



“Rationality” and number interpretation in L1 and L2

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Acknowledgements

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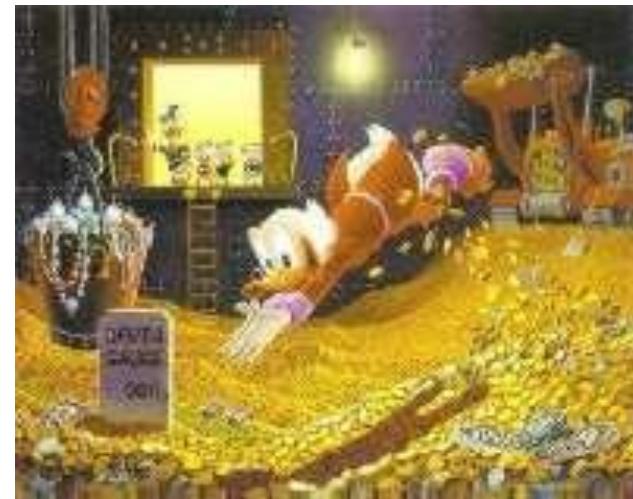
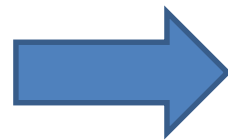
Zoe Schlueter



Antonella Sorace

Rationality boost in L2

- Keysar et al.: L2 users less prone to certain cognitive biases
- people should consider using their L2 when making financial decisions, as this might well be beneficial over a long time span



Agendas for project

- Second look at the L2 rationality boost...
- ...while also trying to collect data on pragmatic interpretation and reasoning experiments...
- ...and on pragmatic interpretation in L2, in general

Today

- Cognitive bias, and pragmatic intrusion onto that
- Prior results on L2 rationality
- Some results from our project so far
- Implications

Cognitive biases

- Line of research mostly associated with Daniel Kahneman and Amos Tversky
 - Kahneman won Nobel Prize in Economics in 2002 for work on prospect theory, core to behavioural economics
- Demonstrating that humans are predictably and systematically irrational in decision making

Example, to be returned to

- The “Linda problem” (conjunction fallacy)
- *Linda is 31 years old, single, outspoken, and very bright. She majored in philosophy. As a student, she was deeply concerned with issues of discrimination and social justice, and also participated in anti-nuclear demonstrations.*

Which is more probable?

1. Linda is a bank teller.
2. Linda is a bank teller and is active in the feminist movement.

A more numerical example: framing

- Differences in decision-making based on how the same information is presented (“framed”)
- Simplest case: Levin (1987)
 - Comparing ground beef described as “25% fat” with that described as “75% lean” (between-participants design)
 - Same product in both cases
 - “75% lean” meat gets superior ratings, even to the extent of participants preferring its taste

A more complex case: the ADP

- Tversky and Kahneman's (1981) classic and much-replicated demonstration of framing effects
 - Disease "expected to kill 600 people..."

Program A:

200 people will be saved

72 | 28

Program B:

1/3 probability that 600 will be saved; 2/3 probability none will be

Program C:

400 people will die

22 | 78

Program D:

