates of the duration of the pauses that occur before (left) and after (right) all types

		Before			After		
		Estimate	SE	t value	Estimate	SE	t value
Fixed effects							
ι		0.139	0.011	12.315	0.140	0.009	15.473
Φ-ar		0.011	0.011	1.040	0.009	0.008	1.158
Φ-app		0.016	0.013	1.215	0.015	0.014	1.017
finnon		0.030	0.022	1.397	0.136	0.026	5.142
adfin		0.050	0.015	3.422	0.046	0.016	2.825
com		0.020	0.018	1.114	0.063	0.022	2.886
adper		0.006	0.016	0.378	0.014	0.018	0.801
appo		0.053	0.020	2.645	0.083	0.022	3.829
admit		0.005	0.022	0.242	0.015	0.026	0.560
Random effects s.d.							
Length	Intercept	0.0061			0.140		
Speaker	Intercept	0.0089			0.009		

Table 7: Estimates of the duration of the pauses that occur before (left) and after (right) all types

The detailed models support the above conclusions, with the previously observed outliers. Now, we focus on the frequency of pauses rather than their duration. Figure 11 presents the number of pauses before and after each phrase type.

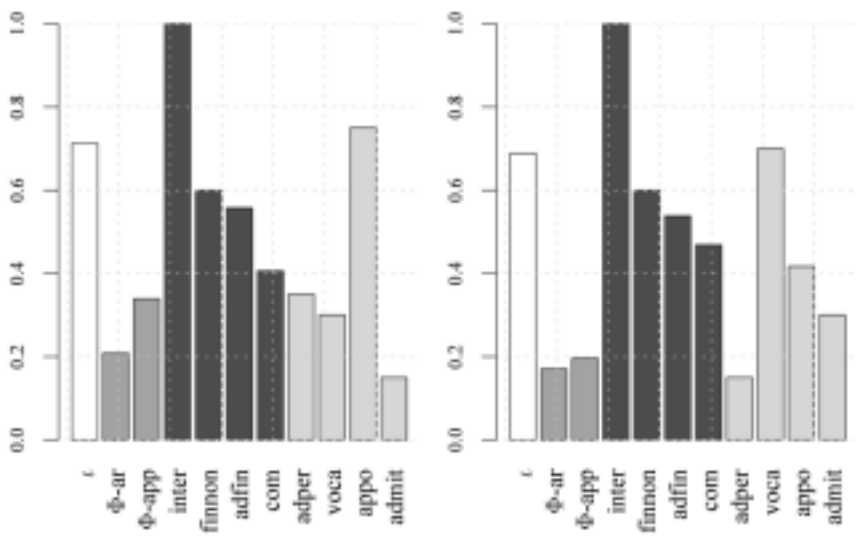


Fig. 11: The rate of pauses before (left) and after (right) constituents for all types

The results of the distribution of the pauses that occur before and after the items analysed showed an ordering similar to the one of the results of the duration of the pauses. Among the parenthetical set, *inter* and *voca* exhibit the highest number of pauses on their right edge, which is at least as high as the number of pauses that come after ι boundaries. When we compare the verbal parentheticals to XP parentheticals (excluding *inter* and *voca*), we see that verbal parentheticals exhibit higher occurrences of pauses, which were also longer. Pauses on both sides of the Φ boundaries are shorter and fewer in number. The pauses surrounding the XP parentheticals are closer to Φ boundaries in duration and distribution. However, in contrast to their right edge, appositives exhibit a higher amount of pauses on their left edge. The ordering is shown in (13):

(13) ι > verbal parenthetical > XP parenthetical > Φ

In addition to the ordering we observed in (13), another conclusion of this subsection is that the pauses that come before each parenthetical type are shorter and fewer in number, whereas the pauses that come after each type are longer and more frequent.

4.3 Final rise

The degree of rise of the final syllables of Φs and ιs in the control data is compared to the degree of rise of the final syllables of each parenthetical in the test data. In the case of ι-final rise, the set 'ι' is divided into two groups; (i) on nucleus-ι (*ι-n*), where the ι-final item itself is the nucleus and the ι ends with a high plateau (8a), and (ii) post-nucleus ι boundary (*ι-pn*), where the ι-final Φ is more than one word and the right edge comes after the nucleus (8b).

