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# Experimenting with Degree

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## Research Questions

What notion of **degree**, if any, underlies the interpretation of (relative) gradable adjectives in their positive form?

- How do speakers' judgments of gradable adjectives change across contexts (comparison classes C)?
- On the basis of what measures can these judgments be described?

### Rank Order

Example:  $[[Fred\ is\ tall]]^C = 1$  iff  $Fred \in$  tallest 1/3 of Cs

### Ordinal Degree (derived from ordering on C)

Example:  $[[Fred\ is\ tall]]^C = 1$  iff  $HEIGHT(Fred) \in$  top 1/3 of heights of Cs

### Measurement Degree (scale with distance metric)

Example:  $[[Fred\ is\ tall]]^C = 1$  iff  $HEIGHT(Fred) > \text{mean}_{x \in C} HEIGHT(x)$

NB: Truth conditions are for purposes of illustration; no account of vagueness of GAs

	Delineation (strong)	Degree as...		
		Equiv. class	Abstraction	Eq. class w/measures
Rank Order	Yes	Yes	Yes	Yes
Ordinal Degree	No	Yes	Yes	Yes
Measurement Degree	No	No	Yes	Only adj. w/num. measure

## Theories of Gradability

### Delineation (Klein 1980)

Gradable adjectives denote partial functions that induce a three-way partition on a comparison class C



- Not explicitly based on degrees
- Strongest version: no notion of degree at all involved

### Degree (Cresswell 1976; von Stechow 1984; Kennedy 2007; a.o.)

Gradable adjectives relate individuals to degrees on a scale

$$[[tall]] = \lambda d \lambda x. HEIGHT(x) \geq d$$

$$[[Fred\ is\ tall]] = 1 \text{ iff } HEIGHT(fred) > d_{std}, \text{ where } d_{std} = f(C)$$

- Degree as **Equivalence Class** (Cresswell 1976; Klein 1991)
  - Relation on domain:  $x \succeq_{HEIGHT} y$  'x has as least as much height as y'
  - $HEIGHT(fred) = \{x: x \sim_{HEIGHT} fred\}$  - ordinal scale only
- Degree as **Abstraction** (von Stechow 1984)
  - $HEIGHT(fred) = n \in \mathbb{R}$  (a number) - scale with distance metric
- Degree as **Equivalence Class w/Numerical Measures** (Bale 2008)
  - For adjectives with corresponding numerical measurement systems, measurements (e.g. 6 feet) participate in relation as individuals
  - Derived scale isomorphic to that associated w/measurement system

