VAAG:
VAgueness, Approximation, Granularity

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Partners of the VAAG Project

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Amsterdam Group: University of Amsterdam, Logic, Philosophy, Linguistics.
“A Game Theoretic Explanation of Vagueness”
PIs: Robert van Rooij, Frank Veltmann; #

Berlin Group: ZAS Berlin: Linguistics
“Semantic Mechanisms for Approximation and Granularity”
PIs: Uli Sauerland, Manfred Krifka; Stephanie Solt

Lund Group: Lund University: Logic, Philosophy, Linguistics
“Combining and Using Vague Concepts”
PI Peter Gärdenfors; Sverker Sikström

Zagreb Group: University of Zagreb: Psychology, Psycholinguistics
“Measures of Vagueness in Natural Language”
PI Velimir Išgum

Associated Project: University of Edinburgh, Linguistics
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Why VAAG?

Vagueness is a pervasive property of human language and communication.

There exist well-established methods to represent vagueness,
but we ask questions like…

- Why is there vagueness in seemingly precise terms,
like number words as *fifteen*?
- How is vagueness linguistically regulated
by expressions like *roughly*, *exactly*, *definitely*?
- Why do related terms slice up the world in continuous ways,
e.g. like *small* and *tall*, or *red* and *orange*, rarely like *even* and *odd*?
- What is the structure of more or less fine-grained scales in language,
such as *newborn -- infant -- toddler -- child -- kid -- youngster*?
- How are vague terms used in communication?

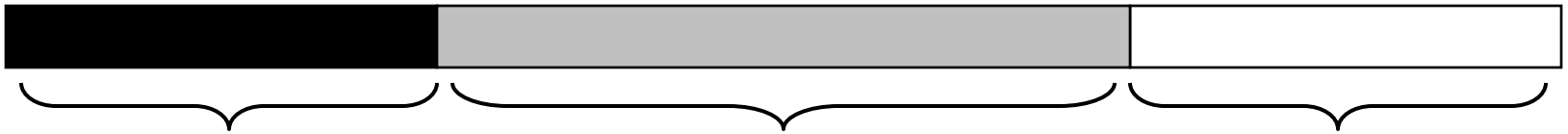
And the central question:

- Why is there vagueness in the first place?

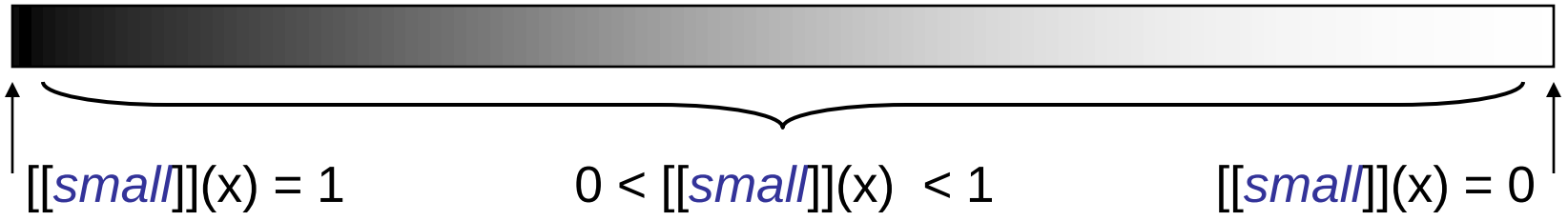
(Yes, Game Theory might provide answers.)

Vagueness: Common semantic tools

Predicates may have truth value gaps:

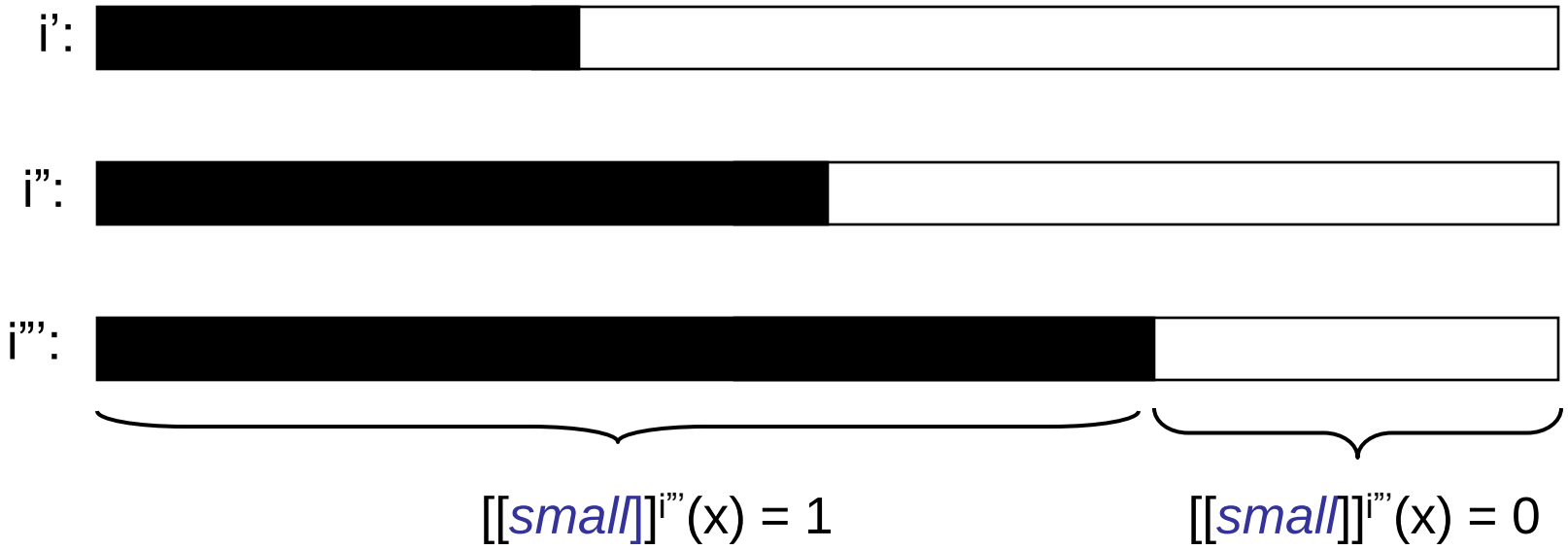


or truth values in [0..1] (fuzzy logic):



Vagueness: Index dependency

Interpretation of vague predicates depends on an index (delineation):



Logical truths retained by supervaluation, e.g. bivalence:

For all indices i, for all x: $[[small]]^i(x) = 1$ or $[[small]]^i(x) = 0$,
i.e. for all things x: x is small or x is not small.

Question: How do we choose indices?

Answer: This is a matter of pragmatics, to be investigated in the project.

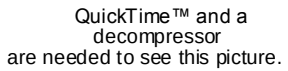
Vagueness in communciation: The symmetric case

Interlocutors have aligned interests:
S wants to communicate p,
and A wants to understand what S wants to communicate.

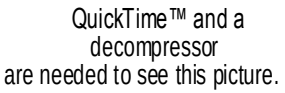
We assume a parametrized (index) account of vagueness,
where the index is set following pragmatic principles.

Example:
I want to have the fat pig.

Situation A:



Situation B:



Parameter is set in a way to satisfy the uniqueness requirements of the definite article;
this would not be possible if we only had a fixed expression *fat*.

Vague expressions are better adaptable to specific situations.

Why not use *the fatter pig*? Many languages don't have comparatives!

