Approximation
as Strategic Communication

Manfred Krifka
Humboldt Universität Berlin
Zentrum für Allgemeine Sprachwissenschaft (ZAS) Berlin

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From the land of bankers and watchmakers

Street sign in Kloten, Switzerland.

Failed attempts to introduce the metric system

Road signs in American National Parks
(Unfortunately, no photograph available, cited from memory)

Eagle Pass
7 miles
(11.265 kilometers)

Overview of the talk:

1. Precise/Approximate Interpretations of number words:
   The basic phenomenon
2. Selection of optimal expressions and interpretations
   with preference for short expressions, approximate interpretations,
   and bidirectional OT: Krifka 2002
3. Selection of optimal expressions and interpretations
   with preference for short expressions and strategic communication:
   Krifka 2006
4. Selection of optimal scales
5. Principles for the construction of optimal scales
6. Adaptation of scales to language use:
   shortening of common expressions
7. Adaption of language use to scales:
   under-use of complex expressions
8. A new perspective on language and language use

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Precise vs. Approximate Interpretations of Number Words: The basic phenomenon

There were forty people at the workshop.

Precise interpretation: $n = 40$
Approximate interpretation: $n \approx 40$, e.g. $35 < n < 45$

The context may favor particular precision levels
(informal talk vs. report to funding agency)
but in many cases choice of precision level is left open within a given range.

Precision level can be indicated explicitly with particles (hedges):
There were <u>exactly</u> forty people at the conference.
There were <u>about</u> forty people at the conference.

...but also implicitly by choice of number words:
There were <u>forty</u> people at the workshop. => approximate interpretation
There were <u>thirty-eight</u> people at the workshop. => precise interpretation

The line is <u>forty</u> centimeters long.
The line is <u>forty point zero</u> centimeters long.

How does speaker infer precision level by choice of number words?
(This should depend on general pragmatic rules of language use.)

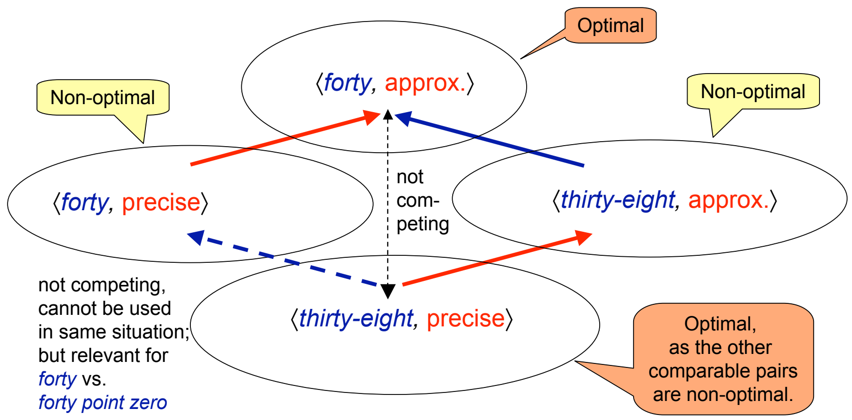
Explanation by general pragmatic principles

(Krifka 2002: 'Be brief and vague! And how bidirectional OT allows for verbosity and precision')

1. A preference for **simple expressions**
   cf. G. K. Zipf 1929, *Relative Frequency*: *Principle of least effort*
   A. Martinet 1962: Speaker economy
   L. Horn 1984: R-Principle
   St. Levinson 2000, *Presumptive Meanings*: I-Principle
   forty > *thirty-eight* (where a > b: 'a preferred over b')
2. A preference for **approximate interpretations**
   cf. P. Duhem 1904, balance between precision an certainty;
   E. Ochs Keenan 1976, vagueness helps to save face;
   reduction of cognitive effort with approximate interpretations,
   evident e.g. design of measuring devices in airplaines
   approximate > precise
3. Interaction of the two principles following Bidirectional Optimality Theory
   Blutner 2000 'Some aspects of optimality in natural language interpretation'
   Jäger 2002, 'Some notes on the formal properties of bidirectional OT'

Optimal expression-interpretation pairs

3. Interaction of the two principles following Weak Bidirectional OT:
   An expression-interpretation pair ⟨F, M⟩ is **optimal** iff
   there are no other **optimal** pairs ⟨F*, M⟩ or ⟨F, M*⟩
   such that ⟨F*, M⟩ > ⟨F, M⟩ or ⟨F, F*⟩ > ⟨F, M⟩.



