Multidimensionality, subjectivity and scales: experimental evidence

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Workshop on Gradability, Scale Structure and Vagueness: Experimental Perspectives
28 May 2015

Focus of today's talk

Investigate the interrelationships between four phenomena that characterize the interpretation of gradable adjectives, and that give rise to meaningful subclasses of the broader class:

- Subjectivity
- Multidimensionality
- Measurability
- Absolute vs. Relative Standards

Subjectivity

Kennedy (2013): Two types of subjectivity:

- Related to location of **standard or threshold** of application for positive form

  (1) A: The Picasso is beautiful. FAULTLESS
  B: No, it's not!

  (2) A: Anna is tall. (potentially}
  B: No, she's not! FAULTLESS

- Related to **ordering** of entities along relevant dimension

  (3) A: The Picasso is more beautiful than the Miró. FAULTLESS
  B: No, the Miró is more beautiful.

  (4) A: Anna is taller than Berta. ONLY
  B: No, Berta is taller! FACTUAL

Multidimensionality

- Some adjectives are dependent on a **single dimension** for their evaluation

  Examples: *tall, short, long, old, expensive*, etc. (the dimensional adjectives of Bierwisch 1989)

- Others are **multidimensional**, in that their interpretation is based on multiple component dimensions

  Example: *healthy* – depends on blood pressure, cholesterol, blood sugar, etc. (Sassoon 2013)

  (5) a. Anna is healthy / ??tall in every respect

  b. Anna is healthy except for her blood pressure /
      ??tall except for …

Measurability

- **Measurable:** Some adjectives are associated with established numerical measurement systems

  (6) 10 cm taller/shorter; 5 euro more expensive; 10 years older

- **Potentially measurable**: Others allow such measures to be created, or have them in specific contexts

  (7) 10 IQ points more intelligent (but: Q: How intelligent is John? A: ??He has an IQ of 120)

  (8) The Pinot Grigio is 10 points better than the Merlot

- **Non-measureable:** Finally, others seem more radically resistant to establishing a unit of measure

  (9) 10 ?? more beautiful / tastier

Absolute vs. relative standards

- Gradable adjectives differ as to whether they have **relative** or **absolute** standards, a difference that has been attributed to scale structure (Kennedy & McNally 2005; Kennedy 2007) – among other factors

  - **Relative:** context/comparison class dependent standard

    (10)   Anna is tall

       ≈ Anna's height exceeds the norm for some group she belongs to (cf. tall for an 8-year old)

  - **Absolut**e: endpoint-based standard

    (11)   The shirt is dirty

       ≈ The shirt has some dirt on it

          (cf. ?dirty for a t-shirt)

Questions

- What relationships exist between these four phenomena?
  - Are they causally related? How?
  - Do they derive from a more basic, common underlying factor?
- How should these patterns be accounted for in a degree-based semantic framework?

SUBJECTIVITY

Ordering subjectivity

(12) A: The Picasso is more beautiful than the Miró.
B: No, the Miró is more beautiful.

(13) A: The cream cake is tastier than the chocolate cookies.
B: No, the chocolate cookies are tastier!

(14) A: Sue's essay is better than the one Anna wrote.
B: No, Anna's essay is better.

Challenge to degree-based analysis

The Picasso is more beautiful than the Miró

$⟦beautiful⟧=$
$λdλx.μ_{beauty}(x) \geqslant d$

$μ_{beauty}$

$μ_{beauty}(Miró)$ $μ_{beauty}(Picasso)$ S_{beauty}

➤ Seems to presuppose unique scale / mapping

Which gradable adjectives exhibit ordering subjectivity?

Evaluative (*good, bad*)	YES
Aesthetic (*beautiful, ugly*)	YES
Predicates of personal taste (*tasty, fun*)	YES
Dimensional (*tall, long, old*)	NO
- i.e. relative GAs with standard measurement systems	
Absolute (*clean, dirty, full, empty*)	??
Relative w/out measurement system (*soft, hard*)	??

Experiment:
Faultless Disagreement Paradigm

- Judgment of short dialogues

  A: Frank is shorter than Jimmy.