How vagueness arises in symmetric communication

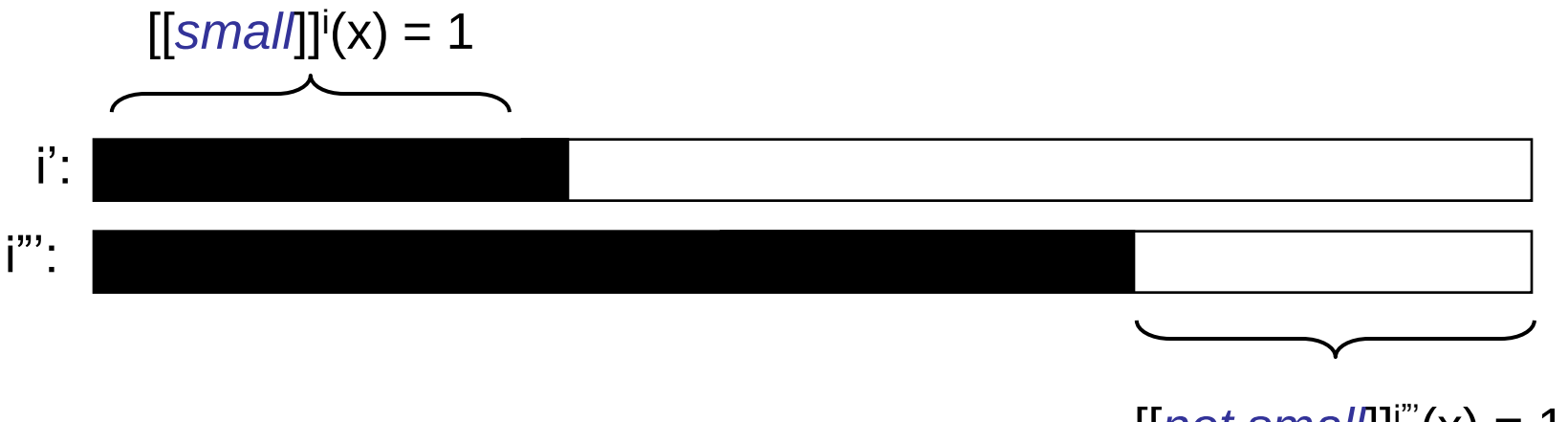
Symmetric communication: Shared interests of interlocuturs,
typically: S wants to get information across to A.

One common situation:

- Speaker wants to communicate the size of John;
  possible predicate: *small*.
- Common knowledge of S and A about *small*:
  -- If x is called *small*, and y is smaller than x, then y is called *small*.
  -- The predicate *small* will be used for at least some entities in the domain.
- No common knowledge about *small*:
  -- What is the tallest x such that both S and A call x *small*.
- Strategy of S:
  Call x *small* only if x has a height such that A would likely call x *small*.
  Stragegy of A:
  Assume that x calls x *small* only if x has a hight such that S thinks
  that A would call x *small*.

The pragmatic origin of truth value gaps

- A predicate like *small* starts out as precise, just as other predicates, where the extension depends on an index of delineation:
  -- $[[small]]^i(x) \in \{0, 1\}$,
  -- If $[[small]]^i(x)$ and y is smaller than y, then $[[small]]^i(y)$
- S and A do not know which index i is used,
  but assume that the more restrictive i is, the more likely i is used.
  (This is checked by a principle that should keep predicates usable, i.e. *tall* should be applicable to a substantial number of cases.
- The use of vague predicates suggests the use of certain indices for **pragmatic** reasons.



Evidence: Interpretation of negated antonyms

Antonyms and their negations:

happy	*not happy*
likely	*not unlikely*
intelligent	*not intelligent*
common	*not common*
successful	*not successful*
frequent	*not frequent*
many	*not many*

