On the processing benefits of roundness

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Preference for Rounding

The phenomenon: An overall speaker/hearer preference for numerical information to be communicated in **approximate** or **round** terms, rather than **precisely**

Why is this funny?

Krifka (2007)

- Greater frequency of round numbers in cross-linguistic corpus data - attributed to their use in expressing approximate quantity (Dehaene & Mehler 1992)
- Approximate expressions used when more precise information available:

  A **third of voters** (34%) supported the proposition

  According to a new survey, **six in ten** Americans (59%) read the bible at least occasionally

  (cf. Williams & Power 2009)
- Rounding when extra effort required:

Excuse me, can you tell me what time it is?

	Analog Watch	Digital Watch	Predicted Level
5x responses	98%	66%	20%

(Van der Henst et al. 2002)

Experiment 1 – Short-Term Memory

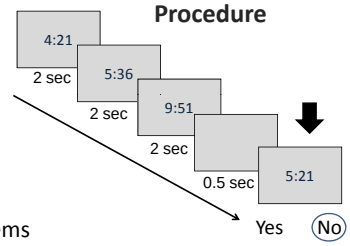
Are clock times that are rounder and/or interpretable relative to coarser grained scale easier to remember?

METHOD: Sternberg task (Sternberg 1966)

- Participants see sequences of clock times, followed by probe time; task is to say whether probe in sequence
- Roundness/granularity of times varied:

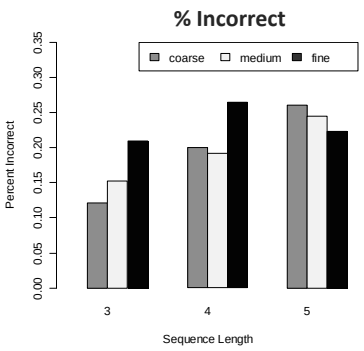
Coarse: 15-minute	2:15	6:30	8:45
Medium: 5-minute	2:10	6:25	8:40
Fine: 1-minute	2:21	6:36	8:51

- 3 sequence lengths - 3,4,5 times; 90 items



PARTICIPANTS: n=34 German speakers (mean age 26.6; 25 female)

PREDICTIONS: i) Coarse > Fine
ii) If roundness crucial, Coarse = Medium; if granularity, Coarse > Medium



RESULTS

- **Coarse** times recalled more accurately & quickly than **fine** (p<0.001 for accuracy and LogRT)
  - ➢Supports processing advantage
- Interaction of **fine** granularity & sequence length (accuracy p<0.01)
  - ➢Learning effects
- No difference between **coarse** and **medium**, suggesting roundness not granularity crucial
  - ➢Were stimuli processed as times?

Conclusions & Discussion

- Choice of rounded value provides numerical information to hearer in an easier-to-process form
  - To the extent that speakers are sensitive to hearer's perspective, findings support that processing factors contribute to prevalence of rounding
- Both the form of a numerical expression (roundness) and the structure of the underlying representation (granularity) play a role – depending on task
- Results do not provide evidence for advantage of imprecise interpretation (tasks require precise interpetation) and do not rule out effects of frequency
  - Next step: processing advantages of coarse-grained interpretation

A hearer-oriented strategy?

- Van der Henst et al. (2002) – rounded answer optimally relevant, because it requires less processing effort for same cognitive benefit

  *Suppose you have an appointment at 3:30 p.m. and it is 3:08. Being told 'It is 3:10' is likely to be optimally relevant: the two-minute departure from the exact time is unlikely to have any consequences, and the rounded answer is **easier to process**.* (p 464; emphasis added)
  - Less rounding when more precise answer relevant

  ➢Existence of processing advantage not experimentally investigated (exception: Mason et al. 1996)

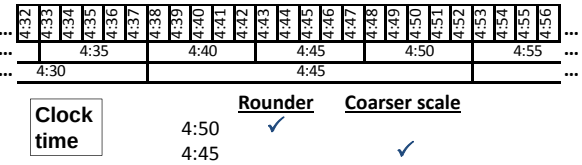
Research Questions

1. Can the hypothesized processing advantage for rounded/ approximate numerical expressions be substantiated?
2. What aspect(s) of 'processing' impacted ?
3. Is advantage driven by:
   a. Roundness – divisibility properties (Jansen & Pollmann 2001)?

Expressible as single digit multiple of…

	100	50	45	43
10^n	1 x 100	5 x 10	×	×
2×10^n	5 x (2 x 10)	×	×	×
5×10^n	2 x (5 x 10)	1 x (5 x 10)	9 x (5 x 1)	×
2.5×10^n	4 x (2.5 x 10)	2 x (2.5 x 10)	×	×

   b. Coarse scale granularity (Krifka 2007)?
   - Measurement results can be reported w.r.t. scales that differ in granularity, i.e. density of representation points



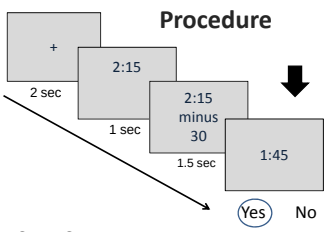
Experiment 2 – Clock Time Arithmetic

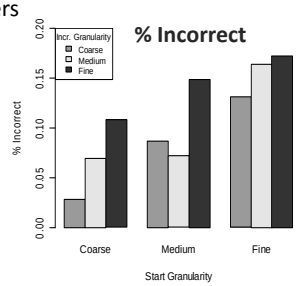
Are rounder / coarser-grained times easier to reason with?

METHOD: Novel clock time addition/subtraction paradigm

- Participants see start time, operation (plus/minus) and increment time followed by possible answer; task is to judge if correct
  - For subset of items, answer 'spills over' to next/previous hour
- Manipulation of…
  - Start granularity: coarse (e.g. 2:15), medium (2:10), fine (2:21)
  - Increment granularity: coarse (e.g. 30), medium (25), fine (27)
- 144 items / subject drawn randomly from list of 720 items

PARTICIPANTS: n=22 German speakers





RESULTS

Start time: Advantage for **coarse vs. fine** (accuracy & LogRT p<0.001) and also for **coarse vs. medium** (accuracy p<0.05, LogRT p<0.01)

Increment time: Advantage for **coarse vs. fine** (accuracy & LogRT p<0.001) and **coarse vs. medium** (accuracy p<0.05, LogRT p<0.001)

➢ Evidence of granularity effects

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