Context and World Knowledge in Gradable Adjective Interpretation

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outline

1. **background** –
   - relative versus absolute gradable adjectives
   - "variable" and "scalar" theories of the distinction
2. **experiments 1/2 (forced-choice judgments)** –
   manipulating access to comparison class and world knowledge/prior expectations in evaluation of gradable adjectives
3. **further analysis** –
   effects of experimental context/presentation order
4. **discussion/conclusions** –
   interpretation of results, and some consequences for theory of gradable adjective semantics

relative/absolute gradable adjectives

relative adjectives
tall/*short*; *big*/*small*; *wide*/*narrow*;...

absolute adjectives
empty/*full*; *straight*; *plain* ... (maximum standard)
bent; *spotted*; *dirty* ... (minimum standard)

key properties
common semantic core: relative and absolute adjectives are both gradable (both support comparison and degree mod.); commonly analyzed with degree semantics

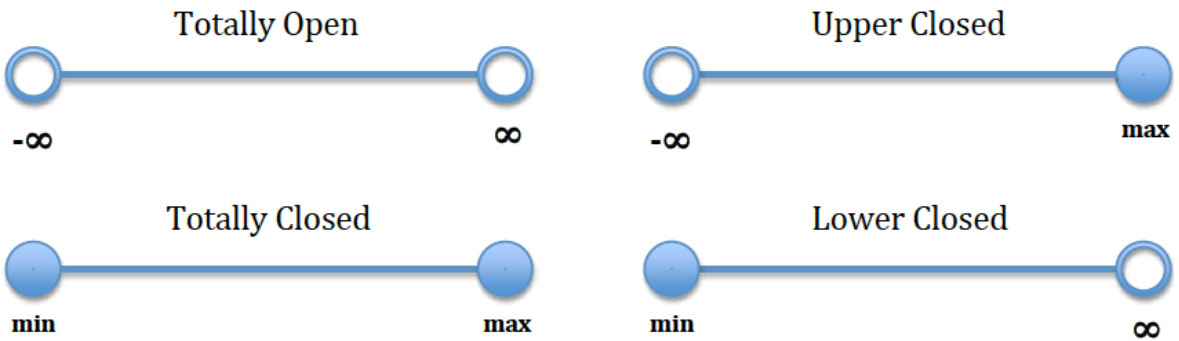
variable thresholds: amount of scalar property required to count as Adj depends on context (the "threshold" or θ)

relative/absolute gradable adjectives

relative adjectives – vague, context dependent

absolute adjectives – less (or not) vague, less (or not) context dependent

scale structures reflected syntactically:
*perfectly straight/*bent/*long*; *slightly bent/*straight/*long*



scale structure constrains possible threshold: endpoint-oriented meanings available for absolute adjectives but not relative

(figure from Lassiter 2010)

theories of the relative/absolute distinction

two approaches can be broadly distinguished:

1. "variable" theories – relative/absolute adjectives are semantically uniform: both simply require fixing threshold/standard variable θ
(e.g. Lassiter & Goodman 2013)

$[\![tall_{pos}]\!] = \lambda x[\mathbf{tall}(x) \geq \theta]$
$[\![full_{pos}]\!] = \lambda x[\mathbf{full}(x) \geq \theta]$

2. "scalar" theories – relative adjectives contain free variable θ; for absolute adjectives, some principle says that the threshold is an endpoint – *min* for minimum standard, *max* for maximum standard
(e.g. Kennedy 2007; Burnett 2012; Toledo & Sassoon 2012)

$[\![tall_{pos}]\!] = \lambda x[\mathbf{tall}(x) \geq \theta]$
$[\![full_{pos}]\!] = \lambda x[\mathbf{full}(x) = max]$

theories of the relative/absolute distinction

different explanations of differences in scale structure between relative and absolute adjectives

VT: absolute interpretations (and grammatical behavior) emerge from statistical information about objects – clustering to scalar endpoints is a fact about the world/object classes and experience with them, not about lexical semantics

