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The Role of Prosody in Syntactic Disambiguation in Turkish[1]

У раду се истражује утицај прозодије на интерпретацију синтаксички двосмислених структура у турском језику. Резултати експерименталне студије показују да прозодијске границе играју битну улогу у решавању синтаксичких двосмислености и разумевању синтаксички двосмислених структура у овом језику.

⊶ **Кључне речи**:
prosody, prosodic boundary, syntactic disambiguation, Turkish.

INTRODUCTION

Previous works on English, Korean, and Japanese (Carlson, Clifton & Fraizer 2001; Kang & Speer 2002, 2005; Kang, Speer & Nakayama 2005, among others) have shown that prosodic structures can carry important information about meaning of sentence and its syntactic structure, and prosodic boundaries can play crucial role in disambiguation of ambiguous sentences. Turkish, which is verb-final and head-final language like Korean and Japanese, has a rather free word order, mostly does not make use of complementizers (such as *ki* and *diye*), but, instead, has non-finite embeded clauses with verb taking special morphology (-*DAn önce, -(y) ArAk*, -ken etc.), its pro-drop and agglutinative nature are all properties that trigger syntatic ambiguity in great number of cases in this language.

Therefore, in this study we assume that in Turkish, as well as in previously investigated languages, prosodic boundaries will

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provide reliable information in reaching the boundaries of syntactic structures, and that prosodic phrase structure can play crucial role in comprehension of syntactic structures and selecting syntactic constituents.

The structures under investigation in the study are: *I. Sentences with relative clauses* and *II. Sentences containing adverbial and*

relative clause, both being divided in a few types:

1. Sentences with relative clauses:

1. Relative clauses followed by complex NPs with genitive constructions [NP1$_{GEN}$ + NP2], as in:

Tören-e	katıl-an	[siyasetçi-nin]$_{NP_1}$	[kuzen-i-ni]$_{NP_2}$	tarif et-ti.
ceremony-DAT	participate-REL	politician-GEN	nephew-POS-ACC	describe-PAST

(He/she) described the nephew of the politician who participated in the ceremony[2].

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In the example above either the first or the second noun phrase (NP1, NP2) can be a subject of the relative clause. When NP1 is the subject of relative clause there is no syntactic boundary between relative marked verb and NP1, and in cases where NP2 is

the subject of relative clause that boundary exists.

2. Relative clauses followed by complex NPs containing postpositional phrases [[NP1 P]PP + NP2], as in:

Kırmızı	giy-en	[kadın-ın]$_{NP_1}$	[yanındaki]$_{PP}$	[kız]$_{NP_2}$	İstanbul'da otur-uyor.
red-ADJ	dress-REL	woman-GEN	next to-PREP	girl-NOM	Istanbul-LOC live-IMPF

The girl next to woman who is dressed in red lives in Istanbul.

As in previous example, in cases when NP1 is the subject of relative clause there is no syntactic boundary between relative marked verb and NP1, and when NP2 is the subject of relative clause that boundary exists.

3 Sentences with two relative clauses, as in:

Balkon-da	dur-an	[hizmetçi-yi]$_{NP_1}$	çağır-an	[kadın]$_{NP_2}$	albay-ın	eşi-dir.
balcony-LOC	stand-REL	servant-ACC	call for-REL	woman-NOM	collonel-GEN	wife-GM

a) The woman who is calling for the servant who is standing on the balcony is collonel's wife.
b) The woman who is standing on the balcony and calling for the servant is collonel's wife.

Here verb of the first relative clause is ambiguous: if there is no boundary between *duran* and NP1, NP1 is the subject of that

clause, if the boundary exist NP2 become subject of the same clause.

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2) From (1) and (2) examples we can notice that the same type of ambiguity stands for English, too. This kind of ambiguity also occurs in Serbian: *Opisao/la je rođaka političara koji je učestvovao na ceremoniji; Devojka pored žene koja je obučena u crveno živi u Istambulu.*

ii. Sentences containing adverbial and relative clause

1. Sentences containing manner and relative clause, as in:

[Ayşe]NP₁	gül-erek	soru	sor-an	[adam-ı]NP₂	destekl-iyor.
Ayşe-NOM	smile-MAN	question-NCM³	ask-REL	man-ACC	support-IMPF

a) Ayşe, smiling, supports the man who is asking questions.
b) Ayşe supports the man who is smiling and asking questions.

