THE INTERPRETATION OF VAGUE PREDICATES - EXPERIMENTAL INSIGHTS

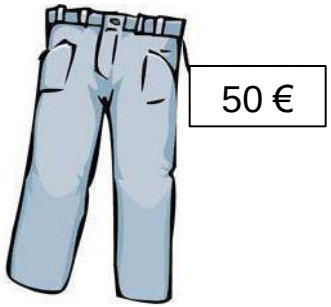
Nicole Gotzner, Marijan Palmovic & Stephanie Solt
LOGICCC Final Conference
September 15-18 2011

Vague Predicates

- Borderline Cases

  These jeans are expensive

TRUE



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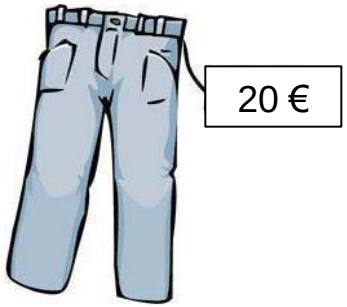


FALSE

- Sorites Paradox

  Jeans that cost 120€ are expensive ✓

  Jeans that cost 0,01€ less than an expensive pair of jeans are expensive ✓

  ∴ Jeans that cost 5€ are expensive ✗

Challenges to semantic analysis

- What is required of a formal model to capture intuitions of 'borderline' truth?
  - E.g. multivalued logic?

- How should truth conditions of a sentence containing a vague predicate be stated?

  [[These jeans are expensive]] = 1

  iff .....

Overall research questions

- How do 'real' speakers behave when presented with borderline cases of a vague predicate?
- On what basis do speakers judge applicability of a vague predicate?
  - **Ultimate goal:** input towards formal analyses of vagueness

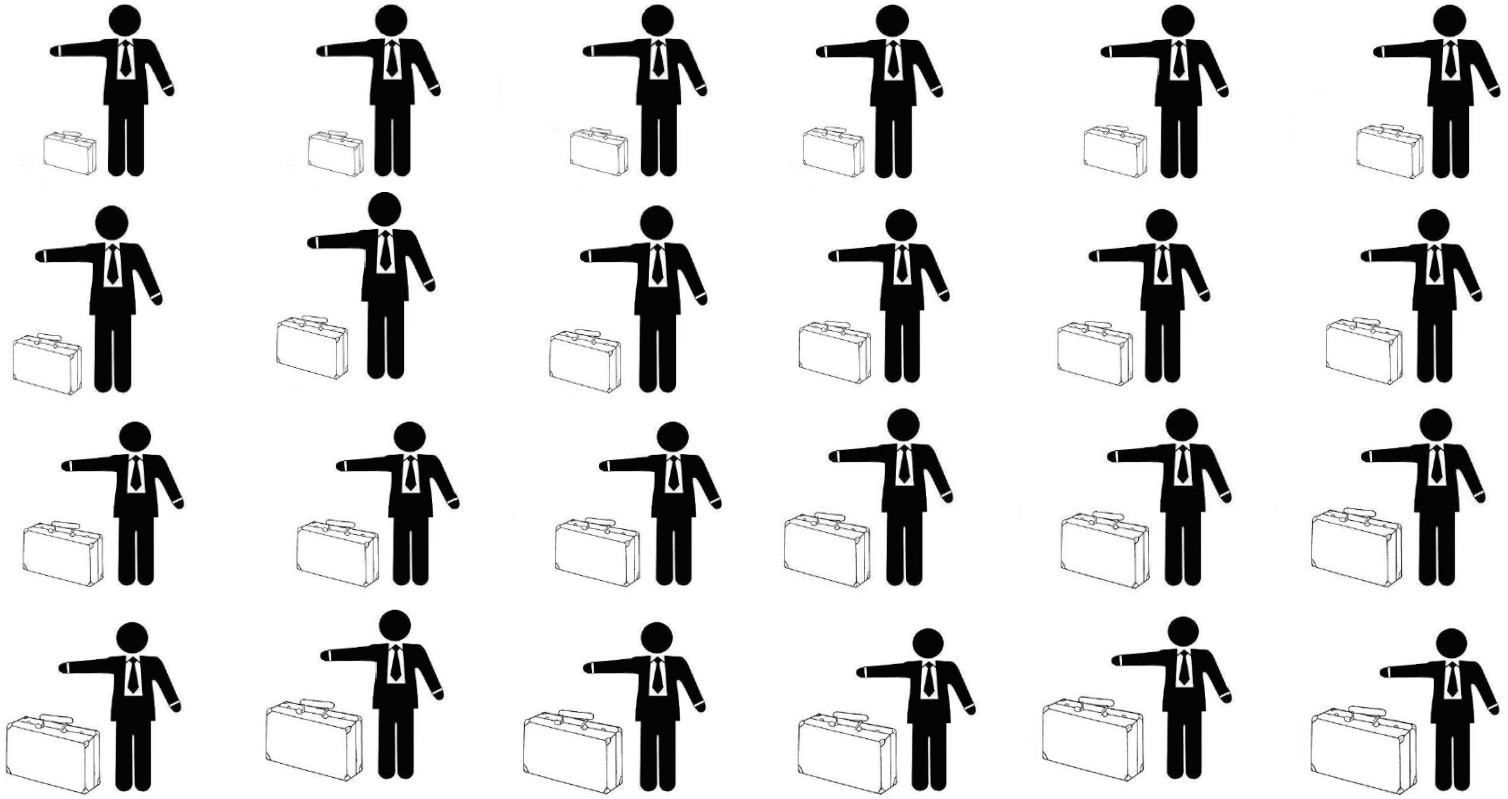
Experiment series 1

Vague adjectives and Sorites series

Research Questions

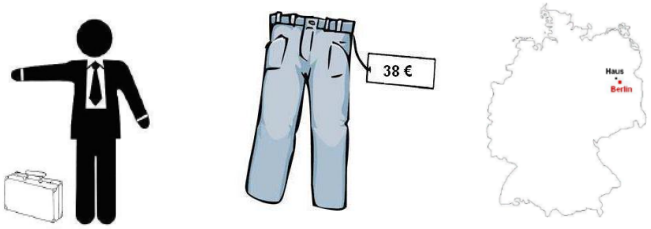
- How do speakers behave when presented with a vague adjective (e.g. *large*) in the context of a set of stimuli representing a Sorites series?
  - Do they allow a 'gap' between positive and negative extensions of a vague adjective? (cf. Bonini et al. 1999)

