

## Introduction

In linguistics a mismatch seems to exist between syntactic structure and phonological structure. Syntactic phrases display recursivity, whereas this recursivity is assumed not to play a role in phonology. However, in music - of which the sound structure is rather similar to phonological structure - recursive phrase structures are quite common, and this made us wonder why linguistic prosody would behave differently from syntax. Thus we investigated whether or not edge-marking processes, such as early pitch accent placement, can be applied recursively to phonological phrases that are embedded in larger phonological phrases.

## Theoretical background

### Syntax:

Recursive rules are capable of repeated application in generating a sentence  
An infinite set of sentences can be generated from a finite set of rules

### Phonology:

Iterative rule application is limited

### Strict Layer Hypothesis (Selkirk, 1984)

- a prosodic category of one level is exhaustively parsed into constituents of the next-lower level;
- those next-lower level constituents are all of the same type
- **prosodic structure is not recursive**
- mismatch between syntactically recursive constituent structure and the linearly segmented structure in prosody

## Hypothesis

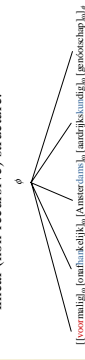
Edge-marking processes such as **early pitch accent placement** (Phrasal Rule) can be applied recursively to phonological phrases

### Syntax:

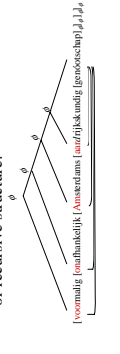
[voornalig [onafhankelijk [Amsterdams [aardrijkskundig genootschap] NP] NP] NP

### Phonology:

linear (non-recursive) structure:



or recursive structure:



## Experiment

### Some data (Dutch)

- (Amsterdams) *aardrijkskundig genootschap*
- (internationale) *diplomatieke organisaties*
- (algemeen) *regionale dagbladpers*
- (progressieve) *socialistische partij*
- (academisch) *psychiatrisch ziekenhuis*

(Early Pitch Accent position, Phrasal acc. stress (= main stress position of word), / = phrasal main stress)

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### Experiment design: Map task



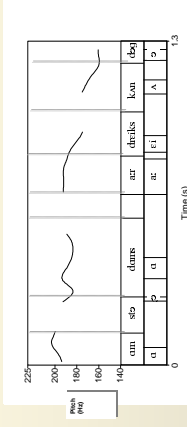
### Maps:

- Each map: 1 recursive NP landmark [Adj [Adj Noun] and 1 non-recursive, non-corresponding NP landmark [Adj Noun]
- 100 phrases in total
- Each subject: 10 recursive and 10 non-recursive phrases (= 10 maps)
- about 550 spoken phrases in total

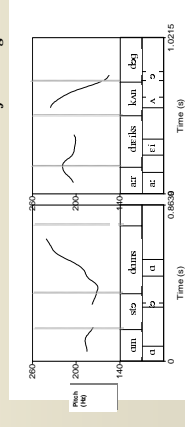
### Subjects:

- 24 Dutch subjects
- 10 men, 14 women (aged 19 to 28)

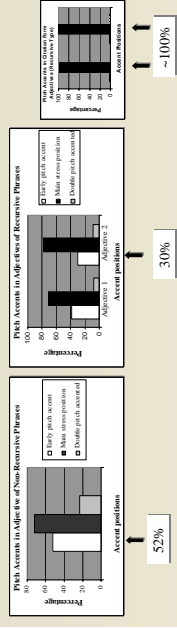
### Pitch contour of phrase *amsterdams aardrijkskundig genootschap*



### Pitch contours of the words *amsterdams* and *aardrijkskundig* in citation form



## Auditory Results



### Pearson Chi-Square tests:

Proportions of early pitch accents and main stress positions in the phrase and in citation form are significantly different ( $\chi^2$  (df 1) = 122.524,  $p < 0.001$ ).

Also the difference between the proportions of corresponding adjectives of the non-recursive and recursive phrases is highly significant ( $\chi^2$  (df 1) = 12.326,  $p < 0.001$ ).

The results confirm our hypothesis that these syntactically recursive phrases can also be recursive prosodically.

## Acoustic Results

(Subset of the data: 7 subjects, 138 items)

### The perception of an early accent depends on de-accenting of the main stress syllable

Mean F0: ( $\chi^2$  (df2) = 13.056,  $p = 0.000$ )  
Duration: ( $\chi^2$  (df2) = 6.891,  $p = 0.016$ )  
Max. F0: ( $\chi^2$  (df2) = 3.825,  $p = 0.074$ )  
Intensity: ( $\chi^2$  (df2) = 0.191,  $p = 0.454$ )

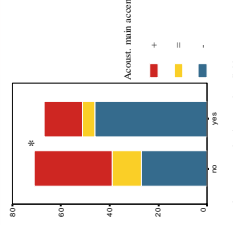
### $\chi^2$ Descriptive Statistics

Number of items	Mean	Std. Dev.	N
100	156.2700	46.21200	67
pitch main	157.2900	46.21400	67
duration	11.1200	1.01100	212
pitch main	11.1200	1.01100	212
intensity	74.6400	3.71000	71
intensity	74.6400	3.71000	71

MANOVA: perceived early accents (1: absence of acoustic accents) (2: in phrases)

Proposed Variable	F	Sig.	Observed Power
perceived accent on	10.527	.001	.912
duration	13.927	.000	.990
intensity	6.723	.011	.751

Dependencies between perceived accent on early syllable and absence of an acoustic accent on the main stress position, values of word in citation form subtracted from words in phrase (chart of mean pitch)



## Conclusions

- The prosodic recursion-hypothesis holds: recursion does exist in prosody.
- Early Accent Placement is a strong tendency, but accenting the main stress syllable is strongly preferred.
- Maximal phonological phrases are early accented significantly more often than embedded phonological phrases. Clearly, there is a lot of optionality involved.
- The results confirm the observation that there is no one-to-one mapping from syntax to prosody, because optionality in syntactic structure would not be an option.
- The perception of early accent placement is triggered by de-accenting of the main stress syllable; accent perception is relative.

This is evidence for a more prominent place for recursion in phonology

## References:

Selkirk, E. (1984). *Phonology and Syntax: The Relation Between Sound and Structure*. Cambridge, Mass.: MIT Press.