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

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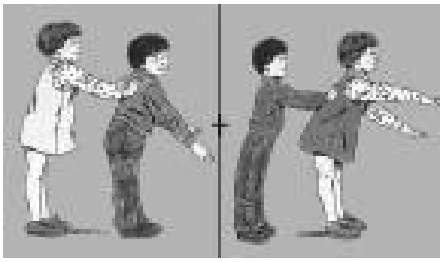
English Actives & Passives

- 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

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 push-ing the boy*
  Passive: *The girl was push-ed by the boy*
- What cues do they use to decide a sentence is passive?
  Active: *The girl pushes the boy*
  Passive: *The girl was push-ed by the boy*
- Why do children and aphasic adults do poorly on passives?

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

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

Child Trial

TRAINING TRIALS

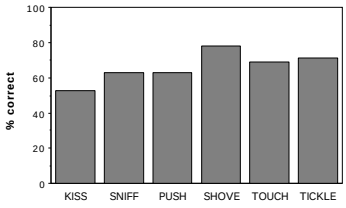
- One person: Which picture shows a man?
  Picture of man Picture of woman
- Action: Which picture shows kissing?
  Pic of girl touching boy Pic of girl kissing boy
- 2 people: Which picture shows a man and a woman?
  Pic of man pushing woman Pic of boy riding girl

CRITICAL TRIAL

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

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,
  5 at chance on Act & Psv, 1 above chance on Act & below chance on 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*, $p = .06$)



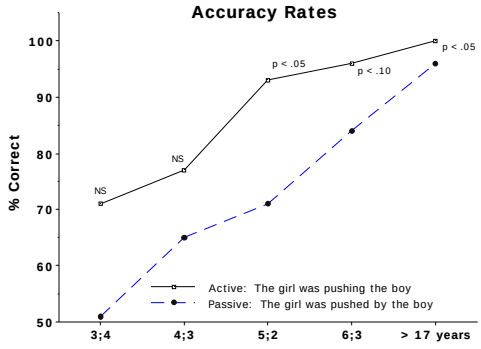
Accuracy: School-Age & College

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 ($p > .10$)

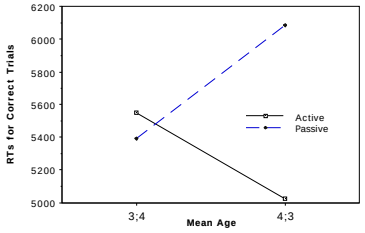
College Age: 23 adults (18-25 years)

- Active: 99.6%, Passive: 96%, $F(1, 22) = 6.11$, $p = .02$
  No subjects did significantly better on actives than passives.
  All above chance on both active and passive
- No Effect of Verb ($p > .10$)



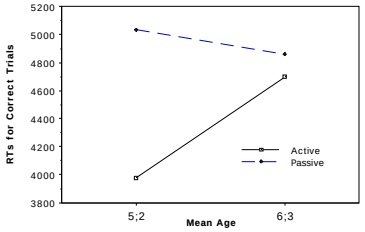
RTs for Correct Trials (Preschoolers)

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



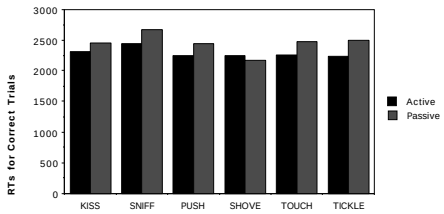
RTs for Correct Trials (School Age)

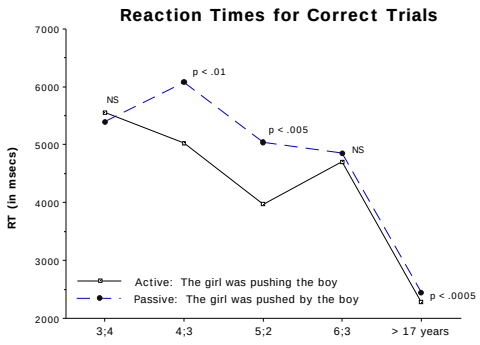
- Active: 4313 msec, Passive: 4953 msec
  $F(1, 13) = 16.61$, $p = .001$
- Act/Psv x Age : $F(1, 13) = 8.11$, $p = .01$



