Statistical Learning and Visual Word Identification: An eye-tracking investigation of natural reading in children

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Background

- Reading proficiency may develop through the chunking of lower-level units (e.g., letters) into larger ones (e.g., words and morphemes).
- Morpho-orthographic chunking in adults may be interpreted similarly — morphology drives regularities in letter co-occurrence within words[1,2,3], which the reading system may exploit to facilitate visual word identification.
- In this perspective, reading may be conceived as a form of **statistical learning**.

Aims and Hypotheses

- We try to identify **statistical learning proxies** in **developing readers of Italian** (3rd – 6th graders).
- The present work focuses on **nGram frequency**. Other possible indexes (e.g., transitional probabilities, word predictability) are currently under investigation.
- Age is expected to play a role in the development of sensitivity to statistical learning cues in reading.
- We will make the data available, thus creating the first database of eye tracking data in children.

Methods

Participants:
39 (22 M) **native Italian speakers** (age range: 8-12 years).

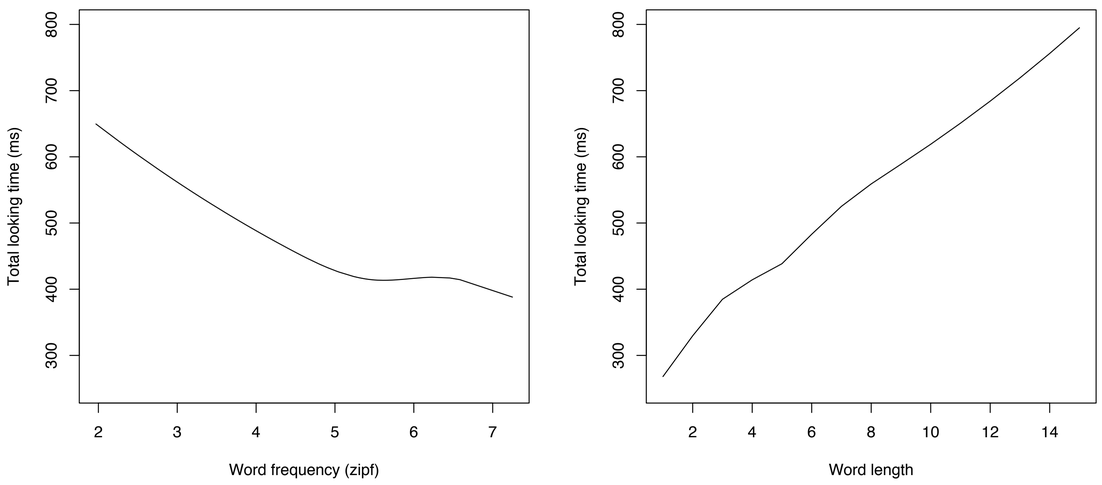
Procedure:
- **Natural reading** task on textfrom kids' books.
- Simple 2-AFC comprehension questions after every other excerpt displayed.
- Eye movements recorded through a tower-mount Eyelink 1000 Plus **eye-tracker.**
- **Computerized cloze probability task,** currently under analysis.

Additional assessment:
- Reading proficiency test (MT test – Speed and Accuracy[4])
- Non-verbal intelligence test (Raven CPM-47[5]).

Stimuli features
- 1935 tokens
- 728 different words
- 609 different lemmas
- 12 parts of speech

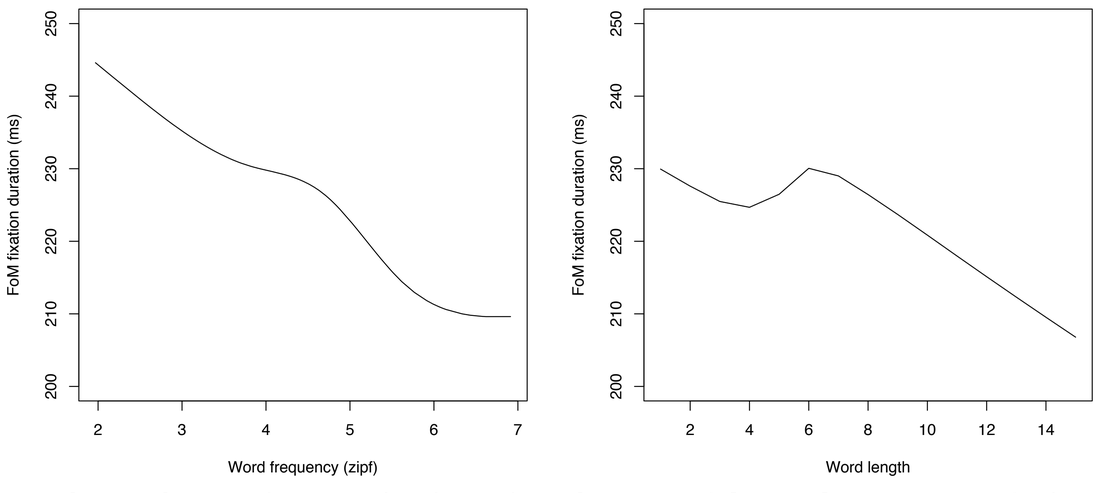
Results

Total Looking Time (TLT)



