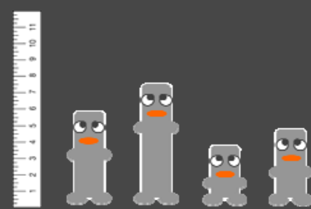
Who here is *tall*?
On degrees, scales and comparison classes

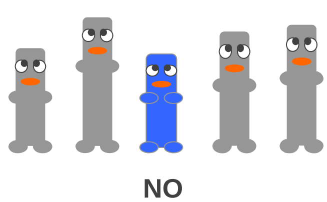


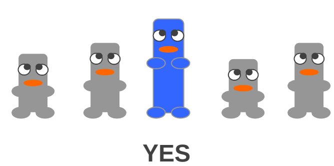
Stephanie Solt & Nicole Gotzner
ZAS Berlin & HU Berlin
Linguistic Evidence 2012, Tübingen
9 – 12 February 2012

Comparison Classes

- Gradable adjectives in positive form are interpreted relative to **comparison class (C)** which provides a standard of comparison

Is he tall?





John is tall for a jockey/a basketball player/an 8-year-old/etc.

Relative Gradable Adjectives (Kennedy 2007)

tall, long, big, large, dark, expensive, rich, fat, strong, pointy, thick, short, small, light, cheap, shallow, poor, thin, weak, blunt, smart, easy, happy, pretty, dumb, difficult, sad, ugly, etc.

- **Gradable**: *taller (vs. *deader, *more wooden)*
- **Contrary antonyms**: *tall/short*
- ****Slightly/*perfectly***: **slightly tall/*perfectly tall*
- ***For*-phrases:** *tall for an 8 year old*
- **Context-dependent standards**

Role of Comparison Class

- Truth/falsity of a sentence such as (1) depends on choice of comparison class

  (1) John is tall

- Dependency captured by formal theories in which comparison class taken to be element of logical form or parameter of interpretation (Bartsch & Vennemann 1972; Klein 1980; Bale 2008; van Rooij 2010; Solt 2011; cf. Kennedy 2007)
- Less attention to <u>how</u> truth conditions should be stated relative to comparison class (though see Schmidt et. al 2009)

Truth conditions relative to C

⟦ John is tall ⟧^{C} = 1 iff…..

a. John $\in$ the tallest *n*% of Cs
(<u>Example</u>: tallest 1/3)

b. HEIGHT(john) $\in$ the top *n*% of heights of Cs — Bale (2008)
(<u>Example</u>: tallest 1/3)

c. HEIGHT(john) > $\text{mean}_{x \in C}$(HEIGHT(x)) — von Stechow (1984)

- Or range around mean/median (von Stechow 2006; Solt 2011)

Research Questions: 1

- Which formulation of the truth conditions best reflects speakers' judgments?

Theories of Gradability

Delineation (Klein 1980)

- Gradable adjectives denote partial one-place predicates that induce a three-way partition on comparison class

  - No notion of degree underlying positive form

Theories of Gradability

Abstract Degree (Cresswell 1976; von Stechow 1984; Kennedy 2007)

- Gradable adjectives relate individuals to degrees on a scale – an abstract representation of measurement
- Standard of comparison for positive form calculated on basis of comparison class:

tall: HEIGHT(x) > d_{Std}

Theories of Gradability

<u>Derived Degree</u> <u>(Cresswell 1976; Bale 2008)</u>

- Scale derived from comparison class:
  - Pre-order established on comparison class
  - Equivalence classes under pre-order constitute degrees of scale
- Standard of comparison as in abstract degree theory…
  - <u>But</u>: scale only ordinal level (no measure of distance)

… a < b < c < d …

Compatibility with Truth Conditions

Who is tall?	Delineation	Abstract Degree	Derived Degree
a. Tallest n% of Cs	Yes	Yes	Yes
b. Top n% of heights of Cs	No(?)	Yes	Yes
c. HEIGHT > $\text{mean}_{x \in C}$ HEIGHT(x) - or any other formula requiring distance metric	No(?)	Yes	No

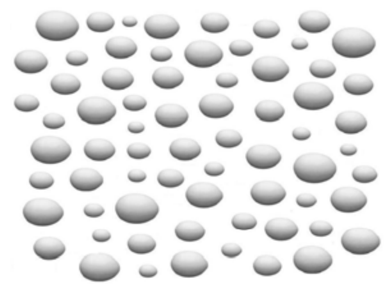
Research Questions: 2

- Can the semantics of gradable adjectives in their positive form be expressed in terms of rankings of individuals (consistent with the delineation theory), or is it necessary to introduce degrees?
- If degrees are needed, what scale structure is required:
  - an ordinal-level scale derived from a ranking on C (per derived degree theory)
  - or a scale with a distance metric (possible under the abstract degree theory)?