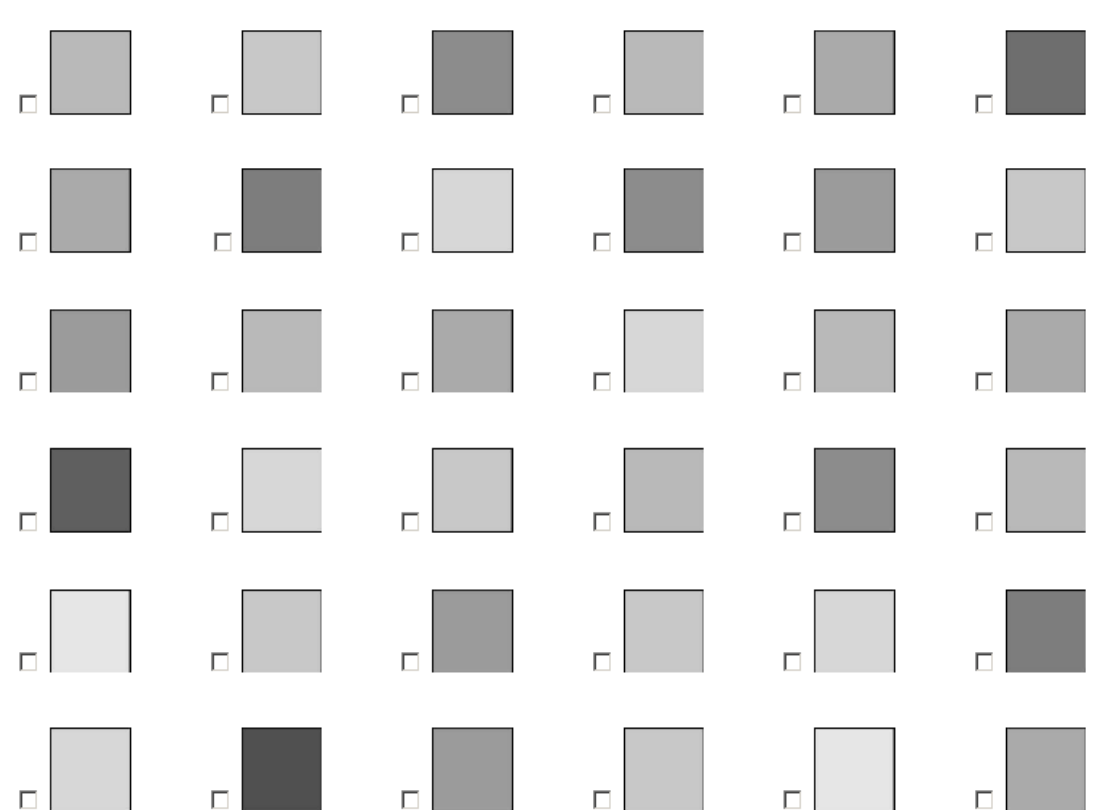
## Experiment 1

**Methodology: Adjective/Picture Matching** (Barner & Snedeker 2008; Schmidt et al. 2009)

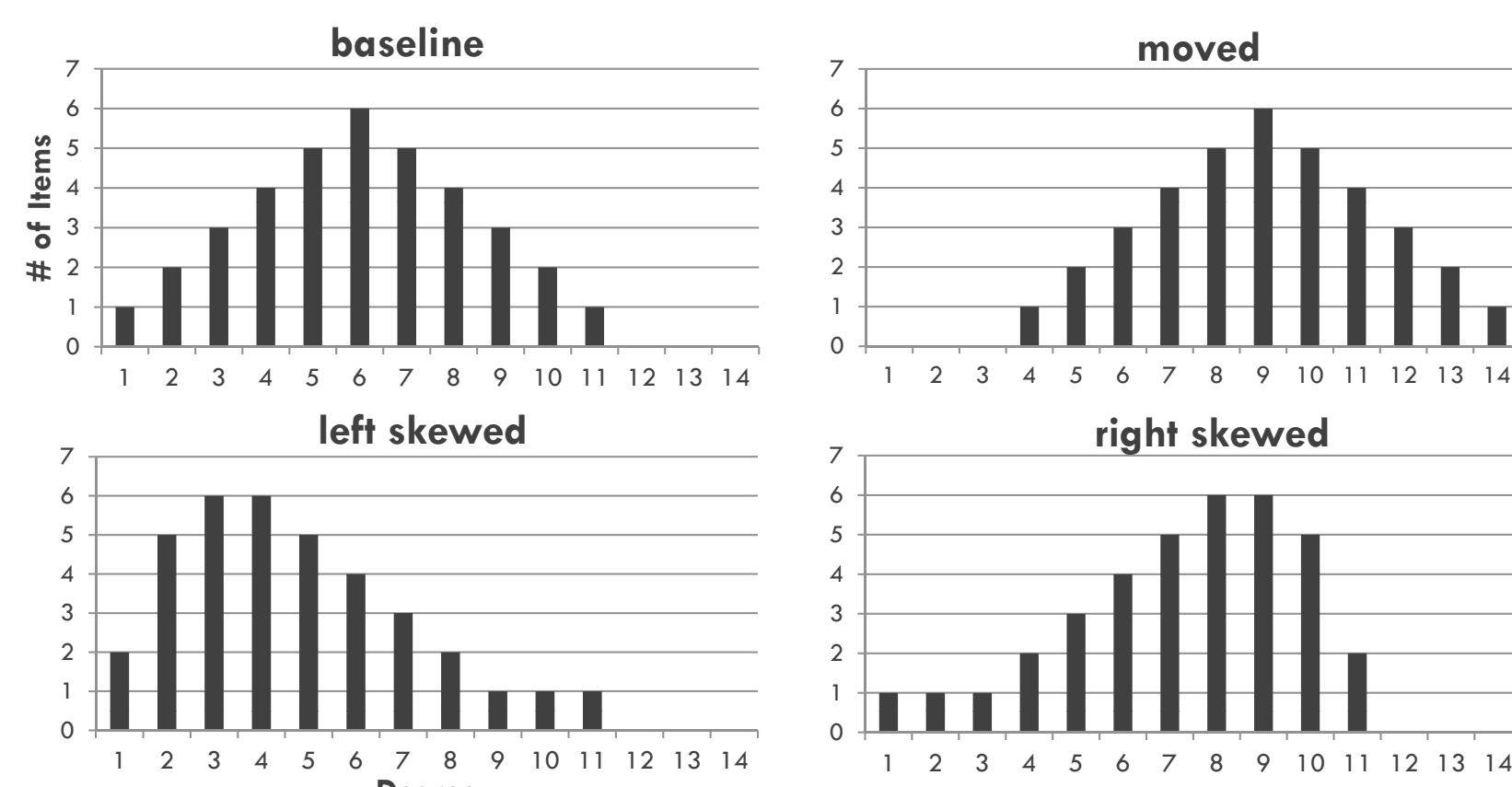
- 4 adjectives evaluated in context of 4 picture arrays (36 pictures/11 degrees)



