Prosodic structure affects processing: The case of English past inflection

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Inflected forms in the mental lexicon

In the literature on lexical access, there is much debate about whether or not inflected forms are stored in the mental lexicon.

Some proposals:

One route models:

- All inflected forms (both regular and irregular) are stored (e.g., Bybee, 1995; Rumelhart & McClelland, 1986)

Two route models:

- Irregular forms are stored but regularly inflected forms are generated by rule (e.g., Pinker & Prince, 1994)
- Regularly inflected forms can be stored under certain conditions, for example, if they are very frequent (e.g., Pinker & Ulmann, 2002)

Our focus: Regularly inflected forms in the past tense in English

Assumption: Regularly inflected forms are recursive prosodic words (PWds) (Goad & White, 2006)

Evidence: Regularly inflected forms can violate the phonotactic and length constraints that hold of monomorphemic (simple) PWds:

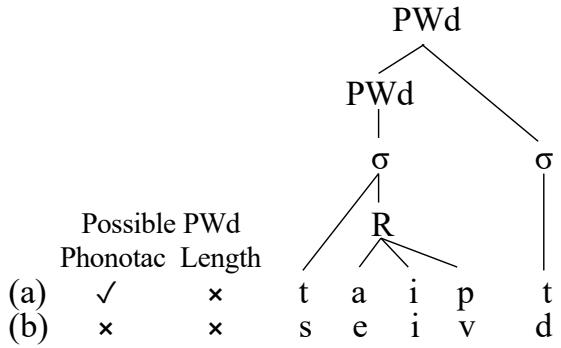
1. Phonotactic (non-exhaustive): obstruent+stop clusters must be voiceless in simple PWds (Goldsmith, 1990): [sɑft]$_{PWd}$ 'soft' *vs* *[sɑvd]$_{PWd}$
2. Length: final rhymes in simple PWds are max 3 segments long (VXC), unless CC# is [cor] (Harris, 1994): [stri:k]$_{PWd}$ 'streak', [strɪkt]$_{PWd}$ 'strict' *vs* *[stri:kt]$_{PWd}$; [peist]$_{PWd}$ 'paste' *vs* *[peift]$_{PWd}$

Hypothesis: The prosodic representation of regularly inflected forms affects their processing; i.e., prosodic shape impacts storage

Representation of inflected forms

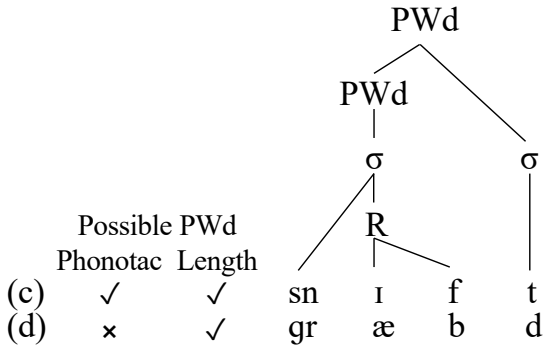
Observation: Inflected forms can violate both phonotactic and length constraints (1 and 2 on previous slide), which suggests that the inflection is not represented within the simple PWd

(1) Regular inflection:
Long base (VXC-final rhyme):



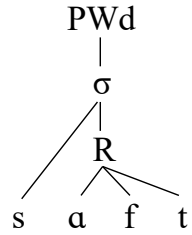
'typed' / 'saved'

Short base (VX-final rhyme):



'sniffed' / 'grabbed'

(2) Monomorphemic (simple) PWd:



'soft'

- **(1c) *vs* (2):** forms whose bases are shaped such that attachment of inflection respects phonotactic and length constraints of monomorphemic words (*sniffed;* cf. *soft*) have a **potentially ambiguous structure**: they could be built recursively or they could be stored as simple PWds
- **(1a-b) and (1d):** inflected forms that do not respect phonotactic and/or length constraints of monomorphemic words (*typed, saved; grabbed)* are **unambiguously recursive**

Experiment

Predictions:

- forms that are unambiguously recursive are retrieved faster ((1a-b), (1d) on previous slide), as they are invariably decomposed prosodically
- forms that are inflected but whose profile could fit the simple PWd structure of monomorphemic words ((1c) on previous slide) are retrieved more slowly

Task: lexical decision with auditory stimuli in OpenSesame (Mathôt et al., 2012)

- stimuli: monosyllabic targets (n = 524, divided into two versions) and fillers (n = 260)
- target items:

- real/nonce (e.g., *save/tave*; nonce verbs were generated by changing the onset of a real verb)

- inflected/uninflected (e.g., *saved/save)*

- long/short stem (e.g., *roll/fill*, *poke/crack*, *sneeze/buzz*)

- inflected verb as possible/impossible simple PWd (e.g., *rolled/poked*, *cracked/buzzed*)

ex: inflected *rolled* → $[[roul]_{PWd}\ d]_{PWd}$, could be $[rould]_{PWd}$ (cf. monomorphemic *cold* → $[kould]_{PWd}$)
inflected *poked* → $[[pouk]_{PWd}\ t]_{PWd}$, could not be $*[poukt]_{PWd}$ (no monomorphemic parallels)