ST: absolute interpretations (and grammatical behavior) emerge directly from lexical semantics and/or scale structure

theories of the relative/absolute distinction

different treatments of non-endpoint oriented readings for absolute adjectives:

VT: endpoints are just like any other values of θ; endpoint-oriented readings emerge from facts/knowledge about object classes

ST: default endpoint-oriented readings can be relaxed under certain conditions (e.g. via pragmatic halos); similar process to approximate readings of numerals (Lasersohn 2005; Krifka 2003)

example: often seems true to say *The stadium is empty* even when some seats are filled ("imprecision")

VT: θ_{empty} simply not equal to max_{empty} in this context (semantics fixes different value for θ_{empty})

ST: max_{empty} is lexical threshold, but pragmatic processes allow wider region of scale to count as "empty"

theories of the relative/absolute distinction

VT and ST lead to different expectations about the effect of world knowledge on the evaluation of relative versus absolute adjectives

VT: impoverished knowledge about/experience with object categories and their distributions – should weaken distinction between relative and absolute meanings, because prior information—which distinguishes relative from absolute meanings—is less available

ST: impoverished world knowledge – no reason to shift absolute thresholds away from endpoints, so strengthened distinction between relative and absolute interpretations expected

experiments

We conducted two experiments in which subjects were shown series of images that varied along scalar dimensions and were asked whether various adjectives applied to them – extension of Kim et al.'s (2013) paradigm

- e.g. is a square **big** or **small** or **neither**?

Access to prior expectations about objects was also varied, to address the issue of variable vs scalar theories

- e.g. are judgments made about a **square** or a **house**?

materials (shape items from Aparacio et al. 2014)

- **relative standard**
  big, long, narrow, short, small, tall, thick, thin, wide
- **maximum standard**
  closed, empty, flat, full, plain, straight
- **minimum standard**
  bent, bumpy, curved, open, spotted, striped

design – each trial is a judgment about an object/picture

- **object type:** shapes, artifacts (between subjects)
- **presentation type:** grouped, isolated (between subjects)
- **adjective type:** relative, maximum, minimum
- **scale position:** 1-5 for artifacts, 1-7 for shapes
  (normalized for analysis)

(note: ternary response data coded as binary in all analyses; 111 subjects total; 168 critical items for shapes, 120 for artifacts)

logic of part 1:

- **object type** – existing knowledge/expectations about artifacts (how full must a cup be to be considered "full"?) but not about shapes (how full must a cylinder be to be considered "full"?)
- **presentation type** – grouped provides subject with explicit comparison class at time of judgment (isolated does not)
- **adjective type** – different distribution of "yes" responses expected for various scale positions
- **scale position** – increased proportion of "yes" responses expected for higher scale position items, depending on adjective type

isolated shapes

isolated shapes

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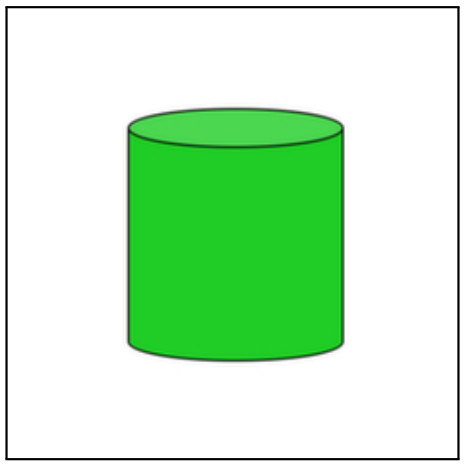

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isolated shapes

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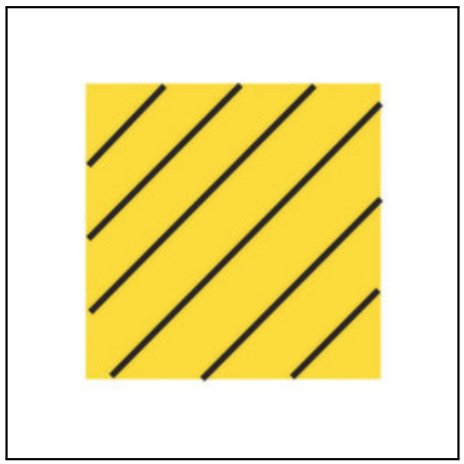