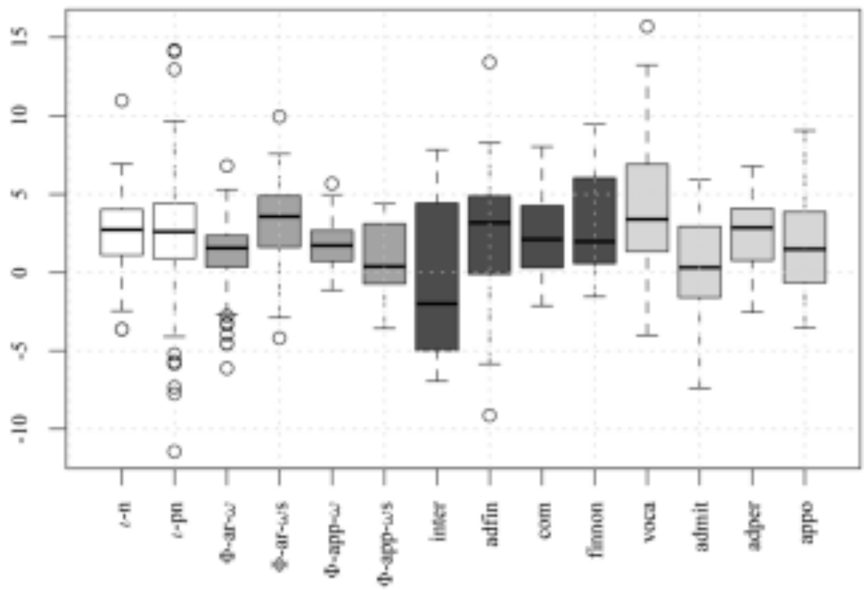


Fig. 12: The degree of rise in the final syllables

The box plot on Figure 12 represents the difference between the mean pitch value of the final and penultimate syllables for all types. The first impression we get from these graphs is again similar to the previous cues. The set of Φs shows the least degree of final rise. Within the set of parentheticals, verbal parentheticals seem to show a higher rise in comparison to XP parentheticals. Again, *inter* exhibits a very different trend than the other verbal parentheticals. Specifically, it exhibits the lowest degree of pitch difference, which indicates in most cases there is no rise but fall indicating a low boundary, L%. This becomes more visible when the individual F0 contours of *inter* are examined. The other exceptional case for its category was *voca* in the set of XP parentheticals. Similar to the

results attained from the previous cues, *voca* exhibits a variation in its group and bears a higher final rise. Excluding the type *inter*, the final rise of ιs and verbal parentheticals are alike. Similarly, excluding the type *voca*, final rise of Φs and XP parentheticals are closer to each other.
We observe that there is some variation in the case of ι based on whether ι shares its last word/syllable with the last syllable of the nucleus (*ι-n*), or whether it follows the nucleus (*ι-pn*). Accordingly, the former bears a smaller magnitude of final rise in comparison to the latter. This variation is expected considering the transmission from the low levelled pitch level of the post nuclear area to a H% boundary which is triggered by comma intonation. The same variation is also observed in the cases of Φ-final rise. Specifically, the phonological phrases that bear only one word (Φ-ar-ω) show a smaller magnitude of final rise, whereas phonological phrases that contain more than one word (Φ-ar-ω) exhibit a higher rise. This variation is due to the difference in the pitch register across the head and non-head parts of the Φs that contain more than one word.

We also fit a model that takes length as well as the speaker variation as random effects (against systematic pitch-range variation due to speakers). First, a model that only distinguishes ι, Φ and two main parenthetical subdivisions is presented in Figure 13 and Table 8.

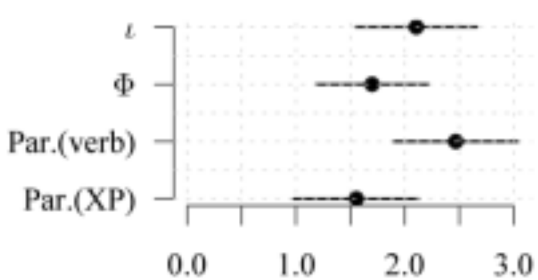


Fig. 13: Estimates of the final F0 rise of ι, Φ, verbal parenthetical and XP parenthetical

		Estimate	SE	t value
Fixed effects				
ι		2.106	0.557	3.782
Φ		1.700	0.519	3.275
Par.(verbal)		2.469	0.577	4.277
Par.(XP)		1.556	0.576	2.700
Random effects s.d.				
Length	Intercept	0.6159		
Speaker	Intercept	0.7905		

