

## Abstract

### Background:

Reading aloud involves the on-line construction of prosody in compliance with the syntactic analysis of the sentence. According to a prevalent assumption, explicit (and implicit) prosody is derived from the syntactic structure assigned to the written string (Koriat et al. 2002). This view is challenged by accumulating evidence suggesting (implicit) prosody might not only *represent* but *contribute* to structure building in reading. Fodor (2002) discusses this as a paradox in the sense that prosody apparently feeds the same parsing process from which it was derived.

### Experiment:

The present experiment aims to clarify the role of prosody for syntactic structure building in reading.

24 participants read out sentences without preparation. The sentences are syntactically ambiguous in writing but unambiguous when spoken. To test the influence of prosody for parsing, the prosodic environment of the ambiguous region was systematically varied such that it either

- obeys a rhythmic alternation (prosodically optimal) or
- induces a stress clash (prosodically suboptimal) depending on which reading was chosen by the reader.

### Results:

Participant's ambiguity resolution was demonstrably influenced by the prosodic environment: A particular reading was chosen significantly less often when it involved a stress clash than when it was prosodically optimal.

### Discussion:

The results indicate that prosody has a much stronger role for sentence processing in reading than previously thought.

This study motivates a model in which *local* prosodic-phonological processing (in this case: the rhythmic environment) directly influences parsing decisions in reading, while a *global* prosodic contour is shaped on the basis of both the local prosodic analysis and the syntactic structure assigned to the string.

## References

- Ashby and Martin (2007). Prosodic phonological representations early in visual word recognition. *Journal of Experimental Psychology*
- Bader, M. (1996). Prosodic effects and the distinction between primary and secondary phrases. Poster presentation, AMLAP, University of Turin.
- Bader (1998). Prosodic influences on reading syntactically ambiguous sentences. In: Fodor and Ferreira (Eds.). *Reanalysis in sentence processing*. Dordrecht: Kluwer.
- Fodor (1998). Learning to parse. *Journal of Psycholinguistic Research* 27(2), 285-319
- Fodor (2002). Psycholinguistics cannot escape prosody. *Proc. Speech Prosody*.
- Koriat et al. (2002). The extraction of structure during reading: Evidence from reading prosody. *Memory and Cognition* 30, 270-280
- Selkirk (1984). *Phonology and Syntax*, Cambridge (Mass): MIT Press

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## I. Background

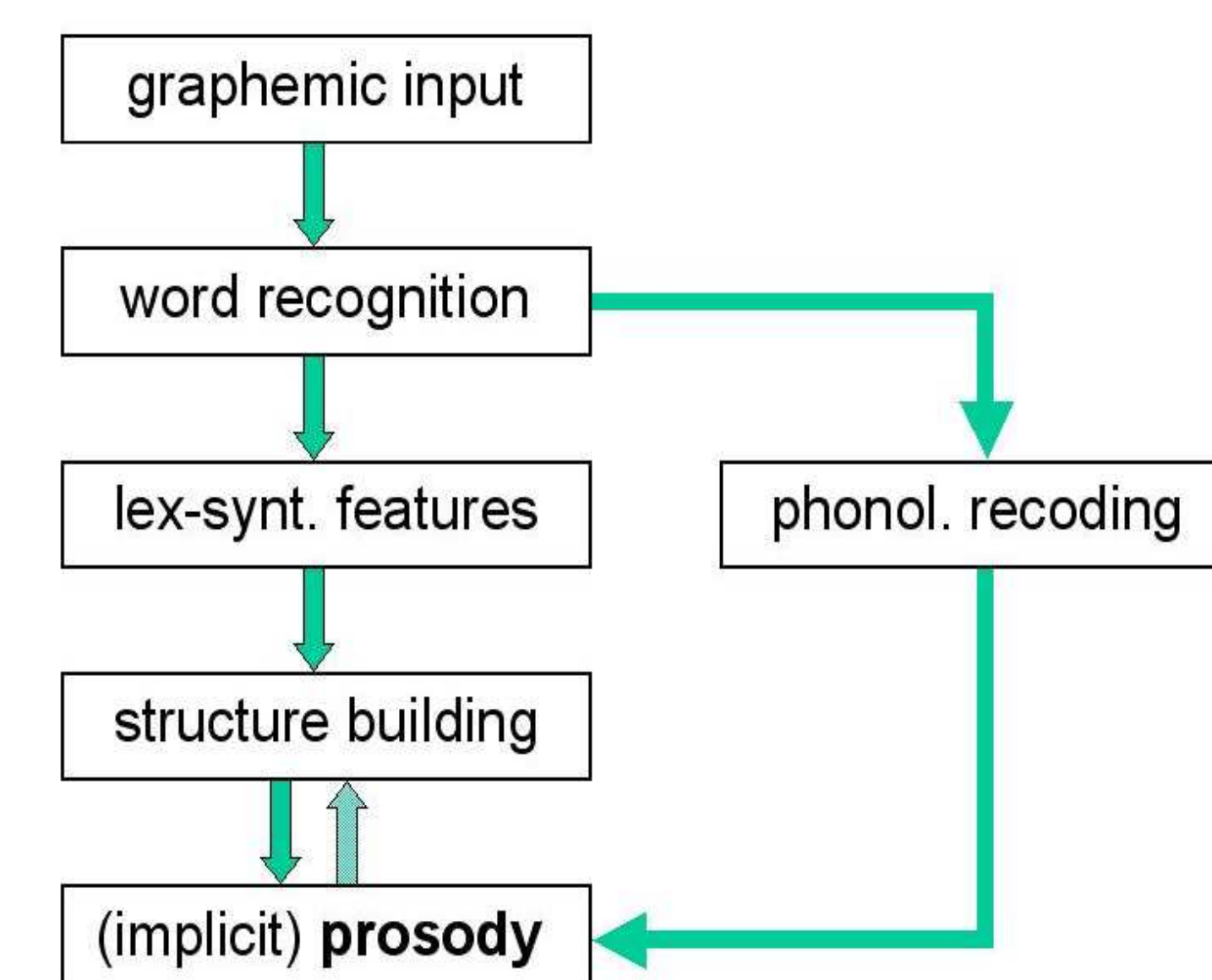
A prevalent conception concerning prosody in reading holds that it is derived from the (lexical-) syntactic analysis of the input (Koriat et al. 2002). Bader (1998) and Fodor (1998) suggest that (implicit) prosody not only represents but contributes to the parsing process.