  B: No, Jimmy is the shorter one.

  A: Those sneakers are uglier than the Converse sneakers you tried on earlier.

  B: No, the Converse sneakers were uglier.

  ○ Only one can be right; the other one must be wrong.   FACT
  ○ It's a matter of opinion.   OPINION

Experiment:
Faultless Disagreement Paradigm

- 35 gradable adjectives:

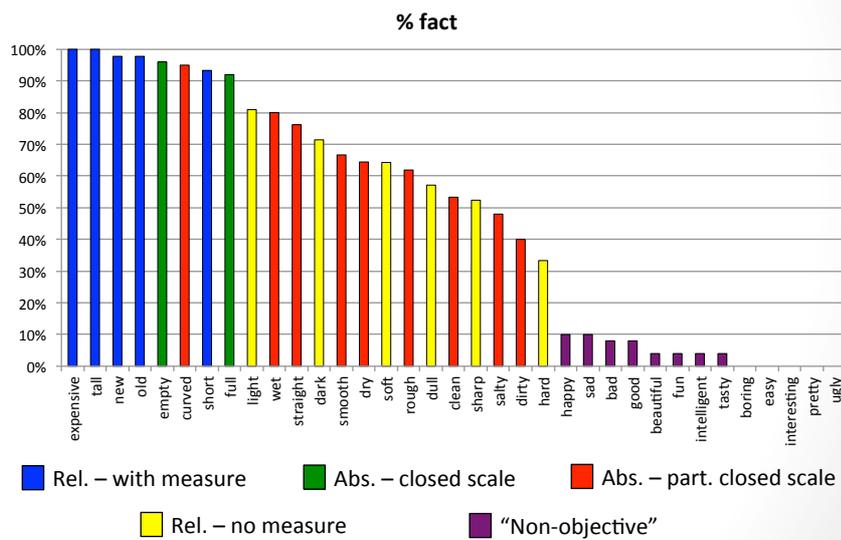| Relative -- with standard measurement unit	tall, short, old, new, expensive
Relative -- without standard measurement unit	sharp, dull, dark, light, hard, soft
Absolute -- partially closed scale	wet, dry, straight, curved, rough, smooth, clean, dirty, salty
Absolute -- totally closed scale	full, empty
"Non-objective"	good, bad, beautiful, pretty, ugly, easy, interesting, boring, tasty, fun, intelligent, happy, sad

Experiment:
Faultless Disagreement Paradigm

- Online via Amazon MTurk
  - 4 lists
  - n=20-25 subjects per list (n=91 total)
  - Fillers: nominal/verbal predicates, deontic modals, factual statements

Results

% Fact
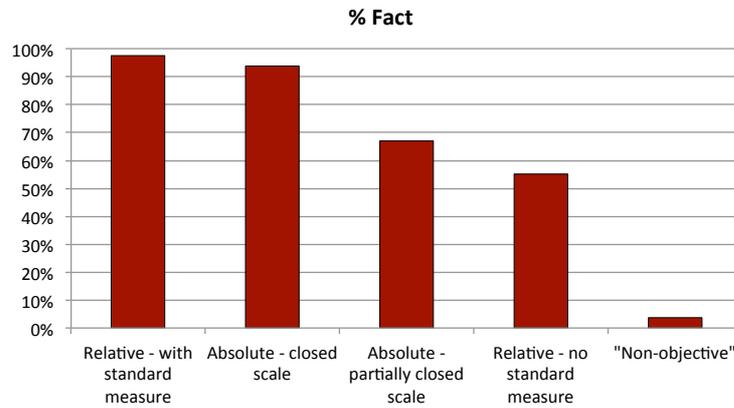
- Significant difference between groups (F=282.3, p<0.001)
- All pairwise comparisons significant at p<0.001 except Rel. w/Measure vs. Abs. Closed (n.s.) and Rel. no Measure vs. Abs. Partial (p<0.01)

Results – details

% fact

- 🟦 Rel. – with measure
- 🟩 Abs. – closed scale
- 🟥 Abs. – part. closed scale
- 🟨 Rel. – no measure
- 🟪 "Non-objective"

