Rhythmic constraints on the realization of contrast

implications for sentence comprehension in reading

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Phonetik & Phonologie 5
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Factors affecting syllabic prominence

- Lexicon (word stress options, lexical accent)
- Phrase Structure (phrase accent)
- Information structure (focal accent)

How do these factors interact?

→In the grammar

→In on-line processing

Metrical representation

Lexicon – syllables/ word stress/ word accent

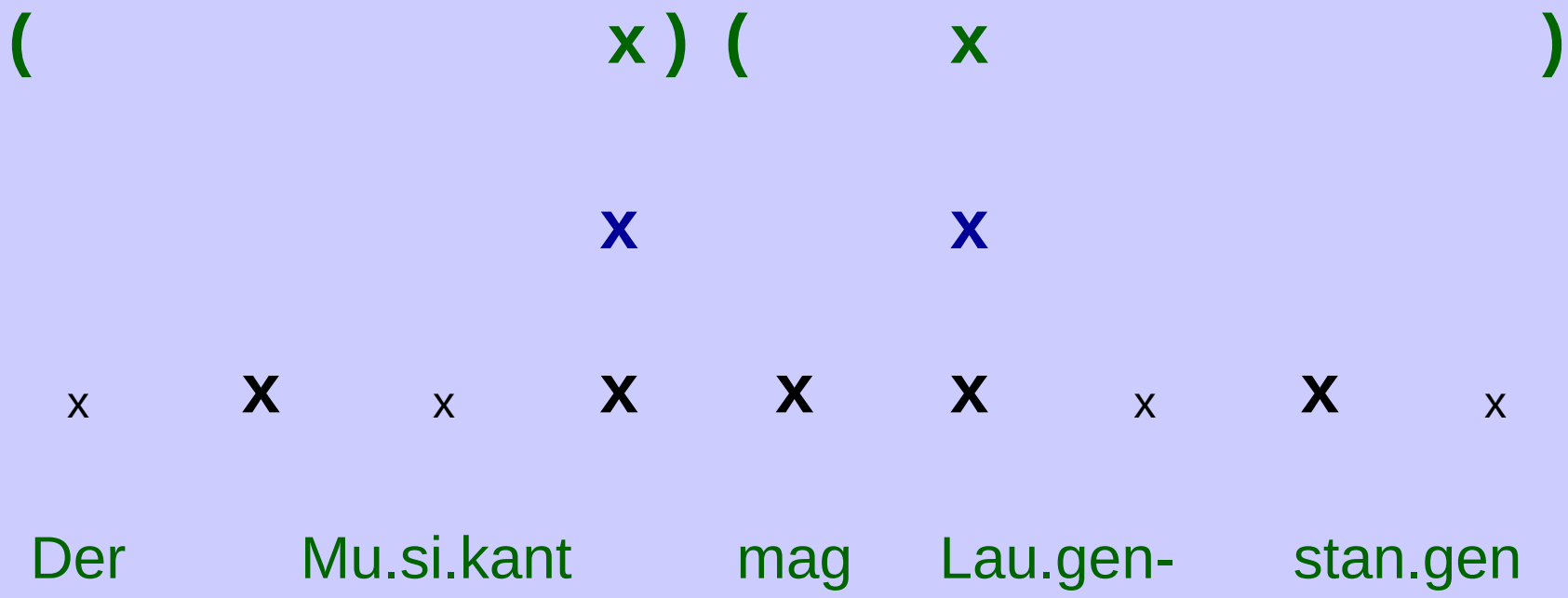
Der Musikant mag Laugenstangen

The musician likes pretzel sticks

			x		**x**			
x	**x**	x	**x**	**x**	**x**	x	**x**	x
Der	Mu	si	kant	mag	Lau	gen	stan	gen

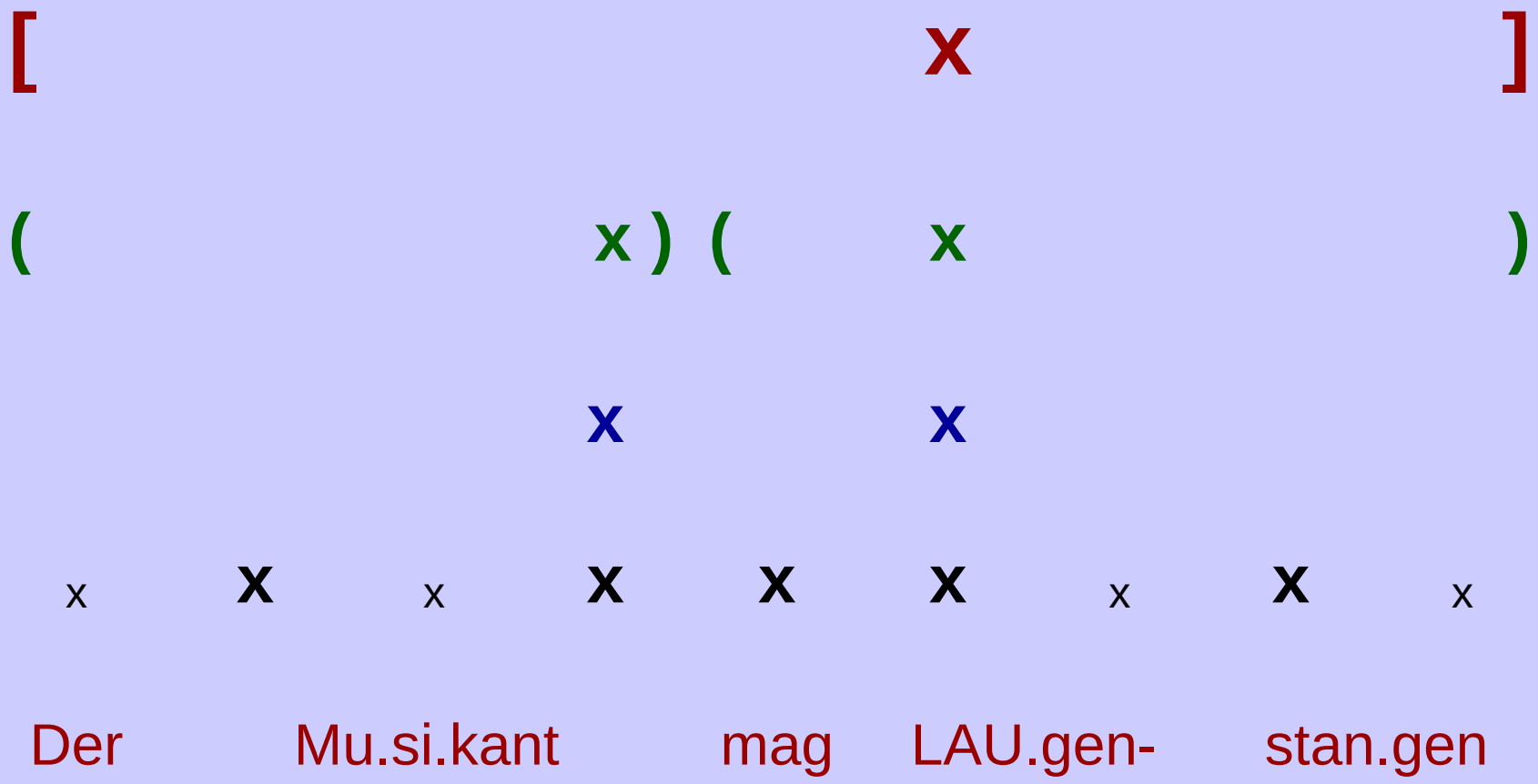
Metrical representation

Phrase Structure - phrase accent (edge alignment)