The suitcase is large



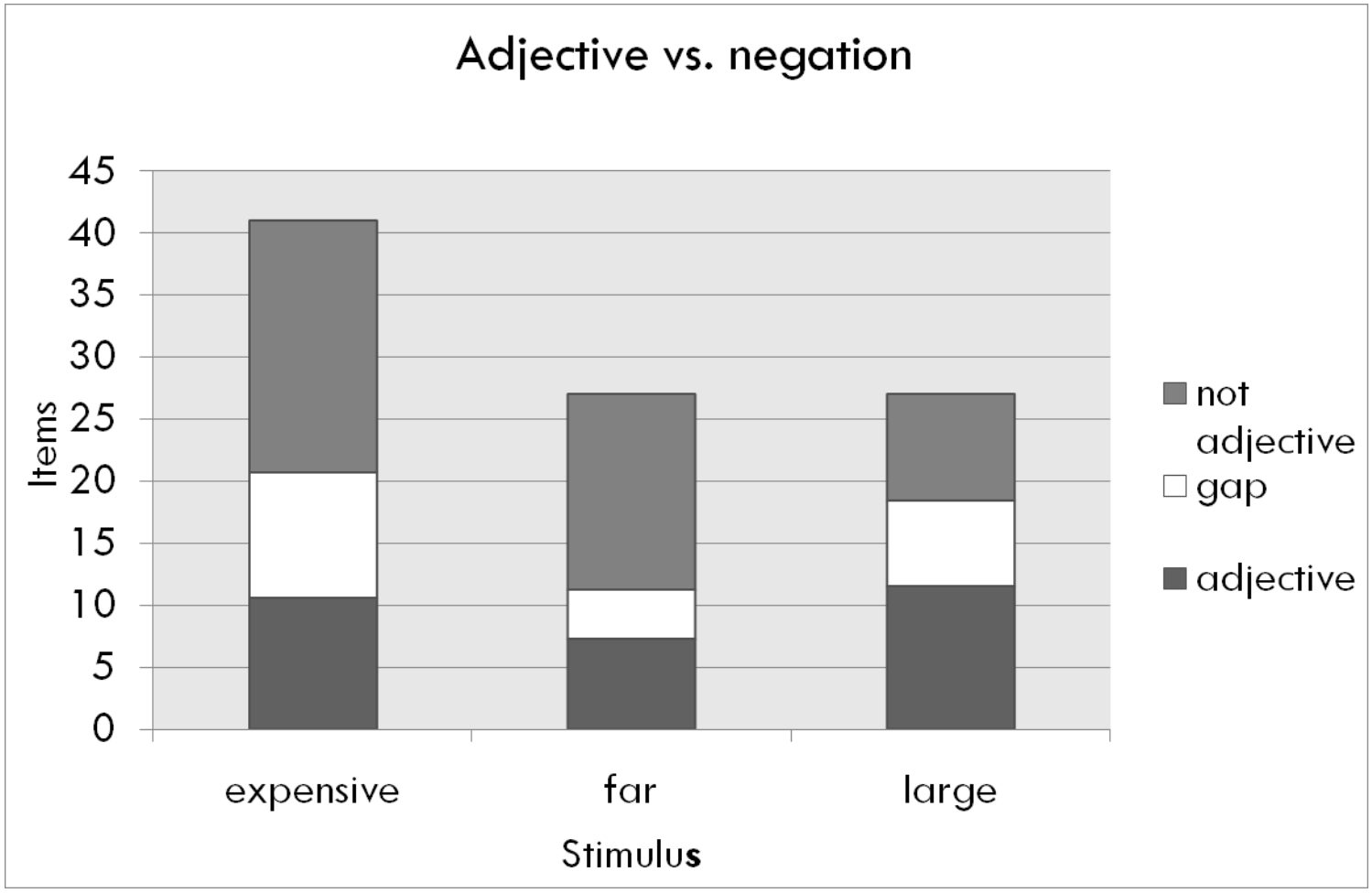
Design

- Stimuli based on gradable adjectives
  - **3 adjectives**: *groß* (large), *teuer* (expensive) and *weit weg* (far)
  - **their negations:** *nicht groß, nicht teuer, nicht weit weg*



- Sentence-picture matching task (adjective vs. negation judged in succession)
- 14 native German students (mean age: 21)

Results


Adjective vs. negation
45
40
35
30
25
20
15
10
5
0
Items
expensive
far
large
Stimulus
not adjective
gap
adjective

Conclusions

- Respondents leave an extension gap: neither adjective nor its negation are applied to borderline individuals
  - Pattern replicated in online follow-up study
  - Speakers acknowledge a gap when judging adjective and negation against the same picture set (pilot results)

☞ Compatible with multiple theories of vagueness

Experiment series 2

Online processing of borderline cases

Research Questions

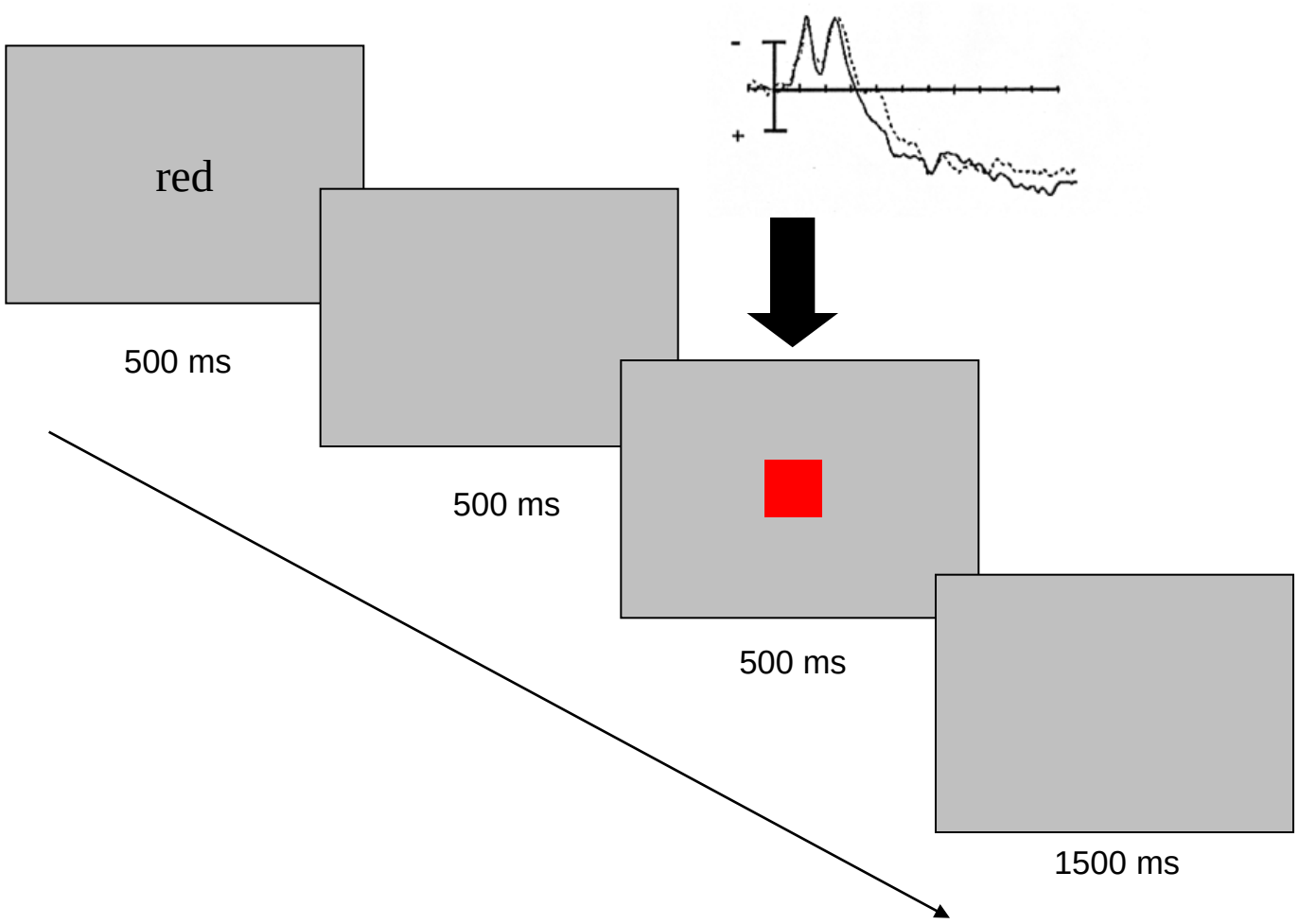
- What are the neural correlates of vagueness?
- How are borderline cases processed?
  - Compared to clear cases of ‘true’?
  - Compared to clear cases of ‘false’?