Table 8: Estimates of the final F0 rise of ι, Φ, verbal parenthetical and XP parenthetical

All phrase types indicate a rise from penultimate syllable to final syllable. Verbal parentheticals show the highest rise, followed by ι, XP parentheticals and Φ, with a rather small difference between the XP parentheticals and Φ. This supports a 'verbal par > ι > XP par >≈ Φ' ordering. The model below shows the case of detailed grouping:

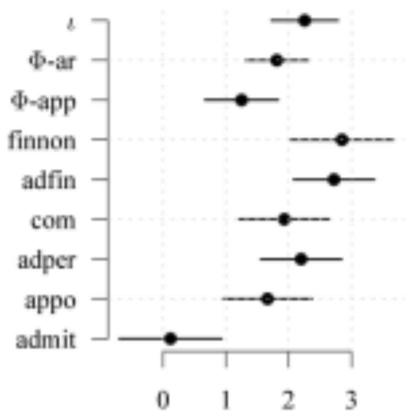


Fig. 14: Estimates of the amount of the final F0 rise for all types

		Estimate	SE	t value
Fixed effects				
ι		2.255	0.531	4.246
Φ-ar		1.811	0.503	3.601
Φ-app		1.250	0.584	2.140
Finnon		2.850	0.822	3.467
Adfin		2.721	0.645	4.221
Com		1.931	0.716	2.698
Adper		2.199	0.645	3.409
Appo		1.663	0.712	2.337
Admit		0.117	0.816	0.144
Random effects s.d.				
Length	Intercept	0.5007		
Speaker	Intercept	0.7907		

Table 9: Estimates of the amount of the final F0 rise for all types

The main trend is similar to the results above. Although the majority of verbal parentheticals exhibit high rise (which is higher than the ι condition), comment clauses diverge and exhibit a rise that is closer to Φ condition. The ordering of the four major groups in terms of the final rise is shown in (14):

(14) verbal par > ι > XP par ≈ Φ

4.4 Initial lowering

In the control, the mean F0 of the initial syllable of the Φ, where the L is observed, is subtracted from the mean F0 of the final syllable of the preceding Φ, where the H- is observed. The same procedure is also applied to ι boundaries. Note that, for this condition, only the non-initial Φs and ιs are calculated - i.e. in Φ cases, sentence initial syllables are excluded. In ι cases, only the ι-initial syllables of the non-initial sentences are analysed.

In the test set, the mean F0 of the initial syllable of the parentheticals is subtracted from the mean F0 of the final syllable of the host (non-)constituent that immediately precedes the parenthetical. The graph in Figure 15 presents the mean difference of initial lowering.

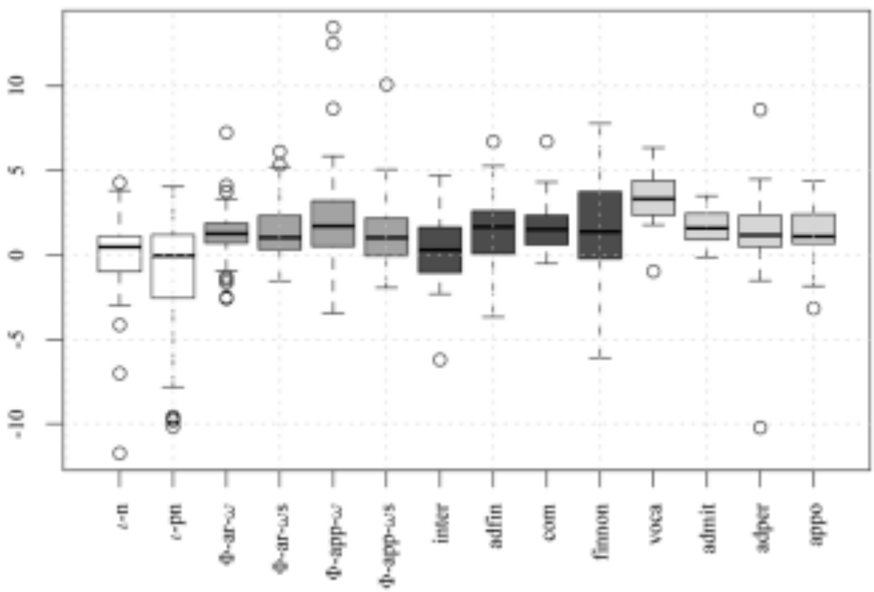


Fig. 15: The difference (in semitones) of the mean F0 of the initial syllables, and the mean F0 of the final syllables of the items that immediately precede them

The graph shows a degree of lowering for all groups. However, there does not seem to be a consistent difference across all types. In fact, the figure shows that for all types, the initial fall values are centred between 1 and 2 semitones for all cases.

