Trying to measure the influence of language on beliefs with exploration behavior

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Learning about the world

Observations

- **Learning from the world**
- **Learning by observing agents**
- **Learning from pedagogy**

e.g., Shafto, Goodman, & Frank (2015)
computational underpinnings

Language

- **Particulars: “That bird is flying.”**
- **Generics: “Birds fly.”**

Generic language

Birds fly.

- Refer to (abstract) categories beyond direct experience & a kind of “language of generalization” e.g., “John runs”

- Common in child-directed and child-produced speech (Gelman, Goetz, Sarnecka, & Flukes, 2008)

- Thought to be present in every language (Behrens, 2005; Carlson & Pelletier, 1995)

What do generics mean?

- A first pass (most psychological papers on generics):
  - Refer to categories (“as a whole”) and permit exceptions

- A thorough pass (Tessler & Goodman, in press):
  - Vague quantifiers that operate on inductive beliefs

$$P(\text{feature} \mid \text{category}) > \theta$$

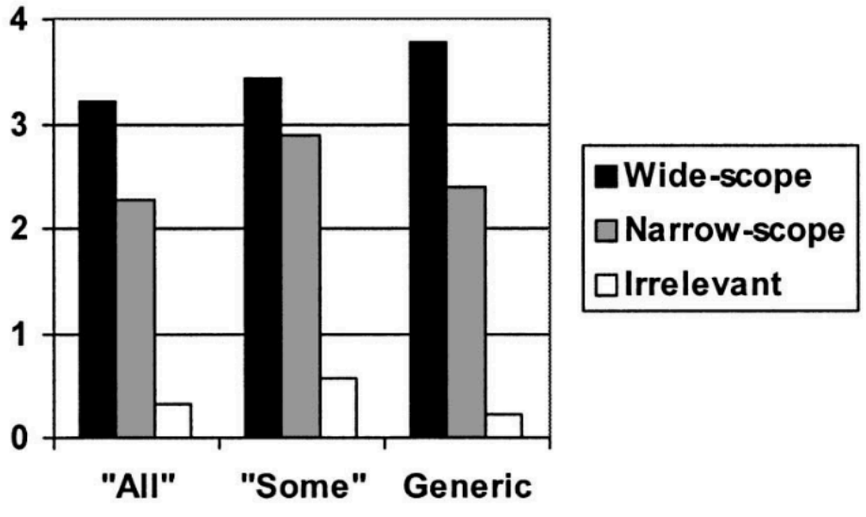
- implications of a generic are highly context-sensitive
e.g, “Wugs have four legs” vs. “Feps get cancer”
(Tessler & Goodman, in prep)

Learning from generics

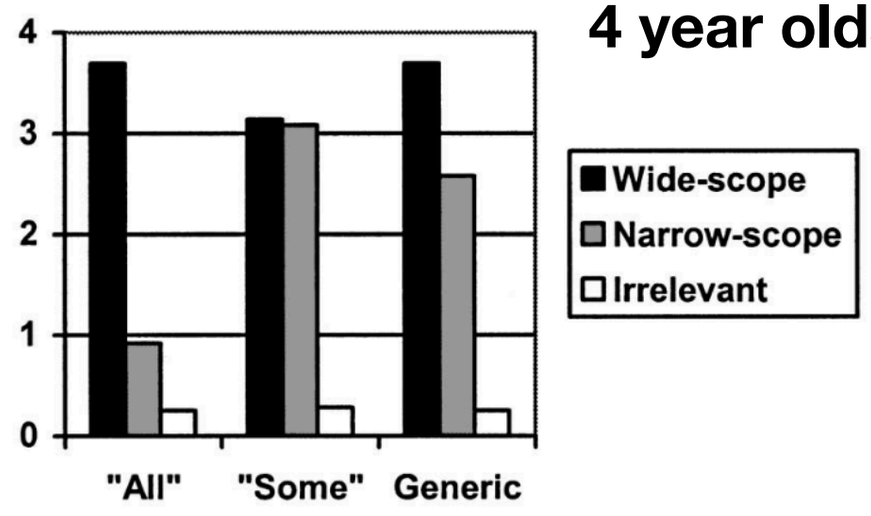
- **Quantification** Gelman, Star, & Flukes (2002)
  “{Bears, all bears, some bears} like to eat ants”
  [pictures of 6 bears]
  “Which ones like to eat ants?”
  4 - 5 year olds: All > generic > some

- **Endorsement** Hollander, Gelman & Star (2002)
  “Do frogs have eyes?” vs. “Do bears have white fur?”