Which of these squares are dark?



Distribution of items over degrees



- n=194 (mean age: 35.7, 124 female); 1 adjective/distribution per subject (rotated)
- Online via Amazon Mturk (U.S. IP address; screened for native English)

### Predictions

If **rank order** alone sufficient:

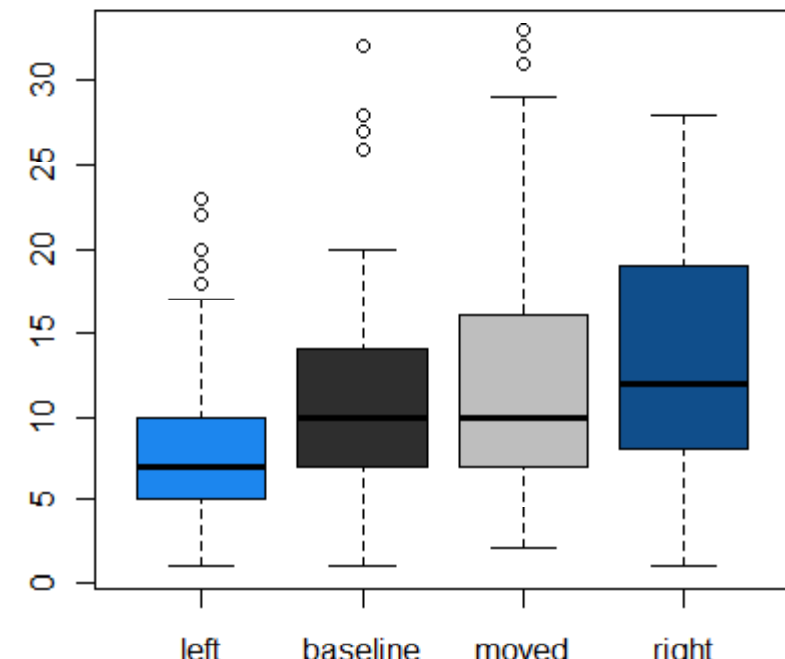
- # of items checked same across conditions

If **ordinal degree** alone sufficient:

- 'cut-off' same for baseline/left/right; higher for moved

### Results

# of items checked

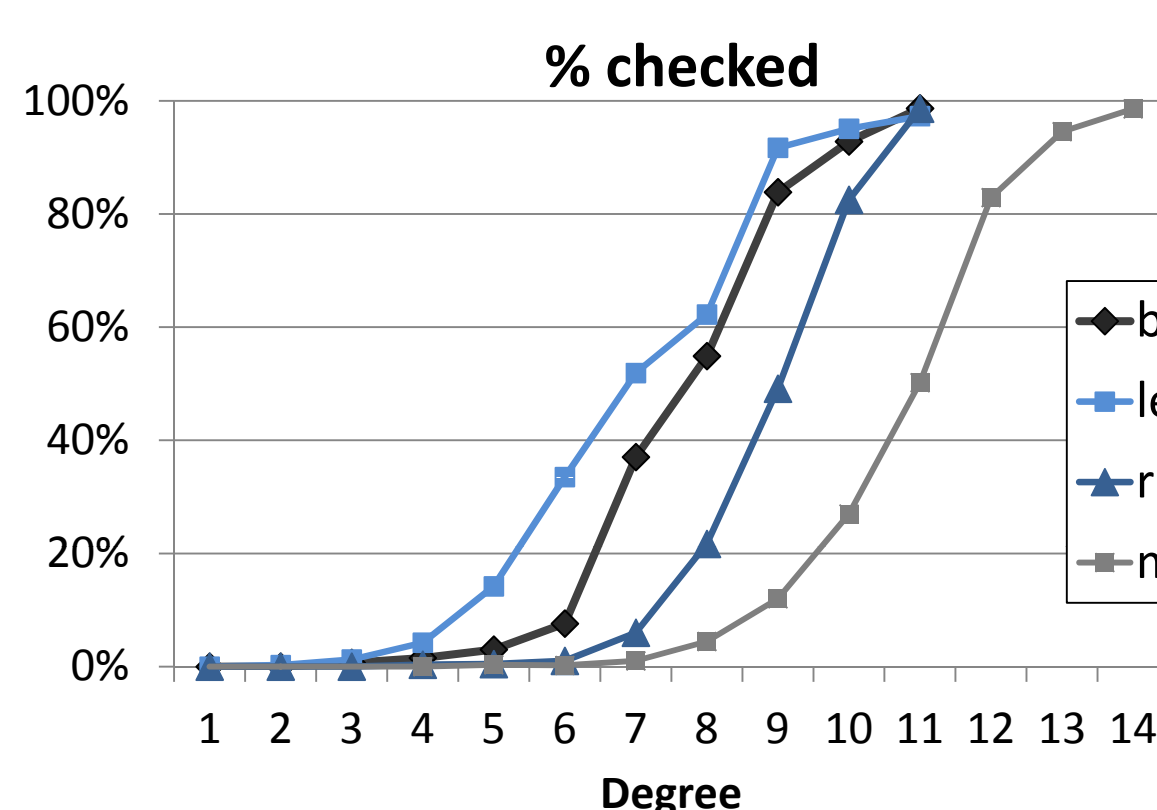


*Linear mixed effects models: Adjective & distribution as fixed factors; subject as random factor*

# of Items: left < baseline (p<0.05)  
tall > big (p<0.01); pointy > big (p<0.05)  
pointy x moved, right (p<0.001)  
- effects more pronounced

Cut-off: left < baseline (p<0.05)  
right, moved > baseline (p<0.001)  
tall < big (p<0.05)  
pointy x moved (p<0.001), right (p<0.01)  
- effects weaker

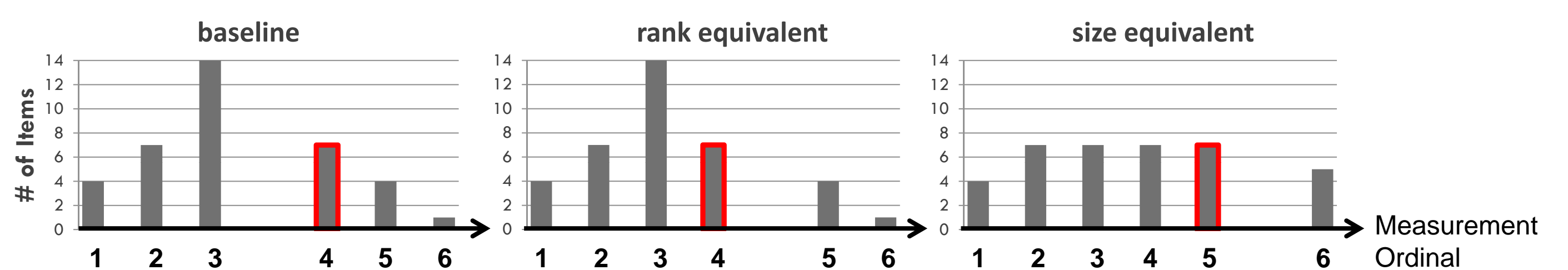
- Neither rank order nor ordinal degree alone sufficient
  - Does not rule out combination of two
- Judgments of non-numerical *pointy* more absolute/less dependent on C



## Experiment 2

**Methodology:** As in Experiment 1

- 3 adjectives (*big, tall, dark*); 3 distributions
  - Designed to distinguish **ordinal degree** vs. **measurement degree**



- n=170 native English speakers (mean age: 30.4, 111 female)