Summary

- "Naïve" subjects can judge disagreements featuring gradable adjectives as fact-based vs. subjective (the paradigm appears to work)

- A wide range of gradable adjectives exhibit at least some degree of ordering subjectivity
  - Phenomenon extends far beyond classic examples of subjective properties or predicates of personal taste

Summary

- Adjectives tested pattern in 3 groups:

  1. **Purely fact-based:** the measurable class
     - Relative GAs with measurement systems
     - Closed-scale absolute GAs
       > (15) The tank is 20% full/empty

  2. **Allow both subjective and fact-based readings**
     - Relative GAs without measurement systems
     - Partially closed scale absolute GAs

  3. **Purely subjective**
     - Evaluative; aesthetic; emotion words; predicates of personal taste; psychological predicates (?)

Questions

- Measurability leads to objective judgments about orderings. What is the source of the ordering subjectivity observed with the remaining subclasses of gradable adjectives?

  - Is there a single underlying factor or multiple?

  - What is responsible for the two distinct levels of subjectivity?

SOURCE OF SUBJECTIVITY: MULTIDIMENSIONALITY

Multidimensionality

"Deciding whether an adjective describing a multidimensional property holds of some individual involves not only determining a threshold of applicability but also determining the relative weight of each of the dimensions that contribute to the property in question. Here, again, there will be room for disagreement between speakers...."

"Two speakers may disagree about whether Ayumi is healthier than Mihajlo because they may disagree about whether one component of health or another (e.g. the state of the cardiovascular system vs. the immune system) should carry more weight."

McNally & Stojanovic (2014)

Multidimensionality

"…we might expect to find faultless disagreement effects in all cases of "dimensional uncertainty" — i.e., scenarios in which the conventions of use are consistent with different ways of evaluating some aspect of meaning, and individual speakers are not in a privileged position to dictate which of the multiple ways are correct. "

"…just as there is uncertainty about how the dimensions involved in vague standard calculation are weighted and applied in different conversational situations, there is uncertainty about how the dimensions of qualitative assessment are weighted and applied by different judges…. in the latter case, [the uncertainty] leads to uncertainty about orderings."

Kennedy (2013)

Hypothesis

Multidimensionality of the property lexicalized by an adjective is a source of ordering subjectivity

Which adjectives are multidimensional?

Tall: Depends purely on height

_____

Intelligent: Mathematical ability, verbal ability, spatial reasoning, people skills, etc. etc.

Beautiful: Line, form, color, draftsmanship, etc.

Which adjectives are multidimensional?

Clean/dirty: How clean/dirty something is is a function of the **amount** and type of **dirt** on it in relation to its **size**

$$\mu_{clean}(x) \approx \sum_i k_i \cdot \mu_{amount}(dirt_i \text{ on } x) / \mu_{size}(x)$$

Which adjectives are multidimensional?

Smooth/bumpy: Which surface is smoother/bumpier??

➢ Other 'mixed' adjectives behave similarly (*straight/ curved, safe/dangerous, light/dark*)
➢ A different sort of multidimensionality?

Diagnostics for Multidimensionality

- Mention of / quantification over component dimensions (Sassoon 2013)

(16) a. Anna is healthy in every respect / in every way

b. ??Anna is tall in every respect / in every way

(17) a. In what respect (way) is Anna healthy / sick?

b. ??In what respect (way) is Anna tall / short?

Diagnostics for Multidimensionality

- However…

(18)	The lecture was interesting / boring in every respect	OK
(19)	The Picasso is beautiful / ugly in every respect	OK
(20)	The shirt is clean / dirty in every respect	?
(21)	The road was bumpy / smooth in every respect	?
(22)	The knife is sharp / dull in every respect	??
(23)	The pillow is hard / soft in every respect	??

Diagnostics for Multidimensionality

- However…

(24) In what respect was the lecture interesting / boring?   OK

(25) In what respect is the Picasso beautiful / ugly?   OK?

(26) In what respect is the shirt clean / dirty?   ?

(27) In what respect was the road bumpy / smooth?   ??