3 year olds



4 year olds



Learning from generics

- **Explanation** Cimpian & Markman (2009)
  "{Butterflies, this butterfly} have/has dust on its wings."
  "Why do you think that is?"
  More functional explanations with generic input
  4- to 5-year olds

- **Pretend play / Imitation** Graham, Gelman, & Clark (2016)
  "{Blicks, these blicks} drink ketchup"
  [demo pretend action with 2 blicks] "Here is another blick"
  30-month-olds imitate with 3rd blick more w/ generics

Learning from generics

- **Quantification / Implied Prevalence**
  Gelman, Star, & Flukes (2002);
  Brandone, Gelman, Hedglen (2014)
- **Endorsement**
  Hollander, Gelman, & Star (2002),
  Brandone, Cimpian, Leslie, & Gelman (2012)
- **Explanation**
  Cimpian & Markman (2008)
- **Pretend play / imitation**
  Graham, Nayer, & Gelman (2011)
  Graham, Gelman, & Clark (2016)

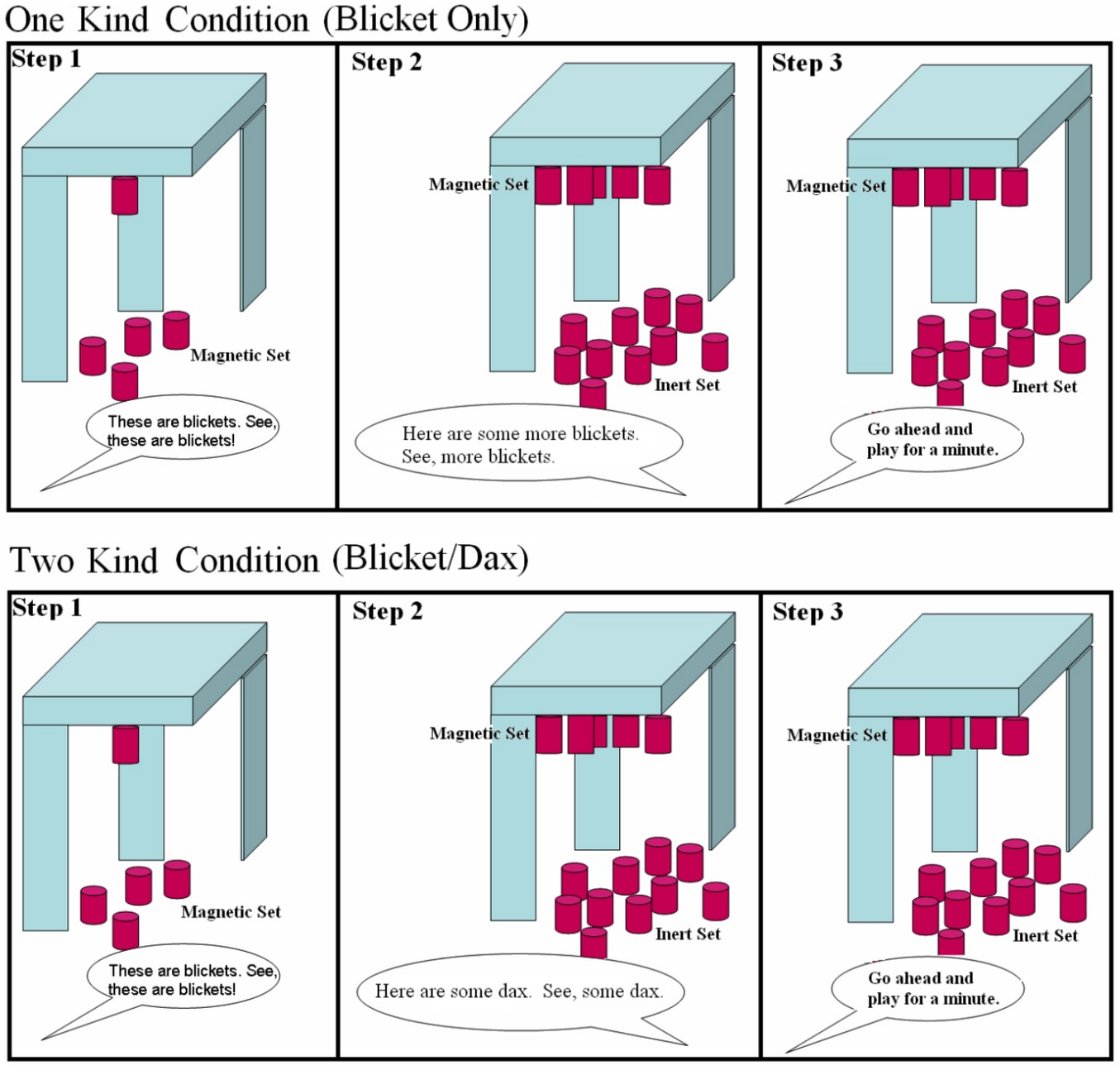
All concerned with the category implications of generics,
as opposed to the context-sensitivity / variability (e.g., Shtulman & Schulz, 2010)