In the example above the verb of manner clause (*gülerek*) is ambiguous: at the same time it can be used to describe action of either the main subject (*Ayşe*) or the accusative marked noun (*adam-ı*). When there is no boundary between the main subject (*Ayşe*) and the verb of manner clause (*gülerek*), the main subject is also the subject of the manner clause; and when that boundary exist the subject of the relative clause (*adam-ı*) will also become the subject of the manner clause. This type of syntactic ambiguity also present in Japanese and Korean, has been investigated in Misono, Mazuka, Kondo & Kiritani (1997), and Kang & Speer (2005).

2. Sentences containing temporal and relative clause, as in:

[Aslı]NP₁	okul-a	gid-er-ken	ağla-ma-ya	başla-yan	[Selim'e]NP₂	muz	ver-di.
Aslı-NOM	school-DAT	go-AOR-TEMP	cry-VN-DAT	start-REL	Selim-DAT	banana-NCM	give-PAST

a) Aslı gave a banana to Selim who started to cry when going to school.
b) Aslı, when going to school, gave a banana to Selim who started to cry.

This study, relying on a two-stage experiment, aims to show that prosodic boundaries can play a crucial role in resolving syntactically ambiguous sentences like those above. In following sections we briefly present intonation model used in the study, and prosody in Turkish and after that discuss data obtained in the experiment.

AUTOSEGMENTAL-METRICAL MODEL
AND TURKISH PROSODY

In Autosegmental-Metrical Model (AM) of Intonation Phonology proposed by Beckman & Pierrehumbert (1986) prosodic features of utterances are investigated in terms of prosodic phrasing, prominence relations and tonal phenomena within the utterance. Being intimately linked with prosodic phrasing, prosodic boundaries have a very important place in phonological and AM studies. Frequently asked questions such as what is the nature of relation between prosodic and syntactic structures, and how are prosodic boundaries used in speech production and comprehension have also been in the focus of this study.

The strength of prosodic boundary has usually been related to length of the pause at that boundary, lengthening of final syllable in the phrase and the degree of variation in intonation pattern. In AM model the strong-

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3) Non-case marked noun when functions as indefinite or categorial direct object usually does not take accusative case marking. Also this direct object can indicate both singular and plural in Turkish.

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est boundary in the utterance indicates presence of the biggest Intonation Phrase (IP). Although a systematic work on Turkish in the framework of AM model does not exist, we can assume, relying on Levi (2005), that each utterance in Turkish is made up of one or more Intonational Phrases which in turn consists of one or more Accentual Phrases (AP). According to Levi (2002), in Turkish most words form a separate AP unless they are dephrased and grouped with another AP. The biggest prosodic unit, an IP ends with boundary tone which can be high (H%) or low (L%). In a similar way, smaller AP can end with high (H-) or low (L-) phrasal tone[4]. As in other languages, actual prosodic phrasings in Turkish are not easy to predict because they depend on syntactic, semantic, pragmatic (information structure), phono-logical (rythm, phrase length), and performance (speech rate) factors.

EXPERIMENT

1. Written study

Written study was conducted to investigate participants` preffered interpretation of sentences like those in (1)–(5). 15 target sentences were mixed with an additional 10 filler sentences and given to the participants in a written questionnare form. Each sentence on the questionnare was followed by a comprehension question about the sentence, such as *Who is standing on the balcony? Who is smiling?* along with two choices but also, in order to determine participants` sensitivity to the ambiguity, they were allowed to mark the both answers. 44 native Turkish
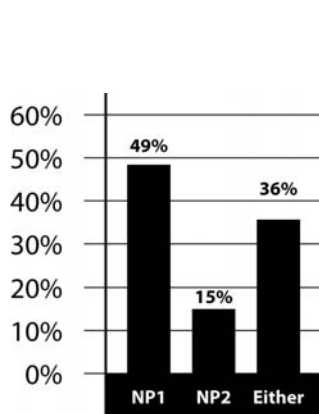

Figure 1.
Results for relative clauses followed by complex NPs with genitive constructions
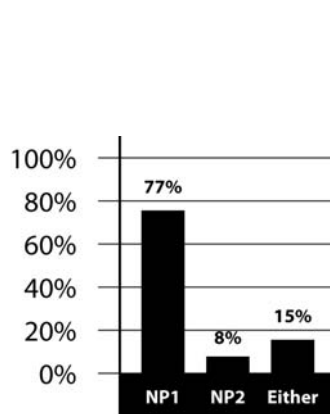