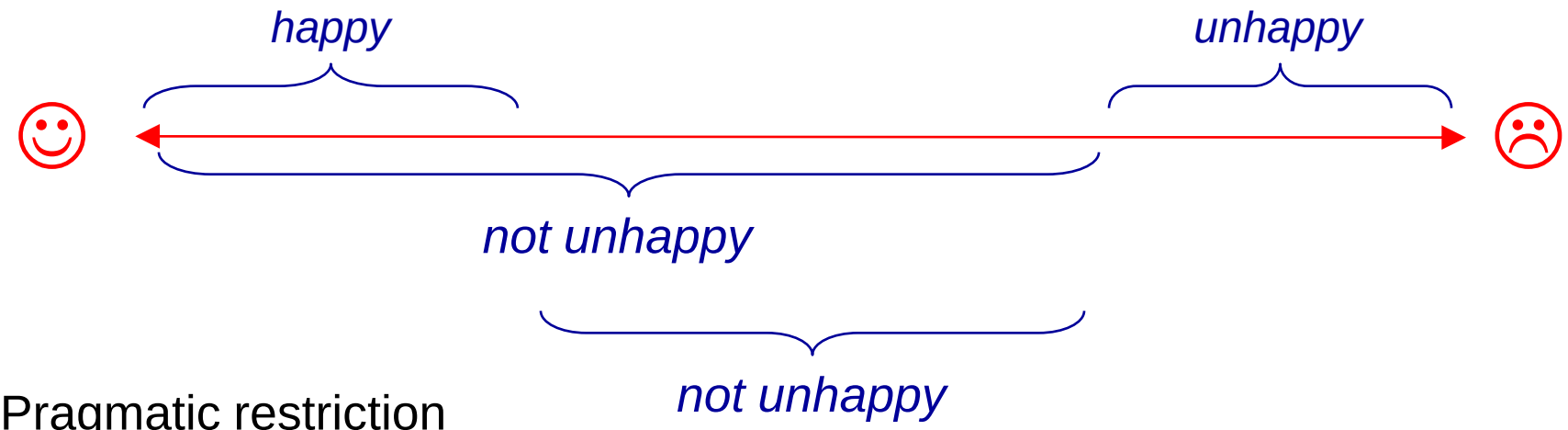
unhappy	*not unhappy*
unlikely	*not unlikely*
unintelligent	*not unintelligent*
uncommon	*not uncommon*
unsuccessful	*not unsuccessful*
infrequent	*not infrequent*
few	*not few*

Double Negatives

Jespersen (1924): The two negatives […] do not exactly cancel one another, so that the result [*not uncommon, not infrequent*] is not identical with the simple *common, frequent*; the longer expression is always weaker: “this is not unkwown to me” or “I am not ignorant of this” means: ‘I am to some extent aware of it’, etc.

Evidence: Interpretation of negated antonyms

A problem with the standard account:

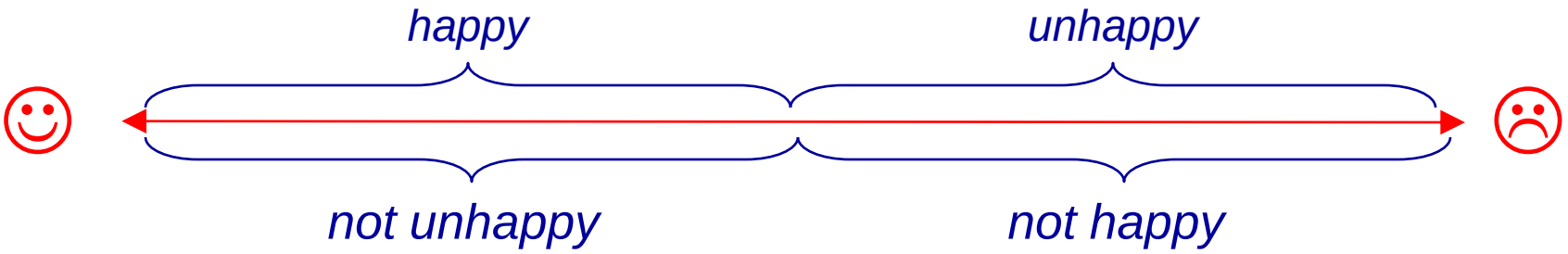


Pragmatic restriction
(competion with simpler *happy*)

