

## Prosodic perception of sentence types in Greek

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### Abstract

This study examines the relation between prosody and sentence-type perception in Greek, through a perceptual experiment using synthetic hum sound analogs of statements, polar/wh-questions and commands. The results indicate that sentence types may be partially identified through prosody. The identification rates were not very high, due to the nature of the synthetic stimuli. Wh-questions were easily perceived, while for the other sentence types falling boundary tones seem to be misleading.

Keywords: perception, sentence types, prosody, Greek

### Introduction

This is an investigation of the effects of prosody on sentence type perception in Greek, i.e. if prosody is decisive for the perception of statements, polar/wh-questions and commands. Previous studies showed that naturally produced stimuli were perceived with about 99% accuracy (Chaida 2005). This experiment is focused on artificial (hum) sound analogs, where linguistic information, except prosody, is eliminated. In the absence of all lexical information, the distinction between sentence types is assumed to depend on the prosodic structure, especially in languages like Greek and Italian. Sentence types are associated with local and global tonal structures (e.g. Botinis 1998, 't Hart, 1998, Makarova 2001). Studies in Greek prosody have revealed several tonal characteristics for each sentence type (e.g. Baltazani 2007, Chaida 2007).





Sentence Type	Tonal structure	Boundary
STATEMENT		Low
POLAR QUESTION		Rise-Fall
WH-QUESTION		Rise
COMMAND		Low

Figure 1: Stylized tonal structures for sentence types in Greek.

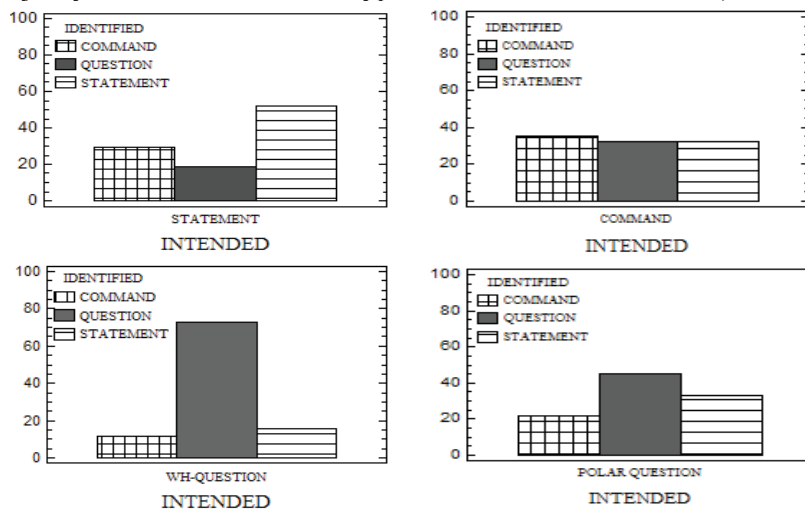
### Materials and Method

A set of utterances produced by 3 female speakers in their twenties was selected from a previously recorded corpus of Greek speech material (Chaida 2007). It included variations of the simple sentence '*O Manólis mazévi lemónja*' (Manolis is picking lemons) and the complex '*O Manólis mazévi lemónja ce/ótan/parólo pu i María mirázi balónja*' (Manolis is picking

lemons and/when/although Maria is distributing balloons), coordinated and subordinated, produced as statements, polar/wh-questions and commands, mainly by prosodical means and minor alterations (wh-word '*jati*' for wh-questions, and the imperative verb form for commands). This set of 20 recorded utterances was randomized 5 times. The perception test stimuli were processed with Praat 4.5.21, in order to create sounds with the algorithm described at Point Process: To Sound (hum) (modifying formants), so as prosody would be the only factor judged without any lexical influences. The modified stimuli were presented to 32 informants (male and female, 20-40 years old) through a program designed on C#. The experiment took place through earphones and the informants were instructed to categorize each stimulus (statement, question, command), and then provide an indication of how certain they were (1-6 scale: 1=least, 6=most certain).

## Results

The results are shown in Figures 2-5. In the first instance, it is evident that, although overall identification rates are not as high as might be expected, the majority of identified sentence types match the intended ones (35-72%).