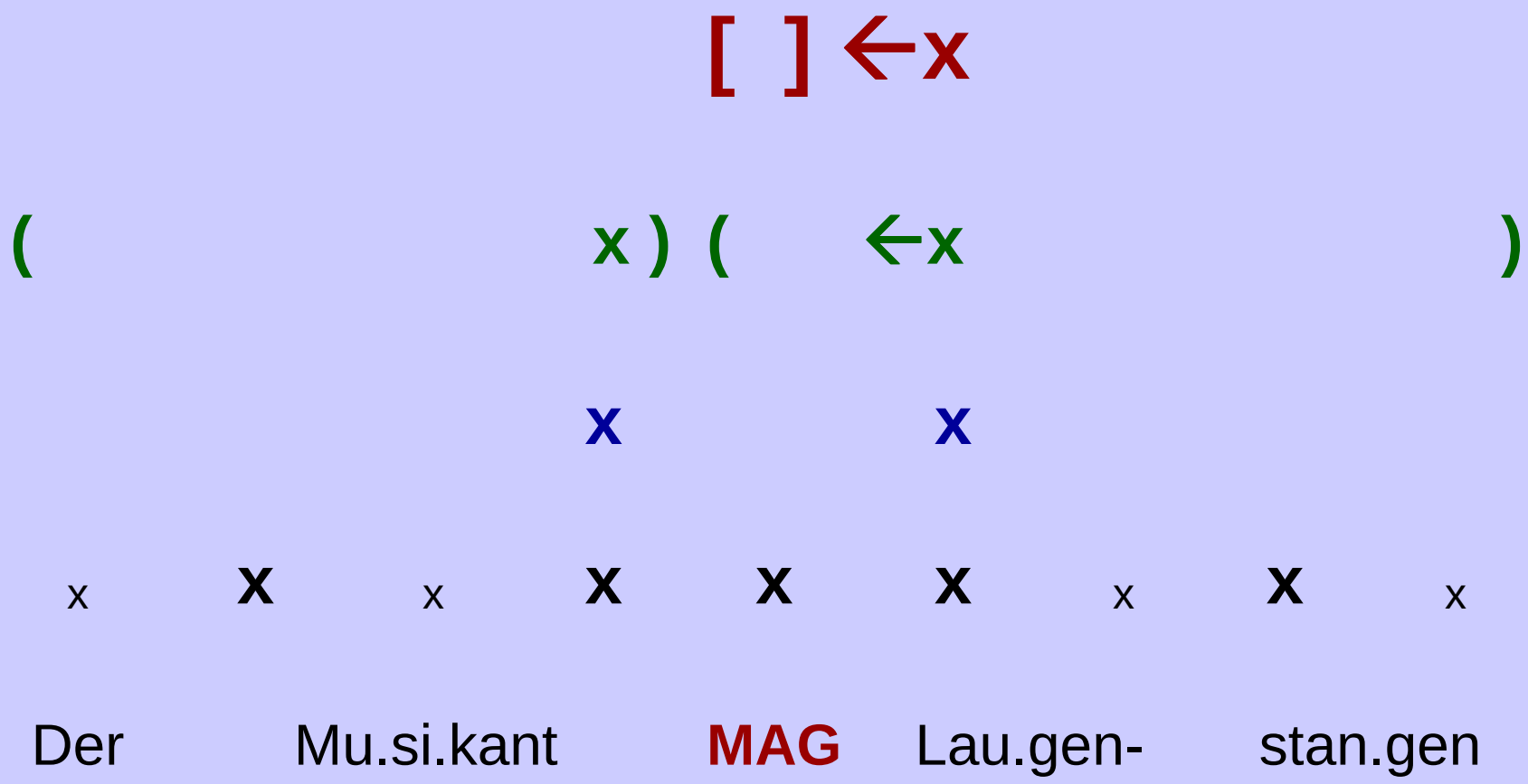


Metrical representation

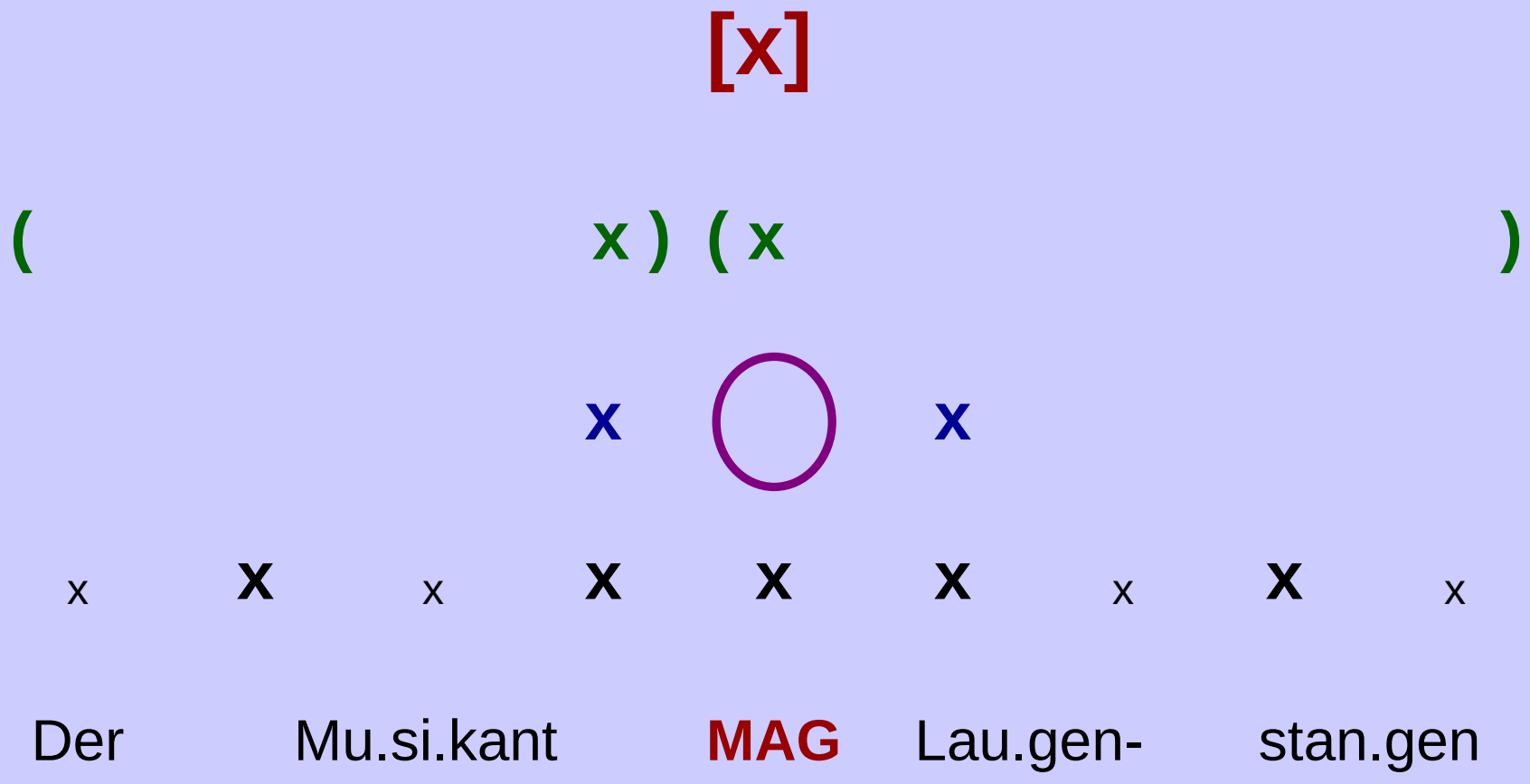
nuclear accent