Analysis: participants' response times (RTs) were examined with mixed-effects linear regressions with by-participant and by-item random intercepts in R (R Core Team, 2020)

Results

Figure 1:
Participants are:

- faster with real than nonce verbs ($\hat{\beta} = -0.16$, $p < 0.0001$)
- faster with inflected than uninflected verbs ($\hat{\beta} = -0.05$, $p = 0.005$)
- slower with short stems than long stems ($\hat{\beta} = 0.10$, $p < 0.0001$)

- Result for **real vs. nonce** verbs is consistent with previous findings (e.g., Vitevich & Luce, 1998)
- Result for **uninflected vs. inflected** suggests that inflection is not more costly for listeners (relative to non-inflection)
- **Length** alone does not determine prosodic structure: it could be that participants are simply faster with long stems because they have more time to retrieve the target item from their mental lexicon

Figure 2:

- To examine the role of prosodic structure in lexical access, we looked at whether being a possible simple PWd affects RT for real inflected verbs
- **Length and prosodic structure:** The statistical model shows an interaction between short stems (e.g., *sniffed*, *grabbed*) and being a possible simple PWd (*sniffed* only, cf. *soft*), with significantly slower RTs ($\hat{\beta} = 0.13$, $p = 0.03$)

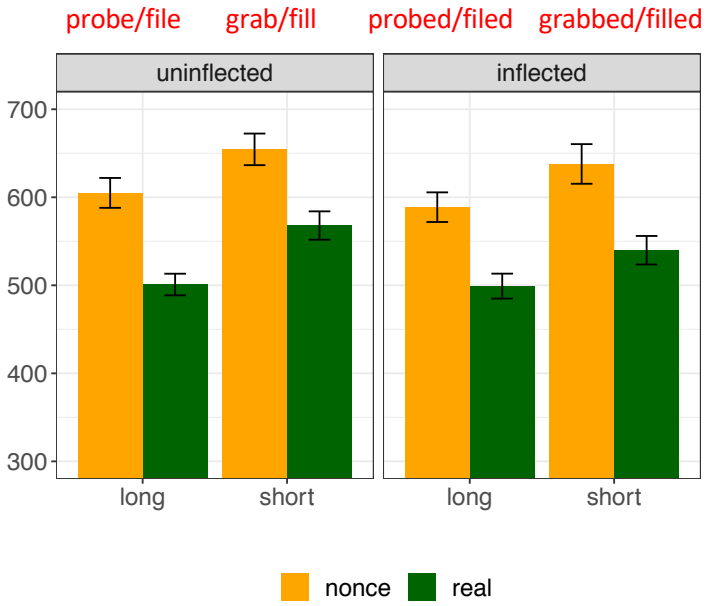


Figure 1. Overall RTs.

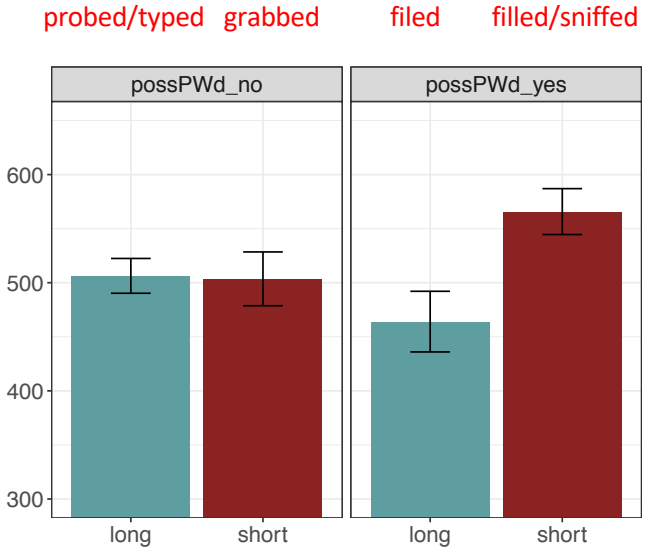


Figure 2. RTs for possible vs. impossible PWd in real, inflected verbs (long vs. short stems)

Discussion and conclusion

- These results are overall **consistent with our predictions:** short inflected possible PWds are retrieved more slowly because listeners must arbitrate between two competing representations: [snɪf]$_{PWd}$ t]$_{PWd}$ and [snɪft]$_{PWd}$ 'sniffed'

- However, Figure 2 suggests that **being a possible PWd affects only the processing of verbs with short stems:** long inflected possible PWds seem to be retrieved as quickly as long inflected impossible PWds

- We conjecture that this is because long inflected forms are possible PWds under much more **restricted conditions** than short inflected forms are (CC# must be coronal; slide 1)

- The results for short inflected stems support our hypothesis that the **prosodic representation of regularly inflected forms affects their processing**

- This finding supports **two route models** of lexical access, where inflected forms are stored under some conditions (irregular *vs* regular, frequent *vs* infrequent), but it adds to the conditions under which inflected forms can be stored: when they respect the phonotactic *and* length constraints of monomorphemic PWds

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