Figure 2.
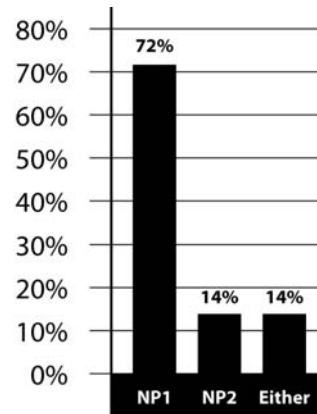Results for relative clauses followed by complex NPs containing postpositional phrases

Figure 3.
Results for senteces with two relative clauses

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4) Beside these boundary tones there are also lexical pitch tones in Turkish. Although the subject has not been well investigated we assume, folowing Özge (2003), the existance of four tones, such as: H*, L+H*, H*+L, and L*

speakers participated in the study. The results in Figures 1, 2, and 3 show the results for the *I. Sentences with relative clauses,* and in Figures 4 and 5 results for *II. Sentences containing adverbial and relative clause* were presented.

As we can see from Figures 1, 2, and 3 for each sentence type NP1 was chosen as the subject of relative clause, but while in relative clauses followed by complex NPs with genitive constructions NP1 was chosen 49% of the time, in other two cases NP1 was chosen significantly more often (77% and 72%). As for participants' sensitivity to ambiguity, results show that the sensitivity is stronger in relative clauses followed by complex NPs with genitive constructions (36%), than in structures with postposition phrase (14%) or two relative clauses (15%).

Kırkıcı (2004) in his psycholinguistic study also investigated the way native speakers of Turkish resolve relative clause attachment ambiguities in relative clauses followed by complex NPs with genitive constructions

and in relative clauses followed by complex NPs containing postpositional phrases. Although his study was dealing just with syntactic aspect of this phenomenon, the results obtained are very interesting for this study, too: 1. in sentences where an ambiguous relative clause has two potential [+human] attachment NP hosts in the genitive condition no attachment preference was displayed, and 2. there was a strong preference to attach the ambiguous relative clause to the low NP1 in conditions where two potential [+human] NP hosts are joined by means of a postposition. From Figures 1 and 2 we can see that the results of both studies show the similar bias.

Comparing with relative clauses much stronger sensitivity to ambiguity was shown in sentences containing adverbial and relative clause with mean percentage of 51% for manner and 54% for temporal clauses. There was no significant difference in chosing NP1 (27% for manner, 25% for temporal clauses) and NP2 (22% and 21%, respectively).
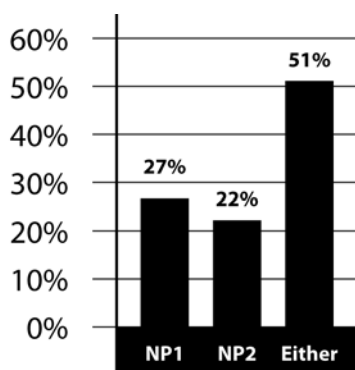
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Figure 4.
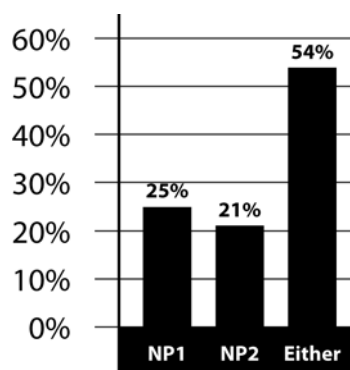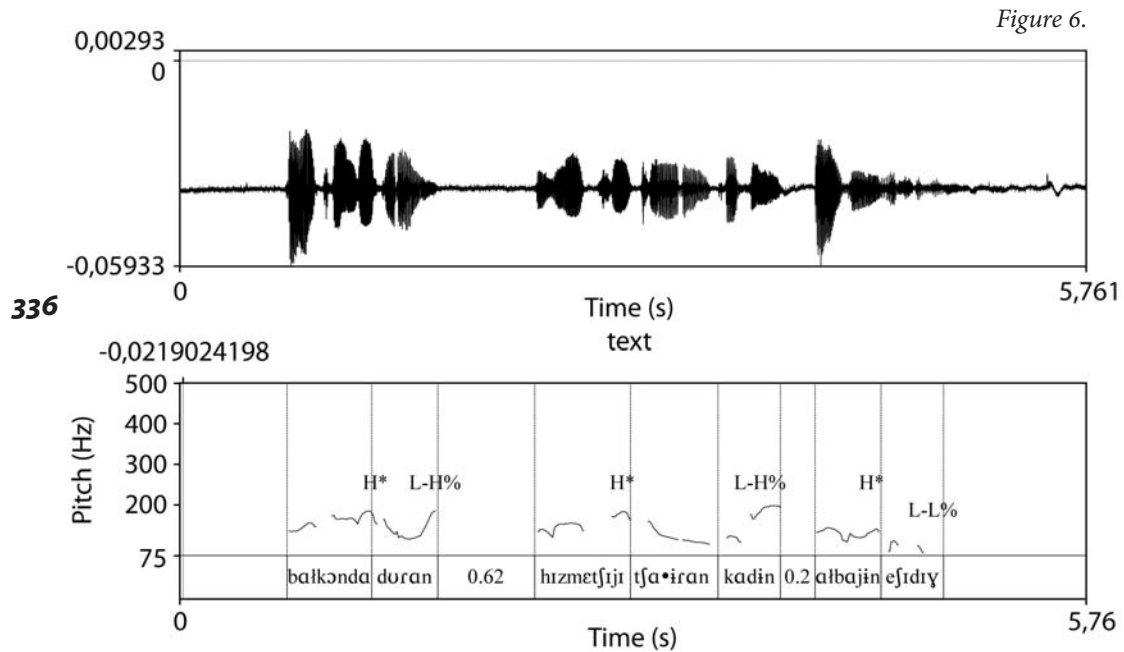Results for sentences containing manner and relative clause