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isolated artifacts

isolated artifacts

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isolated artifacts

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grouped shapes

grouped shapes

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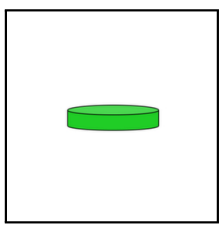

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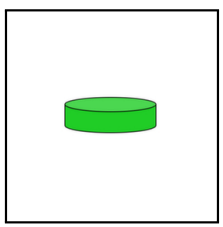

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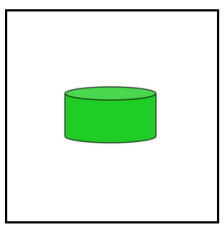

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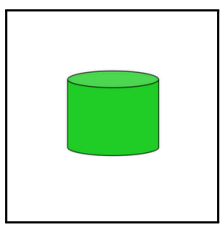

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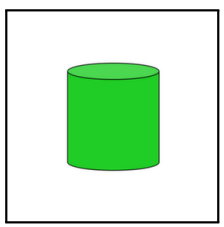

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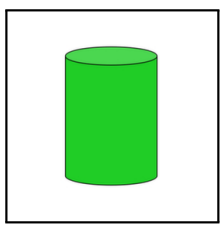

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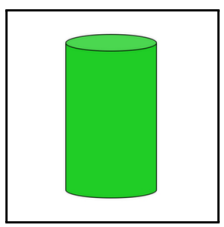

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grouped shapes

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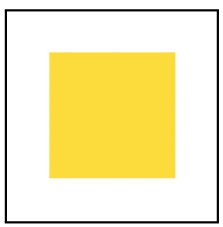

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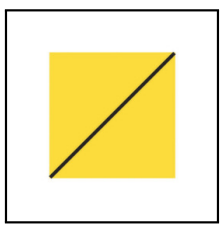

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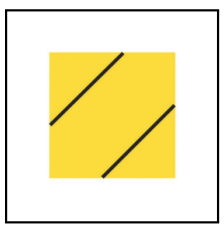

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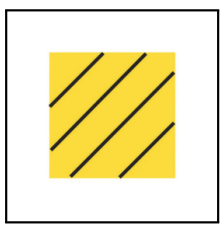

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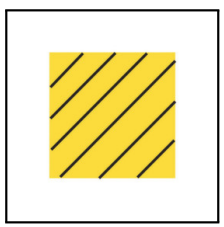

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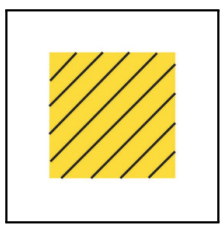

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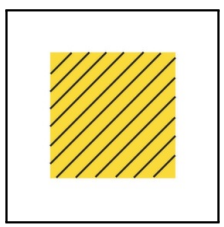

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grouped artifacts

grouped artifacts

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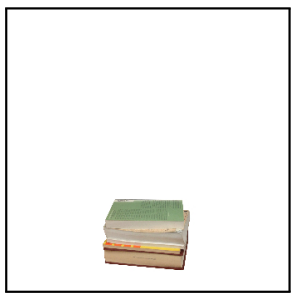