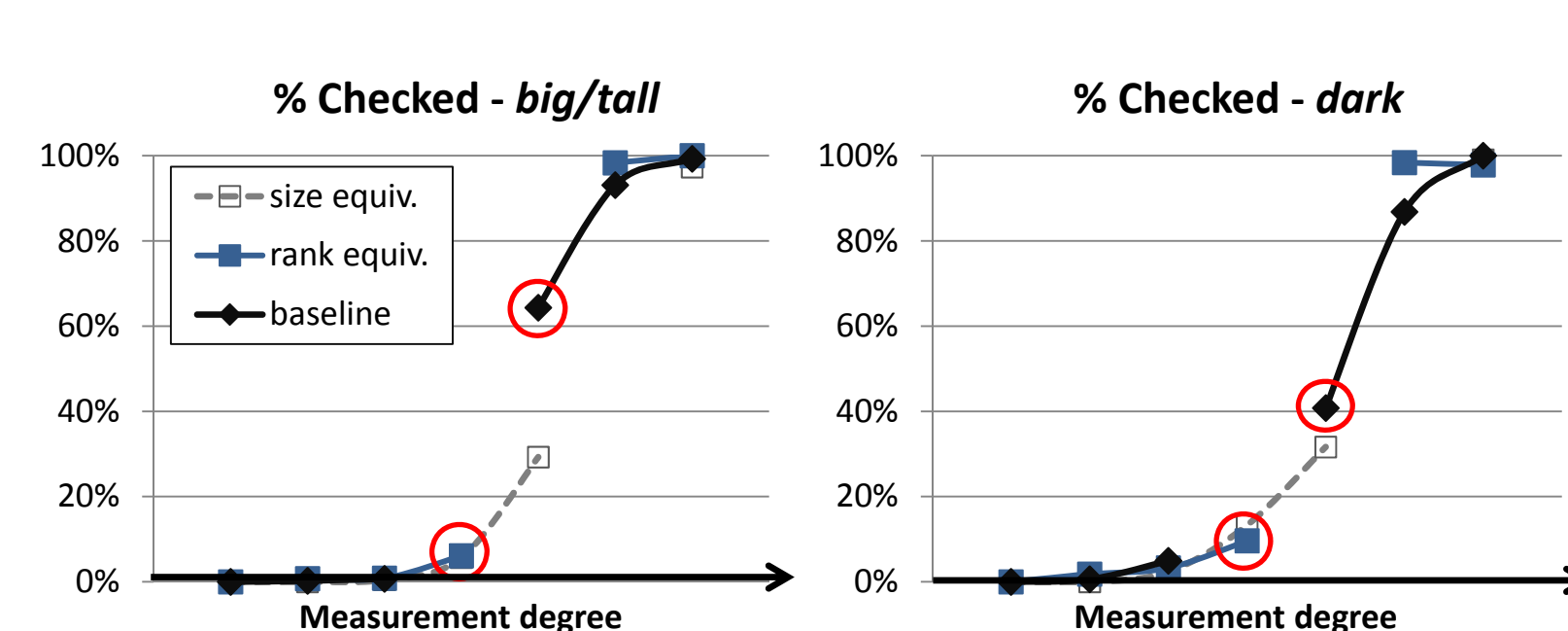
### Predictions

If **ordinal degree** sufficient: **baseline = rank equivalent**

- If not, must infer abstract **measurement degree**

If measurement degree depends on numerical measure: **dark ≠ big/tall**

### Results



*Linear mixed effects model: Adjective & numerical as fixed factors; subject as random factor*

% critical item checked:  
rank < baseline (p<0.001)  
non-numerical x rank, size (p<0.001)  
- effects less pronounced  
- but rank < baseline also for non-numerical (p<0.001)

- Ordinal degree not sufficient; require abstract notion of degree independent of the structure of C
  - Also for adjective without measurement system

## Conclusions

- Interpretation of gradable adjectives in their positive form involves degrees organized into a scale with a distance metric
  - Supports abstract theory of degree over one in which scales are derived from an ordering relation on a comparison class
- Some interadjective differences -- but no evidence that scale structure depends on presence/absence of measurement system
- For the future ...

... More adjectives (numerical/non-numerical; evaluative)

... Overt comparison classes (*tall for a boy*)

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