Figure 5.
Results for sentences containing temporal and relative clause

Figure 6.

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2. Auditory study

In accordance with our hypothesis that prosodic boundaries can provide reliable information about syntactic boundaries and that they can play a crucial role in resolving syntactic ambiguity and comprehension of syntactically ambigous structures an auditory experiment was conducted.

Sentences used in written study were also used in this stage of the experiment. 30 sentences or 15 sentence pairs (every pair with different placement of IP boundary) were readed and recorded by a female native speaker of Turkish. Sentences were presented to the participants over the speakers and participants answered comprehension questions identical to those used in the written experiment, but in this case there were just two possible responses offered. 34 native speakers of Turkish participated in this experiment. Phonetic analyses were conducted using Praat 5.0.5 sound analyze program to make sure that all test sentences were produced with intended prosody. In order to show different patterns of recorded sentences in Figures 6 and 7 we present their wave forms, intonation contour, and phonological transcription in ToBi framework. As mentioned before three phonological phenomena such as length of a pause at the boundary, lengthening of final syllable in the phrase and the degree of variation in intonation pattern are usually used across languages to determine the presence of IP. As shown in Figure 6, length of pause at the first IP boundary is 0.62s with high boundary tone (H%) at the end of the phrase, and the length of the last syllable in IP (in *duran*) is 0.138s. On the other hand, from Figure 7 we can see no pause after the first relative clause,