Figure 16 and Table 10 present the results we obtain when we investigate initial lowering with a model with four groups (also including the *ι-n/ι-pn* distinction):

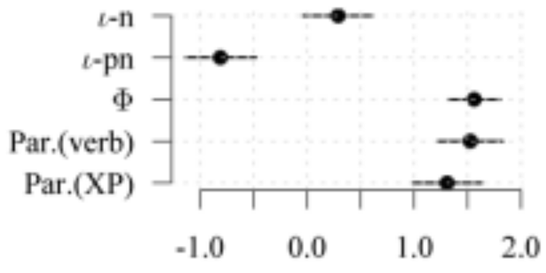


Fig. 16: Estimates of initial lowering for ι-n, ι-pn, verbal parenthetical, XP parenthetical, and Φ

		Estimate	SE	t value
Fixed effects				
ι-n		0.290	0.328	0.886
ι-pn		-0.811	0.333	-2.438
Φ		1.561	0.246	6.349
Par.(verbal)		1.525	0.304	5.024
Par.(XP)		1.308	0.323	4.052
Random effects s.d.				
Length	Intercept	0.0000		
Speaker	Intercept	0.4084		

Table 10: Estimates of initial lowering for ι-n, ι-pn, verbal parenthetical, XP parenthetical, and Φ

While the base level (*ι-n*) shows the least differences in pitch, the post-nuclear ι (*ι-pn*) shows the most. The initial syllable of the ι that follows ι-pn exhibits higher F0 than the final syllable of the preceding ι, which bears a H% tone. This may be due to two reasons: Either the rise on the right edge of ι-pn cases is not as high, or the ιs that succeed the ιs that end with a post-nuclear area start higher (e.g. higher than the right edge of ι-pn cases) and not low. Φ-initial F0 level is almost the same as verbal and XP parentheticals. Φs, verbal parentheticals and XP parentheticals exhibit substantial lowering on their left edges, which is considerably lower than both of the ι-initial cases. The last model below shows the case when we apply the model to all subgroups.

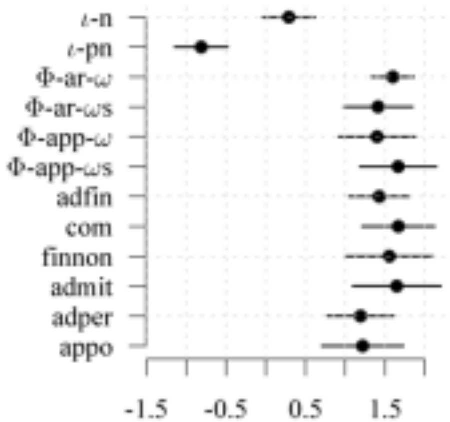


Fig. 17: Estimates of the initial lowering of all sub-types

		Estimate	SE	t value
Fixed effects				
ι-n		0.290	0.328	0.883
ι-pn		-0.811	0.334	-2.432
Φ-ar-ω		1.598	0.264	6.048
Φ-ar-ωs		1.412	0.435	3.250
Φ-app-ω		1.399	0.480	2.913
Φ-app-ωs		1.664	0.480	3.464
Adfin		1.428	0.379	3.769
Com		1.667	0.455	3.661
Finnon		1.553	0.554	2.805
Admit		1.647	0.554	2.975
Adper		1.192	0.417	2.857
Appo		1.218	0.512	2.378
Random effects s.d.				
Length	Intercept	0.0000		
Speaker	Intercept	0.4080		

Table 11: Estimates of the initial lowering of all sub-types

We observe that the difference between Φ types is not substantial, and that all subtypes of parentheticals resemble the Φ condition. The information we gather from initial lowering is not sufficient to attribute these tendencies to left edge marking, since we cannot be sure if the difference is a result of the variation in the low start on the left edge of the constituents, or the higher/lower end on the right edge of the preceding items of the corresponding constituents. Considering the initial lowering results, one cannot conclude that there is a pitch reset in the case of parentheticals. Nor can we conclude that left edge F0 is employed to mark a difference between the left edges of Φs and ιs in Turkish. Precisely how to draw generalizations from these results is not yet clear to us, and hence must remain an issue for further research.