(28) In what respect is the knife sharp / dull?   ??

(29) In what respect is the pillow hard / soft?   ??

Further issues

(30)   The wedding was beautiful in every respect

- The service, the location, the flowers, the dress…

(31)   Anna is beautiful in every respect.

- Typically: character aspects NOT component dimensions of physical beauty

(32)   Anna is beautiful except for her big nose…

- Dimension of beauty?
- What is a dimension of beauty (applied to people)?

(33)   a. The hotel bathroom was clean in every respect
b. ?The plate is clean in every respect

➢ Challenging to separate quantification over dimensions from quantification over parts of object of predication

Pilot study: multidimensionality

- Acceptability judgment task

    x is Adj in every respect

  - 7-point scale (completely acceptable <-> completely unacceptable)

- 9 adjectives
  - 'Classic' multidimensional: healthy
  - Dimensional: tall, old
  - Purely subjective: good, beautiful, interesting, tasty
  - Mixed: clean, soft

- Amazon Mturk, n=24 (1 non-native English speaker excluded)

Results:
acceptability of 'in every respect'

	Mean
healthy	1.58
clean (bathroom)	2.50
interesting	2.50
good	2.54
beautiful	2.58
tasty	3.67
old	3.83
soft	3.88
clean (plate)	4.08
tall	4.25

- *healthy* stands out in acceptability

- Dimensional adjectives get low ratings – as expected

- Purely subjective group patterns as multidimensional on this test (exception: *tasty*)

- Mixed group does not clearly differ from dimensional group – though *clean* at least is intuitively multidimensional

Corpus data:
occurrence of 'in every respect'

	# per Mil.
healthy	137.3
beautiful	53.4
interesting	27.7
good	26.8
clean	23.4
tasty	0
old	0
soft	0
tall	0

- Google Books corpus (American) – 155 billion words

$$\frac{\text{ADJ in every way/respect}*1\text{ million}}{\text{ADJ}}$$

- Similar pattern of results

Interim conclusions

- Multidimensionality is a source of ordering subjectivity

- There are different types / degrees of multidimensionality

- There is no clear test for multidimensionality – accepted diagnostics appear to pick out a subclass of this class

  - **Hypothesis:** those whose component dimensions are available to introspection and are integrated logically (e.g. *healthy*)

- Multidimensionality may not be the whole story

SOURCE OF SUBJECTIVITY: 'SENTIENCE' REQUIRMENT

Where we are…

- Certain adjectives that exhibit subjectivity are not so clearly multidimensional (even in the broad sense)

  (34)   ?In what respect is the pillow hard / soft?
  (35)   ?In what respect is the wine tasty?
         (cf. in what respect is the wine good?)

- Adjectives exhibiting ordering subjectivity divide into two groups:
  - Mixed (*clean/dirty, hard/soft*, etc.)
  - Purely subjective (*good/bad, beautiful/ugly, interesting/boring, tasty, fun*, etc.)

Hypothesis

A further source of subjectivity is the necessary mediation of a sentient individual in the ascription of a property to an individual (McNally & Stojanovic 2013)

- Experiencer (*tasty, fun, interesting, boring*)
- Applier of value judgment (*good, bad*)
- Applier of aesthetic concept (*beautiful, somber*)

  ➢ Inherent aspect of the meaning of some adjectives; a possibility for others (e.g. *soft*)

Diagnostics for 'sentient mediation'

- No general ones (as far as I am aware)
- Diagnostic for experiencer: embedding under *find*

  (36)   I find the cake tastier than the chocolate cookies
  (37)   I find psychology more interesting than chemistry
  (38)   ?? I find Anna taller than Berta

  (Sæbø 2009, Kennedy 2013, Umbach 2013, Bylinina 2014; though see McNally & Stojanovic for issues with this diagnostic)

Pilot study: embedding under *find*

- Acceptability judgment task

I find x Adj-er/more Adj than y

- 7-point scale (completely acceptable <-> completely unacceptable)

- 8 adjectives
  - Dimensional: *tall, old*
  - Purely subjective: *good, beautiful, interesting, tasty*
  - Mixed: *clean, soft*