This project

- Quantitative study of learning from generics
- How beliefs change with diverse data sources
  (language + observation;
  e.g., Bridgers, Buchsbaum, Seiver, Griffiths, & Gopnik, 2016)

- Consequences of generic language for action / exploration
  - interpretations of actions based on linguistic input

Children perseverate longer with category-wide beliefs



Schulz, Standing, and Bonawitz (2008)

Pilot studies

- You're a new teacher.
  Learn from old teacher, and explore on your own.
  Goal: Teach children.

- **Language input**: "Blickets squeak" vs. "This blicket squeaks"
  [put them on a platform, press a button, it squeaks]

- **Observational evidence**:
  All blickets inert (v1) or produce other sound (v2)

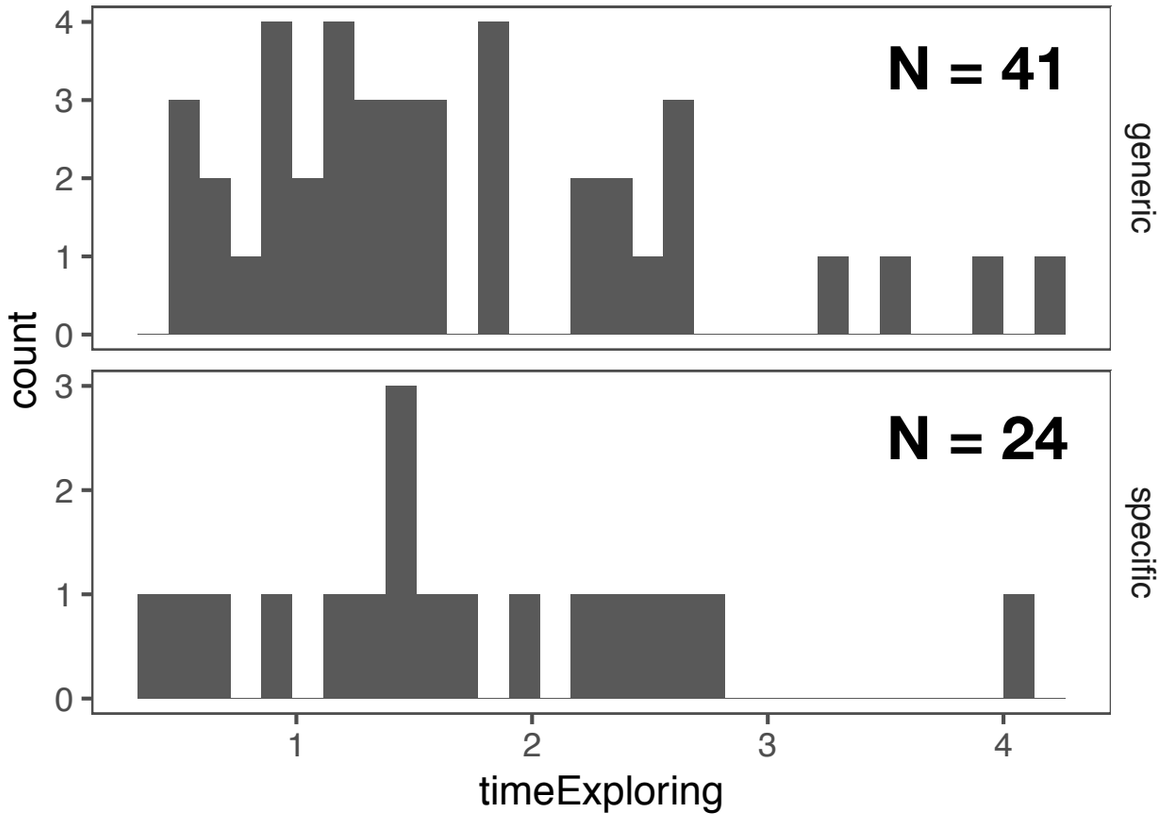
Web experiments

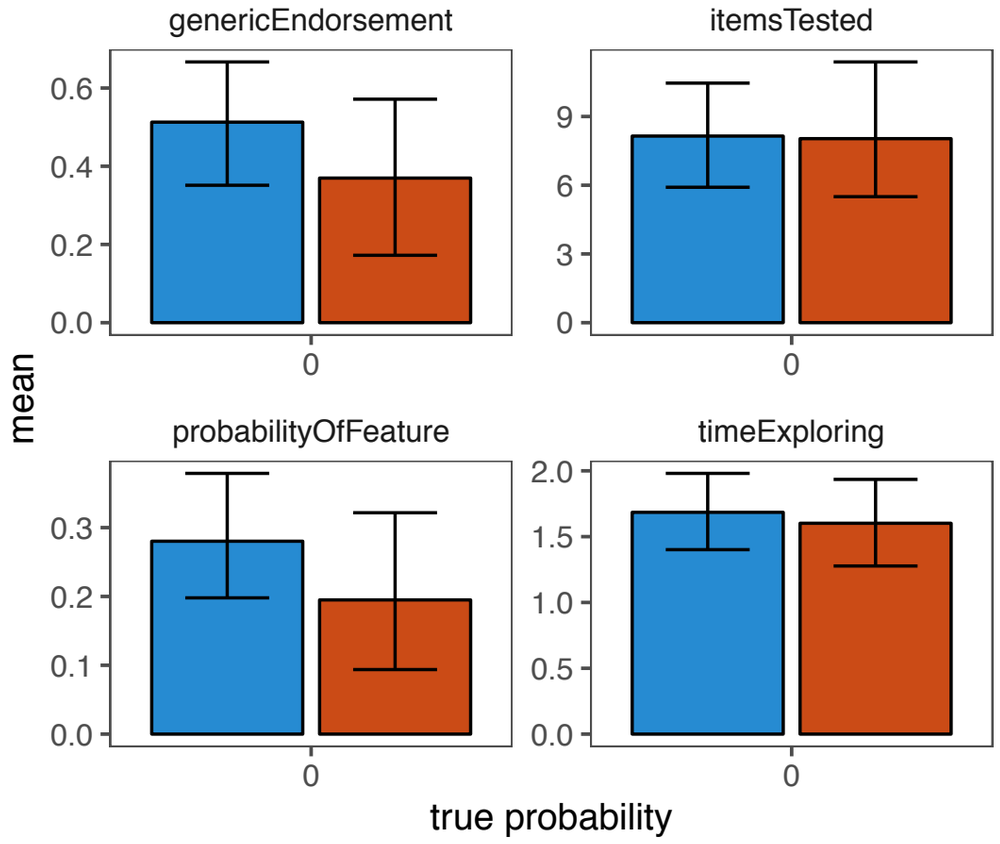
- Generic condition: No alternative sound (n = 43 / 45)
  Specific condition (n = 26 / 45)