4.5 An overview of the results

The tables below summarize the results. Table 12 lists the properties of parentheticals in two main groups: verbal parentheticals and XP parentheticals.[14] Table 13 presents the results in terms of the category (Φ or ι) to which the subtypes of parentheticals are closer.[15]

		Type of parenthetical	
Type of measure	**Type of edge**	**Verbal**	**XP**
Final syllable duration	Right edge	< ι, > Φ	< ι, > Φ
Pre-parenthetical syllable duration	Left edge	= ι	< ι, ≈ Φ
Pause length before	Left edge	≈ ι	< ι, > / ≈ Φ
Pause length after	Right edge	≈ ι	< ι, > Φ
The amount of final rise	Right edge	> ι	< ι, ≈ Φ
The amount of initial lowering	Left edge	-	-

Table 12: Summary of the results with main groups of parentheticals

14 We thank the anonymous reviewer for the suggestion of this table for a summary of the findings.
15 Any sub-type of parentheticals that do not pattern with the other members of its group is italicized.

	Type of measure	Phonological Phrase	Intonational Phrase
Right edge cues	Final rise	admit, appo, adper, *com*	finnon, adfin
	Final syllable duration	admit, appo, adper, *com*	finnon, adfin
	Pause length after	admit, adper	finnon, adfin, com, *appo*
Left edge cues	Pre-par. final syllable duration	admit, adper, *com*	finnon, adfin, *appo*
	Pause length before	admit, adper, *com*	finnon, adfin, *appo*
	Initial lowering	-	-

Table 13: Summary of the results with subgroups of parentheticals

5 Discussion

The orderings of the parenthetical types with respect to ι and Φ boundaries in section 4 encode two important observations. First, verbal parentheticals exhibit 'stronger' boundaries that are similar to ι edges. Second, XP parentheticals exhibit 'weaker' boundaries that are similar, if not identical to, Φ edges. This dichotomy both supports and contradicts the theories of syntax-prosody mapping. That finite clausal parentheticals are prosodically parsed closer to intonation phrases supports the idea of clause-to-ι mapping. It also supports the assumption that parenthetical structures are prosodically isolated. However, XP parentheticals exhibit the properties closer to phonological phrase-hood (i.e. they exhibit prosodic integration). This indicates either (i) that there is not such a tight mapping between syntax and prosody in Turkish, or (ii) that the mapping constraints are ranked and can, in certain environments, override one another.

Mapping appears to be overridden in two ways in Turkish. First, Turkish parentheticals are shown to exhibit instances of both prosodic isolation and integration. This indicates that the prosodic realization of syntactic isolation is not highly ranked. More important is to prosodically mark the clause-hood and phrase-hood of the target syntactic structures. Thus, regardless of whether they are extra-sentential or not, root clauses are parsed as ιs, and structures that do not exhibit the properties of root clause-hood tend to be parsed as Φs.

Ranked higher than constituent-to-constituent mapping (and consequently syntactic isolation) is pragmatic relation. If a parenthetical is pragmatically isolated then it is parsed as an ι, regardless of its syntactic type or level of syntactic isolation. This was observed with vocatives[16] and interjections, which exhibit longer final syllables, and longer pauses on their right edge. The final syllable of the host part that immediately precedes them is also longer than XP parentheticals in the test set, and Φs in the control set. Final rise values also provide evidence of their ι-hood. While vocatives exhibit the highest magnitude of final rise (H%), interjections exhibited the lowest values of final pitch rise, which is even lower than Φs' condition. We claim that this is due to a low tone that marks the right edge of the intonation phrase (L%). It is not surprising to observe falling intonation instead of a rising comma intonation in such cases. Since interjections are not related to the content of the discourse, and since they are, in fact, interruptions not only to the host syntactic structures but also to the host discourse structure, they do not necessitate the use of comma intonation, which typically marks a continuation of the ongoing discourse. Therefore, we conclude that pragmatically isolated parentheticals such as clausal interjections and vocatives, the latter of which are XPs, are parsed as ιs regardless of their syntactic properties.