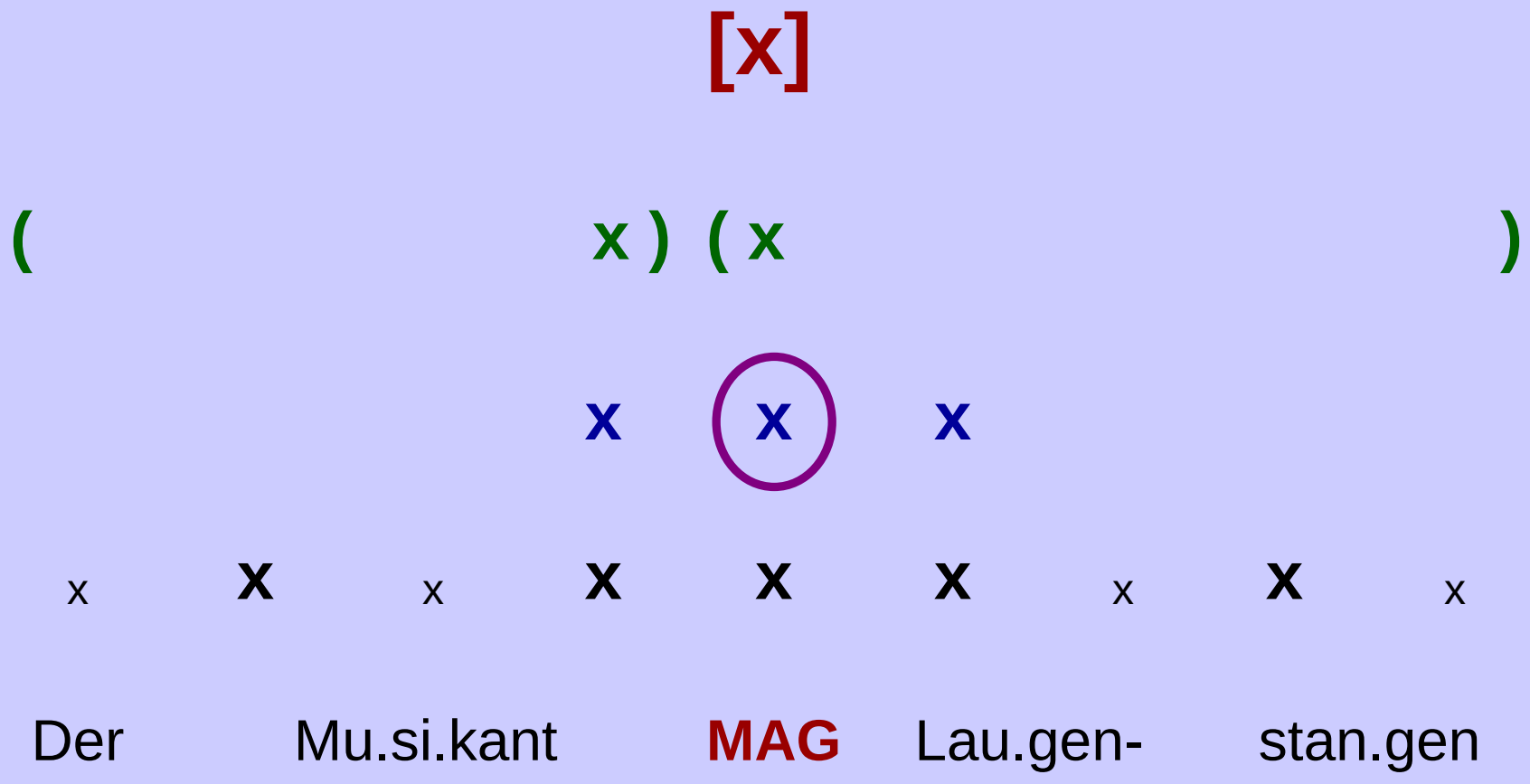
Focal accent overrides phrase accent



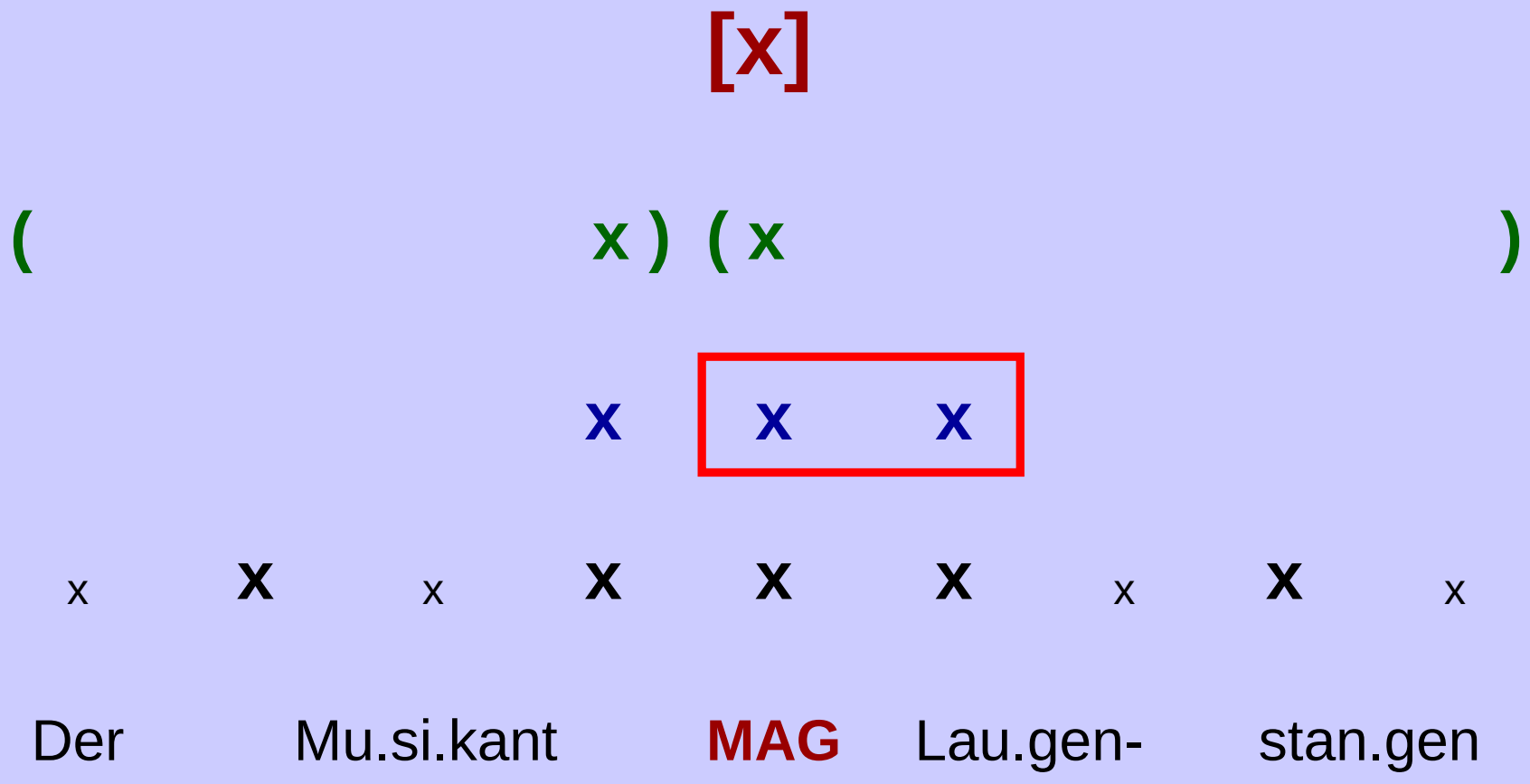
