Acoustic Cues for Active and Passive Structure Vary for Different Verbs

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**Background**
Temporary ambiguity in active/passive sentences:
- The pig was **kiss-ing** the sheep
- The pig was **kiss-ed** by the sheep

Eye-tracking data (Stromswold et al., under review):
- Adults distinguish between active/passive at verb stem (push-) before syntactic disambiguation.

Sentence production data (Rehrig et al., 2015):
- Lengthening of passive verb stems compared to active stems.
- Acoustic cue of incoming syntactic structure?

**Questions**
Is lengthening of passive verb stem:
- Present for all verbs?
- Stronger for some kinds of verbs?

**Method**

**Stimuli:**
- 32 active and 32 passive sentences containing:
  - 20 nouns: animals
  - 16 verbs: actional, high frequency, reversible, -ed passive

**Verb Classifications:**
- **Stop/Non-stop** Verb Stem Coda (excluding tickle and pat)
  - 5 Stop coda verbs: kick, lick, poke, trap, scrub
  - 9 Non-stop coda verbs: chase, comb, kiss, pinch, punch, push, touch, shove, wash
- **Voiced/Unvoiced** Verb Stem Coda (excluding tickle and pat)
  - 3 Voiced coda verbs: comb, scrub, shove
  - 11 Unvoiced coda verbs: chase, kick, kiss, lick, pinch, poke, punch, push, touch, trap, wash

**Participants:** 7 native English-speaking adult monolinguals

**Procedure:**
- Participants read sentences
- High quality recordings done in sound-attenuated booth
- 6 coders used PRAAT to mark morpheme boundaries (inter-rater concordances, p<.0001)

**Results**

**All 16 verbs: Item and Subject ANOVAs**
- Passives 51 ms longer than actives, \(p < .0005\)

**Voiced/Unvoiced Verb Stem Coda Effects**
- Blue: Voiced
- Red: Unvoiced

\[ \text{Verb stem duration (ms)} \]

\[
\begin{align*}
\text{Active} & \quad 200 & \quad 250 & \quad 300 & \quad 350 & \quad 400 \\
\text{ Passive} & \quad 170 & \quad 220 & \quad 270 & \quad 320 & \quad 370 \\
\end{align*}
\]

- 2 (active, passive) x 2 (voiced, unvoiced) ANOVA
  - Passives 73 ms longer than actives, \(p < .0005\)
  - Voiced codas 53 ms longer than unvoiced codas, \(p < .0005\)
  - Interaction: active/passive difference greater for voiced codas, \(p < .0005\)

**Stop/Non-stop Verb Stem Coda Effects**
- Blue: Stop
- Red: Non-Stop

\[
\begin{align*}
\text{Active} & \quad 150 & \quad 200 & \quad 250 & \quad 300 & \quad 350 & \quad 400 \\
\text{ Passive} & \quad 120 & \quad 170 & \quad 220 & \quad 270 & \quad 320 & \quad 370 \\
\end{align*}
\]

- 2 (active, passive) x 2 (stop, non-stop) ANOVA
  - Passives 55 ms longer than actives, \(p < .0005\)
  - Non-stop codas 11 ms longer than stop codas, \(p = 0.10\)
  - Interaction: active/passive difference greater for non-stop codas, \(p = .009\)

**T-Tests Results**

**Paired t-tests: active/passive effect for each verb**
- Voice compared to unvoice:
- Passive greater than active

**Discussion**
- Passive lengthening effect found for all 16 verbs
- Passive verb stem lengthening greater for verb stems with voiced than unvoiced codas
- Passive verb stem lengthening greater for verb stems with non-stop than stop codas

**Conclusions**
- Passive verb stem lengthening is robust
- May be a useful cue for listeners to predict upcoming syntax

**Future Directions**
Are listeners better at predicting syntactic structure for verbs with greater passive stem lengthening

**References**


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