Design

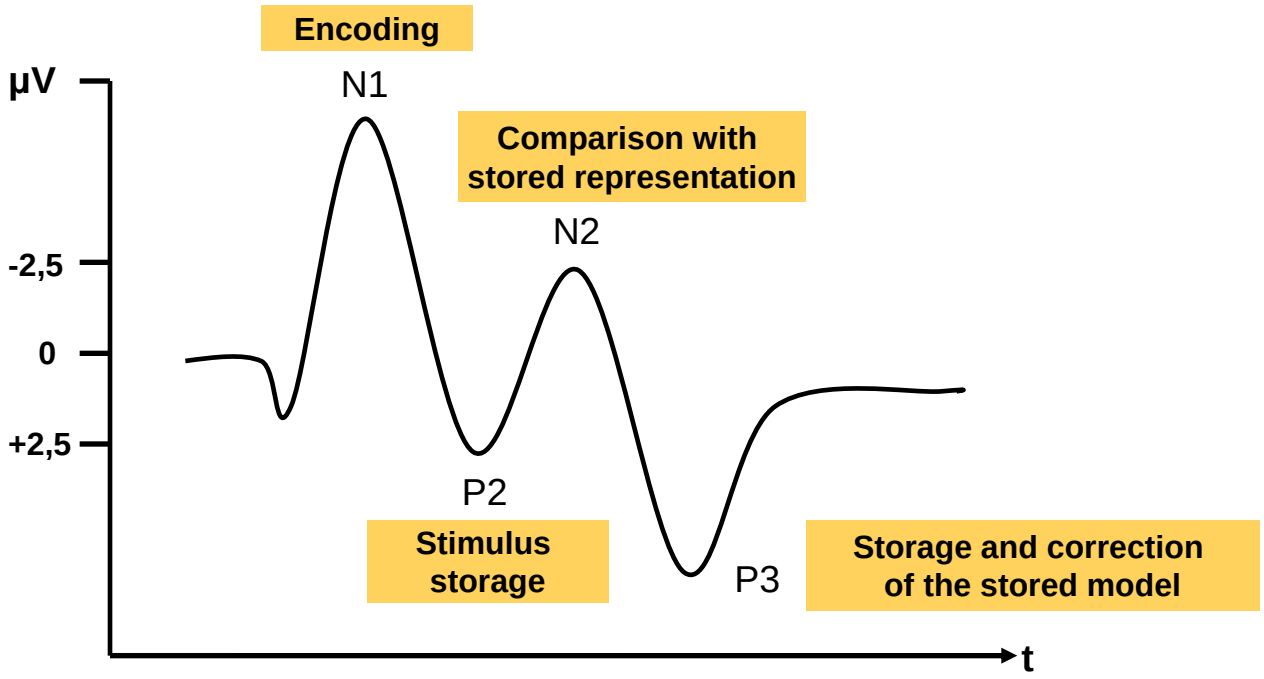
- Event-related brain potential (ERP) study: color adjectives paired with color patches
- 4 conditions (example of color word RED)
  - Congruent
  - Borderline (close)
  - Borderline (distant)
  - Incongruent

- No overt task
- Two orders
  - color word -> color patch (Exp 1a)
  - color patch -> color word (Exp 1b)
- 17 native Croatian subjects (age 20)