In line with previous data[6,7], total looking time depends on **word length** (F[4,22400]=81.93, p<.001) and **word frequency** (F[4,22400]=303.14, p<.001), with no interaction (p=.44).

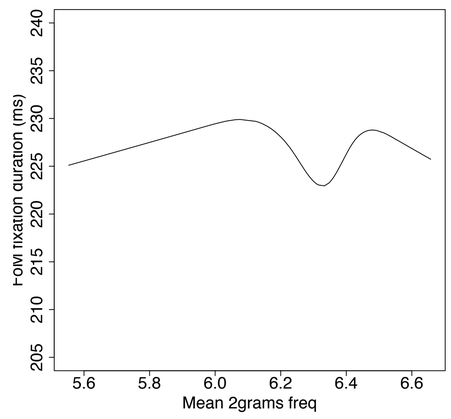
First-of-many fixation duration (FoM)

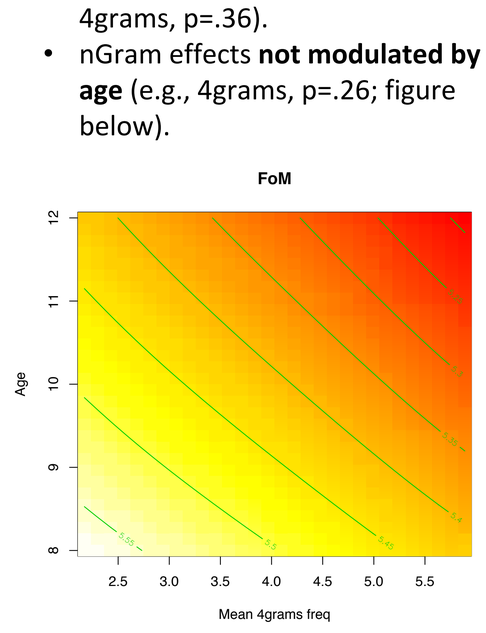


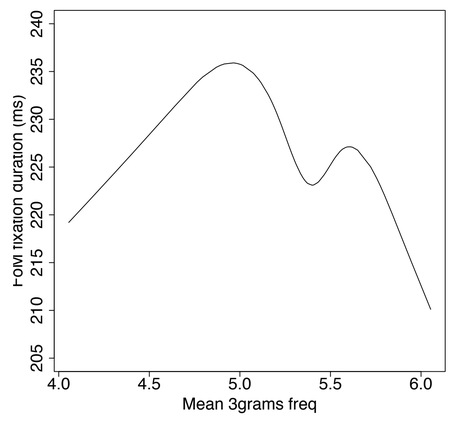
First-of-many fixation duration also depends on **frequency** (F[4,7160]=12.80, p<.001). There's a trend for **word length** too (F[4,7160]=1.89, p=.10), again with no interaction (p=.39).

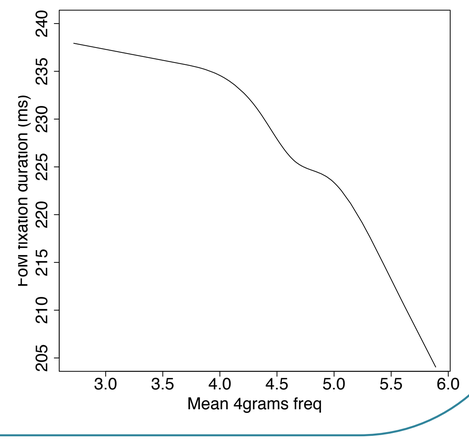
Mean nGram frequency

- A **size gradient**: 2grams don't work (F[4,5900]=.61, p=.61), 3grams do (F[4,5900]=3.09, p=.01), 4grams strongly significant (F[4,5900]=5.05, p<.001; figures on the right).
- Stronger effects on **early measures** (FoM much better than TLT).
- nGram effects **fade** when **word frequency** is considered (e.g., 4grams, p=.36).
- nGram effects **not modulated by age** (e.g., 4grams, p=.26; figure below).









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