Experimental Research

Overall Methodology

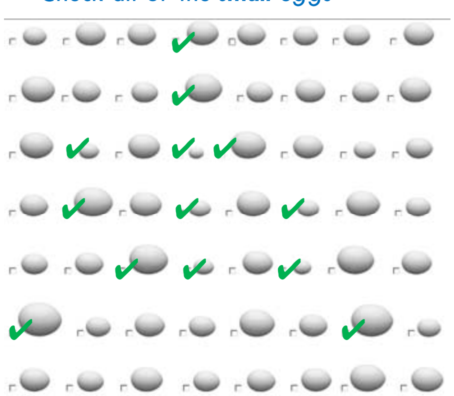
- Adjective evaluated in context of arrays of pictures representing comparison class (cf. Barner & Snedecker 2008, Schmidt et al. 2009)
  - Task: Which pictures can be described by adjective?
- Distribution of items in comparison class varied
- Changes in subjects' judgments assessed relative to predictions of alternate theories



Experiment 1

*Check all of the **big** eggs*

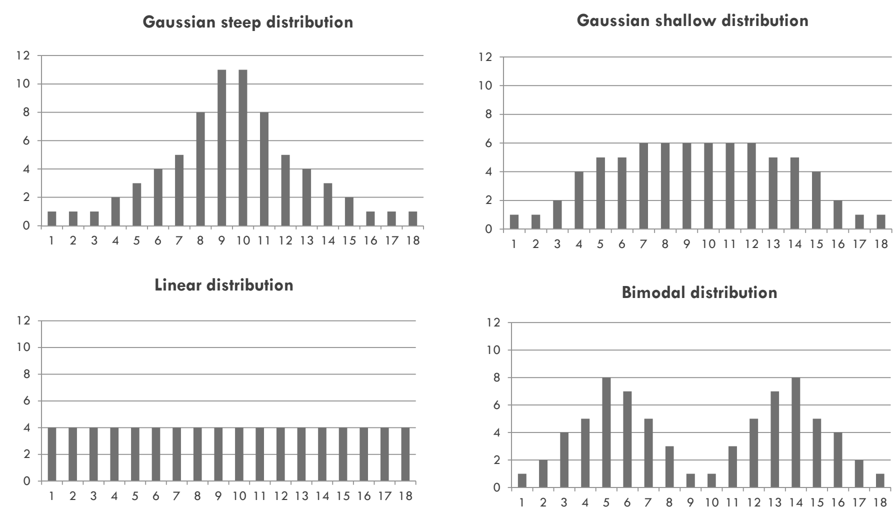
*Check all of the **small** eggs*



(Gaussian steep)

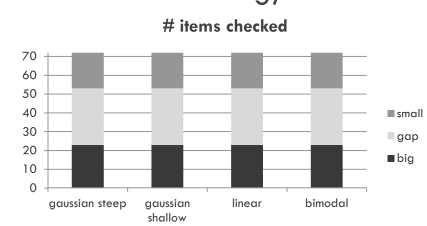
- 1 adjective pair: *groß/klein* (big/small)
- 4 symmetrical distributions (72 eggs / 18 sizes); 2/subject
- 77 native German speakers (mean age: 26, 57 female); recruited by email
- Task completed online
- Instructions:
  - Please check all of the pictures that can be described by the word
  - Check as many or as few items as you like

Comparison Class Distributions



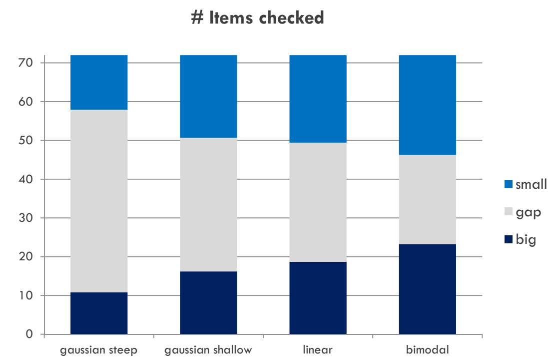
Predictions

- If judgments are based on simple ranking of the comparison class (e.g. top third are called big) …



- If judgments are based only on the range of degrees represented by C …
  - Cutoff points (biggest egg called *small*/smallest egg called *big*) should be in the same place for all distributions (e.g. big = sizes 13-18)

Average Number of Items Classified as...