**Problem:** Relation between syntactic and prosodic processes in reading remains unclear.

**A possible resolution:** Reading prosody involves the processing of local stress information. Readers immediately activate a prosodic-phonological representation of the words (Ashby and Martin 2007). In sentence production, the concatenation of words and phrases is subject to prosodic adjustments: Speakers especially avoid stress clashes (Selkirk 1984) by shifting or deleting stress. Applying such rhythmic optimizations might induce extra processing costs.

**Hypothesis:** In the face of an ambiguity, readers prefer a syntactic analysis that is prosodically simple over a parse that requires rhythmic adjustments.

Standard model for prosody generation in reading



## III. Procedure and Results

### Procedure

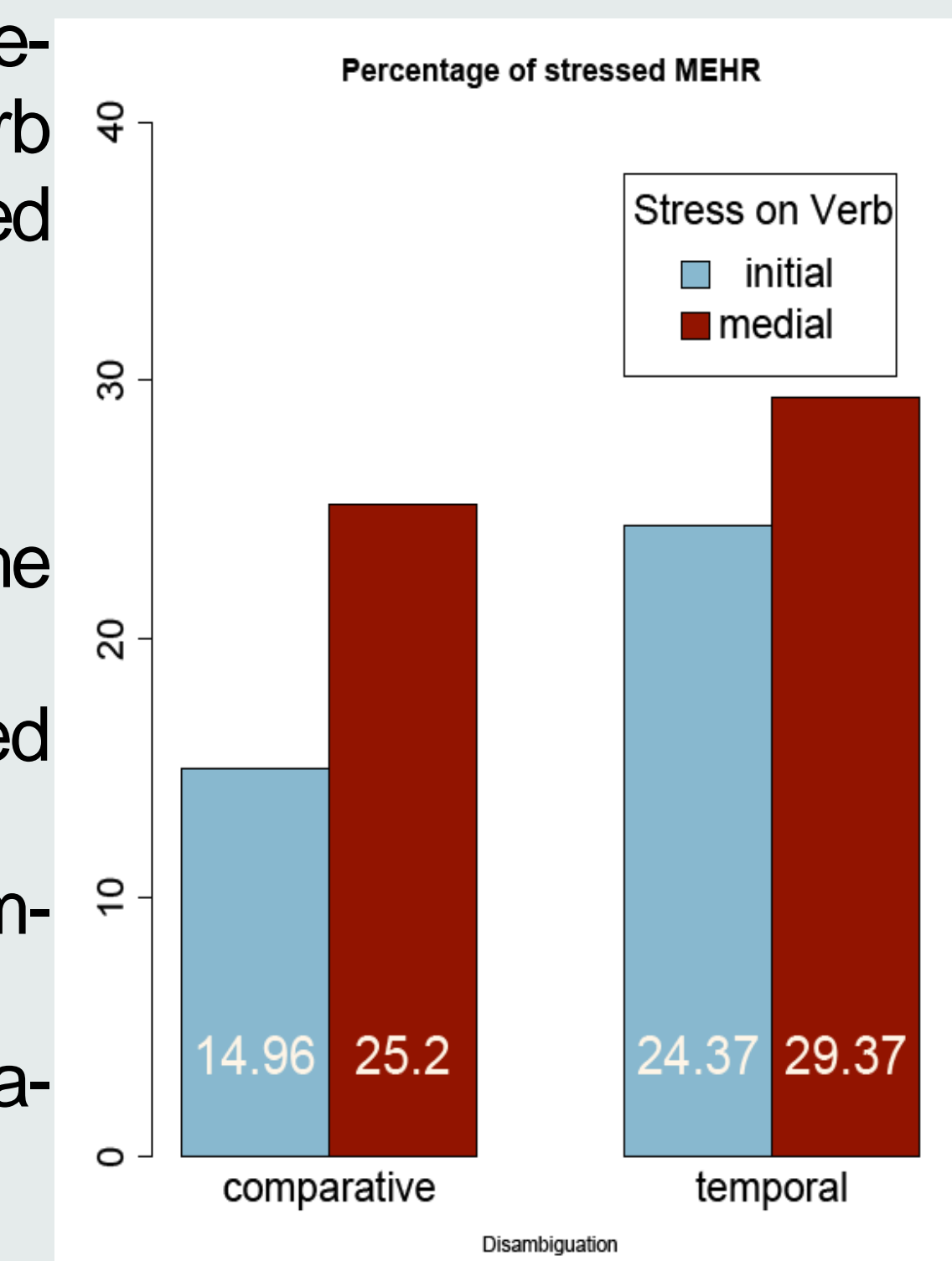
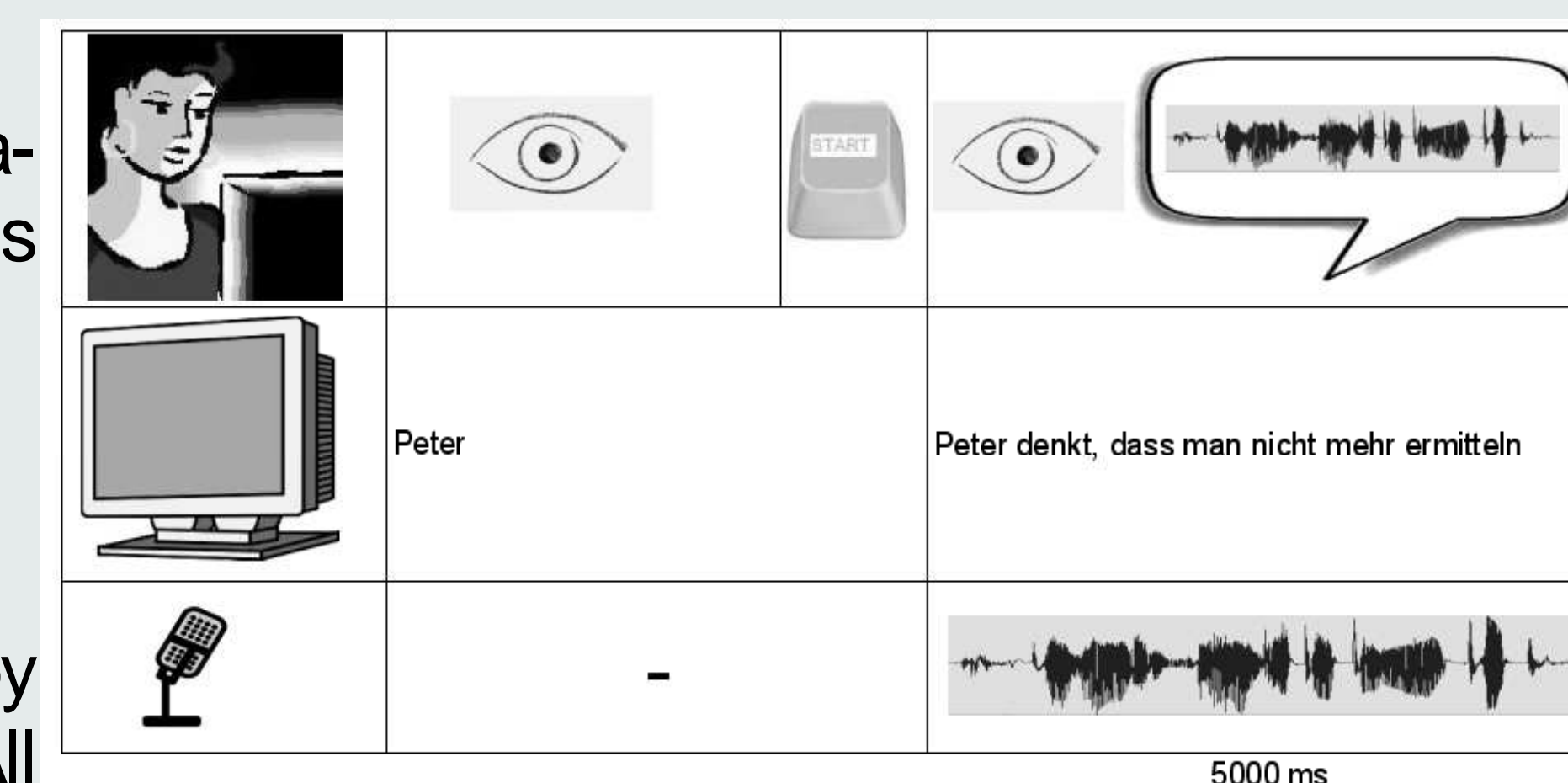
24 participants read out, without preparation, 24 sentences in 4 conditions (plus 69 fillers) in a latin square design = 576 experimental sentences