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Bidirectional Optimization and M-Implicatures

A Bi-OT account of M-Implicatures (Levinson 2000):
Unmarked Expressions -- Unmarked Meanings;
Marked Expressions -- Marked Meanings.

Many, many examples:

Black Bart killed the sheriff.
Black Bart caused the sheriff to die. (McCawley 1978)

Mary went to the library and copied an article.
Mary went to the library, and in addition copied an article.

John went to school. / John went to the school.

match box / box with matches

General explanation by two preferences, one for form, one for interpretation:
Short expression > Long expression
Stereotypical interpretation > Non-stereotypical interpretation

In the case at hand we have the following preference for interpretation:
Approximate interpretation > Precise interpretation

Is it justified to assume a **general** preference for approximate interpretation, as assumed in Krifka (2002)?

Explanation by Principles of Strategic Communication

cf. Krifka 2006, 'Approximate interpretation of number words: A case for strategic communication'

Basic assumptions:

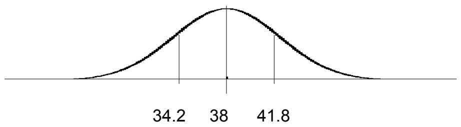
- Preference for short expressions, as before.
- **No general preference for approximate interpretations**
- Strategic communication,
  cf. Parikh 1991, "Communication and strategic inference";
  Parikh 2000, *Communication, meaning and interpretation*:
  Benz, Jäger, van Rooij (eds.) 2006, *Games and Pragmatics*, Oxford: Palgrave
  General principle:
  -- For addressee: Assume the speaker intends **the most likely** interpretation, given the choice of expressions and the a-priori likelihood of message
  -- For speaker: Assume the addressee selects **the most likely** interpretation, given the choice of expressions and the a-priori likelihood of message

Basic question for interpretation:
Given the a-priori-likelihood of the communicated information and general interpretation strategies,
what is the most likely interpretation of an ambiguous or vague form?

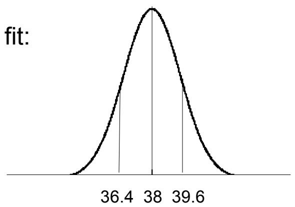
Background: Modelling Precise and Approximate Interpretations

Approximate interpretations of various granularity levels; ways of implementation:

1. Precise: numbers, / approximate: intervals:
   [[*thirty-eight*]]$_{prec}$ = 38, [[*thirty-eight*]]$_{appr}$ = [34..42]
2. Precise and approximate: intervals:
   [[*thirty-eight*]]$_{prec}$ = [38..38], [[*thirty-eight*]]$_{appr}$ = [34..42]
3. Various levels of precision: [[*n*]]$_{1/m}$ = [n ± n/m], e.g.
   [[*thirty-eight*]]$_{1/10}$ = [38 ±3.8] = [34.2 .. 41.8]
   precise interpretation as borderline case:
   [[*thirty-eight*]]$_{1/\infty}$ = [38 ±0] = [38..38]
4. Various levels of precision,
   normal distribution indicating level of fit.
   Using standard deviation as acceptable levels of fit:



[[*thirty-eight*]]$_{1/10}$ = (38 ±3.8)



[[*thirty-eight*]]$_{1/20}$ = (38 ±1,6)

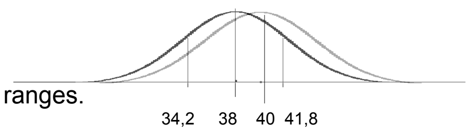
Strategic Interpretation:
Explanation of Precise/Approximate Interpretations

	forty		utterance
p(prec) = 0.5		p(appr) = 0.5	probability of interpretation
(40 ±0)		(40 ±4)	
p(40) = 0.02		p(36 .. 44) = 9 × 0.02 = 0.18	a-priori probability of reported value
least complex: *forty*		least complex: *forty*	reported with least complex expression within range?
p(prec) × p(40) = 0.5 × 0.02 = 0.01		p(prec) × p(36..44) = 0.5 × 0.18 = 0.09	total probability
		☝	Winning interpretation

Strategic Communication:
Explanation of Precise/Approximate Interpretations

Assumptions:

- General tendency for short expressions
  provided that they are interpretatively equivalent
- No general preference for precise or approximate interpretations:
  e.g. two interpretations, prec and appr,
  with p(prec) = p(appr) = 0.5
- Within a given range,
  the a-priori probability of values is comparable or equal,
  e.g. p(38) = p(39) = p(40) = p(41) = p(42) = 0.02
- **Values that differ minimally (under discriminatory threshold, within acceptable level of fit) are interpretatively equivalent:**
  e.g. [[*thirty-eight*]]$_{1/10}$ ≈ [[*forty*]]$_{1/10}$,
  as [[*thirty-eight*]]$_{1/10}$ = (38 ± 3.8) = (34.2 .. 41.8)
  [[*forty*]]$_{1/10}$ = (40 ± 4) = (36 .. 44)
  and 40∈[34.2 .. 41.8]
  and 38∈[36 .. 44]
  Precise values are within each other's ranges.



Strategic Interpretation:
Explanation of Precise/Approximate Interpretations

	thirty-eight		utterance
p(prec) = 0.5		p(appr) = 0.5	Probability of precision levels
(38 ±0)		(38 ±3.8)	
p(38) = 0.02		p(34.2 .. 41.8) ≈ 0.16	a-priori probability of reported value
least complex: *thirty-eight*		least complex: *forty* ≠ *thirty-eight*	reported by least complex number within range?
p(prec) × p(38) = 0.5 × 0.02 = 0.01			total probability
☝			Winning interpretation

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Coarse vs. fine grained levels of representation

Cf. Paul Curtin (1995), *Prolegomena to a theory of granularity,* U Texas MA Thesis

Example: 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---
```

Measurement reports:
Representation of '18 minutes'

The train will arrive in eighteen minutes. (scale a)
The train will arrive in twenty minutes. (scale b or c)
The train will arrive in fifteen minutes. (scale d)
The train will arrive in thirty minutes. (?) (scale e)
The train will arrive in about half an hour.

Length of expression is not always decisive

Preference for short **expressions** cannot explain all interpretation preferences:

I did the job in twenty-four hours.	approximate
I did the job in twenty-three hours.	precise
I did the job in twenty-five hours.	precise
The house was built in twelve months.	approximate
The house was built in eleven months.	precise
The house was built in thirteen months.	precise
Two dozen bandits attacked him.	approximate
Twenty-four bandits attacked him.	precise

... and sometimes even makes the wrong predictions:

Mary waited for forty-five minutes.	approximate
Mary waited for forty minutes.	precise
I turned one hundred and eighty degrees.	approximate
I turned two hundred degrees.	precise
Her child is eighteen months.	approximate
Her child is twenty months.	precise
John owns one hundred sheep.	approximate
John owns ninety sheep.	precise

Alternative theory: A preference for simple, coarse-grained **representations**?

Options for implementation of Coarse/Fine-Grained Scales

1. Values of measure functions are intervals, not numbers, but are named by numbers; example: measurement of a duration d in minutes, granularity levels a, b, c, d, e
   $min_a(d)$ = [18], named *18*
   $min_b(d)$ = [17.5 .. 22.5], named *20*
   $min_c(d)$ = [15 .. 25], named *20*
   $min_d(d)$ = [7.5 .. 22.5], named *15*
   $min_e(d)$ = [15 .. 45], named *30*

```
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---
```

2. Values of measure functions are numbers, but their range of values is constrained; durations are mapped to the number with the best fit.
   RANGE(min_a) = {1, 2, 3, 4, ...}
   RANGE(min_b) = {5, 10, 15, ...}
   RANGE(min_c) = {10, 20, 30, ...}
   RANGE(min_d) = {15, 30, 45, ...}
   RANGE(min_e) = {30, 60, 90, ...}

A well-known fact: "Errors" may add up, i.e. additivity does not hold in a strict way:
$min(x⁀y) = min(x) + min(y)$ is not always satisfied;
e.g. if x and y are durations of 14 minutes each, then x⁀y is a duration of 28 minutes,
$min_c(x) = 10$, $min_c(y) = 10$, $min_c(x⁀y) = 30$, but $min_c(x) + min_c(y) = 20$ (!)

Reinterpretation of approximate interpretation: Selection of the coarsest level in which number word occurs

The train will arrive in fifteen 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---
```