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grouped artifacts

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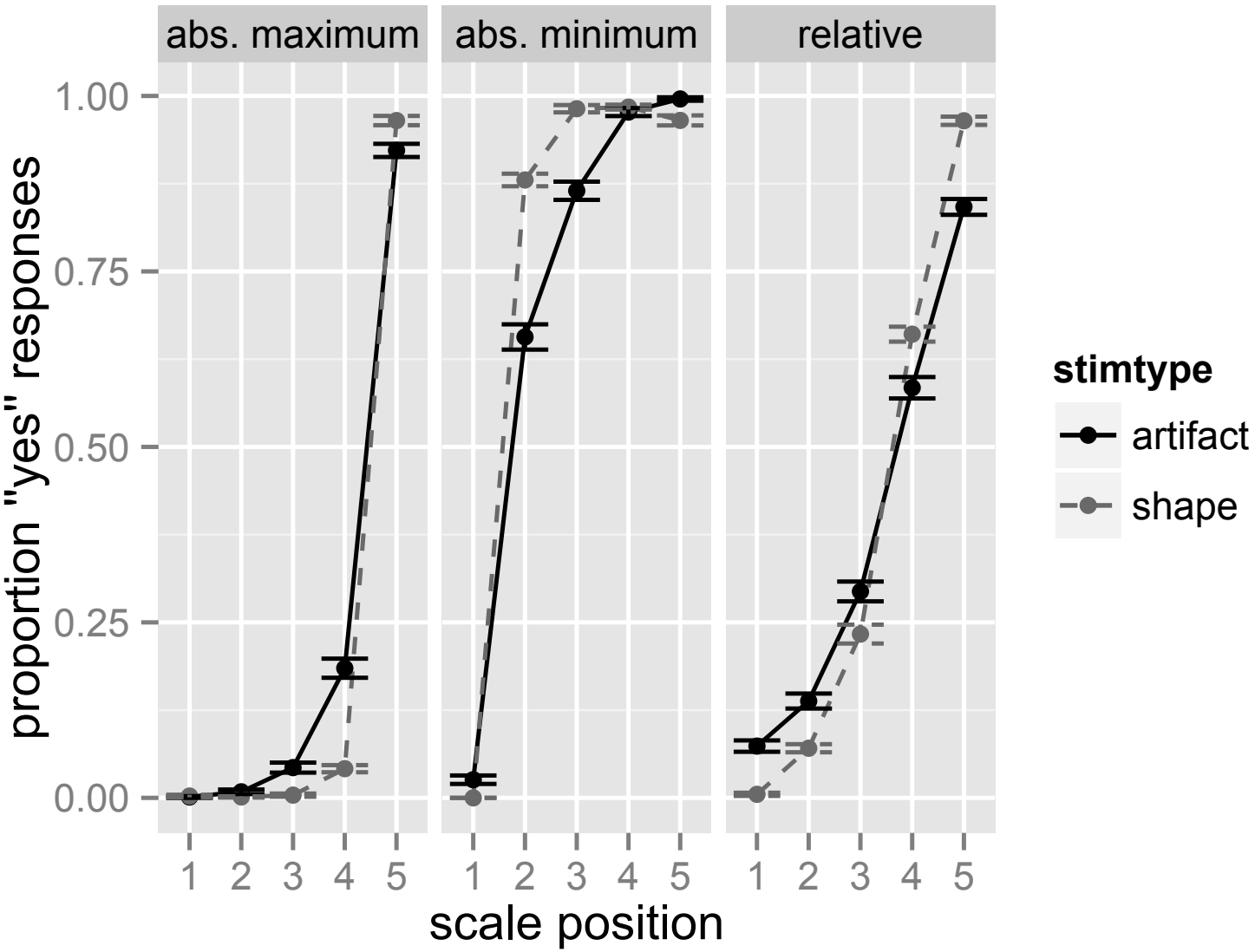
results

note on converting ternary responses to binary:

- a response of *tall* is coded as "tall – yes, short – no"
- a response of *short* is coded as "tall – no, short – yes"
- a response of *neither* is coded as "tall – no, short – no"

part 1 – results (collapsing over presentation type)



part 1 – summary of results

- **main effects:**
  scale position, adjective type (both $p < .001$)

- **two notable interactions:**
  object type × adjective type ($p < .001$)
  object type × adjective type × scale position ($p < .01$)

(see also related results in Foppolo & Panzieri 2012)

(based on linear mixed model including all interaction terms, fit to proportional response data aggregated over items, and with subject as random effect)

part 1 – summary of results

important generalization:

> endpoint-oriented interpretation of maximum and minimum adjectives stronger in shape than artifact (higher proportion of non-endpoint oriented readings in artifacts)

∴ impoverished knowledge about object classes (here operationalized as "shapes") **sharpens** the relative/absolute distinction – absolute adjectives show nearly categorical response profiles for shapes but not artifacts