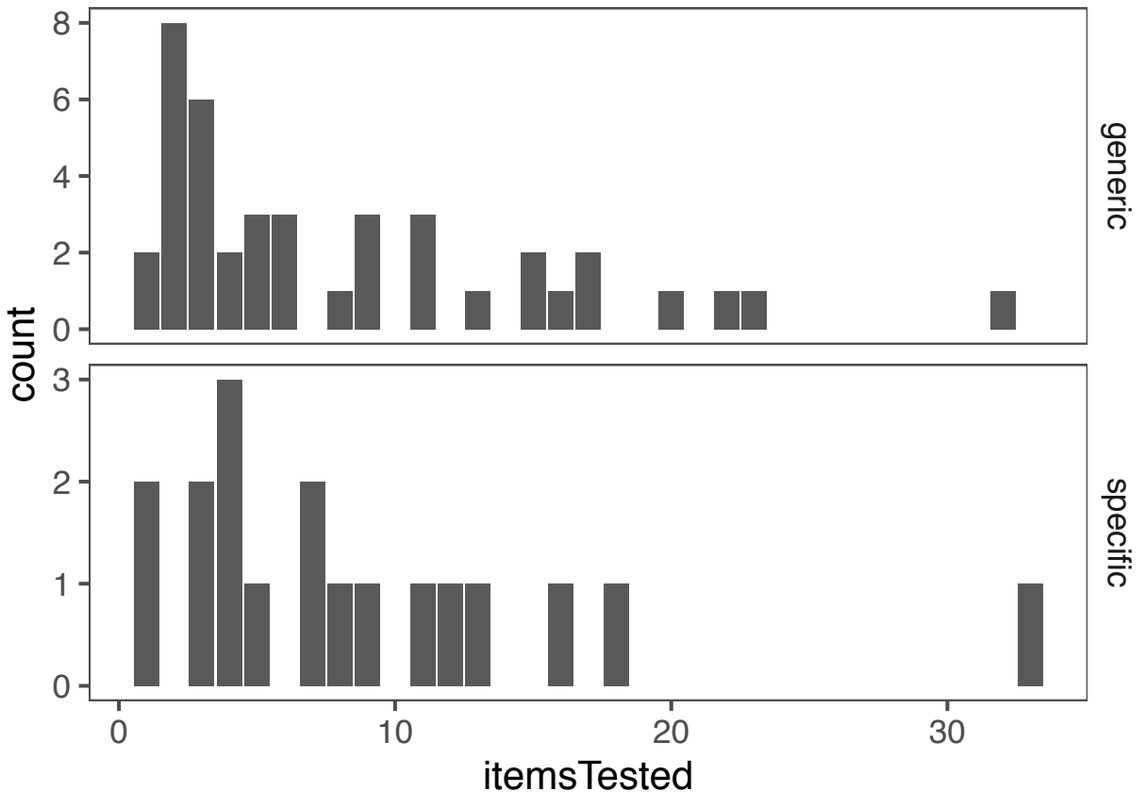
- Specific condition: Alternative sound (n = 22 / 27)
  Generic condition (n = 4 / 27)