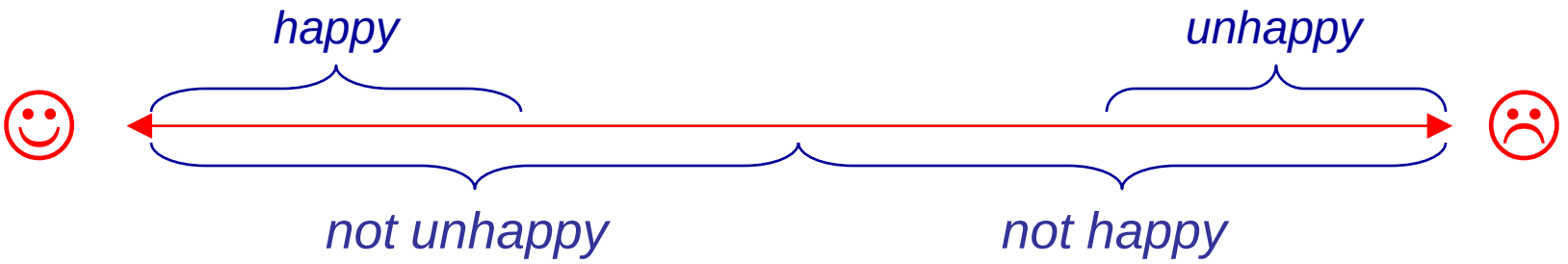
Problem: *not unhappy* does not express a neutral emotion!

Evidence: Interpretation of negated antonyms

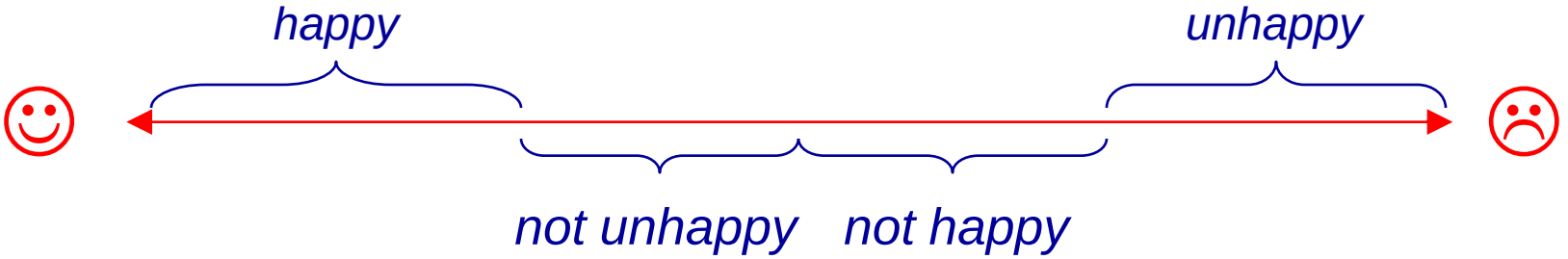
Initial situation: Antonym pairs and their negations.



Restriction of simpler expressions to clear cases.



Restriction of complex expressions due to competition with simpler ones:



Approximation and Granularity

Number words seem to be
the least vague expressions
-- but why is this street sign strange?

Street sign in Kloten, Switzerland.

Why do we expect *100 m* instead,
even if this is literally false?

Why can we interpret *100 m*
in an approximate way,
which is not possible for *103 m*?

Observations about approximate interpretations

It seems that round numbers (multiples of 5, 10, 50, 100 etc.) invite round interpretations:

There were forty-two people in the audience.
There were forty people in the audience.
There were fifty people in the audience.

There were one hundred and sixty people in the audience.
There were one hundred and fifty people in the audience.

But other principles seem to be at work too:

Sue will come in fifteen minutes.
Sue will come in sixteen minutes.

Mary did the job in twenty-four hours.
Mary did the job in twenty-five hours.
Mary did the job in twenty-three hours.

Scales of different granularity

Minute scales of different granularity:

a.3-4-5-6-7-8-9-10-11-12-13-14-15-16-17-18-19-20-21-22-23-24-25-26-27-28-29-30-31
b.----5---------10------------15------------20------------25------------30---
c.-------------10--------------------------20--------------------------30---
d.--------------------------15--30---
e.---30---

Scales indicated with

I will arrive in {eighteen / twenty / fifteen / thirty} minutes.