Focal accent requires lexical accent...



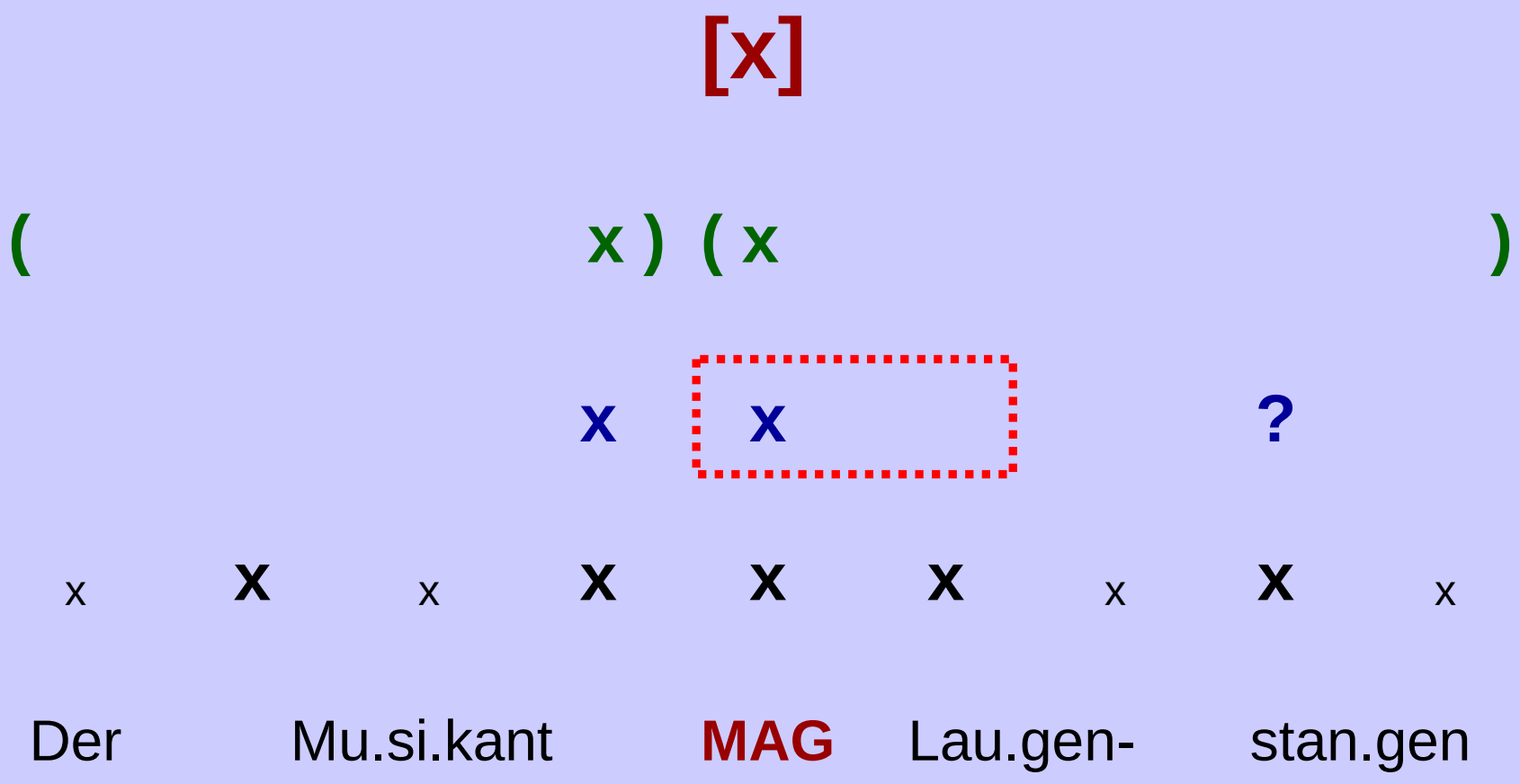
Focal accent requires lexical accent...