The train will arrive in twenty 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---
```

The train will arrive in eighteen minutes.

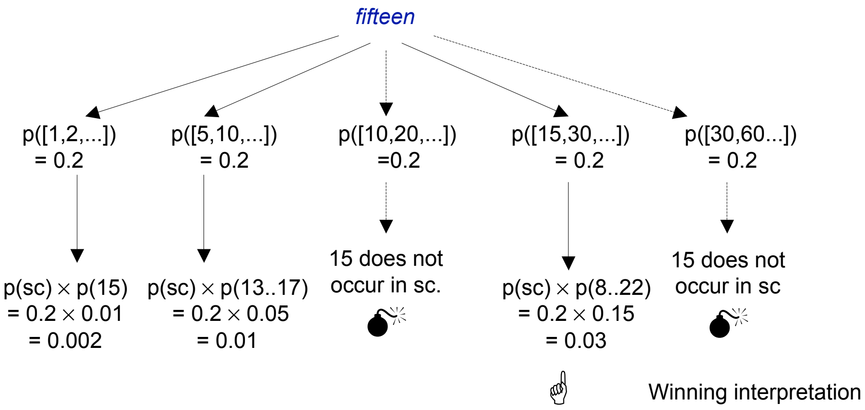
```
a.        3-4-5-6-7-8-9-10-11-12-13-14-15-16-17-18-19-20-21-22-23-24-25-26-27-28-29-30-31   ☜
b.        ----5---------10-------------15-------------20-------------25-------------30---
c.        --------------10----------------------------20----------------------------30---
d.        -----------------------------15-------------------------------------------30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

Overview of the talk:

Explanation of choice of coarseness level by strategic communication

Assume each coarseness level is selected with equal probability,
p([1,2,...]) = p([5,10,...]) = p([10,20...]) = p([15,30,...]) = p([30,60...]) = 0.2

Assume equal a-priori probabilities of durations,
p(15) = p(16) = ... = p(20) = 0.01



Coarse scales and simple expressions: An evolutionary perspective on brevity?

Coarse-grained scales have expressions of reduced complexity (cf. Krifka 2002)

Example: Complexity of number words on scales, average number of syllables

a.	*one, two, three, four, ... one hundred*:	273/100 = **2.73**
b.	*one, five, ten, fifteen, ... one hundred*:	46/20 = **2.3**
c.	*one, ten, twenty, thirty, ... one hundred*:	21/10 = **2.1**

Suspicion:
Scales develop in a way to enable complexity-based optimization, expressions of coarse-grained scales tend to be simpler.

An evolutionary perspective on brevity? The optimization of scales.

Scales and hierarchies of scales of different granularity have to satisfy certain requirements to be useful for communication:

1. Requirement for scales: Equidistance of units (additive, sometimes logarithmic, cf. decibel; *deci-/milli-/micro-/nano-/pico-, kilo-/mega-/giga-/tera-*)
2. Requirements for scale hierarchies of different granularity: Scales of increasing granularity S_n S_{n+1} S_{n+2} should increase granularity by the same factor,

example: powers of 10:	[10, 20, 30, 40, 50, 60, ...]
	[100, 200, 300, 400, 500, ..]
	[1000, 2000, 3000, 4000, ...]
The most natural step:	[1, 2, ...]
decrease granularity	[$^1/_2$, 1, 1$^1/_2$, 2, ...]
by factor 1/2:	[$^1/_4$, $^1/_2$, $^3/_4$, 1, ...]
cf. hour scale:	[1h, 2h, ...],
	[30min, 1h, 1h30min, ...],
	[15min, 30min, 45min, 60min, ...]

cf. J. Hobbs (2001) 'Half Orders of Magnitude', for a refined view of natural magnitude hierarchies with shifted half points, e.g. [1...3...10...30...100...]

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An evolutionary perspective on brevity? The optimization of scales

The expressions of values of scales align with the optimization of scales

Example: Expression of half points between powers of ten

Roman number writing (also motivated iconically, by shape of hand)

I	II	III	IV	V	VI	VII	VIII	IX	X
X	XX	XXX	XL	L	LX	LXX	LXXX	XC	C
C	CC	CCC	CD	D	DX	DXX	DXXX	XM	M

Simplification of number word 'five':

English: *fifteen* (**fiveteen*), *fifty* (**fivety*):
loss of diphthong, shortening
OEng *fi:f* as word vs. *fif-* as prefix; vowel shift only affected i: (> ai),
this did not affect *nine* in *nineteen*