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

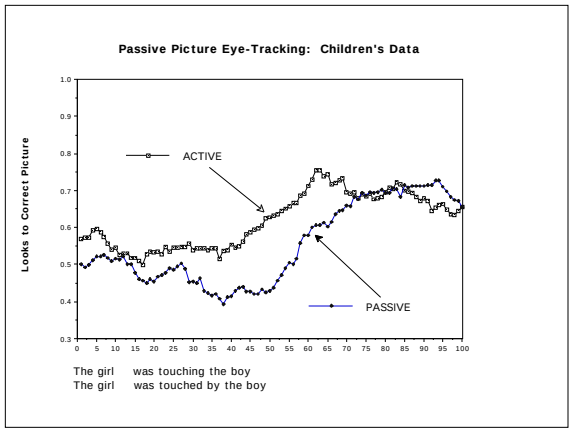
Mean Word Onsets (in frames)

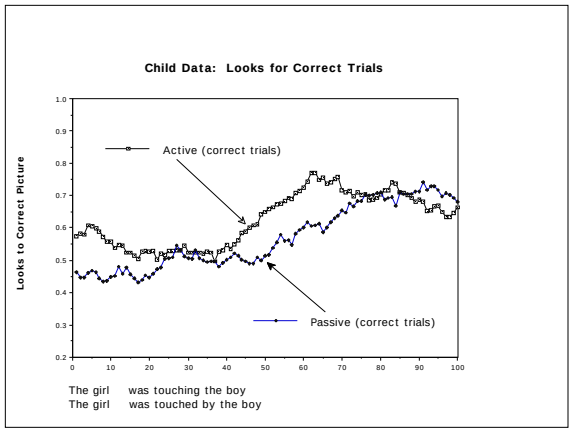
ACTIVE WORD ONSETS

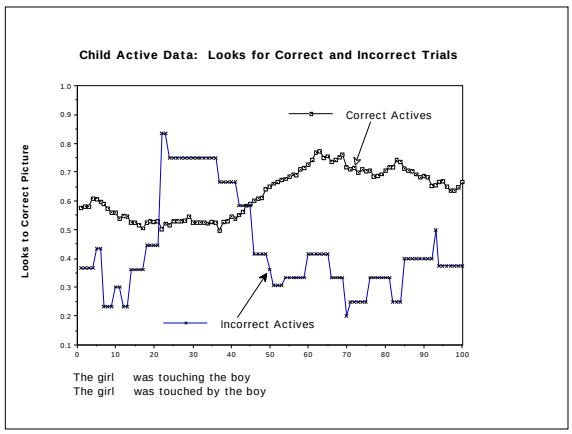
The	girl	was	pushing	the	boy
1	4.6	16.1	21.5	35.9	39.0

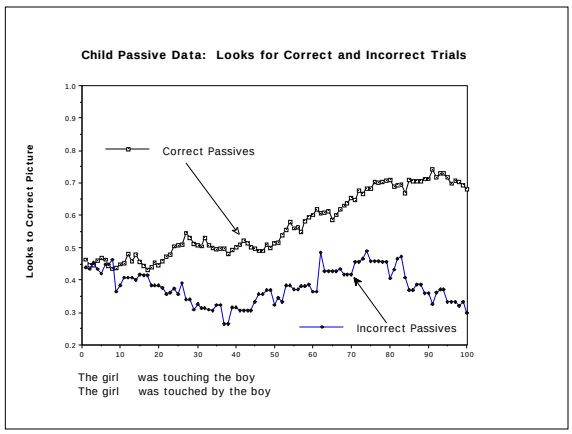
- **PASSIVE WORD ONSETS**

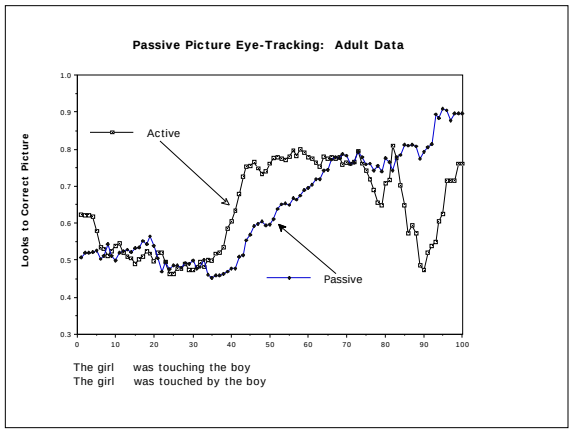
The	girl	was	pushed	by	the	boy	
1		4.4	15.9	21.5	34.3	38.5	41.8