Figures 2-5: Identification for intended statement, command, wh- and polar question productions.

Stimuli based on **statements** (Fig.2) were identified as intended 52.08% of the time, while 29.43% were identified as commands and 18.49% as questions. The mean certainty rating was 3.32 (out of 6), but the ANOVA table showed that certainty was not significant for statements ( $p > 0.05$ ,  $F = 1.33$ ). Stimuli based on **commands** (Fig. 3) were identified as intended 35.42% of the time, while 32.47% were identified as commands and 32.12% as statements. The mean certainty rating was 3.41, although certainty was

not significant for commands ( $p > 0.05$ ,  $F = 2.53$ ). Stimuli based on **wh-questions** (Fig.4) were identified as intended 72.92% of the time, while 11.72% were identified as commands and 15.36% as statements. The mean certainty rating was 3.72 and it was significant for wh-questions ( $p < 0.0001$ ,  $F = 24.37$ ). Stimuli based on **polar questions** (Fig.5) were identified as questions 45.31% of the time, while 21.70% were identified as commands and 32.99% as statements. The mean certainty rating was 3.70 and it was significant for polar questions ( $p < 0.0001$ ,  $F = 35.80$ ). According to the chi-square test, the observed value of 'intended' is related to its value for 'identified' at the 99% confidence level ( $p < 0.01$ ). Concerning the factor of certainty in all cases, the relevant chi-square test showed that it is related to its value for 'answer' ( $p < 0.01$ ). Sentence complexity is also proved to be a significant factor for sentence-type perception ( $p < 0.01$ ). An interesting observation is that simple sentences had lower rate of accurate identification (42.86%), compared to complex ones (50.82%). Furthermore, conjunction variation seems to influence listeners' choice ( $p < 0.01$ ).

## Discussion

The results of the present study indicate that sentence types in Greek may be identified through prosody, but it seems that this might not be the only distinctive cue for perception, since the identification rates were not very high in all cases. However, identification rates could not be expected to rise higher, because of the nature of the stimuli, which were obtained by synthetic modification (hum), as also proved by other studies with synthetic stimuli (e.g. Makarova, 2001). Thus, in the present experiment, an identification of 50-60% might be considered as an indicator of categorization between the 3 sentence types (statement, question, command). Apart from that, statistical analysis revealed that the listeners' choices were not incidental, since they were closely related to all contributing factors. **Wh-questions** are clearly 'marked' by their distinct prosodic structure, since there was very good correspondence between production and perception (72.92%). Acoustically, this may be attributed to the salient tonal rise-fall aligned with the wh-word and to the abruptly rising boundary tone, while the rest of the melody forms a low plateau (see Fig. 1). On the other extreme, **commands** seem to be quite difficult to perceive on the basis of prosody alone, since they had the lowest identification rates (35.42%) and they were equally confused with all the other sentence types. Their prosodic structure may vary quite a lot, mostly due to phrasing, while it generally resembles that of statements, especially at the falling boundary tone. **Polar questions** did not fall to very low identification rates (45.1%); the fact that they were confused with all sentence types may be acoustically attributed to their boundary tone, which forms a rise-fall tonal movement and might be

misleading for listeners. **Statements** had fairly good identification (52.08%) and they were mostly confused with commands, probably due to their low boundary tone. These findings agree with experiments in other languages which show that low or falling boundary tones elicit ‘declarative judgments’, and high or rising tones lead to ‘interrogative’ (e.g. Makarova 2001, Thorsen, 1980). Moreover, although tonal cues for sentence types are in general distributed throughout an utterance, the last stressed syllable and the poststressed ones are sufficient indicators for perception (Thorsen 1980).

Each sentence type has an acoustically distinct tonal structure, characterized in Greek by the type and location of tonal prominence (nucleus) and boundary tone (Baltazani, 2002; Botinis et al., 2000; Chaida, 2005, 2007). However, the findings of the present study with hum sound stimuli differ from our previous findings with natural stimuli (Chaida, 2005), which achieved 1:1 identification. Concluding, the difficulty that listeners had in identifying sentence types using only prosodic cues raises the question: is prosody the most significant factor for the perception of sentence types, or are other linguistic cues also needed?

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