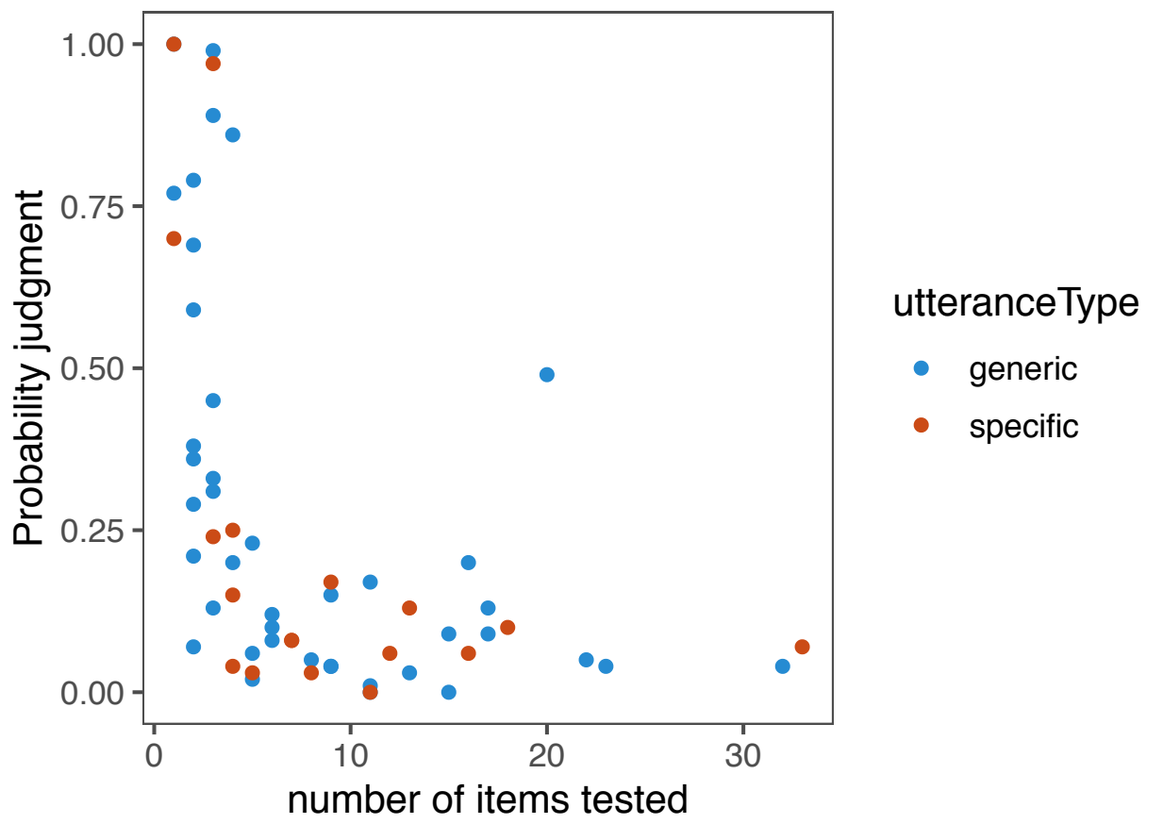
Free response

	Sometimes blickets will squeak	Blickets are **supposed to** squeak	The ones that didn't squeak **aren't blickets**	Blickets **do not squeak**	Blickets squeak	Blickets **tend** to squeak
Generic	///// ///// ///// ///// ///	/	///	////	///// /	//
Specific	///// ///// ///// ///// /	/			/	/


N = 41
N = 24
generic
specific
count
timeExploring
0
1
2
3
4


genericEndorsement
itemsTested
probabilityOfFeature
timeExploring
mean
true probability
utteranceType
generic
specific