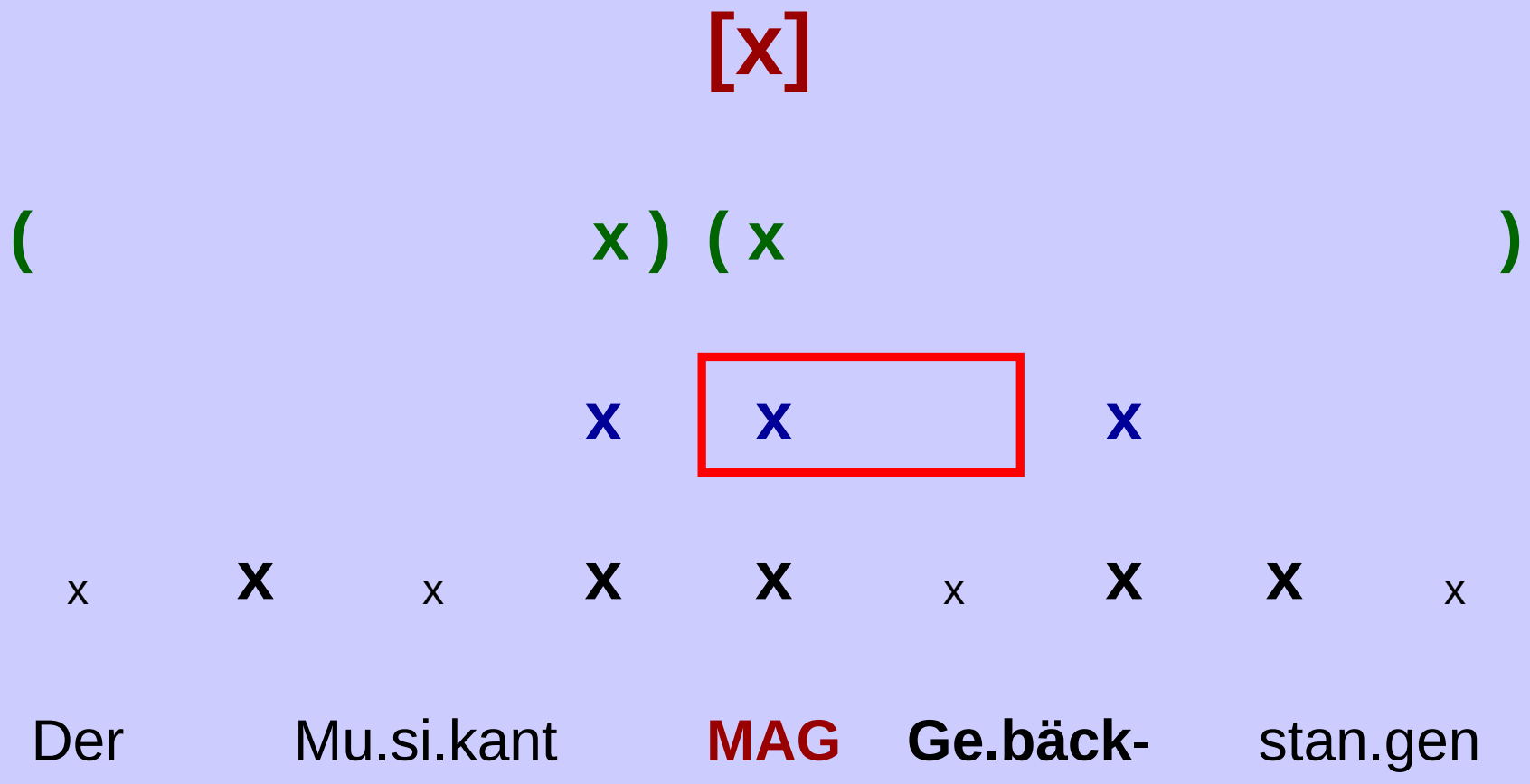
...inducing a stress clash...



...which is (possibly) resolved by stress shift or stress deletion



no stress clash, no rhythmic adjustments



Hierarchy of prominence assignment

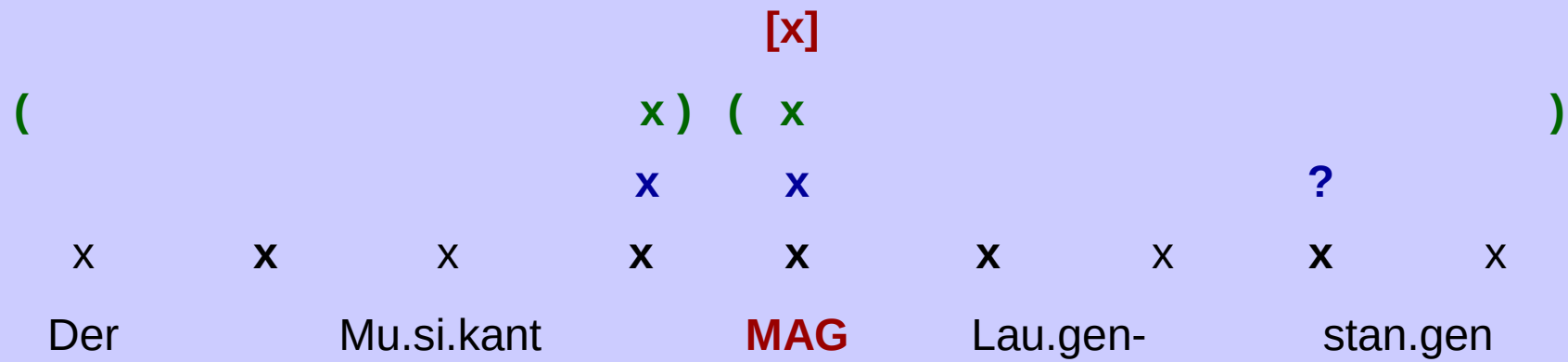
Focal accent...

a) overrides nuclear accent/phrase accent

b) requires lexical accent

c) possibly induces a stress clash and rhythmic adjustments, overriding lexical prominence patterns

Focus >> Phrase Structure >> Lexicon



Factors affecting syllabic prominence

- Lexicon (word stress / word accent)
- Phrase Structure (phrase accent)
- Information structure (focal accent)

How do these factors interact?

→In the grammar

→In on-line processing (reading aloud)

Background I: Phonological recoding in reading

Koriat et al. 2002 (and everyday experience):

- Reading aloud involves both sentence comprehension and production.
- Readers generate sentence prosody online (without advance preparation) when reading aloud.
- Reading prosody reflects syntactic structure of the written string.

The fat cat # with the gray stripes # ran quickly to the little kitten…

Syllabic prominence in sentence production (reading)

Elliptic and non-elliptic coordinations as a test case:

Der Dirigent lacht und der Musiker isst Gebäck.

Der Dirigent kauft und der Musiker isst Gebäck.

The conductor is laughing/buying and the musician is eating cookies

Elliptic and non-elliptic coordinations as a test case:

intransitive

Der Dirigent lacht und der Musiker isst Gebäck.

transitive

Der Dirigent kauft __ und der Musiker isst Gebäck.

