

Eye movements during silent reading of poetry reflect metric and rhyme structure

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Children's literature cross-linguistically includes metrically regular rhymed language (MRRL) [1], as evidenced in nursery rhymes and authored poetry [4]. MRRL is thought to be one of the factors contributing to children's acquisition of phonological awareness and subsequent reading skills [6], perhaps by enhancing implicit prosodic representations. Based on research of the acoustic properties of reading MRRL in a popular American children's book [2], the current study investigated the extent to which features of poetry (metric structure and rhyme) are reflected in eye movements during silent reading by modeling these along with segmental, lexical, and syntactic predictors. While prior work investigating eye-movements during MRRL reading has focused largely on metrical and rhyme violations [1], the current study considers eye movements during naturalistic reading of an authentic MRRL text as indices of implicit prosody.

Thirty-one college students, all native English speakers, read silently *The Cat in the Hat* [9] while eye movements were recorded with an EyeLink 1000 Plus. The 76 rhyming verses in the book are couplets of anapestic tetrameter composed almost entirely of high-frequency monosyllables as seen in (1). Mixed-effects models were fit to predict first fixation duration, first pass time, go-past time, dwell time, skips, and regressions in/out of all monosyllabic words as a function of phoneme number, lexical repetition, word class (open/closed), capitalization, syntactic dependency structure [10], hierarchical metric structure [5], and rhyme predictability (no rhyme/rhyme target). Phoneme number predicted first fixation duration and regressions out: The longer the word, the shorter the fixation and the bigger the probability of a regression. Lexical frequency predicted go-past time and dwell time: The more frequent the word, the shorter the fixation duration. Word class predicted skips and regressions: Open class words were skipped less and more frequently regressed out of, while closed class words were more frequently re-fixated. Lexical repetition predicted go-past time and regressions: Repeated words had shorter fixations and greater probability of regressions out. Capitalization predicted late reading measures, skips, and regressions: Capitalized words were fixated longer, skipped less frequently and were less frequently regressed into and out of (B in Figure 1). Syntactic dependency predicted all duration measures, with fixation durations increasing relative to dependency weight (D and F in Figure 1). Metric height predicted reading times with longer fixations durations with increases in metric height (C and E in Figure 1). Finally, rhyme predictability predicted late reading measures: Predictable rhymes were fixated longer and more often regressed out of, while unpredictable words were re-fixated more often (A in Figure 1).

The study identifies metric hierarchy as a unique predictor of eye-movement patterns during MRRL reading; specifically, readers realized five levels of metric hierarchy with durations significantly increasing on each metrical level, similar to work in speech production [2]. These results also replicate many well-known eye-tracking effects during naturalistic reading of an authentic text. Segmental factors (phoneme number) affect early fixations; lexical factors (frequency, word class) and syntactic dependency structure affects both later reading measures and probability of skipping and regressions [7,8]. Salience factors (capitalization, repetition) affect skips and forward/backward regressions. These patterns of fixation probability and duration are all qualitatively similar to those observed in spoken productions (word durations) of the same text [2], further supporting the connection between explicit and implicit prosodic representations [3]. Moreover, the creation of this dataset facilitates investigation of eye movement patterns of developing readers; work in progress explores how children's reading patterns across age and reading proficiency compare to adult patterns, enhancing future literacy teaching methods and screening tools.

(1) “Put me **down!**” said the **fish**.
 This is **no** fun at **all!**
 Put me **down!**” said the **fish**.
 “I do **NOT** wish to **fall**.”

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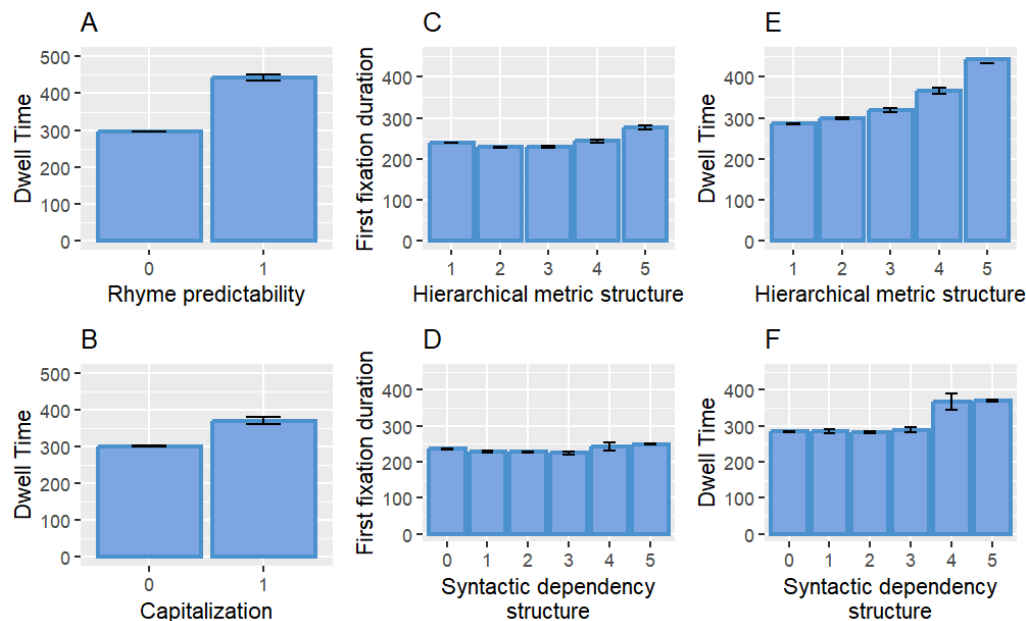


Figure 1: Fixation durations for rhyme predictability, capitalization, syntactic dependency structure and hierarchical metric structure for first fixation duration and dwell time measures