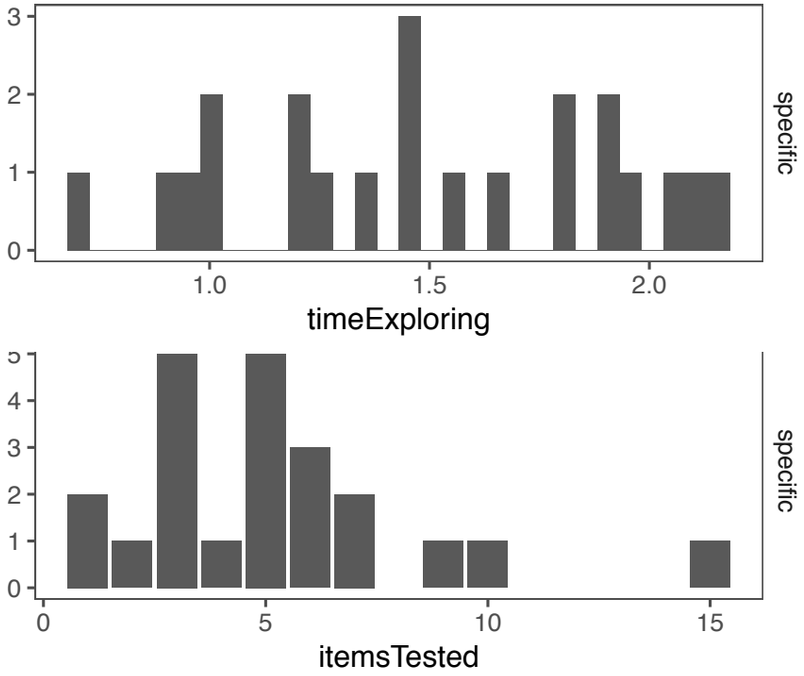

generic
specific
count
itemsTested

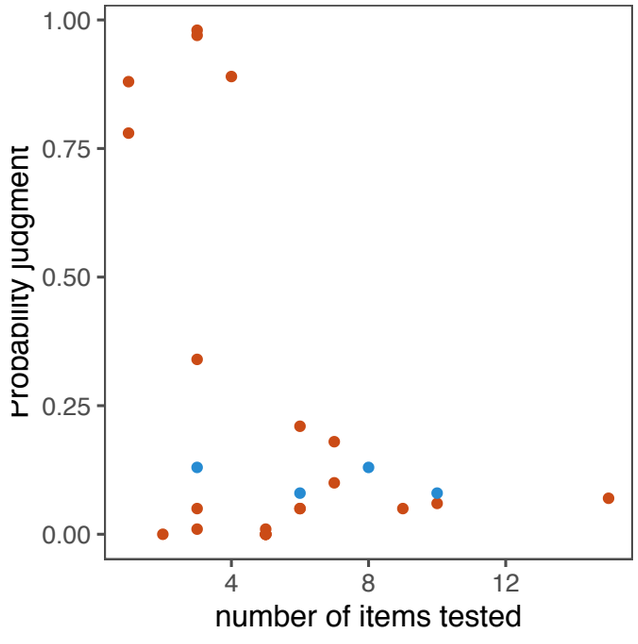

Probability judgment
number of items tested
utteranceType
generic
specific

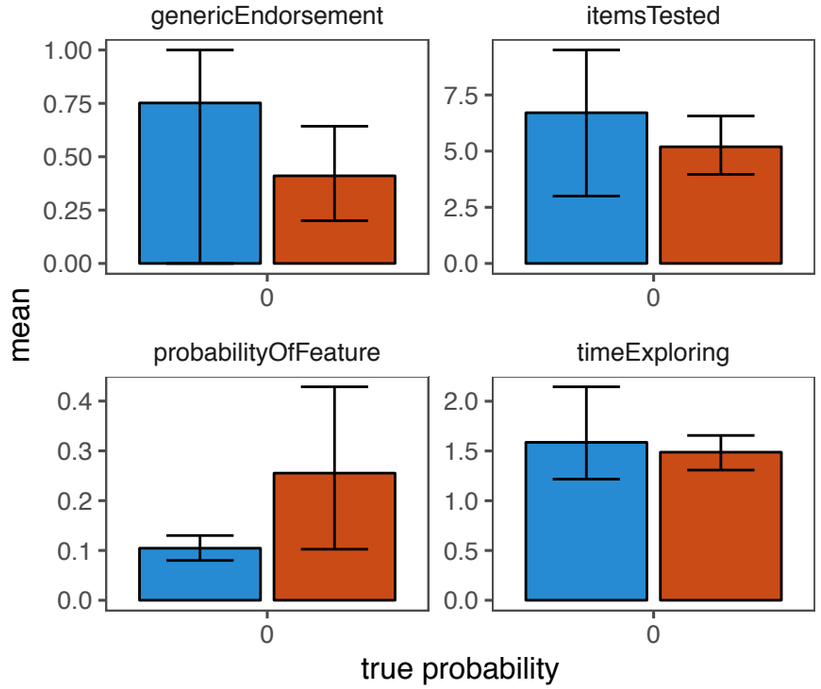
Free response (alternative sound)

	Sometimes blickets will squeak	Blickets are **supposed to** squeak	The ones that didn't squeak **aren't blickets**	Blickets **do not squeak**	Blickets squeak	Blickets **tend** to squeak	Blickets make **other sound**	**2 kinds of blickets**
Generic	II							II
Specific	IIIII II			I	I		III	IIIII IIII