<u>**Significant effect of Distribution** (LMER)</u>

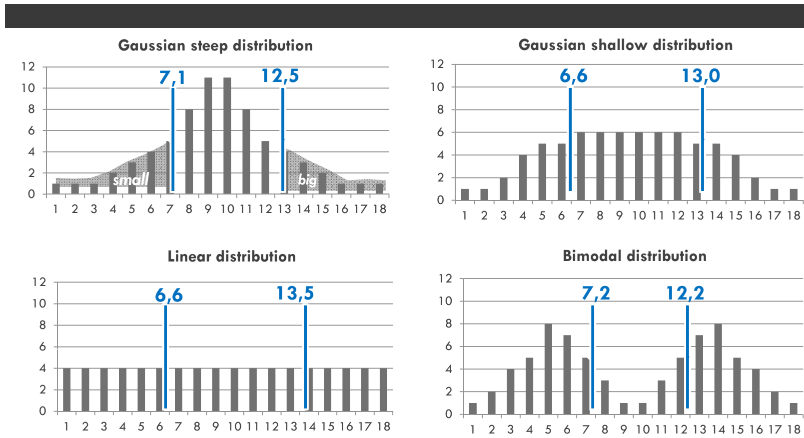
Distribution: $F_{(3,303)} = 23.9$; $p < 0.001$

Adjective: $F_{(3,303)} = 15.8$; $p < 0.001$

No interaction

Big does **not** mean 'biggest n% of the comparison class' (similarly for *small*)

Cutoff Points



No significant effect of Distribution

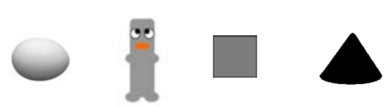
Does *big* simply mean 'top n% of the egg sizes' (e.g. sizes 13-18)?

Experiment 2: Goals

- Extend previous findings
  - to additional adjectives
  - to different types of distributions (asymmetric)
- ☞ Further investigate relative role of rankings and degrees
  - Can positive form be associated with fixed segment of the range of degrees?

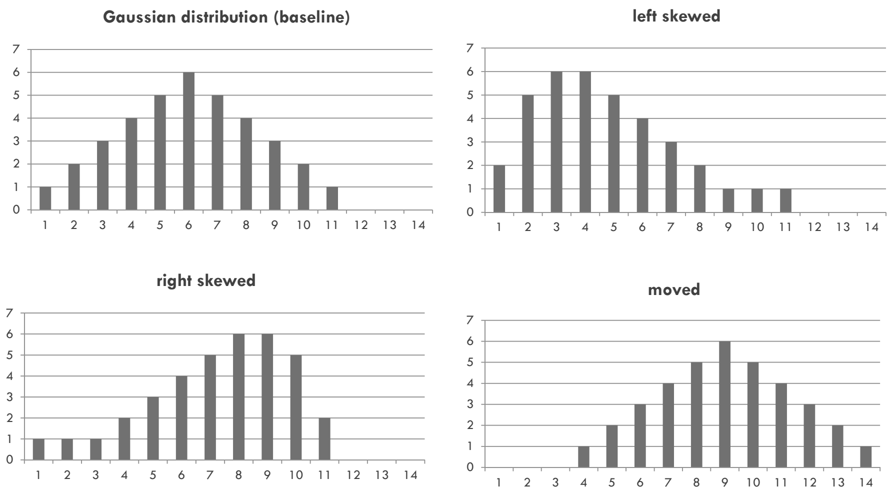
Experimental Design

- 4 Adjectives (36 picture stimuli each)
  - big
  - tall
  - dark
  - pointy



- 4 distributions (4/participant, rotated across stimuli)
- 192 native English speakers (mean age: 36, 124 female)
- Online via Amazon MTurk