Phonological simplification of 'fifteen', 'fifty' in colloquial German:
fuffzehn, fuffzig vs. regular *fünfzehn*, *fünfzig*:
unrounding ü > u, loss of n, shortening (3 to 2 morae)

Phonological simplification of 'half' in German
anderthalb 'one and a half', lit. 'the second half' vs. regular *eineinhalb*

Morphological simplification of 'fifty' in Danish:
halvtreds vs. older *halvtredsind-s-tyve*,
similarly for 'seventy', 'ninety'

The optimization of scales in language change

Development of number system in Old World history:

Babylonian system: based on 60;

60 and multiples thereof as estimation number e.g. in Ancient Greek (K. Menninger, 1962, *Number words and number symbols*):
The swineherd always sent them the best one of the fattened pigs for them to feast on, and the number of the swine remaining was only three hundred and sixty. (Odyssey)

Different complexity of number words in ancient languages; break after "60"; has disappeared in modern languages

	Greek	Anglo-Saxon	Gothic	Celtic
50	*penté-konta*	*fiftig*	*funf-tigjus*	*coí-ca*
60	*hexé-konta*	*sixtig*	*saihs-tigjus*	*ses-ca*
70	*hebdomé-konta*	*hund-seofontig*	*sibunt-e-hunt*	*secht-moga*
80	*ogdoé-konta*	*hund-ahtatig*	*ahtaút-e-hund*	*ocht-moga*

Phonological realizations of number words in current-day Russian:
pjat'disját [p'is'at] '50', *šest'disját* [šys'at'] '60',
sém'disját [s'emis'ət] '70', *vósem'disjat* [vosimis'ət] '80'

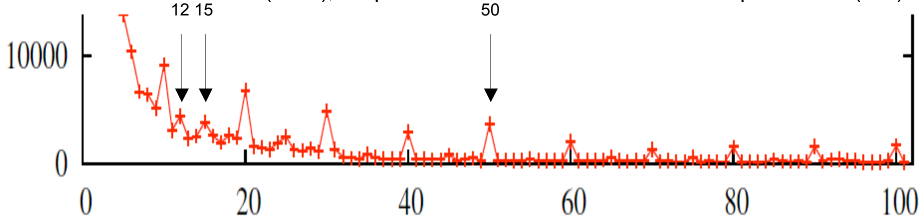
Evidence for preferred reference points: Frequency of number words

If fine-grained / coarse-grained scales are used to report measurements,
and if with coarse-grained scales, only certain number words occur,
then these number words should occur more likely
in a natural linguistic corpus containing measurement reports.

Cf. Dehaene & Mehler (1992), Cross-linguistic regularities in the frequency of number words, *Cognition* 43,
Jansen & Pollmann (2001), On round numbers: Pragmatic aspects of numerical expressions. *Journal of Quantitative Linguistics* 8, Corpora of English, French, Dutch, Japanese, Kannada:

- Between 10 and 100, the powers of ten occur most frequently
- Frequency decreases with higher powers of 10, but there is a local maximum for 50
- Between 10 and 20, there are local maxima at 15, also at 12 (“dozen”)

Example: Number words in British National Corpus,
after H. Hammarström (2004), Properties of lower numerals and their explanation... (ms.)



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Evidence: Frequency of number words

Frequency of approximate numbers on *-aine* in French
French web sites of Google, April 11, 2005,
search for strings “une X de”

dixaine	**4.230**		*vingtaine*	737.000
onzaine	19		*trentaine*	**866.000**
douzaine	**262.000**		*quarantaine*	272.000
treizaine	16		*cinquantaine*	**490.000**
quatorzaine	47		*soixantaine*	159.000
quinzaine	**540.000**		*septantaine* *soixante-dixaine*	614 4
seizaine	6		*quatre-vingtaine*	85
dix-septaine	1		*quatre-vingtdixaine*	0
dix-huitaine	11		*centaine*	**548.000**
dix-neuvaine	1			

Still an effect of complexity of expression?