Alternative sound condition

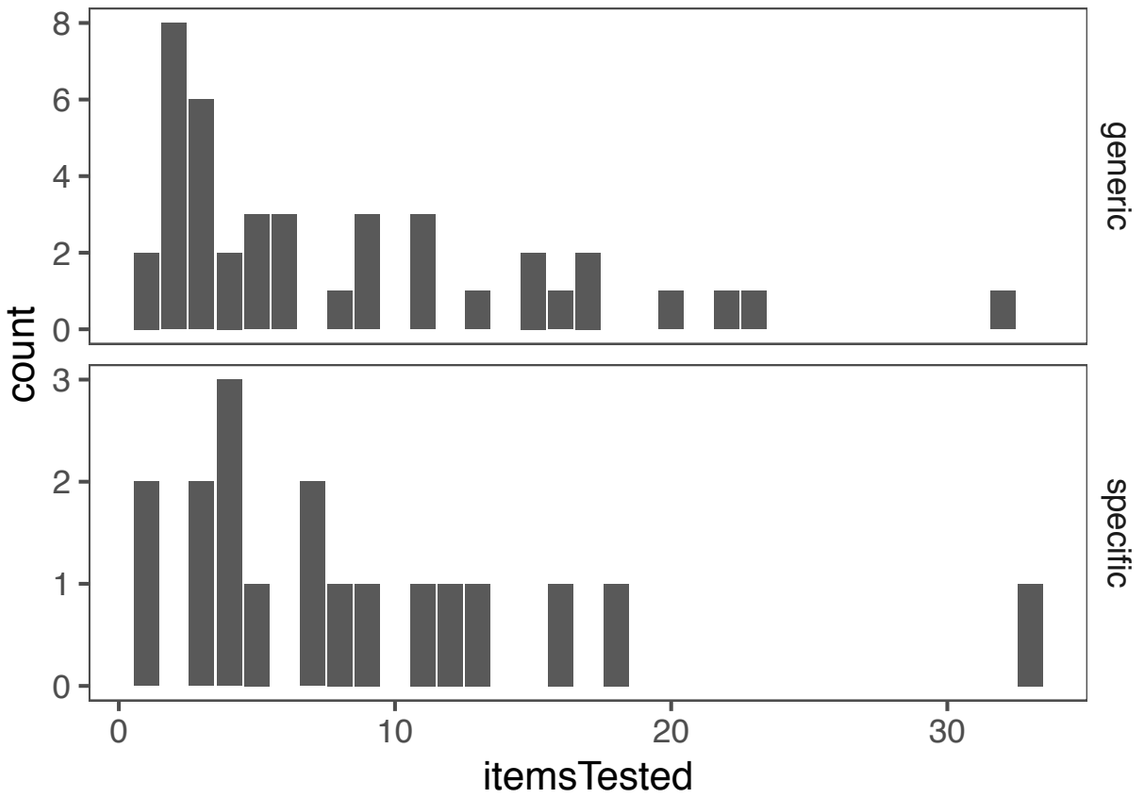


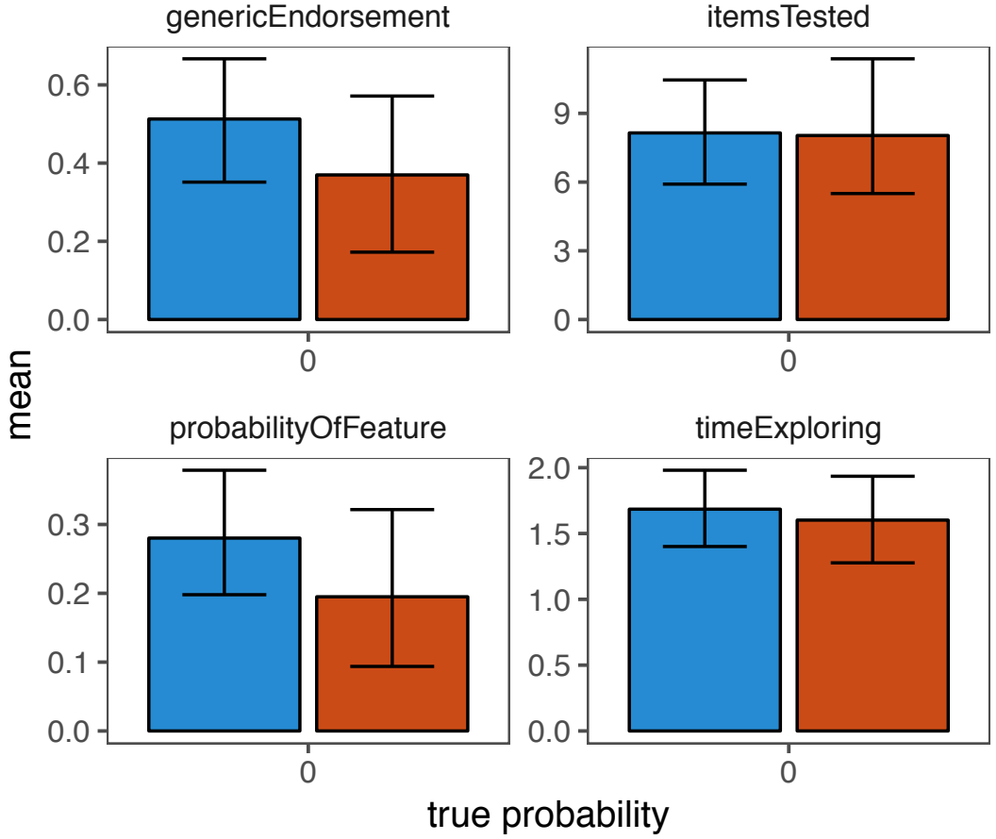




N = 22

No alternative sound condition





Summary and discussion

- Trying to measure influence of language on action (exploration)

- Language might be affecting participants' explanations, but not their exploration

- *Specific condition* might induce strong sampling (many participants mis-remembered specific as generic)