Elliptic and non-elliptic coordinations as a test case:

intransitive

Der Dirigent lacht und der Musiker isst Gebäck.

transitive

Der Dirigent kauft __ und der Musiker **ISST** Gebäck.

Focal accent on verb in 2nd conjunct due to contrast with elliptic verbal phrase in 1st conjunct (Selkirk 2002, Féry & Samek-Lodovici 2006)**.**

Elliptic and non-elliptic coordinations as a test case:

intransitive

Der Dirigent lacht und der Musiker **ISST** Gebäck.

transitive

* Der Dirigent kauft __ und der Musiker isst Ge**BÄCK**.

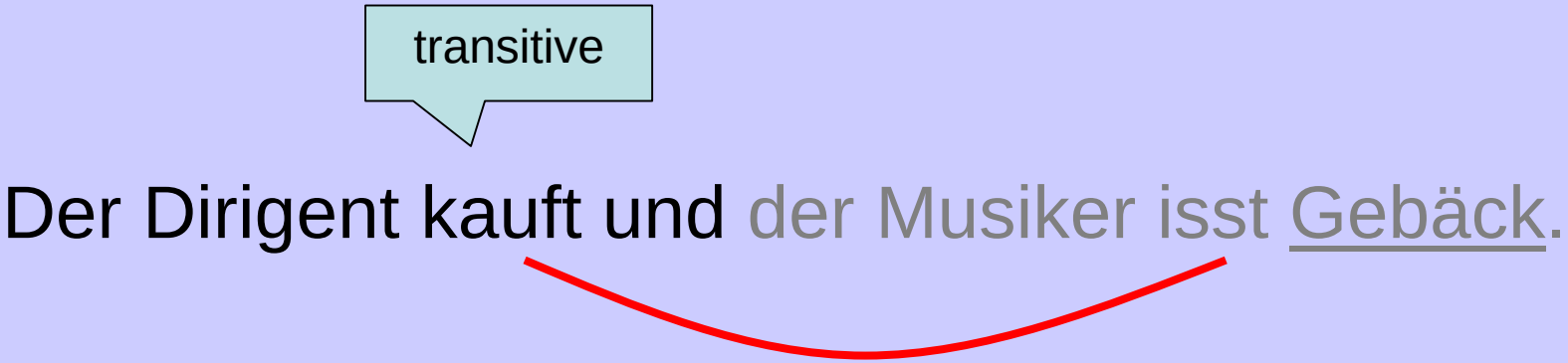
Contrastive accent on verb in non-elliptical sentence needs to be contextually licensed.

Nuclear accent on object without contrastive accent on verb is ungrammatical in elliptic condition.

Elliptic and non-elliptic coordinations as a test case:

Processing elliptic structures involves

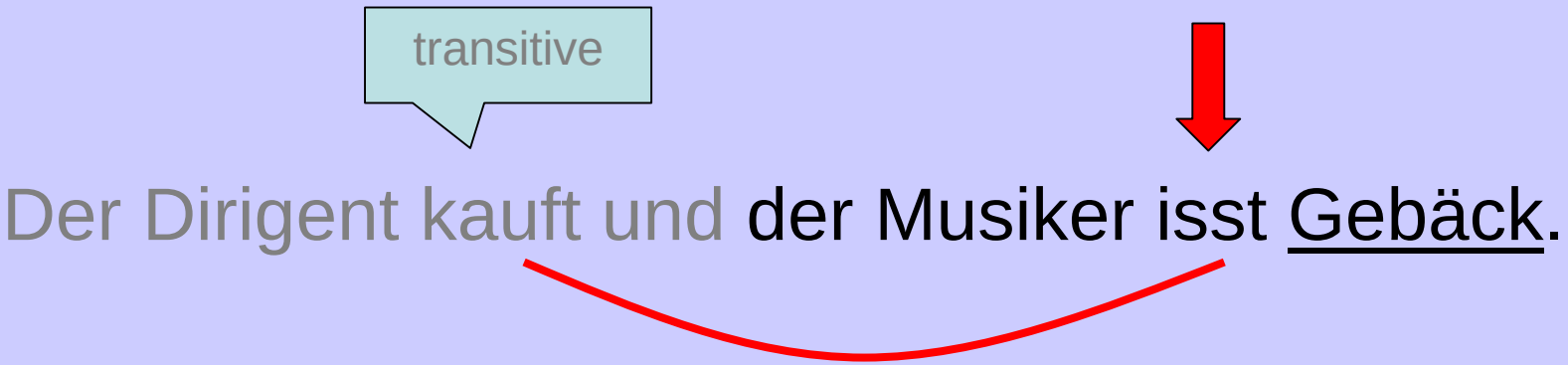
- Encoding the first verb‘s argument structure requirements
- Positing a gap
- Predicting a contrast



Elliptic and non-elliptic coordinations as a test case:

Processing elliptic structures involves

- Retrieving the first verb‘s argument structure requirements
- Retrieving the gap
- Realizing the contrast



Reading aloud...

involves integrating...

- sentence comprehension
  - syntactic analysis
  - semantic interpretation
- sentence production
  - phonological recoding
  - Articulation

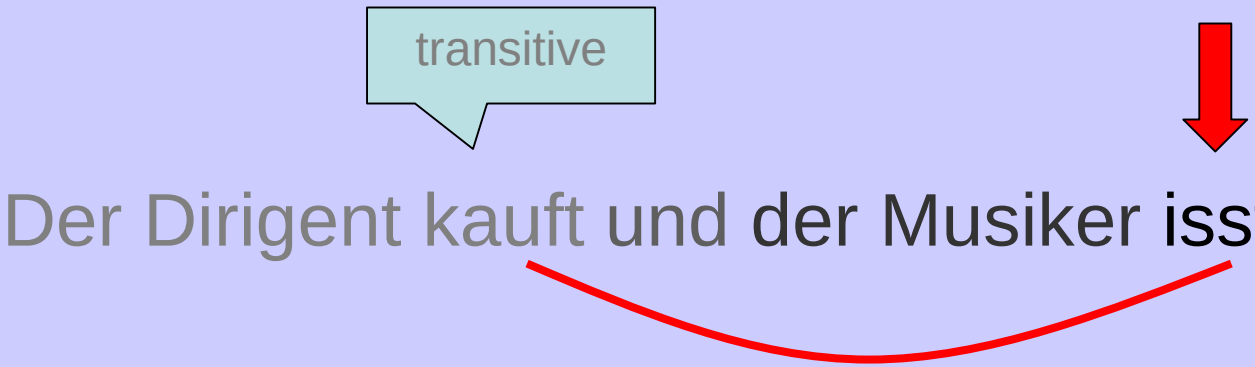
Interference of these processes?