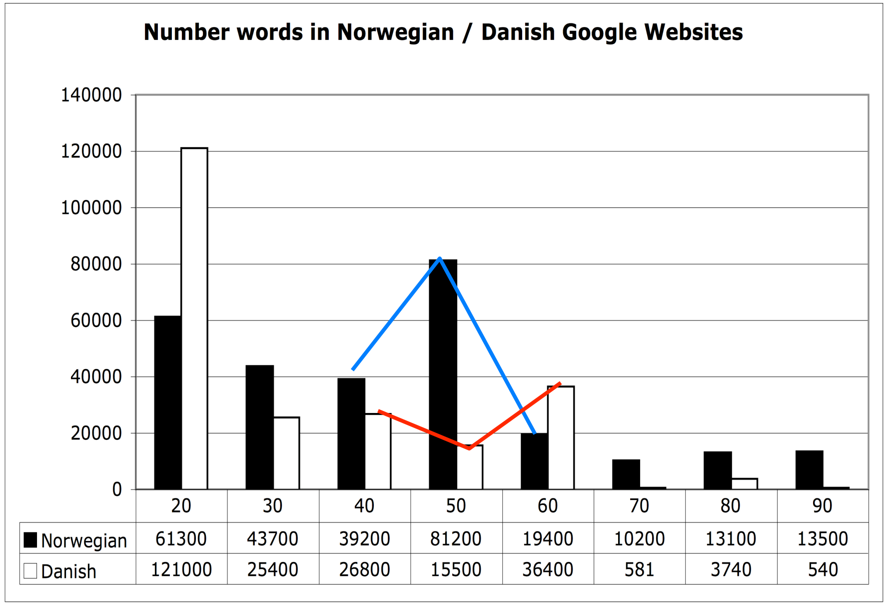
In vigesimal number systems, ‘50’ is more complex than ‘40’/‘60’

Question:
Is ‘50’ nevertheless used as approximate number word?
Conflict cognitive preference / communicative preference

Cf. Hammarström (2004), Number bases, frequencies and lengths cross-linguistically.

Inspired by this work: Investigation of occurrernces of number words
on Norwegian vs. Danish web sites of Google (March 4, 2005)

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



Complexity of multiples of 10 in Danish, Basque, Georgian

Danish	Basque	Georgian
ti	*hamar*	*ati*
tyve	*hogei*	*otsi*
tredive	*hogei ta hamar*	*otsdaati*
fyrre	*berrogei*	*ormotsi*
halvtreds (halvtredsindstyve)	*berrogei ta hamar*	*ormotsdaati*
tres	*hirurogei*	*samotsi*
halvfjerds (halvfjerdssindstyve)	*hirurogei ta hamar*	*samotsdaati*
firs	*larrogei*	*otkhmotsi*
halvfems (halvfemsindstyve)	*larrogei ta hamar*	*otkhmotsdaati*
hundrede	*ehun*	*asi*

Experiment on number estimation: Decimal vs. vigesimal systems

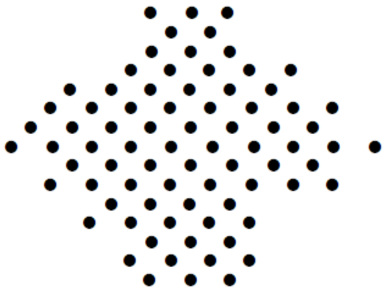
Problem of corpus analysis:
There might be a wide variety of reasons for number word frequency

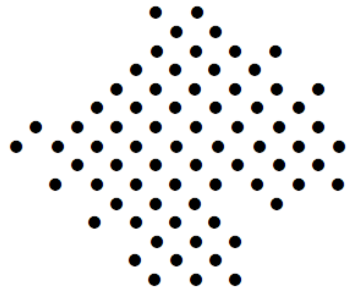
Hence: Experimental evidence is necessary.

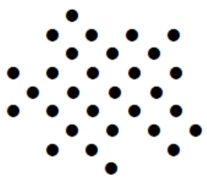
Number estimation experiment:
Subjects should estimate number of dots on a screen;
all numbers between 12 and 100 were shown once
in nearly random order;
(two subsequent pictures differed by at least 15 points).

Hypothesis:
Speakers of languages with a vigesimal system
use complex multiples of 10 less often,
(i.e. number words for 50, 70, 90)
than speakers of languages with decimal system.