Experiment 1a

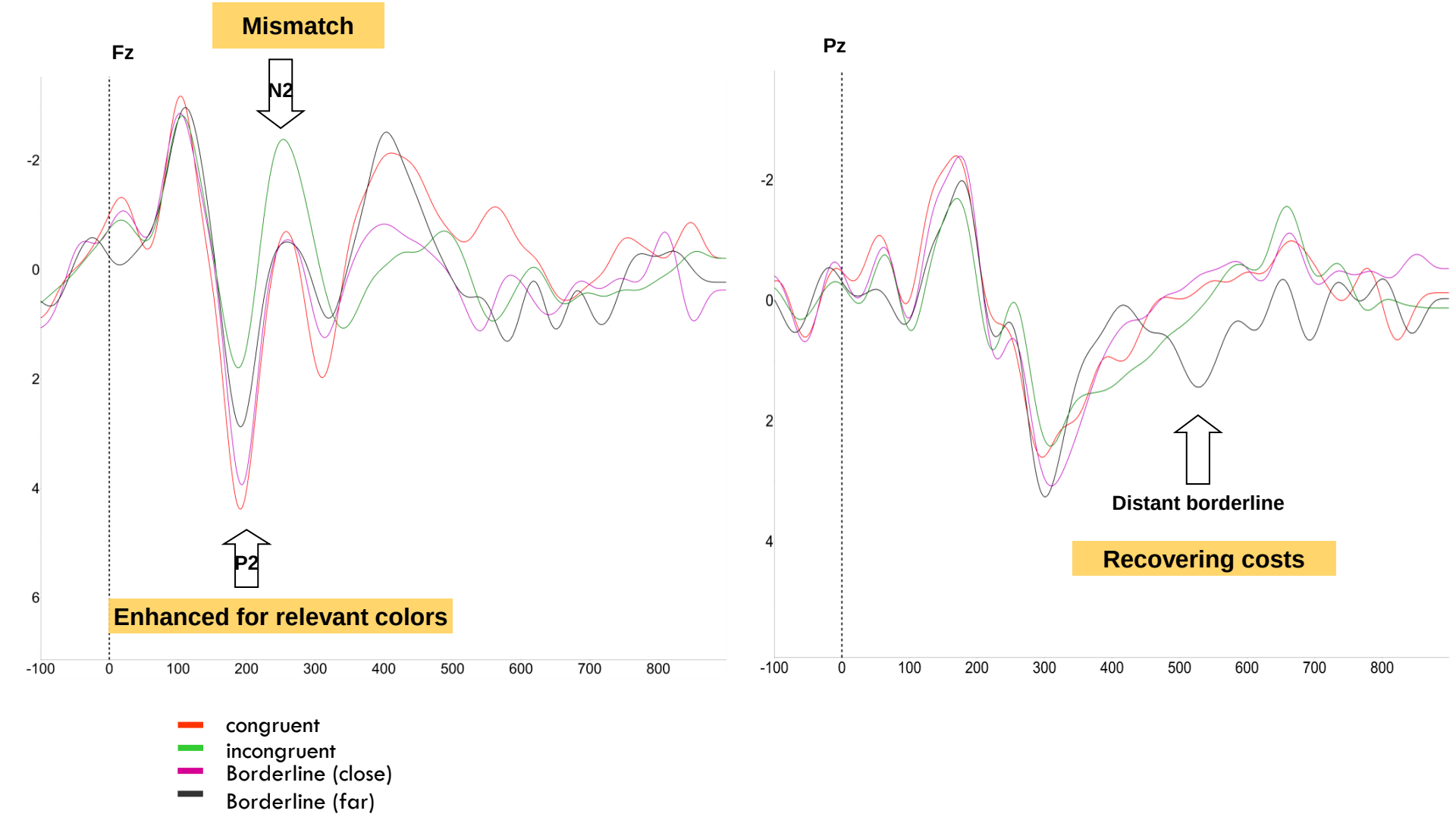


Rough sketch of components

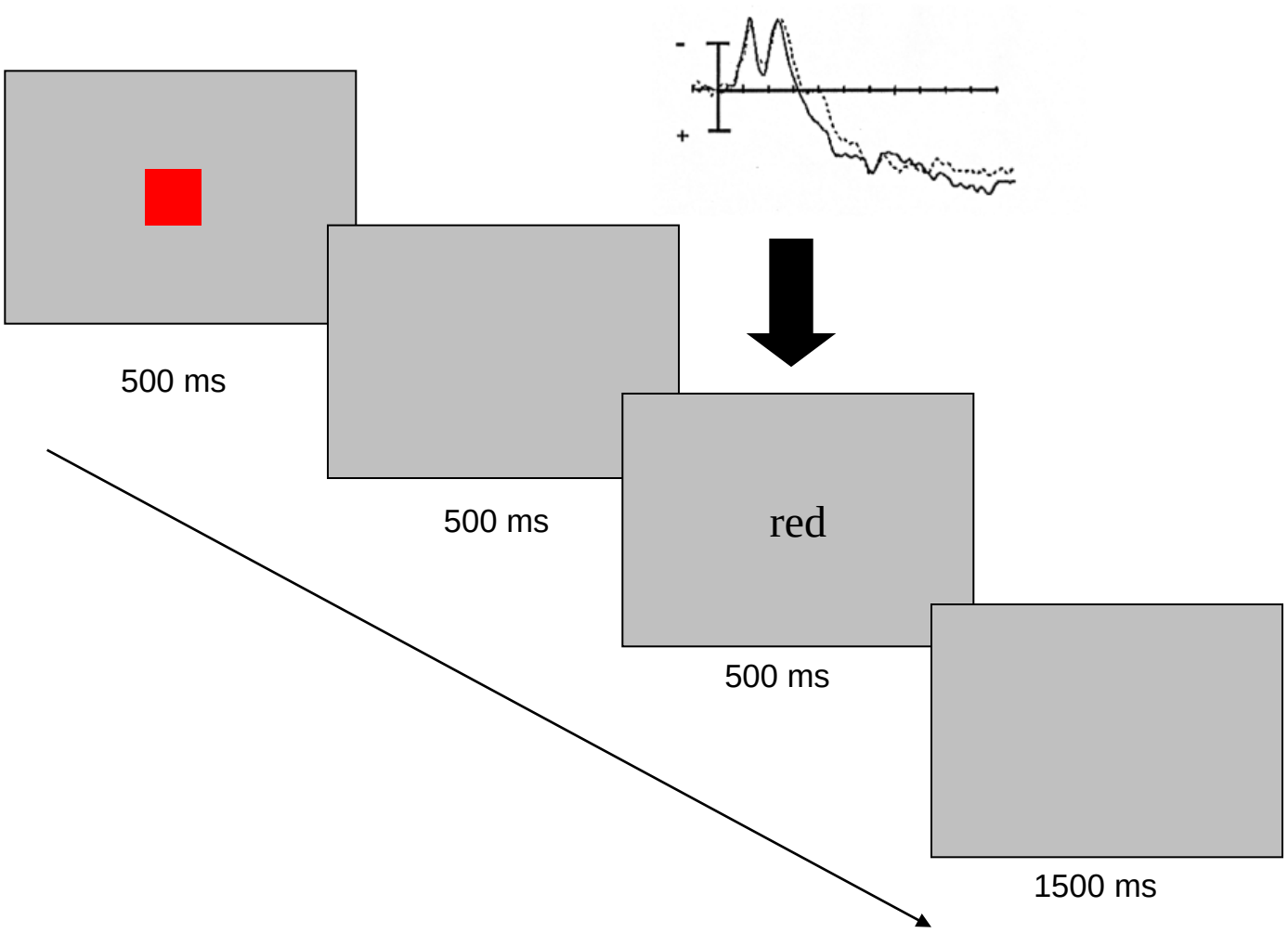


Adapted from Birbaumer & Schmidt (2006)

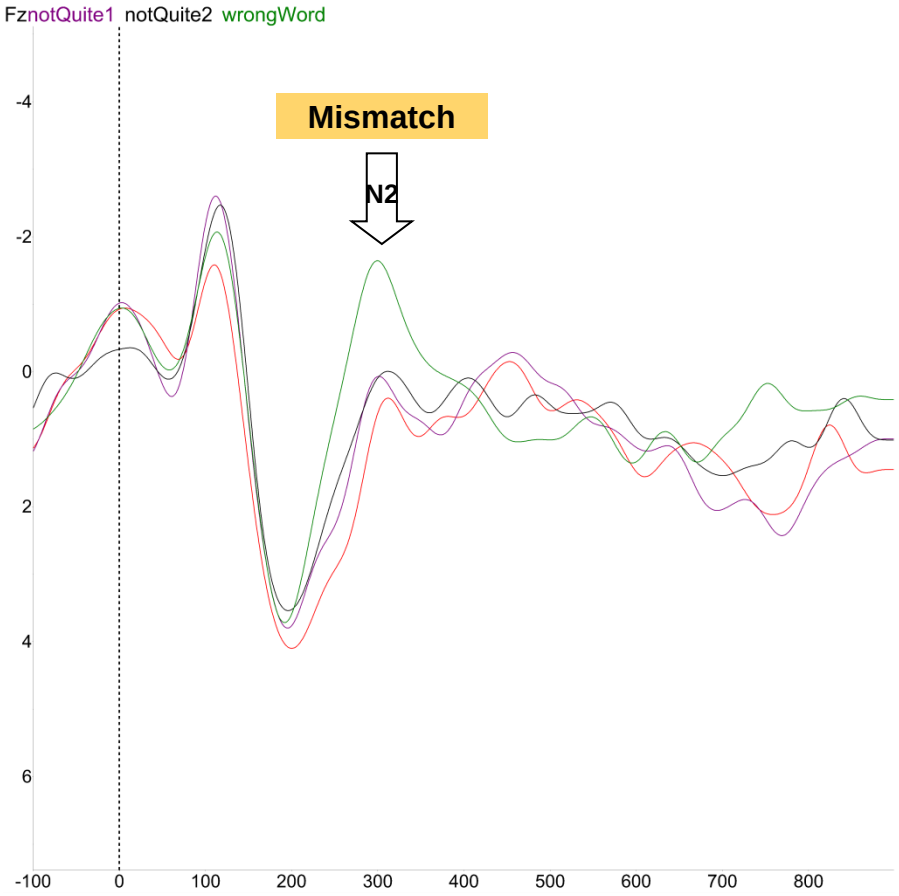
Results (Exp 1a)

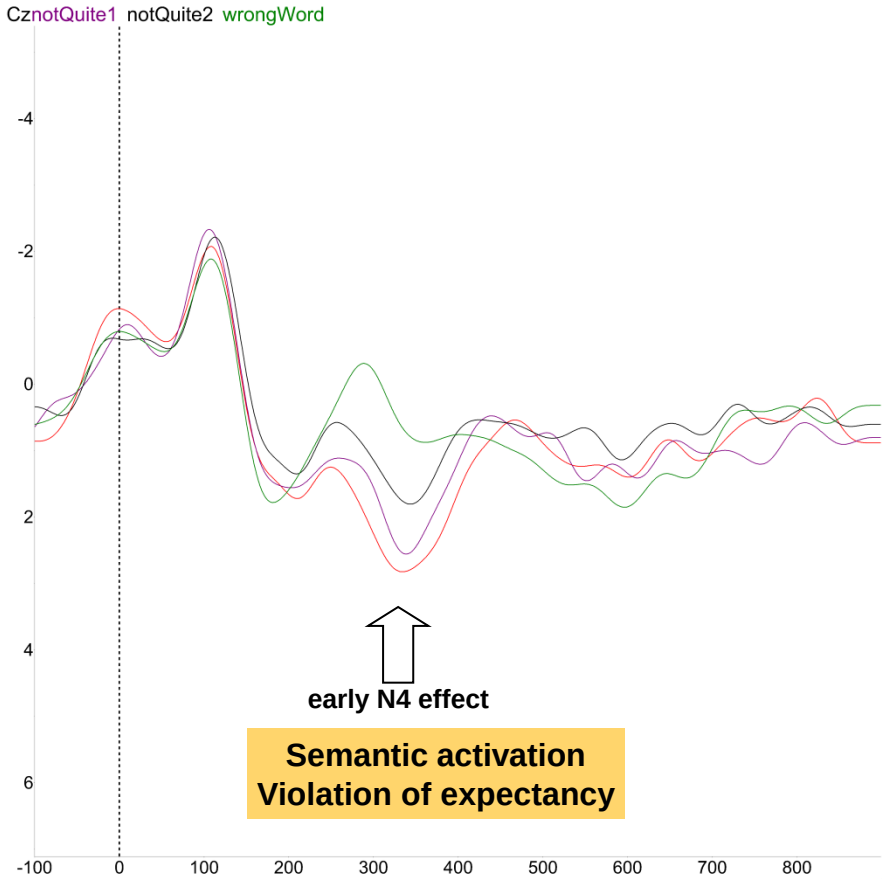


Experiment 1b



Results (Exp 1b)





no early mismatch effect for borderline stimuli

Conclusions

- Processing of borderline cases is distinct from both clear cases of true and false
- Borderline cases do not elicit an early mismatch effect
- Color word -> color patch
  - Early prototypicality effect (differentiation of clear cases of true vs. false vs. borderline cases)
  - Additional processing costs for (distant) borderline cases
- Color patch -> color word
  - Effect on word recognition (again graded pattern)
- Potential next step: overt classification task