Elliptic and non-elliptic coordinations as a test case:

Reading elliptic structures involves

- **Computing 1st verb‘s argument structure, positing a gap**
- **Predicting a contrast**
- **Retrieving the first verbs argument structure requirements**
- **Retrieving the gap**
- **Realizing the contrast**

Interference of **syntactic** and **phonological** processes?



Elliptic and non-elliptic coordinations as a test case:

The experimental design:

Der Dirigent	lacht kauft	und der	Musiker Musikant	isst / **ISST**	Kuchen Gebäck	mit Sahne.

Factor #1: Elliptic vs. non-elliptic coordination

Factor #2: Rhythmic environment to the left of 2nd verb

Factor #3: Rhythmic environment to the right of 2nd verb

Testing the relative influence of contrast and rhythmic structure

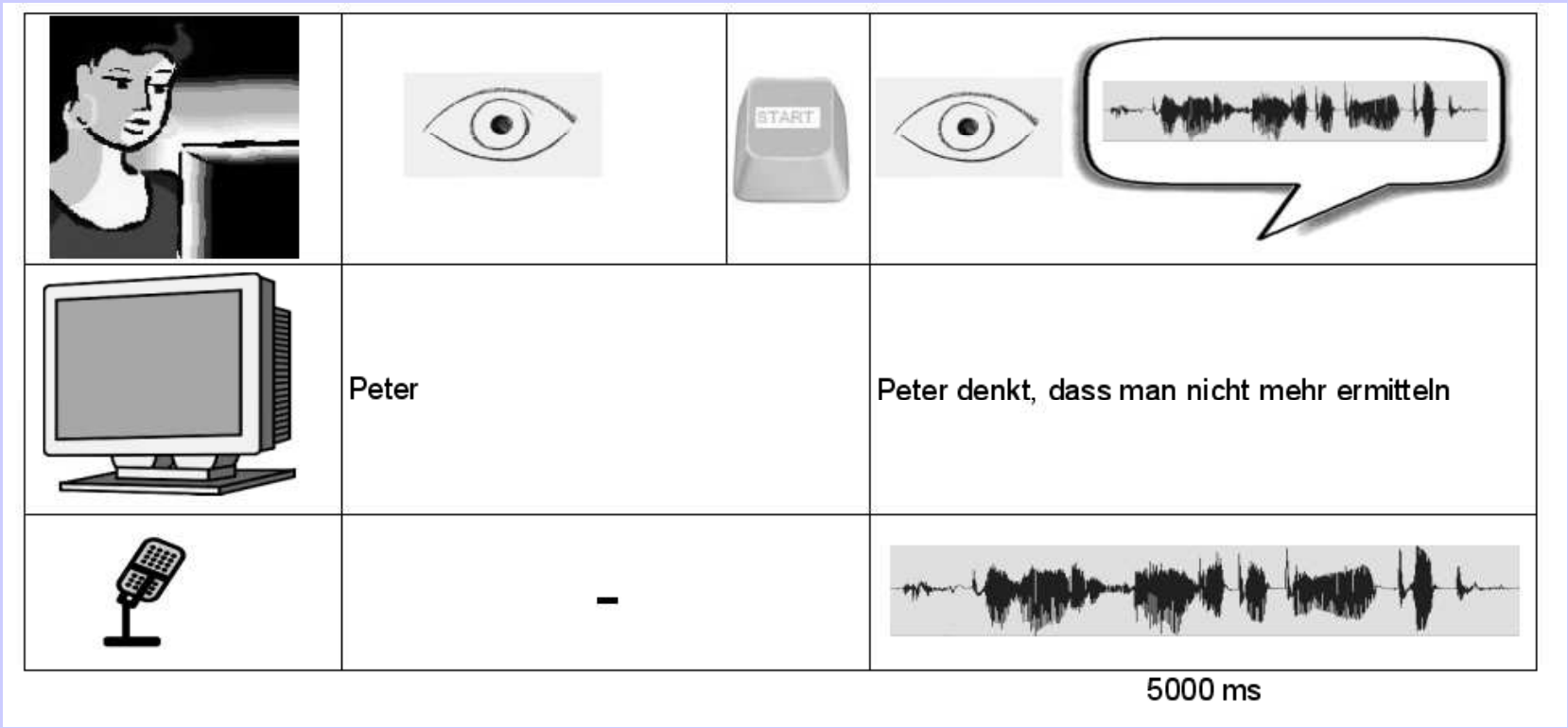
Hypotheses:

0 According to the hierarchy for prominence assignment (Focus>>Phrase Structure>>Lexicon), the realization of contrastive accent should not be affected by the lexical prominence patterns surrounding the critical verb.

1 Contrastive accentuation of a monosyllabic verb that is adjacent to a stressed syllable implies a stress clash; clashes are generally avoided (they possibly necessitate rhythmic adjustments). The lexical prominence patterns should affect accentuation.

Testing the relative influence of contrast and rhythmic structure

Unprepared reading aloud protocol:



Experiment

24 female speakers read

28 target sentences in 8 conditions, latin squared (target-filler ratio ~ 0.3)

→672 sentences

16.7% of the sentences were flawed (slips of the tongue, hesitation phenomena)

Sentence fragments (2nd conjunct) were judged for relative prominence of verb and object

Criterion: Contrastive accent on verb when verb perceived as more prominent than object

Experiment

Is the high number of flawed sentences (16.7%) related to the experimental factors?

Logistic regression (flawed vs. fluent) – linear mixed effects model (subjects and items as random effects):

Fixed effects:

	Estimate	Std.Err	z	p
(Intercept)	2.0588	0.278	7.407	<0.001
elliptic	-0.0337	0.1154	-0.292	0.77
clashL	-0.1528	0.1166	-1.310	0.19
clashR	-0.007	0.1168	-0.060	0.95
elliptic:clashL	-0.0679	0.1164	-0.583	0.56
elliptic:clashR	-0.0612	0.117	-0.523	0.60
clashL:clashR	-0.0251	0.1736	-0.145	0.89
elliptic:clashL:clashR	-0.2105	0.1467	-1.435	0.15