Figure 7.
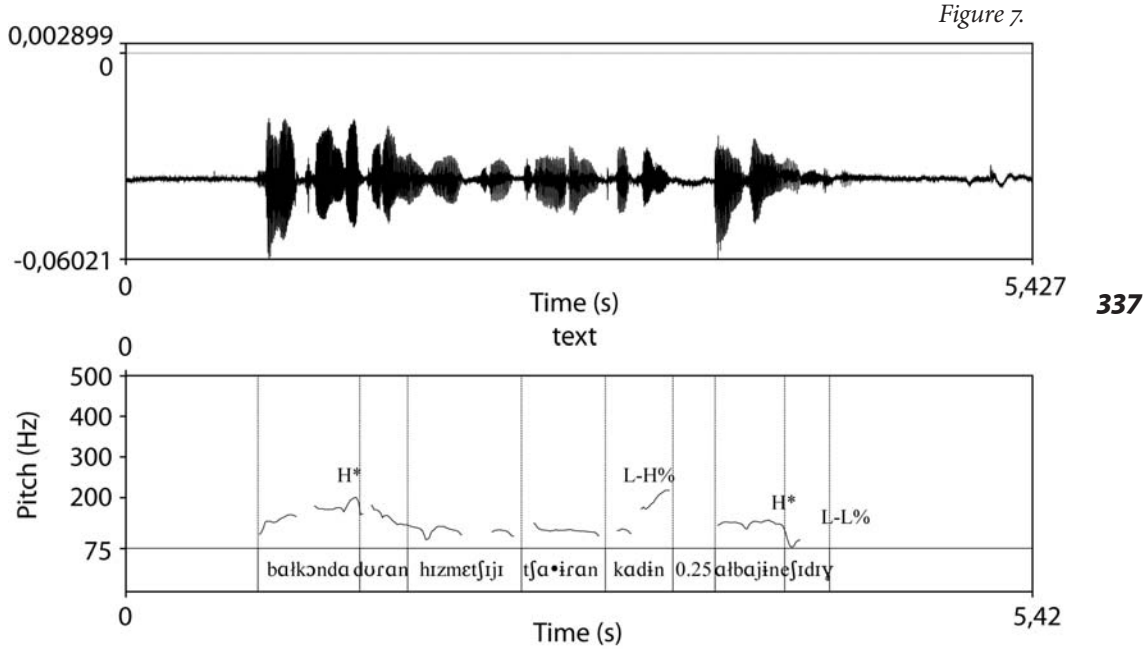
there is no rising boundary tone and length of the same syllable is 45% shorter than in previous case (0.76s).

Results of auditory study below show importance of IP boundaries in all sentence types:

Relative clauses followed by complex NPs containing postpositional phrases. As Figure 8 shows 98% of participants have chosen NP1 in examples without IP boundary, and 75% preferred NP2 in examples with IP boundary.

Example:

Kırmızı giyen kadının _{AÖ1} yanındaki kız _{AÖ2} İstanbul'da oturuyor.

Kırmızı giyen / kadının _{AÖ1} yanındaki kız _{AÖ2} İstanbul'da oturuyor.

(Figure 8)

Relative clauses followed by complex NPs with genitive constructions. This type
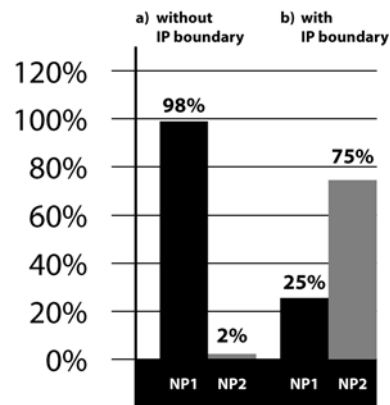

Figure 8.
Effects of IP presence in relative clauses followed by complex NPs containing postpositional phrases

of sentences were pronounced in three ways. In examples without IP boundary 58% of participants marked NP1 as a subject of relative clause. In examples with IP after relatively marked verb NP2 was preferred as subject of the same clause (53%). Diferrent pronounciation had less effect here than expected. But in sentences with IP boundary between NP1 and NP2 effect of boundary is more significant. As Figure 9 shows 85% of participants have chosen NP1 for a subject of relative clause.

Example:

Törene katılan siyasetçinin$_{AÖ1}$ kuzenini$_{AÖ2}$ tarif etti.
Törene katılan / siyasetçinin$_{AÖ1}$ kuzenini$_{AÖ2}$ tarif etti.
Törene katılan siyasetçinin$_{AÖ1}$ / kuzenini$_{AÖ2}$ tarif etti.
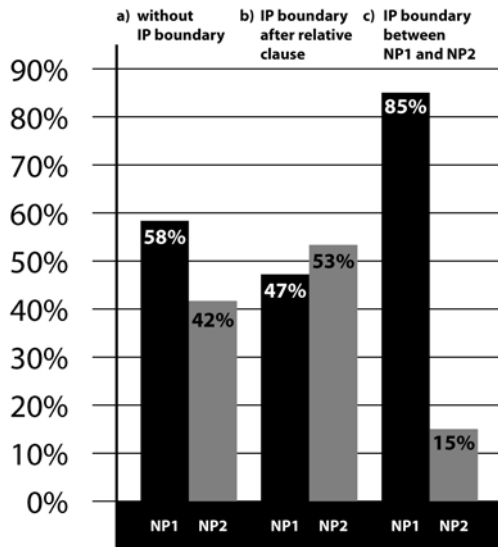(Figure 9)

Figure 9.
Effects of IP presence in relative clauses followed by complex NPs with genitive constructions

Sentences with two relative clauses. Here the presence of IP have significantly influenced comprehension of given sentences. In examples without IP boundary 100% of participants marked NP1 as subject of the first relative clause, and in examples with IP boundary 86.5% chosed NP2 (Figure 10).