Experiment series 3

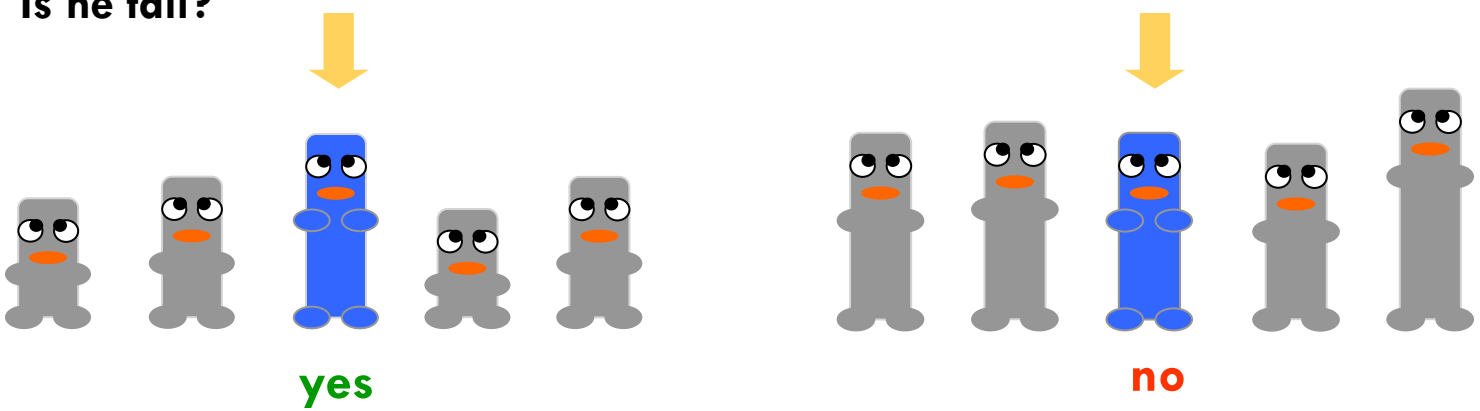
Role of comparison classes

Comparison Classes

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

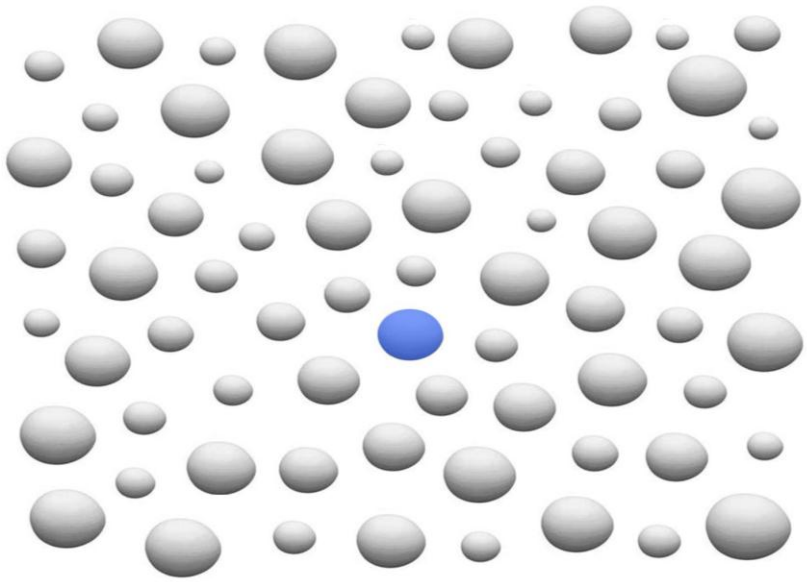
(Bartsch & Vennemann 1972; Klein 1980; Bale 2008; van Rooij 2011; Solt 2011)

Is he tall?



Impact of comparison class

- Impact of comparison class could potentially be stated in various ways:



72 eggs / 18 sizes

The blue egg is **big** iff….

… it is among the biggest n% of the eggs

… its size is among the top n% of egg sizes

… its size is greater than the mean egg size

… Etc.

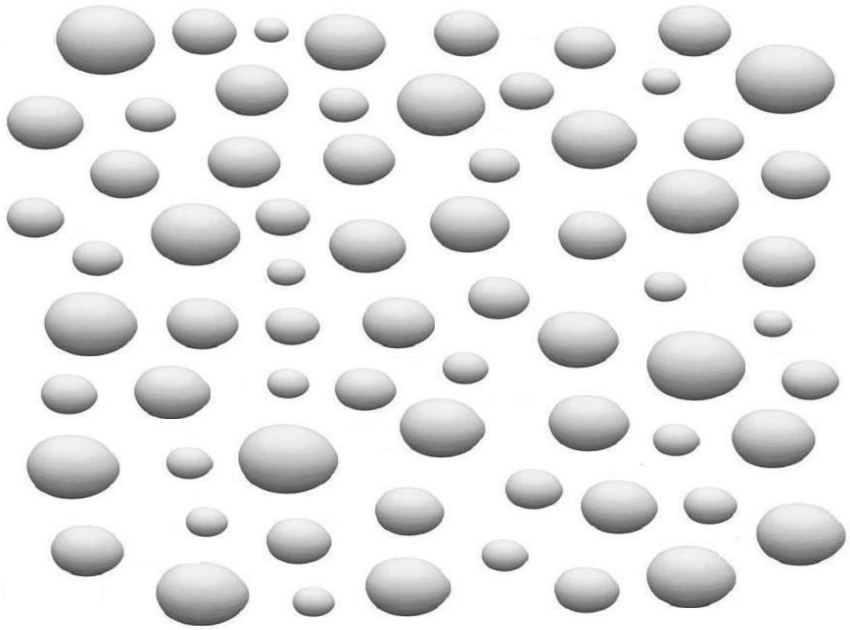
- Different partitions of C
- Different requirements on model

Research questions

- What information does the comparison class provide?
- How should the truth conditions for the adjective be expressed?
- Strategy:
  - Adjective evaluated in context of comparison classes varying in distribution
  - ☞Identify factors which impact extension of adjective