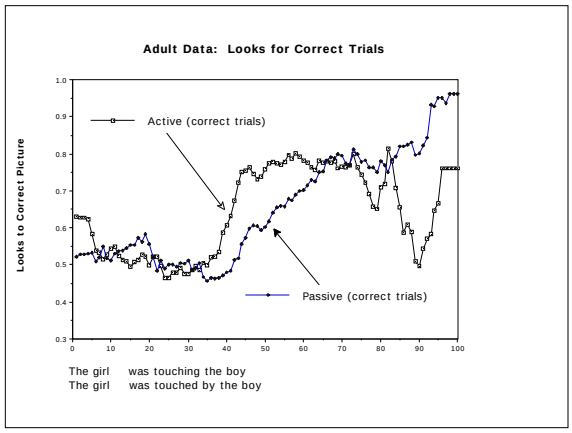

Passive Picture Eye-Tracking: Children's Data
Looks to Correct Picture
ACTIVE
PASSIVE
The girl was touching the boy
The girl was touched by the boy

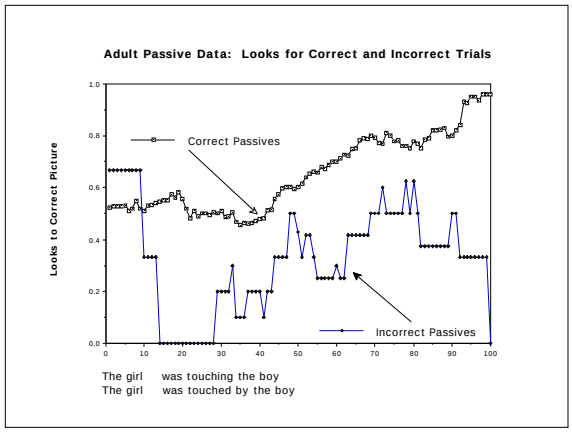

Child Data: Looks for Correct Trials
Looks to Correct Picture
Active (correct trials)
Passive (correct trials)
The girl was touching the boy
The girl was touched by the boy

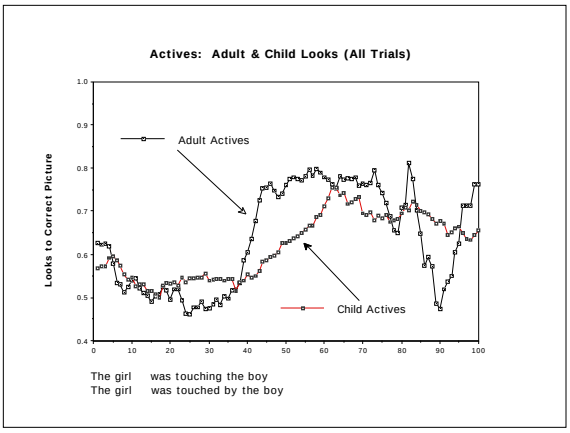

Child Active Data: Looks for Correct and Incorrect Trials
Looks to Correct Picture
Correct Actives
Incorrect Actives
The girl was touching the boy
The girl was touched by the boy

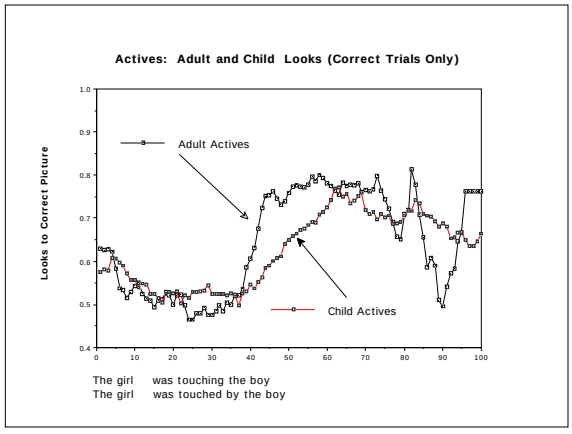

Child Passive Data: Looks for Correct and Incorrect Trials
Looks to Correct Picture
Correct Passives
Incorrect Passives
The girl was touching the boy
The girl was touched by the boy