In a similar fashion semantic/pragmatic properties of comment clauses override their syntactic properties in mapping to prosody, yielding them to be parsed as Φs and not ιs. In this case, we observe that when a parenthetical presents a speaker's stand towards the truth of the entire host proposition, then it is prosodically integrated regardless of its syntactic makeup. Güneş (2013) observes that *yanılmıyorsam* 'if I am not mistaken', a clausal parenthetical, is prosodically integrated. This is not surprising considering its function as a comment clause. In fact, based on the syntactic data and their pragmatic behaviour, Griffiths and Güneş (2014) conclude that regardless of their clausal syntax and undominated (parenthetical) syntactic behaviour, comment clauses in Turkish do not exhibit root clausal properties. In this regard, they suggest, these structures should be analysed on par with non-clausal parentheticals. Our findings support the syntactic-pragmatic analysis of these authors. This phenomenon that we observe in Turkish comment clauses is also observed in other languages (cf. Reinhart 1983, Reis 2000, Dehé and Wichmann 2010, Dehé 2014).

16 See Göksel and Pöchtrager (2013) for various prosodic realizations of a wider range of vocatives in Turkish. One should note that the types of vocatives investigated by these authors are not the same as the ones that are analysed in this paper. These authors investigate non-interpolating vocatives that convey meanings such as surprise, calling, checking for identity, and so on (ibid.:92).

Another parenthetical type that does not seem to follow the generalization made in this study is nominal appositives. We observe that appositives exhibit stronger isolation cues especially on their left edge. This is not surprising considering the linear position of appositives and the way they modify their anchors. The appositives that are tested in this study are constituent-modifying parentheticals, which must immediately linearly follow their anchors (Griffiths and Güneş 2014).[17] Functionally, appositives provide an alternative referent for their anchor, while syntactically, they and their anchors share the same maximal projection (ibid.). Their linear position and syntactic-semantic similarity with the anchor forces a stronger prosodic boundary in the juncture of the appositive and its anchor, which acts as a parser that separates these syntactic-semantic likes. One can envisage this as a prosodic strategy that ensures that Richard's (2001) Distinctness Condition on Linearization, or some constraint similar to it, is satisfied. However, the presence of a stronger left edge boundary does not engender total prosodic isolation of appositives, as they do not exhibit ι-level properties on their right edge. That they are parsed as Φs is further supported by Griffiths and Güneş (2014). These authors note that, while prosodically isolated parentheticals such as *ki* clauses (9b) cannot occupy the nucleus of their hosts, appositives can. Similarly, while parentheticals that are parsed as ιs cannot occupy post-nuclear area of their host-ι, appositives can. In this respect, appositives exhibit the same prosodic properties as their anchors, and as other arguments of their host. Therefore, we consider appositives to be parsed as Φs, but with a more pronounced left edge.

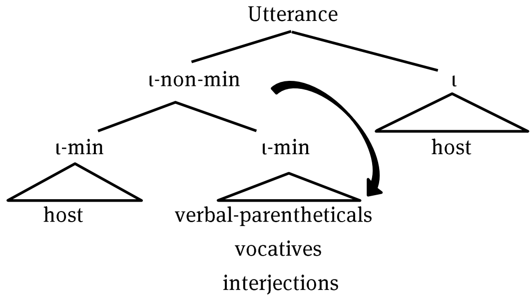
Our results show that pauses are employed to mark the edges of both Φ and ι. However, the duration of the pauses displays variation. While verbal parentheticals exhibit similar values to the edges of ιs, XP parentheticals are found to be closer to the pauses surrounding Φs. Note that, in all cases, a pause that precedes a parenthetical is shorter than the pause that follows it.

This fact may be analysed in two ways. First, although their prosodic category type matches with their syntax (XP to Φ and clause to ι), parentheticals inherit some properties of their paratactic nature. The resulting prosodic form may be represented as a hybrid prosodic category type, which has slightly stronger boundaries than their already existing correlates, call it "Φ_{par}" for XP parentheticals, and "ι_{par}" for verbal parentheticals, where the hierarchical order of types is $\Phi < \Phi_{par} < \iota_{par} < \iota$. Alternatively, instead of postulating a new category

17 Their correlate structure in English is constituent modifying appositives; i.e. *namely*-parentheticals. In Turkish, instead of *namely* an Arabic loan *yani* is optionally used. For a detailed syntactic analysis of *yani* parentheticals see Griffiths and Güneş (2014).