⇒ **support for scalar theory**

part 1 – summary of results

observation:
no effect of presentation type!

next:
how does experience/context accumulated over the course of an experiment affect judgments? (such effects observed in syntactic processing, e.g. Fine et al. 2013)

strategy:
in isolated trials, for each subject look at how identity of previous trials affects subsequent judgments about related images

many ways to code "previous experience" – we look at just one here

part 2 – ordering effects

questions:

- in isolated presentation, do people build contexts as experiment progresses?
- if so, is information gained in previous trials used differentially in establishing threshold for different adjective classes?

strategy:
for each isolated artifacts subject, code trials for:

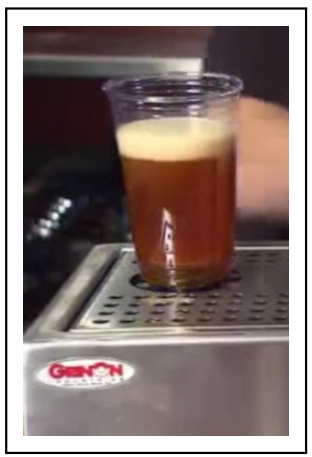
- **prevmaxA** - have you seen any scale-maximal picture with the same adjective?

then ask whether this category is a reliable predictor of response

NB: analyses run only on artifacts data, because imprecise tokens not accepted in shapes data (see previous plot)

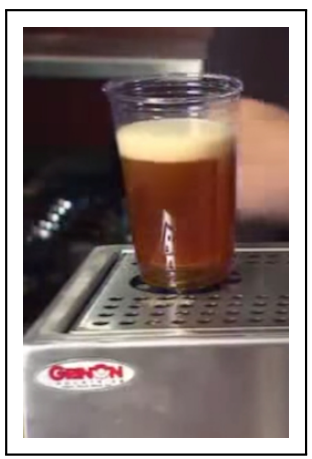
part 2 – prevmaxA (isolated artifacts) – illustration

for the judgment "full" on trial n, prevmaxA = 'yes' because trial 1 is maximal on the same adjective scale (the fullness scale)

