Tracking the Acquisition & Processing of English Passives: Using Acoustic Cues to Disambiguate Actives & Passives

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Supported by NSF (BCS-9875168, BCS-0042561, BCS-0124095)

Questions to be addressed

- Do children and adults process passives in the same way?
- When do they “decide” if a sentence is active or passive?
  - Active: The girl was pushing the boy
  - Passive: The girl was pushed by the boy
- What cues do they use to decide a sentence is passive?
  - Active: The girl pushes the boy
  - Passive: The girl was pushed by the boy
- Why do children and aphasic adults do poorly on passives?

English Actives & Passives

- Actives: Mary was pushing Bill (full active)
  - Production: children never make mistakes
  - Comprehension: children better than chance by 24 mos
- Passives: Bill was pushed by Mary (by passive)
  - Production: By passives rare in adult & child speech
  - Comprehension: Children at or near chance until age 4.
  - Processing: Even normal adults find passives harder

Sentence-picture matching task

Active: e.g., The girl was pushing the boy
Passive: e.g., The girl was pushed by the boy

Stimuli

- Sentences (All pre-recorded & digitalized)
  - 12 Actives: e.g., The girl was pushing the boy
  - 12 Passives: e.g., The girl was pushed by the boy
  - 30 Fillers (adults only)
    - 14 Verb: The boy was touching/kissing the woman
    - 16 Verb & Agent/Patient shift:
      - The boy was touching the woman
      - The woman was kissing the boy
- Verbs: touch, tickle, push, shove, kiss, sniff
- NP pairs: girl & boy; woman & man

Design

- 6 verbs x Act/Psv x Adult/Child = 24 trials
- Also controlled/balanced for whether
  - Target picture was on the left or the right
  - Agent was to left or right of patient
  - Agent was male or female
  - Male or female character was mentioned first
- Sentences in pseudorandom order
Subjects

- Normal, native, monolingual English speakers
- **Preschool**: 17 children (3;1-4;8, mean 3;10) => Error rates, RTs
- **School-age**: 16 children (4;9-7;4, mean 5;8) => Error rates, RTs, Eye-movements
- **College students**: 23 adults => Error rates, RTs, Eye-movements

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**Adult Trial**

**CRITICAL TRIAL**
- Fixation: Look at the cross
- Critical: Which picture shows …
  - The girl was pushing the boy
- Distractor: Which picture shows …
  - The boy was wearing the blue shirt

**FILLER TRIAL**
- Fixation: Look at the cross
- Filler: Which picture shows …
  - The boy was climbing the woman
- Distractor: Which picture shows …
  - The woman was wearing the blue shirt

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**Child Trial**

**TRAINING TRIALS**
- One person: Which picture shows a man?
  - Picture of man    Picture of woman
- Action: Which picture shows kissing?
  - Pic of girl touching boy    Pic of girl kissing boy
- 2 people: Which picture shows a man and a woman?
  - Pic of man pushing woman    Pic of boy riding girl

**CRITICAL TRIAL**
- Fixation: Look at Woody
- Critical: Which picture shows …
  - The girl was pushing the boy
- Reward: Cartoon on side of screen child chooses

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**Accuracy: Preschoolers**

- **Active**: 74%, Passive: 58%, $F(1, 15) = 5.79, p = .03$
  - 4 did significantly better on Act than Psv, 13 children no significant difference
  - 5 above chance on Act & Psv, 6 above chance on Act but not Psv
- **3 yr olds**: 61%, 4 yr olds: 71%, $F(1, 15) = 2.99, p = .10$
  - Verb: $F(5, 75) = 2.26, p = .06$ (push vs. shove, $p = .06$)

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**Accuracy: School-Age & College**

**School Age**: 16 children (4;9-7;4)
- **Active**: 94%, Passive: 78%, $F(1, 14) = 9.56, p = .008$
  - 3 did significantly better on Act than Psv, 13 children no significant diff.
  - 12 above chance on Act and Psv, 4 above chance on Act but not Psv
- **No Effect of Age (5 yr : 82%, 6 yr : 90%, $p > .10$)**
- **No Effect of Verb ($p > .10$)**

**College Age**: 23 adults (18-25 years)
- **Active**: 99.6%, Passive: 96%, $F(1, 22) = 6.11, p = .02$
  - 3 did significantly better on actives than passives.
  - All above chance on both active and passive
- **No Effect of Verb ($p > .10$)**
RTs for Correct Trials (Preschoolers)

- Active: 5289 msec, Passive: 5739 msec
  \( F(1, 14) = 7.85, p = .01 \)
- Act/Psv x Age : \( F(1, 14) = 14.48, p = .002 \)

RTs for Correct Trials (School Age)

- Active: 4313 msec, Passive: 4953 msec
  \( F(1, 13) = 16.61, p = .001 \)
- Act/Psv x Age : \( F(1, 13) = 8.11, p = .01 \)

RTs for Correct Trials (College Age)

- Active 2289 msec & Passive 2449 msec
  \( F(1, 22) = 29.40, p < .0005 \)
- Verb: \( F(5, 110) = 4.85, p < .0005 \)
- Act/Psv x Verb: \( F(5, 110) = 2.39, p = .04 \)

Eye-Movement Data

- Apparatus: I-Scan Mobile Eye-Tracker (30 frames/sec)
  Children: Head-mounted system
  Adults: Table top system

- Linking Hypothesis: People look at the picture that matches what (they think) a sentence means

- Coding: All data hand-coded.
  Which picture: Target or Competitor Picture
  [Within picture: Agent, Patient, Point of Contact, Else]

- Graphs: Track-loss & looks to cross eliminated
  Graphs depict means of subject means

Mean Word Onsets (in frames)

ACTIVE WORD ONSETS

<table>
<thead>
<tr>
<th>The girl was pushing the boy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 4.6 16.1 21.5 35.9 39.0</td>
</tr>
</tbody>
</table>

PASSIVE WORD ONSETS

<table>
<thead>
<tr>
<th>The girl was pushed by the boy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 4.4 15.9 21.5 34.3 38.5 41.8</td>
</tr>
</tbody>
</table>

CUNY Conference on Sentence Processing
March 21-23, 2002

Passive Picture Eye-Tracking: Children's Data

Child Data: Looks for Correct Trials

Child Active Data: Looks for Correct and Incorrect Trials

Child Passive Data: Looks for Correct and Incorrect Trials

Passive Picture Eye-Tracking: Adult Data

Adult Data: Looks for Correct Trials

The girl was touching the boy

The girl was touched by the boy

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Adult Passive Data: Looks to Correct and Incorrect Trials

Correct Passives
Incorrect Passives

The girl was touching the boy
The girl was touched by the boy

Adults: Active & Child Looks (All Trials)

Looks to Correct Picture

The girl was touching the boy
The girl was touched by the boy

Passives: Adult & Child Looks (Correct Trials Only)

Looks to Correct Picture

The girl was touching the boy
The girl was touched by the boy

Duration of Morphemes in Actives & Passives

The woman
was
kissed
ing/ed
the
man
Conclusions

- Children and adults process passives in different ways
  Adults: process on-line. No “active” bias.
  Children: process off-line. Have an “active” bias.
- They begin to “decide” a sentence is active at different points
  Adults: at or before the verb stem (i.e., before participle)
  Children: at or after the progressive participle
- They begin to decide a sentence is passive at different points
  Adults: at the passive participle
  Children: after the sentence is over
- Only adults appear to use early acoustic cues to disambiguate
- Perhaps this partially explains why young children (and aphasics) do poorly on passives