- Amazon Mturk, n=24 (1 non-native English speaker excluded)

Results: embedding under *find*

	Mean
interesting	1.08
soft	1.25
beautiful	1.54
good	1.79
tasty	1.79
tall	2.54
clean	2.79
old	3.00

- Only moderate differences between adjectives

- Purely subjective adjectives – and one member of the mixed class – more acceptable than measurable class

  ➢ Evidence for experiencer

CONCLUSIONS AND CONSEQUENCES

Conclusions

- While fully adequate diagnostics have not (yet) been identified, findings so far point to **two distinct sources of ordering subjectivity** with gradable adjectives:

  1. Multidimensionality, specifically uncertainty as to the choice and manner of integration of component dimensions, each of which is (in principle) objectively measurable

     ➢ May support objective judgments about orderings

  2. Necessary mediation of a sentient individual (experiencer, holder of evaluative attitude) in property ascription

     ➢ Purely subjective judgments about orderings

Consequences for degree semantics

Scale as a triple of the following form:

$S = \langle D, >, DIM \rangle$

where:

- D is a set of degrees
- $>$ is an ordering relation on D
- DIM is a dimension of measurement

A single dimension DIM can thus be associated with multiple specific scales S_{DIM}

$S_{beauty} = \langle D, >, BEAUTY \rangle$

Consequences for degree semantics

Gradable adjectives encode **dimensions**, not **scales** (cf. Kennedy 2013):

NOT: $[\![beautiful]\!] = \lambda d \lambda x. \mu_{beauty}(x) \geqslant d$

INSTEAD: $[\![beautiful]\!] = \lambda d \lambda x. \mu_{S_{beauty}}(x) \geqslant d$

- **A** scale of beauty, not **THE** scale of beauty

Consequences for degree semantics

Representation of subjectivity (preliminary):

- Multidimensional:

$$\mu_{S_{clean}}(x) = f (\mu_1(x), \mu_2(x), \dots \mu_i (x))$$

- Sentient:

$$\mu_{S_{interesting}} (x) = \mu_{interesting}(j)(x)$$

AND A PUZZLE ABOUT THE RELATIVE VS. ABSOLUTE DISTINCTION

The puzzle

- All classic examples of measureable gradable adjectives pattern as relative (open scale) rather than absolute

  tall, long, wide, deep, high, large, old, heavy, expensive, fast, strong

- Standard examples of absolute gradable adjectives lack standard measurement systems/units of measure

  clean, flat, straight, dry, safe, smooth, salty

- Exceptions to 2nd generalization:
  - Absolute totally closed scale GAs: *80% full/empty*
 - Adjectives of deviation: *10 min early/late/fast/slow*

The puzzle

Accounting for this correlation has the potential to tell us something about the nature of measurability, and the source of the absolute vs. relative distinction

A partial solution

- The simplest basis for a measurement unit is an additive structure wrt. concatenation – typical for measurable GAs.

Example: *tall/short*
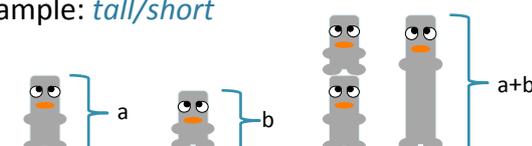
$$\mu_{S_{height}}(x \oplus y) = \mu_{S_{height}}(x) + \mu_{S_{height}}(y)$$

- Every entity whose height we can discuss must have nonzero degree of height (cf. standard axiomatizations of extensive measurement; Kranz et al. 1971)

- Nothing mapped to 0 / scalar minimum a trivial standard

A partial solution

- Classic examples of absolute gradable adjectives are multidimensional, encoding measure functions whose form is such that an entity can have zero degree of the property in question without ceasing to exist as such

Example: *clean/dirty*

$$\mu_{S_{clean}}(x) \approx \sum_i k_i \cdot \mu_{amount}(dirt_i \text{ on } x) / \mu_{size}(x)$$

Tying it together

An additive measure function results in measurability, lack of subjectivity and a relative standard

Other classes of adjectives/measure functions still require further study!

THANK YOU!