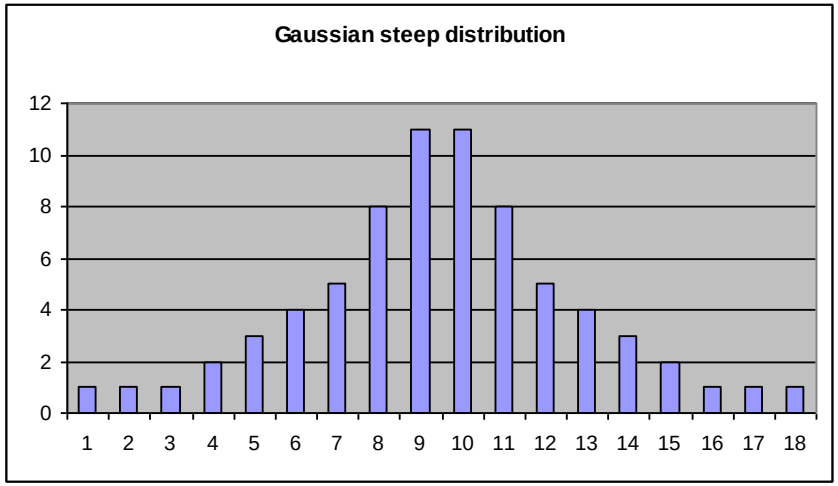
Experiment 1

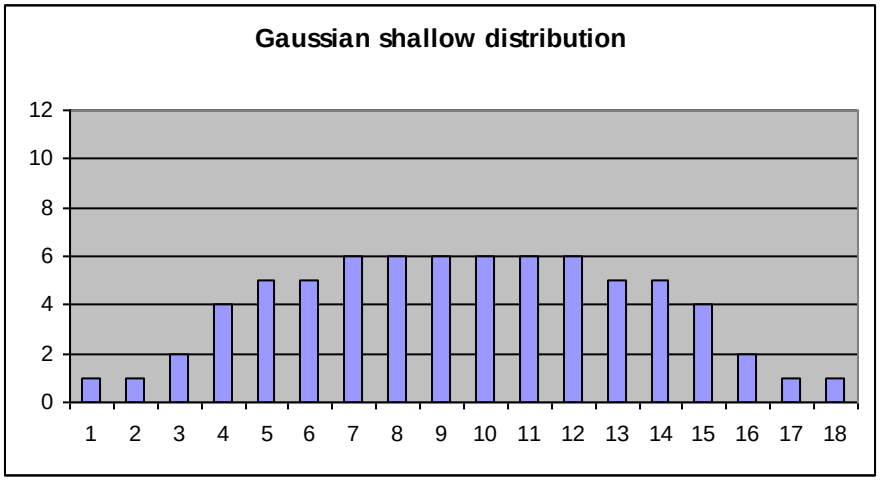
Check all of the **big** eggs

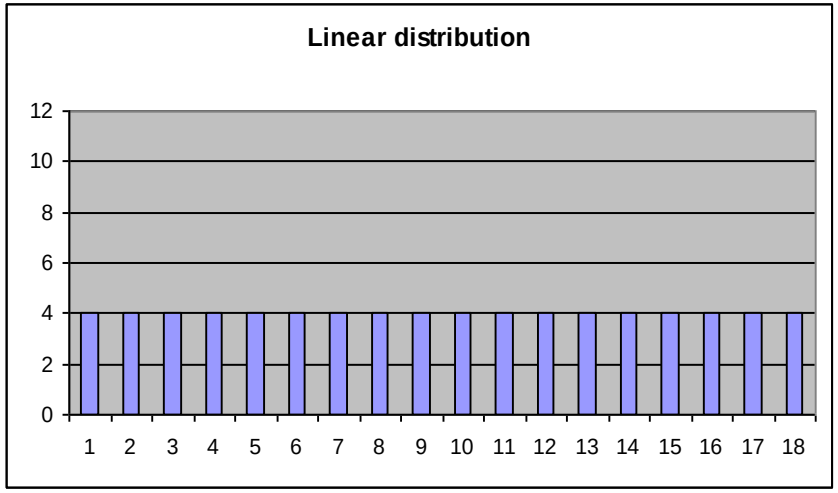


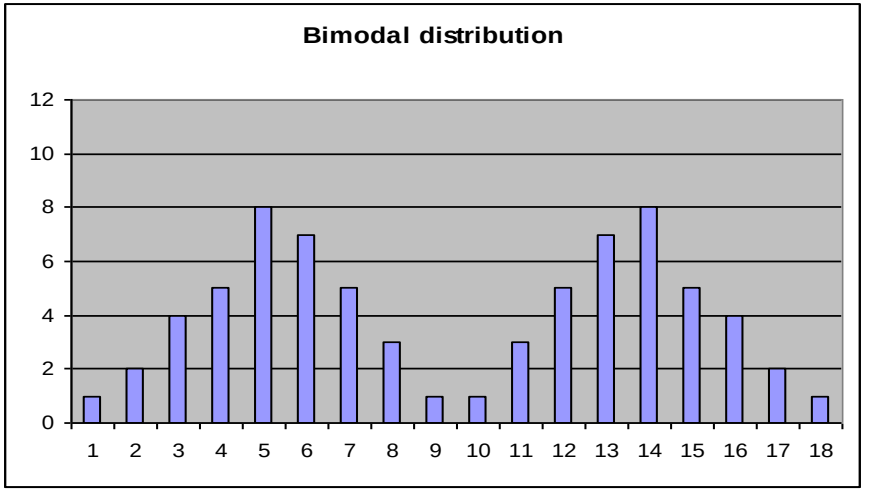
- Online experiment with 1 adjective pair (big/small)
- 4 symmetrical distributions (72 eggs / 18 sizes)
- Classification task
  - *big* and *small* judgments made in succession
- 77 native German speakers (mean age: 26)

Comparison Class Distributions

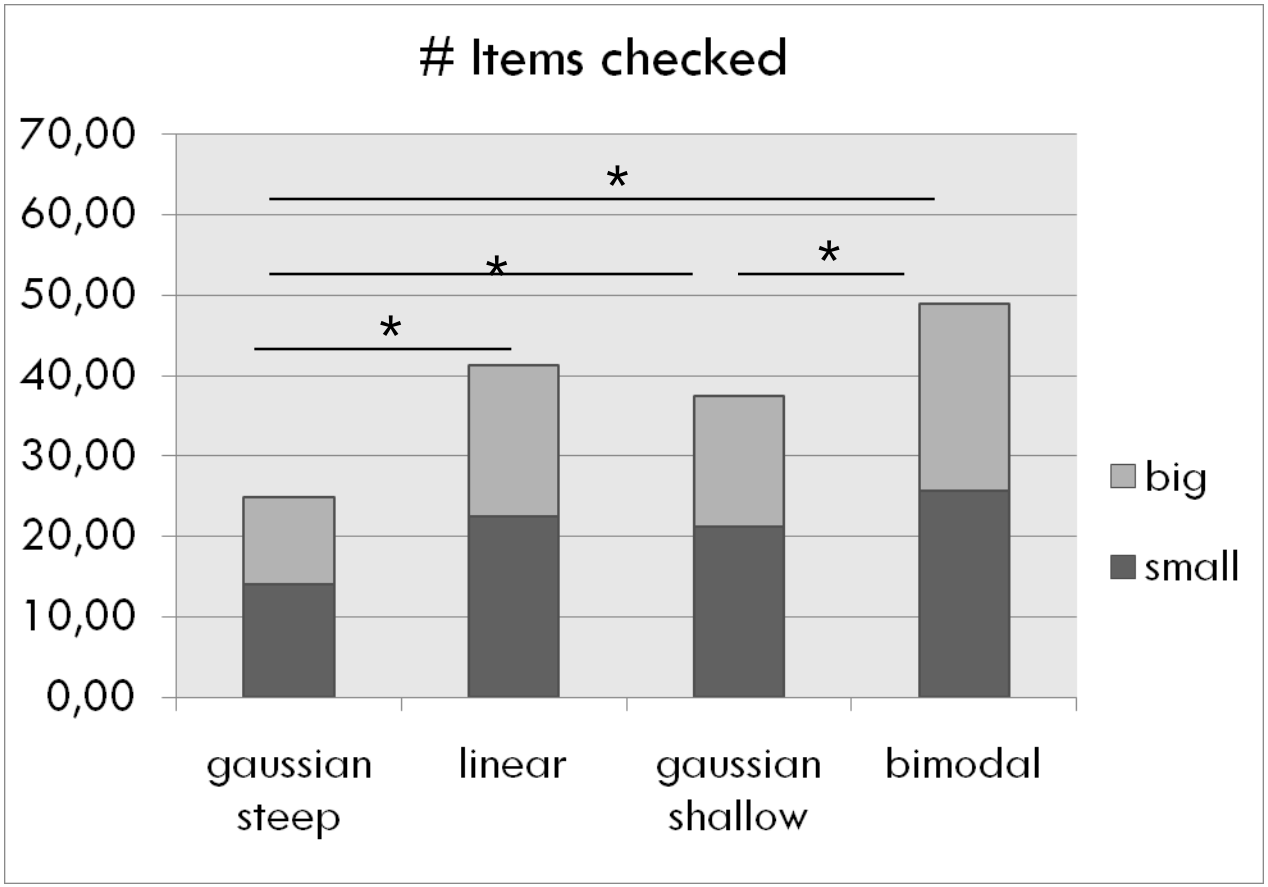








Average Number of Items Classified as...



