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

Comparison Classes

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

Is he tall?

NO

YES

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 how truth conditions should be stated relative to comparison class (though see Schmidt et. al 2009)
Truth conditions relative to C

\[[ \text{John is tall} \]_C^n = 1 \text{ iff} \ldots.\]

a. John ∈ the tallest \( n\% \) of Cs
   (Example: tallest 1/3)

b. \( \text{HEIGHT(john)} \) ∈ the top \( n\% \) of heights of Cs
   Bale (2008)
   (Example: tallest 1/3)

c. \( \text{HEIGHT(john)} > \text{mean}_{x \in C}(\text{HEIGHT(x)}) \)
   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

\[
\text{not tall} \quad \text{extension gap} \quad \text{tall}
\]

- No notion of degree underlying positive form

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:

  \[
  \text{tall: } \text{HEIGHT}(x) > d_{\text{Std}}
  \]

  \[
  d_{\text{Std}}
  \]
Theories of Gradability

Derived Degree (Cresswell 1976; Bale 2008)

- 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...
  - But: scale only ordinal level (no measure of distance)

\[ a < b < c < d \]

Compatibility with Truth Conditions

<table>
<thead>
<tr>
<th>Who is tall?</th>
<th>Delineation</th>
<th>Abstract Degree</th>
<th>Derived Degree</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Tallest ( n% ) of Cs</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>b. Top ( n% ) of heights of Cs</td>
<td>No(?)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>c. ( \text{HEIGHT} &gt; \text{mean}_{x \in C} \text{HEIGHT}(x) ) - or any other formula requiring distance metric</td>
<td>No(?)</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
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

  - 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

- 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...

![Bar chart showing average number of items classified as small, gap, and big across different distributions.

**Significant effect of Distribution (LMM):**
- 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)*

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Cutoff Points

<table>
<thead>
<tr>
<th>Distribution</th>
<th>Cutoff Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gaussian steep</td>
<td>7,1 12,5</td>
</tr>
<tr>
<td>Gaussian shallow</td>
<td>6,6 13,0</td>
</tr>
<tr>
<td>Linear</td>
<td>6,6 13,5</td>
</tr>
<tr>
<td>Bimodal</td>
<td>7,2 12,2</td>
</tr>
</tbody>
</table>

*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

Gaussian distribution (baseline)

left skewed

right skewed

moved

Sample Arrays

left skewed

right skewed
Predictions

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>If judgments based entirely on…</th>
</tr>
</thead>
<tbody>
<tr>
<td># items checked</td>
<td>Same across conditions</td>
</tr>
<tr>
<td>Cutoff points</td>
<td>vary</td>
</tr>
<tr>
<td></td>
<td>Gaussian &lt; moved</td>
</tr>
<tr>
<td></td>
<td>left = Gaussian = right</td>
</tr>
</tbody>
</table>

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

Interaction effect for pointy (p<.0001)
Smaller effect of distribution on cutoff

Summary of Results

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>If judgments based entirely on…</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ranking</td>
</tr>
<tr>
<td># items checked</td>
<td>Same across conditions</td>
</tr>
<tr>
<td></td>
<td>Cutoff points</td>
</tr>
<tr>
<td></td>
<td>Gaussian &lt; moved</td>
</tr>
<tr>
<td></td>
<td>Gaussian = left = right</td>
</tr>
</tbody>
</table>

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

Matched in terms of # items

Predictions

- If an ordinal-level scale is sufficient...
  Baseline (Critical item % checked) = rank equivalent

- If not, we need to assume independent measurement scale
Results

Ordinal scale is not sufficient

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
  
  \[ \text{tall} \neq \text{tallest n\% of } C \]
  
  \[ \text{tall} \neq \text{top n\% of heights of } Cs \]

- Best model so far:

  \[ d_{\text{Std}} = \text{mean}_{x \in C}(\text{HEIGHT}(x)) + k \cdot \text{STDEV}_{x \in C}(\text{HEIGHT}(x)) \]
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

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)
References