Experiment - Results

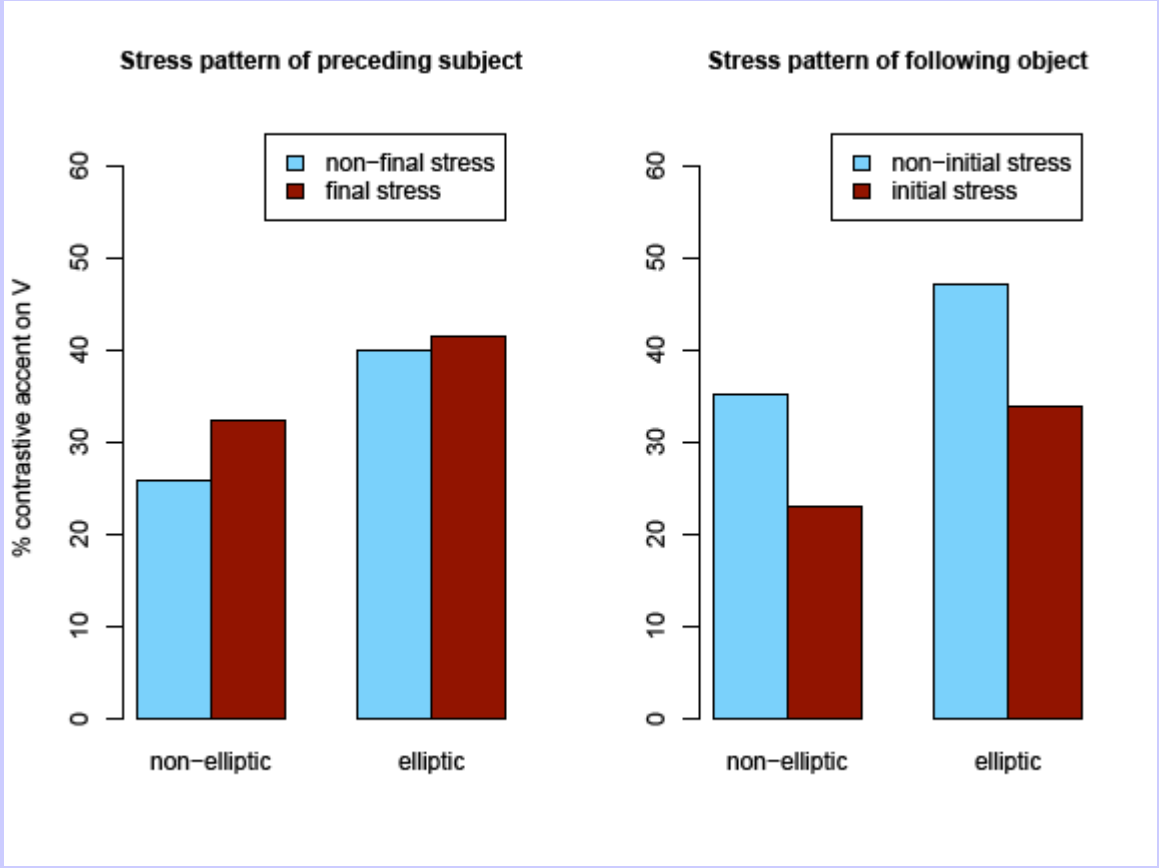
Logistic regression on judgement data (contrast)

linear mixed model (subjects and items as random effects):

Fixed effects:

	Estimate	StdErr	z	p
(Intercept)	-0.75492	0.1831	-4.124	<0.001 ***
elliptic	0.28811	0.0953	3.022	0.003 **
clashL	0.11843	0.0954	1.241	0.215
clashR	-0.32064	0.0956	-3.352	<0.001 ***
elliptic:clashL	-0.09715	0.0954	-1.018	0.308
elliptic:clashR	0.00899	0.0953	0.094	0.925
clashL:clashR	0.03545	0.1229	0.288	0.773
elliptic:clashL:clashR	0.06185	0.1173	0.527	0.598

Experiment - Results



Der Dirigent {lacht; kauft} und der **Musiker** / **Musikant** **isst** **Gebäck** / **Kuchen**

Effect of ellipsis

Across conditions, contrastive accent on 2nd verb was realized in ~35% (expected: 50%)

In non-elliptic sentences, contrastive accent on 2nd verb was realized in 29% of cases (expected 0%) → 29% of “marked“ realizations.

In elliptic sentences, contrastive accent on 2nd verb was realized in 41% of cases (expected 100%) → 59% of “ungrammatical“ realizations

→ More realizations of contrast in elliptic structures, but:

Contrastive accent on verb is often omitted at the cost of the grammaticality of the realization.

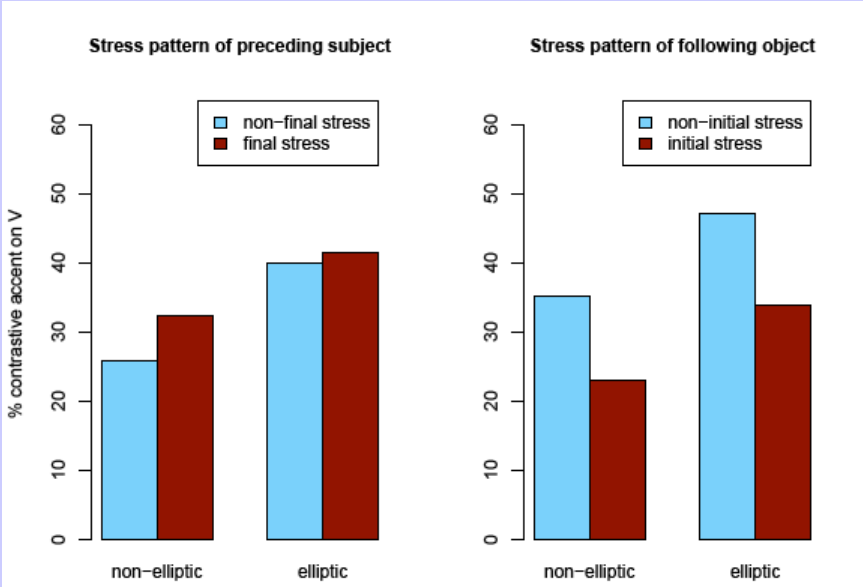
Effect of rhythmic environment

Across conditions, contrastive accent on 2nd verb was realized in ~35% (expected: 50%)

In non-clash environments: 41% of verbs contrastively accented

In clash environments: 28 % of verbs contrastively accented

According to the 0-Hypothesis no difference between clash and non-clash environments was predicted → **reject H0**



Discussion

Contrastive accentuation in elliptic sentences is often omitted at the cost of the grammaticality of the realization

This effect is especially strong when the rhythmic environment involves a stress clash

→ *stress clash avoidance by omission of focal accent*

Phonological processes (avoiding a possible stress clash) interfere with syntactic processes (processing ellipsis) in unprepared reading aloud.

Do phonological processes (clash avoidance) hamper sentence comprehension in these cases?

Discussion

Do suboptimal prosodic representations (stress clash) hamper sentence comprehension (processing ellipsis) in reading? – No definite answer, but:

Readers aim for successful communication. They will therefore intend to produce outputs that represent their analysis in a transparent way, i.e. outputs that are easy to parse.

Non-tranparent outputs in reading are a mark of sentence processing difficulty.

Implications for reading: (implicit) rhythmic structure affects sentence comprehension such that rhythmically optimal sentences will be understood better than rhythmically suboptimal ones

→ **(Implicit) rhythm is crucial in written communication**

Thank you

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