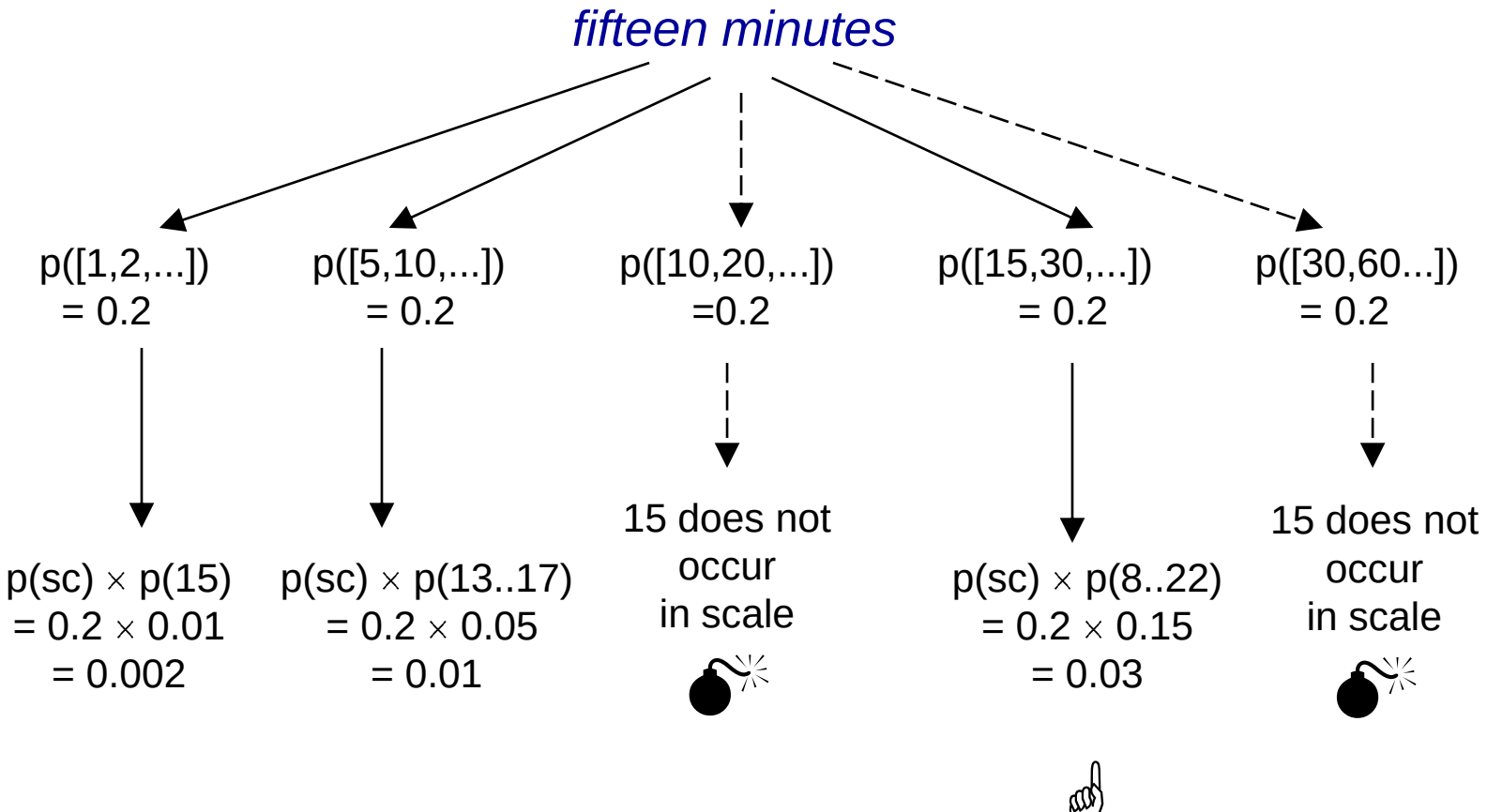
a.3-4-5-6-7-8-9-10-11-12-13-14-15-16-17-**[18]**-19-20-21-22-23-24-25-26-27-28-29-30-31
b.----5---------10------------15------**[--------20------]**------25------------30---
c.-------------10------------**[--------------20---------------]**-----------30---
d.--------**[-------------------15----------------------]**--------------------30---
e.--------------------------**[--30---**

Principle of scale selection:

Select the most coarse-grained scale at which the number is represented.