### Data analysis

63 sentences (11%) were affected by slips of the tongue or hesitations. All other sentences were given to two independent judges. To avoid an effect of the disambiguating region on judgments, the sentences were cut after the verb complex. The judges assessed whether *mehr* was realized with stress or not. Judges agreed in 96% of the cases.

### Results

- Across conditions, *mehr* was stressed in 23.5% of the sentences.
- Mehr* was stressed significantly less often when followed by a verb with initial stress ( $z=-2.61$ ,  $p<0.01$ ).
- Mehr* was stressed less often in sentences with a comparative disambiguation ( $z=-1.977$ ,  $p=0.048$ ).
- The interaction of rhythmic environment and disambiguation is non-significant ( $z=-0.976$ ,  $p=0.33$ )



## II. Material / Design

Sentences with a local syntactic ambiguity in written representation (ambiguity resolved in spoken speech) were presented in a 2x2 design:

### 1. Factor: reading

*mehr* is ambiguous with respect to part of speech:

- stressed comparative adverb
- unstressed temporal adverb

### 2. Factor: stress position on verb

Verb following *mehr* has either

- initial stress (*nachweisen*)
- medial stress (*ermitteln*)

Stressed *mehr* followed by initially stressed verb (1a) involves a stress clash

(1a) Tim meint, dass man nicht mehr nachweisen kann, als das Gewicht der Konstruktion.

(1b) Tim meint, dass man nicht mehr ermitteln kann, als das Gewicht der Konstruktion.

*Tim thinks that one cannot a) detect / b) determine more than the weight of the construction*

(2a) Tim meint, dass man nicht mehr nachweisen kann, ob es einen elften Planeten gibt.

(2b) Tim meint, dass man nicht mehr ermitteln kann, ob es einen elften Planeten gibt.

*Tim thinks that one cannot a) detect / b) determine anymore if a 11th planet exists*

## IV. Discussion

In general, the temporal reading of *mehr* is preferred over the comparative reading (cf. Bader 1996).

Unexpectedly, readers stress *mehr* more often when the disambiguating region prohibits stress.

Importantly, as predicted, the rhythmic environment directly affects structure building during reading aloud. Although stress is not explicitly encoded in the written string, it has a significant effect on participants' choice of reading: Readers avoid renditions that involve a stress clash.

The results support simplicity based theories on sentence processing. Traditionally, these are concerned with syntactic simplicity. The present study motivates an extension towards prosodic simplicity: Readers avoid costly prosodic adjustments in the face of a possible stress clash by adopting a syntactic parse that results in a prosodically inconspicuous representation.

The parser uses rhythmic information for incremental structure building.

Extended model for prosody generation in reading