Examples of test items







Description of experiment:

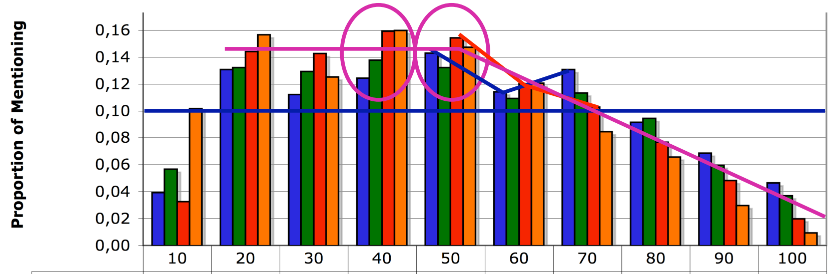
Number of dots in these examples: 79 - 30 - 73

Principles of presentation of items:

- Dots are spaced out regularly to allow for numerosity-based estimations (cf. Stanislas Dehaene 1997, *The number sense*),
- Dots were presented for 5 seconds,
- Every number between 12 and 100 occurred once in pseudo-randomized order,
- Subjects reacted by pronouncing a number.
- Instructions suggested to subjects to give estimations like *forty*, *eighty*, and changed midway through the experiment to force multiples of 10.

Experiment still ongoing:
Norwegian (20) -- thanks to Anton Benz
Danish (20) -- thanks to Torgrim Solstad
Georgian (12) -- thanks to Rusudan Asatiani
(Basque (7) -- thanks to Miren Lou Oinenderra;
a more comprehensive experiment on Basque to be carried out soon.

Preliminary Results of Number Estimation Experiment:

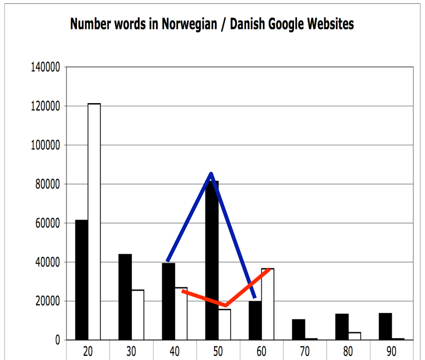


	10	20	30	40	50	60	70	80	90	100
Norwegian	0,04	0,13	0,11	0,12	0,14	0,11	0,13	0,09	0,07	0,05
German	0,06	0,13	0,13	0,14	0,13	0,11	0,11	0,09	0,06	0,04
Danish	0,03	0,14	0,14	0,16	0,15	0,12	0,10	0,08	0,05	0,02
Georgian	0,10	0,16	0,13	0,16	0,15	0,12	0,08	0,07	0,03	0,01

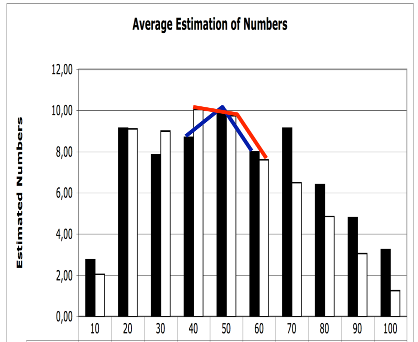
Multiples of 10

- Higher number words are used less often, esp. by Georgian and Danish speakers; lower frequency of lower number words reflect higher use of precise numbers.
- No significant differences between languages for “50”, against hypothesis.
- Greater frequency of “40” for Danish, Georgian, corresponding to hypothesis.
- Peak for Norwegian (and German) at “70”, lacking for Danish, Georgian

Why difference between corpus study and experiment?



	20	30	40	50	60	70	80	90
Norwegian	61300	43700	39200	81200	19400	10200	13100	13500
Danish	121000	25400	26800	15500	36400	581	3740	540



	10	20	30	40	50	60	70	80	90	100
Norwegian	2,75	9,15	7,85	8,70	10,00	8,00	9,15	6,40	4,80	3,25
Danish	2,05	9,10	9,00	10,05	9,75	7,60	6,50	4,85	3,05	1,25

Average Frequency of Estimation

Possible explanation (Jason Mattausch):
Use of arabic numbers in written text; should appear more frequently in Danish
-- planned corpus study

Number estimation experiment: Discussion

No valley at “50” for Danish/Georgian speakers:
This scale position has high cognitive prominence, regardless of complexity (at least for the population the subjects are drawn from -- university students)

Explanation of peak at 70 with Norwegian (and German) speakers:

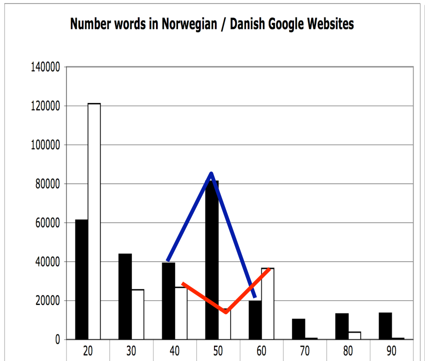
1. “50” is a natural estimation number, cf. St. Dehaene 1997, *The number sense*
2. Differences of +/– 5 are difficult to recognize for point sets around size 50; differences of +/– 10 are recognizable.
3. As “50” is a natural attractor, “60” is a less natural attractor, as it is not sufficiently distinct from “50”
4. “70” is a better attractor, as it is sufficiently distinct from “50”

Explanation of lack of peak for “70” for Danish and Georgian speakers:
Even though “70” is a natural attractor for cognitive reasons, the complexity of the number word for “70” mitigates against it.

Explanation of peak at “40” with Danish/Georgian: Simplicity of number word?

More experiments are needed,
Basque seems particularly attractive due to greatest complexity diffferences.

Numerals in Norwegian vs. Danish Web Sites



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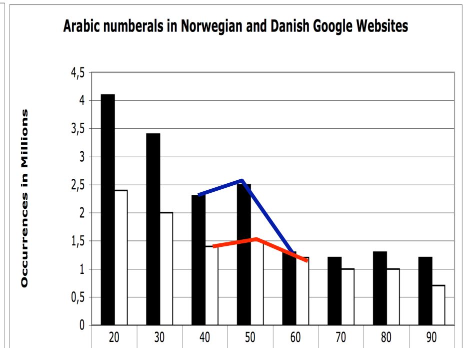

	20	30	40	50	60	70	80	90
Norwegian	4,1	3,4	2,3	2,5	1,3	1,2	1,3	1,2
Danish	2,4	2	1,4	1,5	1,2	1	1	0,7

- Frequent occurrence of number base *tyve* “20” in Danish in spellect-out form
- Slight summit for 50 in Danish Arabic numerals, but even more pronounced in Norwegian.

Problems of the experiment

- Influence of second native language,
  e.g. Basque: Spanish/French, Welsh: English
- Influence of formal education in school,
  better don't take university students as subjects!
- Make subjects estimate higher numbers:
  Run experiment with numbers n, $30 < n < 90$

Overview of the talk:

1. Precise/Approximate Interpretations of number words:
   The basic phenomenon
2. Selection of optimal expressions and interpretations
   with preference for short expressions, approximate interpretations,
   and bidirectional OT: Krifka 2002
3. Selection of optimal expressions and interpretations
   with preference for short expressions and strategic communication:
   Krifka 2005
4. Selection of optimal scales
5. Principles for the construction of optimal scales
6. Adaptation of scales to language use:
   shortening of common expressions
7. Adaption of language use to scales:
   under-use of complex expressions
8. A new theoretical perspective on language use

A new perspective on language and language use

Common functionalist belief:
"Grammars do best what speakers do most" (DuBois 1987)

But perhaps we also have to assume:
Sometimes speakers do most what grammars do best,

or perhaps:
Speakers do least what grammars do worst.

That is:
Meanings that are difficult to encode are expressed more rarely.

Related to Codability Hypothesis, Brown & Lenneberg (1954):
Color words and color recognition.

Other evidence for this?
For example, marking of aspectual distinctions,
Progressives in English vs. German,
difference in complexity, and corresponding frequency of use.

John read the book.	*John was*$_{\text{AUX}}$ *reading the book.*
John las das Buch.	*John las gerade*$_{\text{ADV}}$ *das Buch.* *John war das Buch am*$_{\text{P}}$ *Lesen*$_{\text{NOM}}$*.* (Rhenish dialects)

A new perspective on language use

An analogy to economics: Optimization of transaction costs
Example (unfortunately, not based on any study):
Typical prices of goods at Dutch fleamarkets before January 1, 2002:
2.5 guilders (ca. 1.136 Euros) or multiples thereof (Rijksdaalder)
Typical prices of goods at Dutch fleamarkets after January 1, 2002:
1 Euro (2.2 guilders) or multiples thereof

=

The End

1. Precise/Approximate Interpretations of number words:
   The basic phenomenon
2. Selection of optimal expressions and interpretations
   with preference for short expressions, approximate interpretations, and bidirectional OT: Krifka 2002
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Slides can be downloaded at: http://amor.rz.hu-berlin.de/~h2816i3x, Talks

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