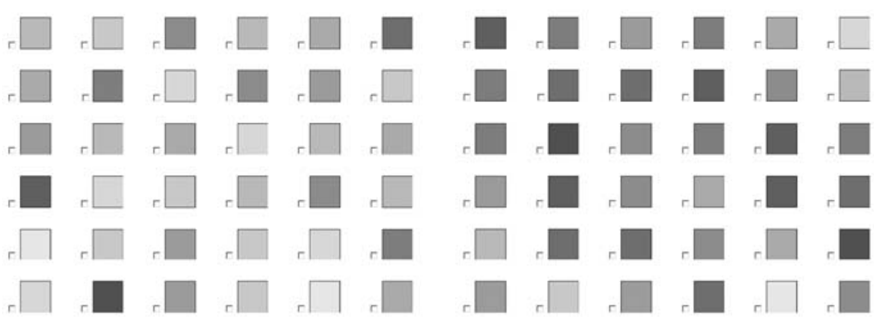
Distributions



Sample Arrays

left skewed

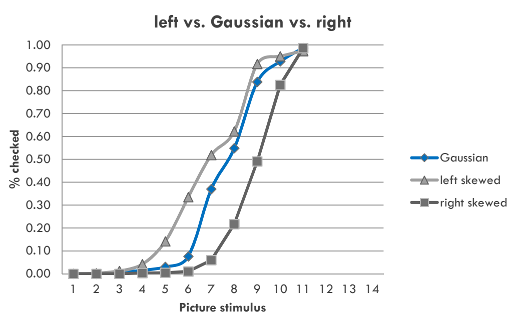
right skewed



Predictions

Dependent variable	If judgments based entirely on… Ranking	Degree
# items checked	Same across conditions	vary
Cutoff points	vary	Gaussian < moved left = Gaussian = right

Left vs. Gaussian vs. Right skewed



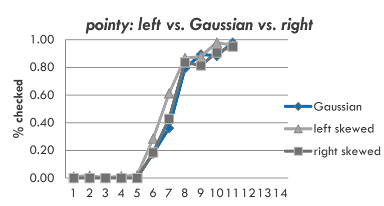
Effect of distribution on Cutoff

- gaussian vs. left (p< .05)
- gaussian vs. right (p<.001)

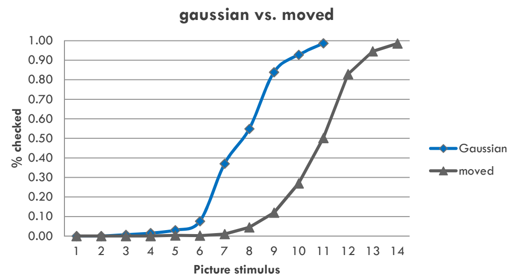
and # items checked

- gaussian vs. left (p< .05)
- gaussian vs. right (ns)

Interaction effect for pointy (p<.001) in both analyses



Gaussian vs. moved



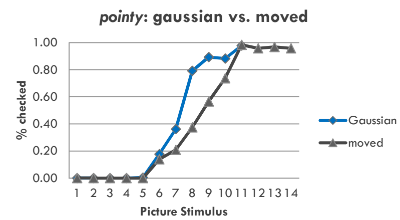
Cutoff shifted

- gaussian vs. moved ($p<.0001$)

But same # items checked

Interaction effect for pointy ($p<.0001$)

Smaller effect of distribution on cutoff



Summary of Results

Dependent variable	If judgments based entirely on…	
	Ranking	Degree
# items checked	Same across conditions ✗	vary ✓
Cutoff points	Vary ✓	Gaussian < moved ✓ Gaussian = left = right ✗

☞Truth conditions cannot be expressed as:

Top *n*% of items

Top *n*% of degrees

Experiment 3: Goals

- So far, we have shown that:
  - Truth conditions cannot be stated in terms of rankings; degrees are needed
  - Distribution of items over degrees also matters

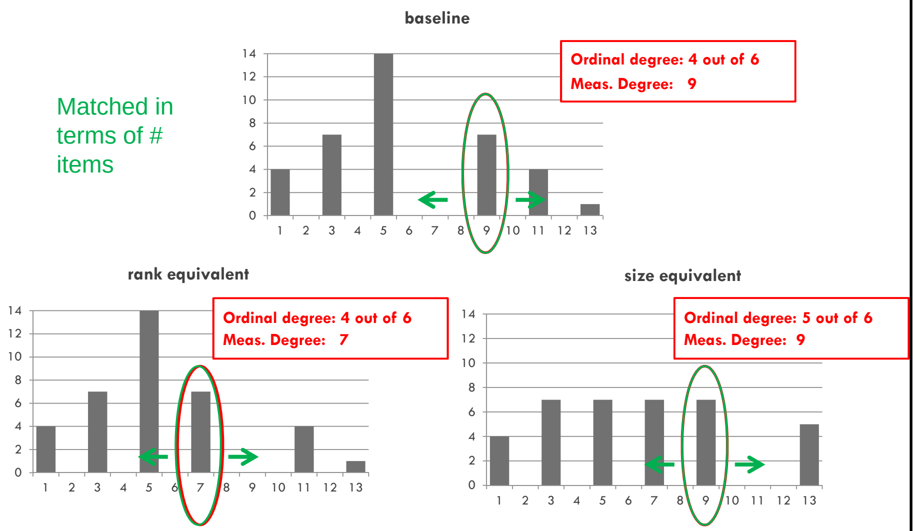
☞ What notion of degree/scale structure is relevant?
  - **Ordinal degree**: relative to set of degrees in C