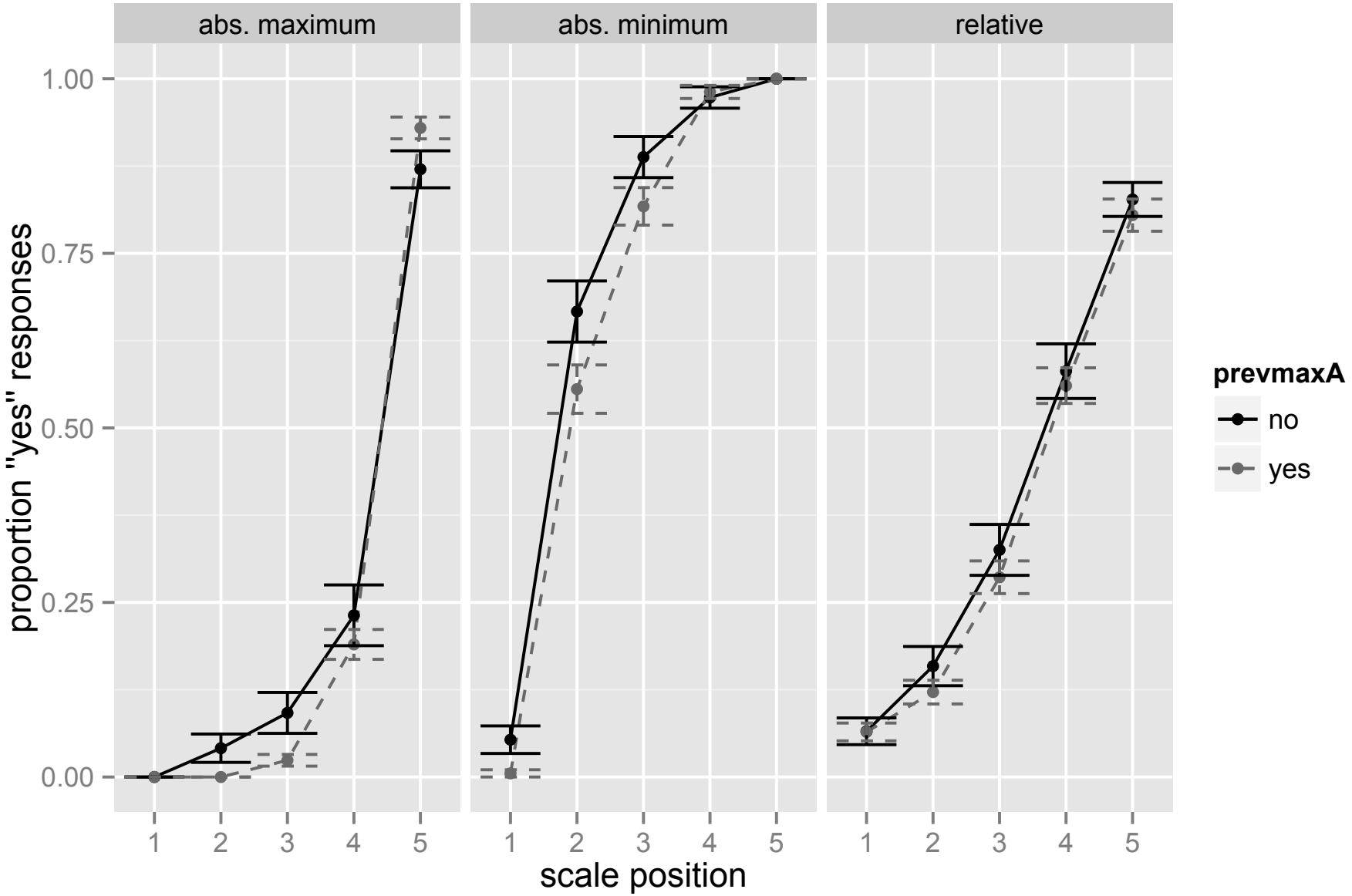
trial 1	trial 2	⋯	trial n
`this item is`	`this item is`		`this item is`
		$\cdots \Rightarrow$	
◉ `full`	◉ `tall`		◉ `full`
◉ `empty`	◉ `short`		◉ `empty`
◉ `neither`	◉ `neither`		◉ `neither`

part 2 – prevmaxA (isolated artifacts) – illustration

for the judgment "full" on trial n, prevmaxA = 'no' because no previous trial is a maximally full thing

trial 1	trial 2	⋯	trial n
`this item is`	`this item is`		`this item is`
		$\cdots \Rightarrow$	
◉ `striped`	◉ `tall`		◉ `full`
◉ `plain`	◉ `short`		◉ `empty`
◉ `neither`	◉ `neither`		◉ `neither`

part 2 – results



part 2 – summary of results

result:

significant prevmaxA $\times$ adjtype interaction such that

- prevmaxA reliable predictor of response for maximum standard ($p < .01$) and minimum standard ($p < .05$) absolute adjectives
  – prevmaxA = yes: decreases likelihood of 'yes' response, but
- not a significant predictor for relative

(results based on logistic mixed effects models fit to converted binary responses, with random effects for subject and item)

part 2 – summary of results

broad conclusions for ordering effects

- for artifacts, exposure to scalar endpoints decreases likelihood of 'yes' response to subsequent items lower on the scale for absolute adjectives only
- suggests a difference in the resources used to set threshold for relative and absolute adjectives –

absolute adjective thresholds shift as prior information about object categories and their distributions on scales accumulates

no corresponding shifting for relative thresholds

- subjects adapt interpretation to the local experimental context, similar to syntactic adaptation (Fine et al. 2013)

conclusions

1. **scalar theory** supported by basic results: decreased world knowledge about object classes leads to strengthened distinction between relative and absolute thresholds/meanings

2. ordering effects suggest that different resources/information are used to fix the threshold for relative and absolute adjectives – points to additional difference between the two classes

acknowledgments

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