Passive Sentences can be Predicted By Adults
Karin Stromswold, Melinh Lai, Gwendolyn Rehrig, Paul de Lacy

Background
Temporary syntactic ambiguity between active & passive sentences is resolved by the inflectional morpheme:

The pig was **kiss** —the sheep
ed by the sheep

- Naïve listeners are able to predict syntax before hearing verb ending in sentences spoken by a trained phonetician (Stromswold 2002; under review)
- Passive verb stems spoken by 7 naïve English speakers were ~52 ms longer than active verb stems (Rehrig et al., 2015)
  - Verb stems w/voiced codas ~24 ms longer than verb stems w/unvoiced codas
  - Verb stems w/non-stop codas ~17 ms longer than verb stems w/stop codas

Questions & Predictions
Do naïve listeners use speakers’ verb stem duration to predict active and passive structures?
- If listeners are sensitive to verb durational differences they should be able to correctly identify active & passive sentences without hearing the verb inflection

How does phonetics affect acoustic cue comprehension?
- Coda properties (i.e., voicing and manner of articulation) that affect syllable duration could either aid or interfere with comprehension of verb stem duration

Materials & Methods
Stimuli
- Audio recordings of a participant from Rehrig et al.’s production study
- 32 actives: The __________was **ing** the _______
- 32 passives: The _______ was **ed** by the _______

Verbs (grouped by coda properties)

<table>
<thead>
<tr>
<th>Voiced</th>
<th>Unvoiced</th>
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<tbody>
<tr>
<td>bear</td>
<td>cat</td>
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<td>duck</td>
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<td>brush</td>
<td>kiss</td>
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<td>wash</td>
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Comprehension gating experiment
1) Fixation (500 ms)
2) Audio recording truncated at offset of verb stem coda plays e.g., “The pig was kiss—”
3) Forced choice between fully written active & passive sentences
   - Key presses corresponding to L and R sentences

Results
Performance distributions
- 64 targets; at least 40 correct to perform at above chance levels
- 23/38 participants scored at above chance level; 15 at chance level; none below chance

Overall results: Active vs. Passive
- Participants were more accurate and faster at predicting passive sentences

Stem length & prediction accuracy
- Verb stems were 29 ms shorter on correct active trials and 25 ms longer on correct passive trials

Effect of coda voicing & coda articulation
- Higher accuracy in active & passive sentences when verb stem had unvoiced coda
- Lower accuracy in active sentences when verb stem had stop coda
- Effects of voicing and manner of articulation on RT were NS

Discussion
Listeners may use verb stem duration as a cue to predict passives
- Participants identified passive sentences faster & more accurately, regardless of phonetic properties of verb stem coda

Verb stem lengthening as a probabilistic cue
- Active sentences more prevalent than passive sentences
- Participants may update probabilistic distributions of potential structures after listening to verb stem duration

Comparison of stem duration in utterance to “normal” duration stored in lexicon informs distribution of probabilities of active/passive structures

Unclear whether acoustic cues exist for just passives or for actives also
- Presence of acoustic cue for actives would have resulted in higher accuracy
- But correctly identified active sentences clearly had shorter stems
- Interactions of phonetics & syntax more significant in active sentences
- Stem length does at least inform their decision during the task
- Perhaps participants could not fully decide after hearing actives

Just noticeable difference in passive stimuli
- Durational differences of ~20% are perceptually important (Klatt 1976)
- Active cue in stimuli may not have been shortened enough to be noticeable

Phonetic effects of coda
- Phonetics of coda may interfere with comprehension of acoustic cue
  - Lower accuracy in voiced passives & non-stop actives
  - Listeners may be unaware of stem duration due to syntax or coda effects
- Participants may be listening specifically for vowel duration (as opposed to the entirety of the verb stem)
- Vowels shorter if followed by unvoiced consonants (Umeda 1975; Klatt 1976)
- Actives may get additional cue from unvoiced coda due to shortened vowel
- No prior established effects of manner of articulation on vowel duration

Unclear what drives higher accuracy in actives with non-stop codas
- Investigation of robustness across phonetic effects is ongoing

References

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