    1, 2, …., 10, 11
  - **Measurement degree**: relative to independent measurement scale (e.g. height in cm)

Methodology

- 3 distributions, constructed to tease apart ordinal degree and measurement degree
  - 3/participant, rotated across stimuli
- 3 adjective/picture pairs:
  - big (eggs)
  - tall (cartoon characters)
  - dark (squares)
- 170 native English speakers (mean age: 30.4, 111 female)
- Executed online via Amazon MTurk

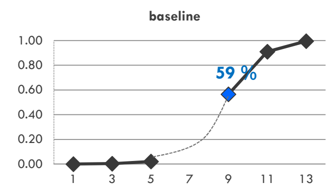
Distributions

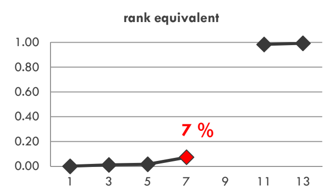


Predictions

- If an ordinal-level scale is sufficient…
  Baseline (Critical item % checked) = rank equivalent
- If not, we need to assume independent measurement scale

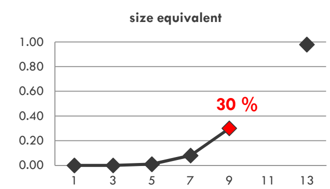
Results





$p < .001$ (t test)

☞ Ordinal scale is not sufficient



$p < .001$ (t test)

☞ Distribution of items over degrees matters

Conclusions

- In judging which items a gradable adjective (e.g. *large*) can be applied to, speakers make use of the statistical properties of the comparison class
- Simplest formulae do not capture judgments

  tall ≠ tallest n% of C

  tall ≠ top n% of heights of Cs

- Best model so far:

$$d_{Std} = \text{mean}_{x \in C}(\text{HEIGHT}(x)) + k \bullet \text{STDEV}_{x \in C}(\text{HEIGHT}(x))$$

Conclusions

- Truth conditions for sentences with gradable adjectives cannot be stated purely in terms of rankings of individuals. Degrees are required.
  - Most compatible with Degree-based theory of gradability
  - But does not require that degrees be represented in semantics (cf. Delineation theory)
- The relevant notion of a degree involves a scale with a distance metric
  - Supports Abstract Degree theory vs. Derived Degree theory

Conclusions

- Not all gradable adjectives behave the same
  - *Tall/big/dark*: clear effect of comparison class
  - *pointy:* less pronounced effect
- Suggests a more fine-grained view of adjective classes (vs. Kennedy 2007)
- Future work: additional types of adjectives
  - With/without numerical measure
  - Evaluative adjectives (e.g. *pretty, smart*)

Thank you!

References

Bale, A. C. (2008). A universal scale of comparison. *Linguistics and Philosophy* 31, 1-55.

Barner, D. and J. Snedeker. (2008). Compositionality and statistics in adjective acquisition. *Child Development* 79, 594-608.

Bartsch, R. and T. Vennemann (1973). *Semantic structures: A study in the relation between syntax and semantics. Frankfurt: Athaenum.*

Cresswell, M. J. (1976). The semantics of degree. In B.H. Partee (ed.), Montague Grammar, 261-292. New York: Academic Press.

Kennedy, C. (2007). Vagueness and grammar. *Linguistics and Philosophy* 30, 1-45.

Klein, E. (1980). A semantics for positive and comparative adjectives. *Linguistics and Philosophy 4, 1-45.*

van Rooij, R. (2011). Implicit versus explicit comparatives. In P. Égré and N. Klinedinst (eds.), *Vagueness and language use*. New York: Palgrave Macmillan.

Schmidt, L.A., N.D. Goodman, D. Barner, and J.B. Tennebaum (2009). How tall is *tall*? Compositionality, statistics, and gradable adjectives. *Proceedings of the Thirty-First Annual Conference of the Cognitive Science Society*, 2759-2764.

Solt, S. (2011). Notes on the comparison class. In R. Nouwen, R. van Rooij, U. Sauerland and H.-C. Schmitz (eds.), *Vagueness in Communication (ViC2009), Revised Selected Papers (LNAI 6517)*, 189-206. Berlin, Heidelberg: Springer.

Stechow, A. von (1984). Comparing semantic theories of comparison. *Journal of Semantics*, 3, 1-77.

Stechow, A. von (2006). Time as degrees. Ms, Tübingen.