Computation of Language Laboratory
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Do you really mean it?
Linking lexical semantic profiles and the age of acquisition for the English passive

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1. Introduction

- Within the domain of passives, children's performance differs
  i. By-phrase passive: Alex was loved by Emma.
- Proposed factors (Demuth et al. 2010; Maratsos et al. 1985; O'Brien et al. 2005; Snyder & Hyams 2015; a.o.).
  - **Frequency**
  - **Lexical Semantics**
  - Syntax
  - Pragmatics
- This study:
  1) Experimental meta-analysis capturing the demonstrated age of acquisition for English verb passive use.
  2) Corpus analysis of children's input.

Goal: Identify the contributions of frequency and lexical semantic factors for children's acquisition of English *by*-phrase passives.

2. Verb Frequency Hypothesis

- Crain & Fodor (1993): Children and adults rarely produce *by*-phrase passives.
  Frequency-based Idea: Differing performance due to hearing some verbs in the passive form more than others.

3. Lexical Semantic Feature Hypothesis

- Performance depends on verb lexical semantics
  Lexical semantics-based idea: Differing performance due to lexical features.
- **Important:** Potentially relevant features have been proposed but no formal investigation of how well these descriptive features account for the development of the *by*-phrase passive.

Lexical Semantic Properties				
Studies	**Property**	**Defined as…**	**+**	**–**
Liter, et al. (2015)	Stative	simple present tense in out-of-blue context	hate	paint
Liter, et al. (2015)	Volitional	"deliberately VERB"	fix	spot
Pinker, et al. (1987)	Affectedness	X affects Y & Y is impacted	annoy	like
Messenger, et al. (2012)	Object-Experiencer	non-actional where the object is the experiencer	frighten	hug
Messenger, et al. (2012)	Subject-Experiencer	non-actional where the subject is the experiencer	like	annoy
Messenger, et al. (2012)	Agent-Patient	actional where agent and patient are the thematic roles	find	frighten
Maratsos et al. (1985), Nguyen et al. (2015)	Actionality	not a mental state, psych, or perception verb	carry	upset

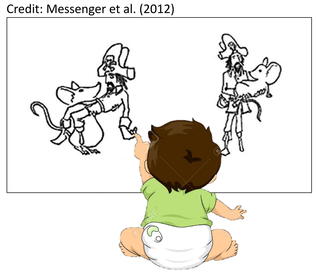
4. Research Questions

Do children's age of acquisition of the passive form of a particular verb correlate with…
Frequency factor: … the verb's frequency in the input?
Lexical Semantic factor: … the lexical semantic features of that verb?

5. Annotating Verbs for Lexical Semantic Features

Example annotations of the lexical semantic features								
Ex verb		Stative?	Volitional?	Affectedness?	Obj-Exp?	Subj-Exp?	Agt-Pat?	Actional?
find	reason	*John finds Mary.	*John deliberately finds Mary.	John finds Mary – Mary is unaffected	John finds the ball – John is the agent, the ball is the patient			*find* is not a mental, psych, or perception verb
	value	0	0	0	0	0	1	1
carry	reason	*John carries Mary.	John deliberately carries Mary.	John carries Mary – Mary is affected.	John carries the ball – John is the agent, the ball is the patient			*carry* is not a mental, psych, or perception verb.
	value	0	1	1	0	0	1	1
love	reason	John loves Mary.	*John deliberately loves Mary.	John loves Mary – Mary is unaffected.	John loves Mary – John is the subject and he is experiencing love			*love* is a psych verb.
	value	1	0	0	0	1	0	0

Credit: Messenger et al. (2012)



6. Meta Analysis

- 12 experimental studies
  - 50 verbs total
  - 31 verbs had an "age of acquisition" (*AoA*)
    - **AoA**: Determined by assessing at which age children start performing significantly above chance in any of the studies.
- All meta-analysis verbs were annotated for lexical semantic properties.