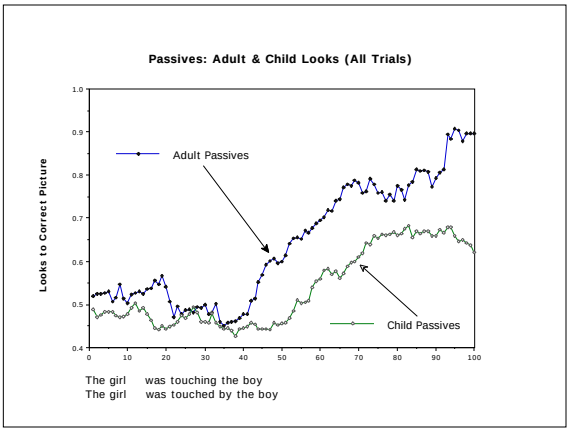

Passive Picture Eye-Tracking: Adult Data
Looks to Correct Picture
Active
Passive
The girl was touching the boy
The girl was touched by the boy


Adult Data: Looks for Correct Trials
Looks to Correct Picture
Active (correct trials)
Passive (correct trials)
The girl was touching the boy
The girl was touched by the boy


Adult Passive Data: Looks for Correct and Incorrect Trials
Looks to Correct Picture
Correct Passives
Incorrect Passives
The girl was touching the boy
The girl was touched by the boy


Actives: Adult & Child Looks (All Trials)
Looks to Correct Picture
Adult Actives
Child Actives
The girl was touching the boy
The girl was touched by the boy


Actives: Adult and Child Looks (Correct Trials Only)
Looks to Correct Picture
Adult Actives
Child Actives
The girl was touching the boy
The girl was touched by the boy


Passives: Adult & Child Looks (All Trials)
Looks to Correct Picture
Adult Passives
Child Passives
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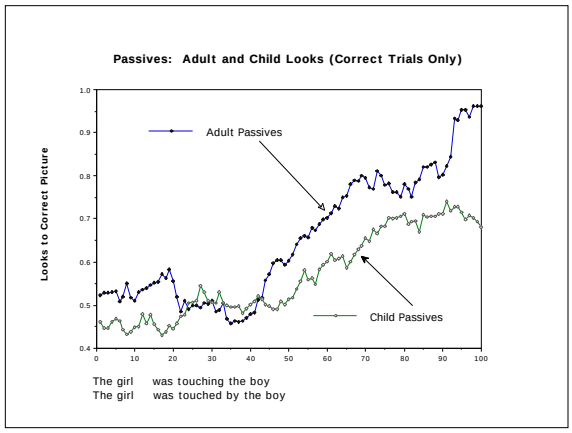
Passives: Adult and Child Looks (Correct Trials Only)
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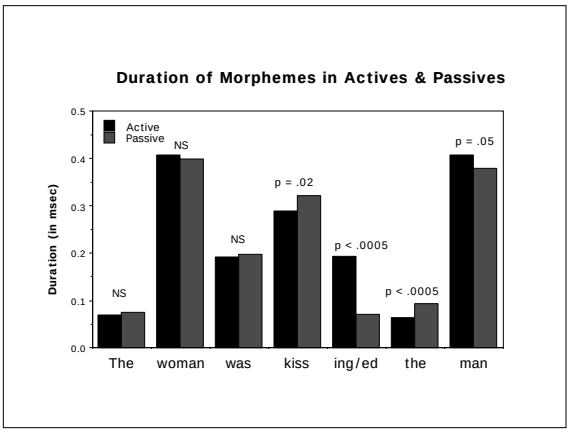
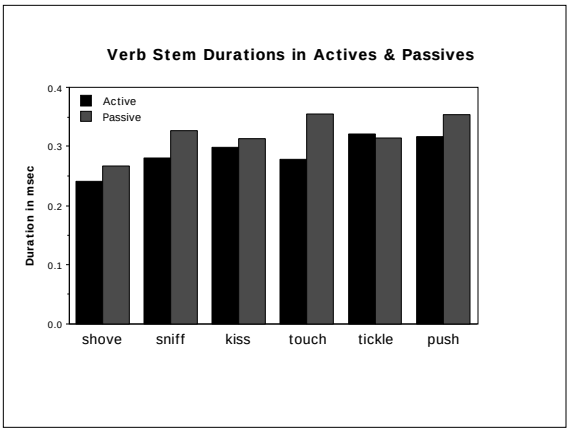

Duration of Morphemes in Actives & Passives
Duration (in msec)
Active
Passive
NS
NS
p = .02
p < .0005
p < .0005
p = .05
The
woman
was
kiss
ing/ed
the
man



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