type, one can analyse this observation as a case of prosodic recursion, where the prosodic unit created by recursion is marked by a greater degree of prominence than a unit not created by recursion on its right edge. To illustrate the latter analysis, we postulate the structure in (15) for verbal parentheticals, interjections and vocatives.[18]

(15)



The structure in (15) is a recursive prosodic structure in which the non-terminal prosodic type ι-non-min displays a 'more prominent' right edge. This prominence is realized on the right edge of the parenthetical, which is the right-branching daughter of ι-non-min. The structural position of the parenthetical in (15) thus explains why pause durations before the parenthetical are shorter than those that occur after the parenthetical: the former marks the edge of an 'atomic' prosodic unit, while the latter marks the edge of a prosodic unit built from self-similar units (in this case, the self-similar units are ιs).

Longer pauses are not reserved for marking verbal parentheticals. XP parentheticals also exhibit pauses on their right edge, yet these pauses are not as long as the pauses observed in the ι boundary condition, even though they were longer than the pauses that linearly precede XP parentheticals. In fact, the pauses observed after XP parentheticals are longer, but still closer to the duration of the pauses that follow Φ boundaries. Keeping in mind that the XP parentheticals are also similar to the Φ condition in terms of final syllable lengthening, final rise, and pre-parenthetical host-final syllable durations, we claim that sentence-medial XP parentheticals are not the immediate daughters of any ι (neither a ι-non-min, nor a ι-min). For XP-parentheticals, we postulate the structure in (16).

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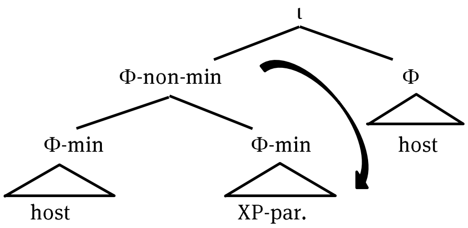
18 *ι-non-min* refers to any ι that dominates another ι. *ι-min* refers to any ι that does not dominate another ι. See Elfner (2012) for cross-linguistic evidence that necessitates the use of minimal and non-minimal projections.

(16)



Like (15), (16) is a recursive structure. Again, recursion explains the disparate durations of the pauses on each side. The only difference between (15) and (16) is that, in (16), the non-terminal unit created by recursion is a Φ, whereas in (15) it is an ι. Thus, we expect – and do – observe that the right edge of Φ-non-min displays the properties of a Φ-boundary, albeit one that is more prominent than the boundary observed on an 'atomic' Φ on its right edge.

The argument propounded above accords with the idea of recursive prosodic levels, where the more recursive layers there are, the stronger the boundaries are marked (Kawahara 2012; Itô and Mester 2009, 2012). What is novel about our argument is the claim that recursion is encoded in only pause duration, and that other cues, together with the duration of pauses, are employed only to mark a prosodic unit as a ω or Φ or ι.

Note that a non-recursive model cannot explain the data adequately since it would predict equal boundary strength on both edges of any category.

6 Conclusion

In conclusion, verbal parentheticals exhibit ι-level properties on both edges. XP parentheticals, on the other hand, exhibit phonological phrase-level properties on both edges. Clausal parentheticals are prosodically isolated, supporting the theories of syntax-prosody mapping, while XP parentheticals are prosodically integrated, partially supporting syntax-prosody mapping theories. The latter result supports theories that assume XP-to-phonological phrase matching, but not those that predict the prosodic isolation with parentheticals. We conclude that Turkish marks constituent-to-constituent matching of syntax and prosody more faithfully than the mapping of syntactic isolation. Additionally, mapping of pragmatic isolation is highly favoured. Specifically, pragmatically isolated parentheticals such as vocatives or interjections are prosodically isolated, regardless of their syntactic make-up. In this sense our findings are on par with the findings of Güneş (2013). We discussed the prosodic structure of Turkish parentheticals and proposed a representation that favours the recursion of various prosodic category types. Both types of parentheticals are found to exhibit relatively longer pauses on their right edges. To account for the unequal distribution and duration of the pauses, we have proposed a recursive prosodic representation. Overall, our experiment has revealed various aspects of the prosody of parenthetical insertions in Turkish. However, our study is exploratory and leaves several questions for future inquiry. Additionally, the results reported here were based on the controlled productions of four speakers; for a more elaborate account of the parentheticals in Turkish, experiments with more speakers should be carried out, as well as the analyses of spontaneous speech.

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