ANOVA

Distribution: $F_{(3,300)} = 13.7$; $p < 0.0001$

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

Average Cutoff Points

Adjective/ Condition	small	big
linear	6,6	13,5
Gaussian shallow	7,1	12,5
Gaussian steep	6,6	13,0
bimodal	7,2	12,2

ANOVA

Small

Distribution not significant

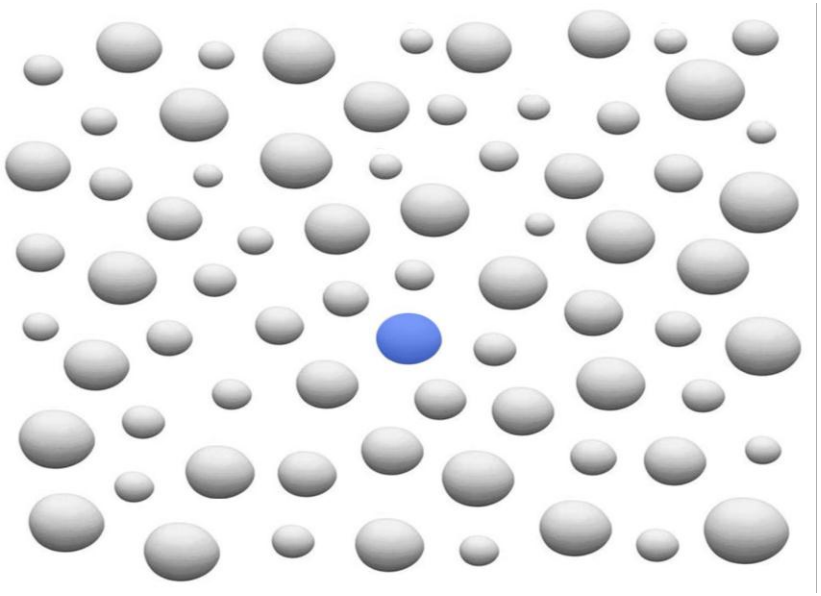
Big

Distribution: not significant

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

Follow-Up Study (Mturk)

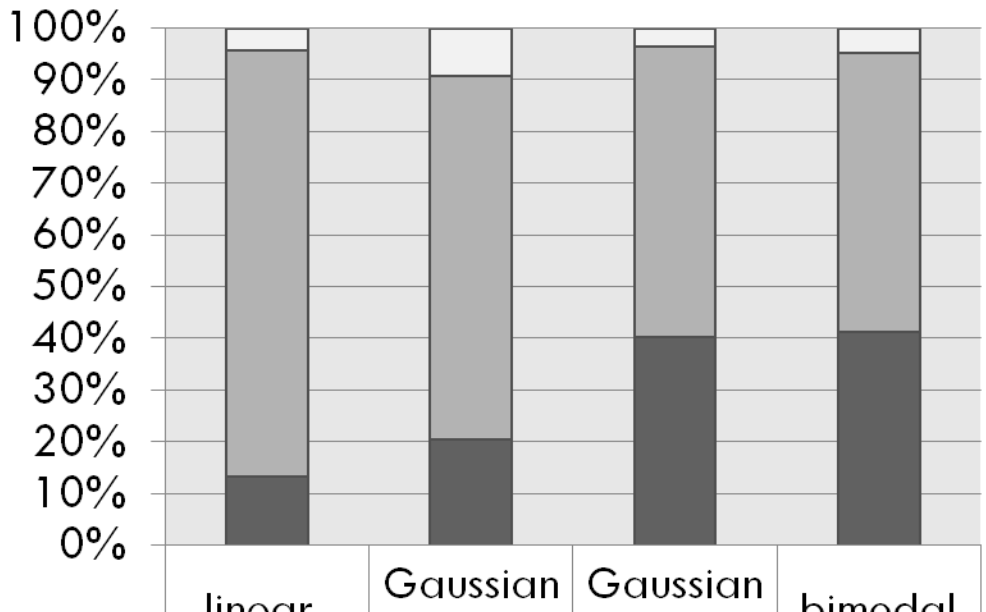
The blue egg is one of the big eggs.



☐true ☐false ☐ can`t decide

- Online experiment (MTurk)
- 4 distributions (1/participant)
- Truth-value judgment task
- 342 native English speakers with U.S. IP addresses (mean age: 34)

Results



	linear	Gaussian shallow	Gaussian steep	bimodal
can`t decide	4,4%	9,4%	3,5%	4,9%
false	82,4%	70,3%	56,3%	53,9%
true	13,2%	20,3%	40,2%	41,2%

Chi-squared test

$X^2 = 28.3$, df= 4

$p < 0.0001$

Big doesn't simply mean 'top n% of the egg sizes' – distribution of items across sizes matters

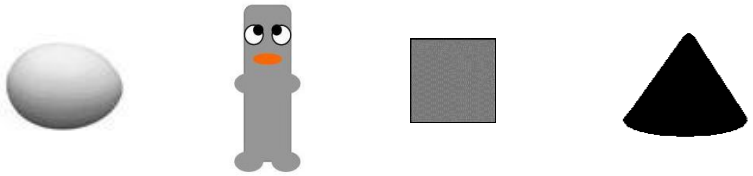
Experiment 2

- Extend previous findings
  - to additional adjectives
  - to different types of distributions

☞ Better understanding of relevant factors

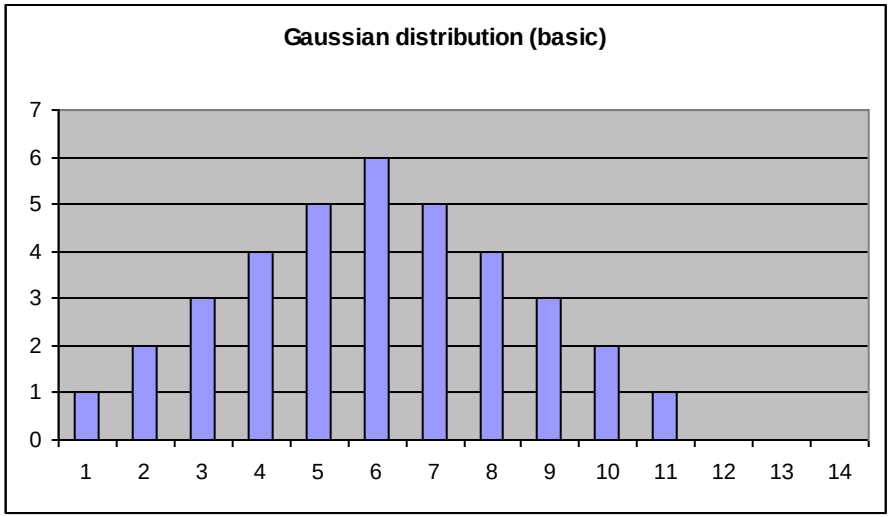
Design

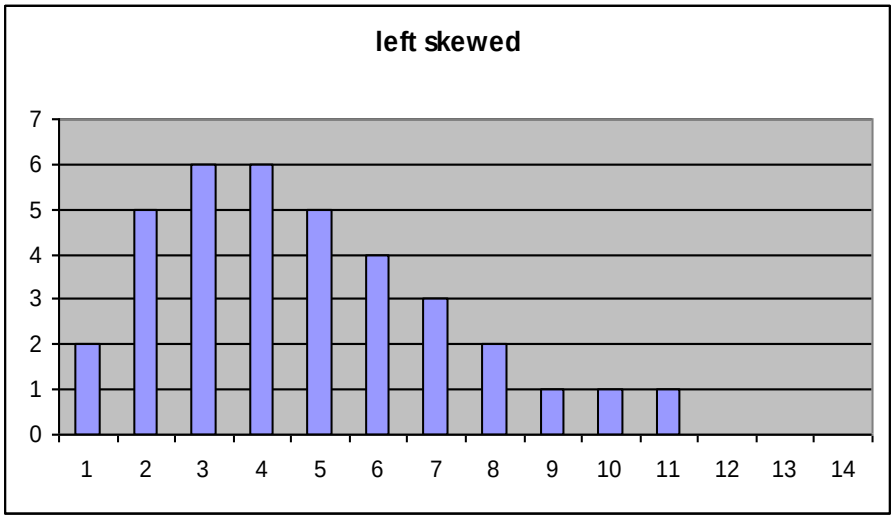
- Online experiment (MTurk)
- 4 Adjectives (36 picture stimuli each)
  - big
  - tall
  - dark
  - pointy