Studies	**Verbs tested**
Crain, Thornton, & Murasugi (2009)	eat, kiss, push, hit, bite, crash, kill, knock, lick, pick up, punch, scratch, shoot
de Villiers and de Villiers (1973)	kiss, push, hit, bite, bump, touch
Fox & Grodzinsky (1998)	chase, hear, see, touch
Gordon & Chafetz (1990)	carry, drop, eat, hold, hug, kick, kiss, shake, wash, forget, hate, like, remember, believe, hear, know, see, watch
Hirsh & Wexler (2006)	push, kiss, kick, hold, remember, love, hate, see
Liter, Huelskamp, Weerakoon, & Munn (2016)	wash, find, fix, forget, paint, spot, hate, love, know,
Maratsos and Abramovitch (1975)	kick, kiss, push, hit, bite, bump, tickle, touch
Maratsos, Fox, Becker, & Chalkey (1985)	hold, kick, kiss, push, shake, wash, find, forget, hate, like, love, remember, hear, know, miss, see, smell, watch
Messenger, Branigan, McLean, & Sorace (2012)	carry, hit, frighten, pat, pull, scare, shock, squash, surprise, upset, hate, love, remember, annoy, bite, hear, ignore, see
Nguyen, Lillo-Martin, & Snyder (2016)	hug, chase, like, see
O'Brien, Grolla, & Lillo-Martin (2005)	hug, chase, like, see
Orfitelli (2012)	carry, kick, kiss, push, love, remember, hear, see

Color Key: 3 yrs 3-4 yrs 4-5 yrs 5 yrs (black = no AoA)

7. Corpus Analysis

- CHILDES Treebank (MacWhinney 2000; Pearl and Sprouse 2013)
  Brown Corpus (Brown 1973): Adam, Eve, and Sarah
  Valian Corpus (Valian 1991)
- 113,024 total child-directed speech utterances spanning from 1;06 to 5;01
  62,772 tokens of 747 verbs (73% were passivizable)
  361 tokens of 119 verbs were in the passive
  0.5% of the total tokens → not a lot! (Aligns with Crain & Fodor (1993).)

+Passivizable: *break — it was broken*
-Passivizable: *go — *it was went*

8. Findings

We find a striking correlation between the lexical semantic profile of verbs and the demonstrated age of acquisition for their passive use by English-speaking children with no relationship at all to individual verb frequency.

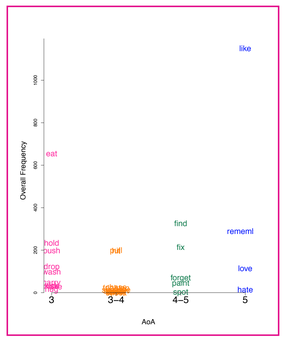
Lexical Semantic Features

- Verbs were sorted based on the age of significantly above chance performance.
  Profiles emerged.

Profile	Verb	Stative	Volitional	Affected	Obj-Exp	Subj-Exp	Agt-Pat	(+) Act	Observed AoA
1	carry	0	1	1	0	0	1	1	3yrs
1	chase	0	1	1	0	0	1	1	3-4yrs
2	annoy	1	1	1	1	0	0	0	3-4yrs
1	fix	0	1	1	0	0	1	1	4-5yrs
3	find	0	0	0	0	0	1	1	4-5yrs
4	forget	0	0	0	0	1	0	0	4-5yrs
5	hate	1	0	0	0	1	0	0	5yrs

Do semantic features correlate with age of acquisition?
→ Answer: Suggestive! But needs to be experimentally validated.
These profiles could suggest a natural developmental trajectory for the lexical semantic cues that influence children's ability to interpret *by*-phrase passives.

Individual Verb Frequency



Predictions:
- Expectation if individual verb frequency matters:
  → **negative correlation** between verb's overall frequency in the input and the AoA.
- Expectation if individual verb frequency *doesn't* matter:
  → **no correlation** between verb's overall frequency in the input and the AoA.

Findings: **no correlation.**
→ r = 0.29
- Also, within each group of verbs acquired at a certain age, there is variation in input frequency.

Does a particular verb's frequency in the input correlate with age of acquisition?
→ Answer: No

Future Directions

Explore lexical semantic features further.
Corpus Analysis: How reliable are these features in the input?
Theoretical: There seems to be overlap — identical or different features?
Computational: Even if the features are reliable, can children access them?
Experimental:
- Testable predictions for experiments targeted at children of specific ages, based on verb's lexical semantic profiles. Ex. *fix* learned by 3yr
- Novel verb-learning experiment: manipulation of lexical semantic features may impact children's acceptance of *by*-phrase passives.

Final Remarks

Theoretical, Experimental, & Corpus: This synthesis of the literature and analysis of the input is needed to capture how kids are learning by-phrase passives.

Upshot: Lexical features matter. Individual verb frequency doesn't.

Future work: Frequency may still matter, but perhaps it's the frequency of lexical features associated with the verbs that are passivized in the input.
These results provide a strong foundation for future **corpus**, **theoretical**, **computational**, and **experimental** investigations about the learnability of the English passive.

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