Example:

Balkonda duran hizmetçiyi$_{AÖ1}$ çağıran kadın$_{AÖ2}$ albayın eşidir.
Balkonda duran / hizmetçiyi$_{AÖ1}$ çağıran kadın$_{AÖ2}$ albayın eşidir.
(Figure 10)

Sentences containing manner and relative clause. As Figure 11 shows presence of IP boundary plays also a great role in sentence comprehension. When IP boundary is placed after NP1 in most cases NP2 was chosen for the subject of manner clause (94%). On the other hand, in cases where this boundary is placed after the manner marked verb NP1 was mostly chosen for subject of manner clause.

Example:

Ayşe$_{AÖ1}$ / gülerek soru soran adamı$_{AÖ2}$ destekliyor.
Ayşe$_{AÖ1}$ gülerek / soru soran adamı$_{AÖ2}$ destekliyor.
(Figure 11)

Sentences containing temporal and relative clause. Similar to previous case the presence of IP has a great influence on sentence comprehension. When IP boundary is placed after NP1 88.5% of participants have chosen NP2 for subject of temporal clause, and in cases when the boundary came after temporal marked verb 87% marked NP1 as subject of temporal clause (Figure 12).

Example:

Ebru$_{AÖ1}$ / okula giderken ağlayan Banu'ya süt aldı.
Ebru$_{AÖ1}$ okula giderken / ağlayan Banu'ya süt aldı.
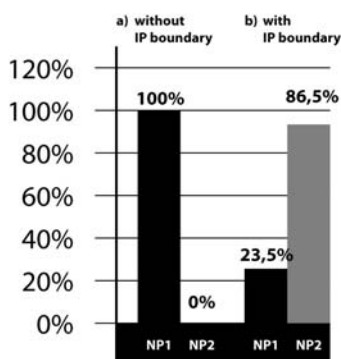(Figure 12)

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Figure 10.
Effects of IP
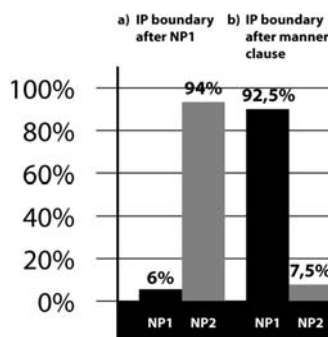presence in
sentences with two
relative clauses

Figure 11.
Effects of IP presence
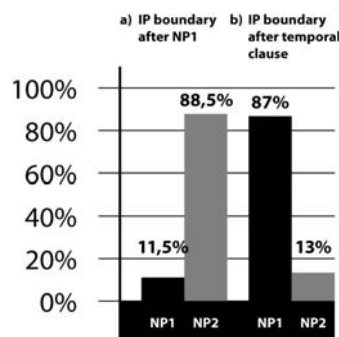in sentences
containing manner
and relative clause

Figure 12.
Effects of IP presence
in sentences
containing manner
and relative clause

CONCLUSION

This study presented results from a two-stage experiment conducted to investigate effects of prosodic boundaries on the listeners' interpretation of syntactically ambiguous sentences. Results from the study show that, despite of variations that this effect can have on different types of sentences, IP boundaries carry crucial information about syntactic structure of sentences and display strong effects on resolving syntactic ambiguity in Turkish.

In order to better understand the role of prosodic boundaries in resolving syntactic ambiguity, and relation between prosody and syntax in Turkish there is a need for works in which a larger number of syntactic stuctures will be examined. In spite of that we hope that we put some light on this uninvestigated area of Turkish linguistics.

symmary

Σ **The Role of Prosody in Syntactic Disambiguation in Turkish**

This study investigates the effects of prosody in comprehension of syntactically ambigous structures in Turkish. A two-stage experimental study was conducted to investigate the effect of prosodic boundaries on the listeners' interpretation of syntactically ambiguous sentences. Data from the experiment show that in Turkish, like in previously studied Korean, Japanese and English, prosodic boundaries display strong effects on resolving syntactic ambiguity and comprehension of syntactically ambigous structures.

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