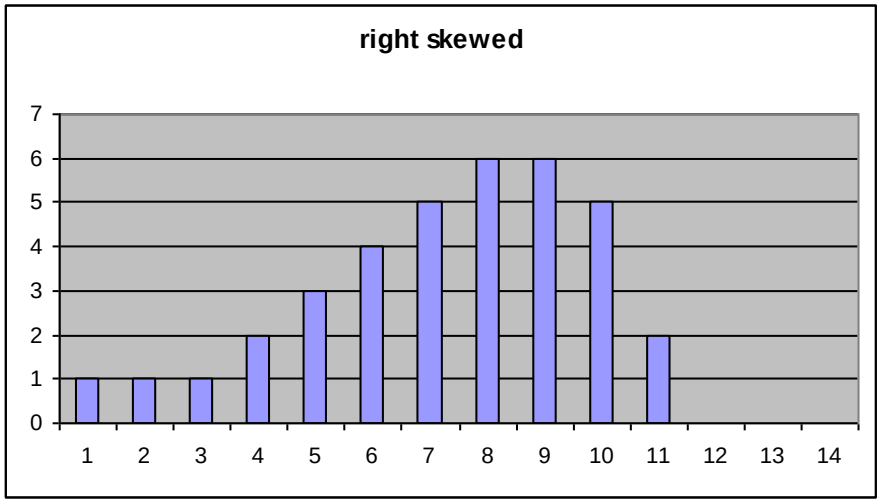


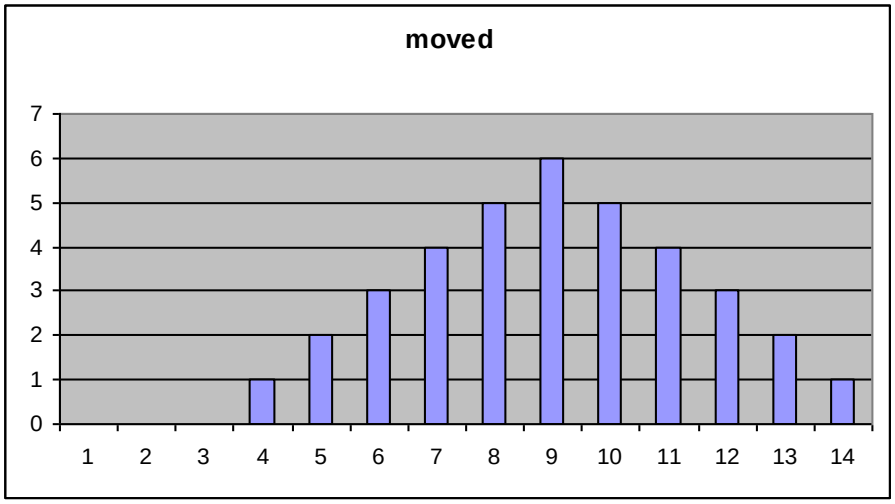
- 4 distributions (4/participant, rotated across stimuli)
- 192 native English speakers (mean age: 36)

Distributions

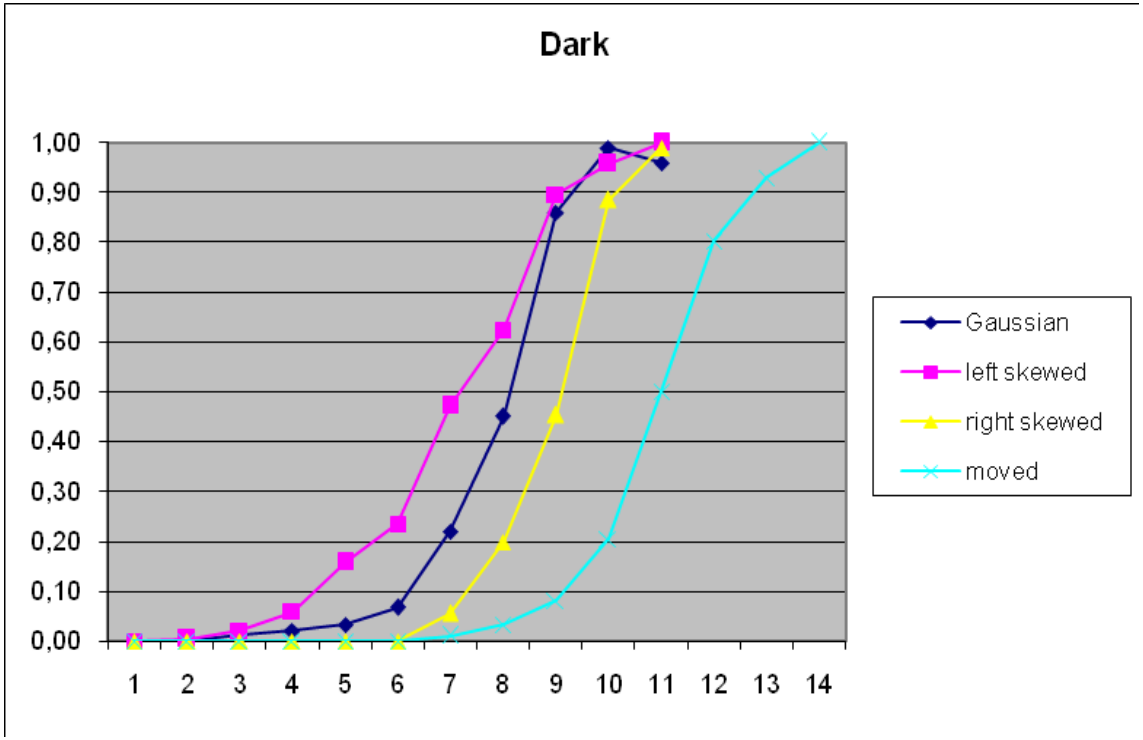








Results



Significant difference in average cutoff points

- $F(3,754)= 194,96$; $p < 0.0001$

And significant difference in # items classified as dark/tall/big/pointy

- $F(3,756)= 23.9$; $p < 0.0001$

Summary

- In judging which items a gradable adjective (e.g. large) can be applied to, speakers make use of statistical properties of comparison class
- Threshold **cannot** be stated in simple terms:
  - E.g. large does not mean "in the largest 1/3 of the comparison class
- Rather, judgments apparently based on multiple factors, e.g.
  - range of sizes represented
  - distribution of items across sizes
- Next step: modelling of results

Overall summary

- Exp. series 1
  - speakers allow an extension gap when they are supposed to apply a predicate to borderline individuals
- Exp. series 2
  - In online processing, a speakers` brain differentiates borderline cases from clear cases of true and false
  - Borderline cases are associated with processing costs at later stages, neither elicited by clear cases of false and true
- Exp. series 3
  - An interaction of multiple factors determines how speakers interpret vague predicates

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