Strategic rationale behind scale selection

- Assume greatest overall likelihood of communicated message
- Assume each granularity level is selected with equal probability, p = 0.2
- Assume equal a-priori probabilities of durations,
  ... p(14) = p(15) = ... = 0.01



The importance of scales

Influence of scale differences:

Decimal languages with scale [10-20-30-40-50-60-70-80-90-100…]
vs. vigesimal languages with scale [20-40-60-80-100…]

Influence on frequency in corpora, e.g. Norwegian vs. Danish:

Number	**Norwegian**	Occurrences	**Danish**	Occurrences
20	*tjue*	61300	*tyve*	121000
30	*tretti*	43700	*tredive*	25400
40	*fært*	**39200**	*fyrre*	**26800**
50	*femti*	**81200**	*halvtreds*	**15500**
60	*seksti*	**19400**	*tres*	**36400**
70	*sytti*	10200	*halvfjerds*	581
80	*ti*	13100	*firs*	3740
90	*nitti*	13500	*halvfems*	540

More on scale structure:

Influence on expressions of scale values:
Shortening of English *five* => *fif-* in *fifteen*, *fifty*

Relevance of non-numerical scales:
cold -- warm vs. *ice cold - cold - cool - tepid - lukewarm - warm - hot,*
differences between languages

Principles of optimal scale construction:

- equidistance of scale values
- logarithmic scales (*kilo-, mega-, giga-, tera-*)
- Natural logarithmic scales: *hamlet - village - town - city*
- optimal minimal refinement by 1/2 and coarsening by 2:
  one hour, two hours, …
  half an hour, one hour, one and a half hours, …
  a quarter of an hour, half an hour, three quarters of an hour, …

Optimal minimal refinement/coarsening might be reflected by *twice* and *half*:
half as happy, *twice as happy* (> 10,000 Google hits)

Project goals: Investigation of scales and their use in different languages, including vigesimal languages (Basque; Standard vs. Swiss French > 60)

Explicit indication of approximation level

Languages can indicate approximation level explicitly:

There were exactly fifty people in the audience.

These indicators are sensitive to the scale type:

*The water is definitely / *exactly warm.*

*John is definitely / completely / *exactly bald.*

Languages have hedges to increase approximation level explicitly:

There were roughly fifty / ?forty-eight people in the audience.

Coherence phenomena in discourse:

There were exactly one hundred fifty people in the audience yesterday, and there are two hundred people today.

(preferred interpretation: *exactly 200*)

Goal of project:

Investigation of vagueness regulators in dependence on scale structure in several languages.

Experimental evidence for the use of vagueness

There is little experimental data concerning the use of vague terms.

Projected experiments (the Zagreb group):

- Parameter setting with vague predicates, avoidance of borderline area (Replication of experiment of Bonini e.a. with wider range of terms: *old, older than average*, *rather old*, *very old*, *not very old* etc.)
- Use of vague terms of a scale before / after a scale term was introduced (e.g. *lukewarm* on the temperature scale)
- Use of modifiers *twice as* and *half as*
- Contextual effects of vagueness regulators like *roughly*, *exactly*
- Judgement of applicability of predicates in sorites paradox setting, possible investigation of hysteresis effects.
- Event-Related Potential (ERP) study of the nature of vagueness regulator use like *roughly 48 people*, etc.
- Reaction time / Eyetracking / ERP study comparing the use of vague term (*the small object*) vs. non-vague terms (*the square object*).

Vagueness in communication: The asymmetric case

Interlocutors have **opposed** interests.

Diplomatic communication:

In case the armament is not stopped, we will initiated serious measures.

Which kind of measures?
At which time will they be initiated?
How much of the armament must be stopped?

Legal documents:

Company X will pay for any defects except those that result from any use of the product in non-intended ways.

What counts as intended ways?

Election campaign speeches:

Politician wants to predict action,
but at the same time does not want to be bound by promises.

E.g. President G. Bush sen.: *Read my lips: No new taxes!*
What did he say after he had to raise taxes due to the first Iraq war?
People offered: *No new taxis! No gnu taxes! No new Texas!*