1/3 probability that no-one will die; 2/3 probability that 600 will

Irrationality in the ADP

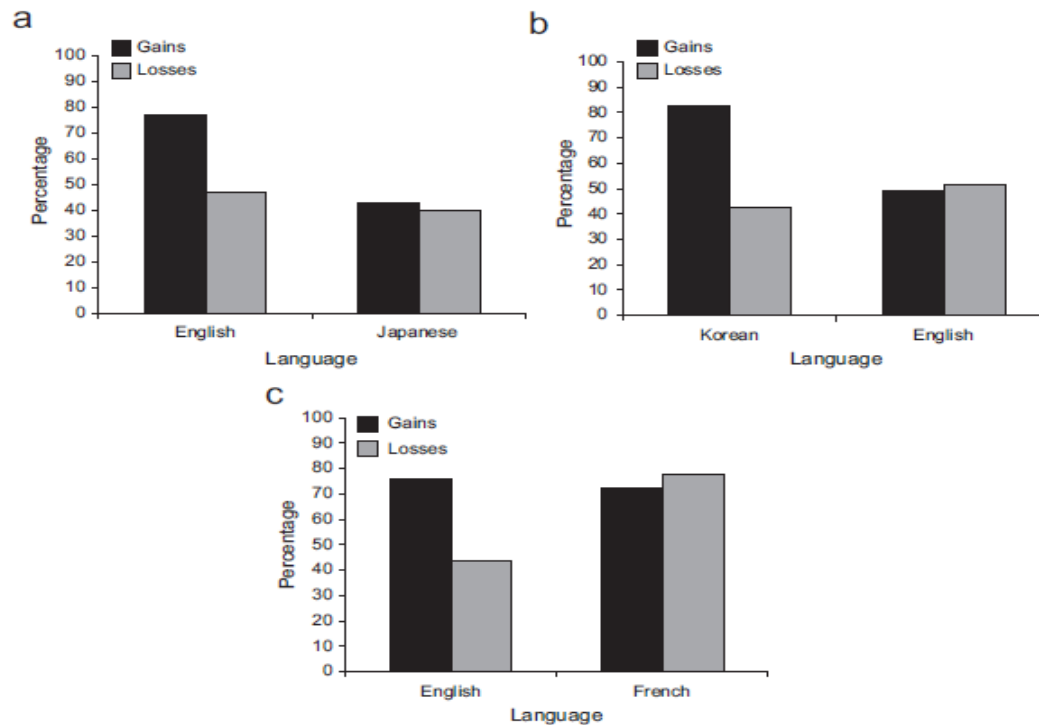
- Note that there is not intended to be any rational reason to prefer B to A, or C to D
 - Expected utility, in terms of the number of lives saved, is set up to be the same in both options, so choice should reflect risk appetite
- By “irrational” we mean that, among the participants, some are making inconsistent choices between the two frames
 - Specifically, many are apparently choosing the safe option in the gain frame and the risky option in the loss frame

Heuristics

- General idea that irrationality of this kind is due to over-reliance on quick and inaccurate reasoning (heuristics)
 - If we always relied on our slower but more accurate reasoning system, we wouldn't succumb to these errors
- If so, natural to wonder how we might switch these off
- Idea: reasoning in a foreign language (Costa, Keysar, and colleagues)

Foreign language effect...

- People less prone to cognitive bias in their L2
 - That is, the A-B / C-D difference is smaller (Keysar et al. 2012, fig. 1)



...but with variations

- Still, rather dissimilar patterns in L2 preferences
- (Also cognitive bias tasks for which there isn't an L2 boost)

Broader questions

- Could number interpretation play a role in explaining
 - the differences between L1 and L2 reasoning patterns?
 - the differences among L2 reasoning patterns?
- More generally, are there pragmatic confounds in the classic reasoning tasks, and if so, how serious are they?

Linda revisited

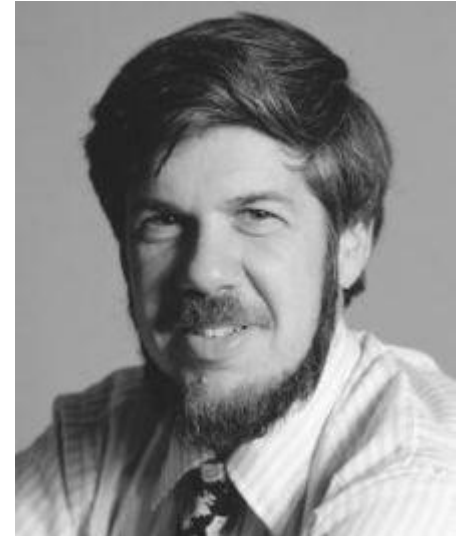
- The “Linda problem” (conjunction fallacy)
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Which is more probable?

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Gould's "homunculus"

"I am particularly fond of this example [the Linda problem] because I know that the [conjoint] statement is least probable, yet a little homunculus in my head continues to jump up and down, shouting at me—"but she can't just be a bank teller; read the description.""



- But the description doesn't say "She's just a bank teller" – it just says "She's a bank teller"

Extensional equivalence

- Simplest case: Levin (1987)
 - Comparing ground beef described as “25% fat” with that described as “75% lean” (between-participants design)
 - Same product in both cases
 - “75% lean” meat gets superior ratings, even to the extent of participants preferring its taste
- But, to be a case of irrationality, this relies on extensional equivalence
 - All that is fat is not lean, and vice versa
 - 75% and 25% take exact values (rather than, say, lower bounds)
- Idea applied to the ADP by Mandel (2014)

Recall...

- Tversky and Kahneman's (1981) classic and much-replicated demonstration of framing effects
 - Disease "expected to kill 600 people..."

Program A:

200 people will be saved

72 | 28

Program B:

1/3 probability that 600 will be saved; 2/3 probability none will be

Program C:

400 people will die

22 | 78

Program D:

1/3 probability that no-one will die; 2/3 probability that 600 will

Extensional equivalence in the ADP

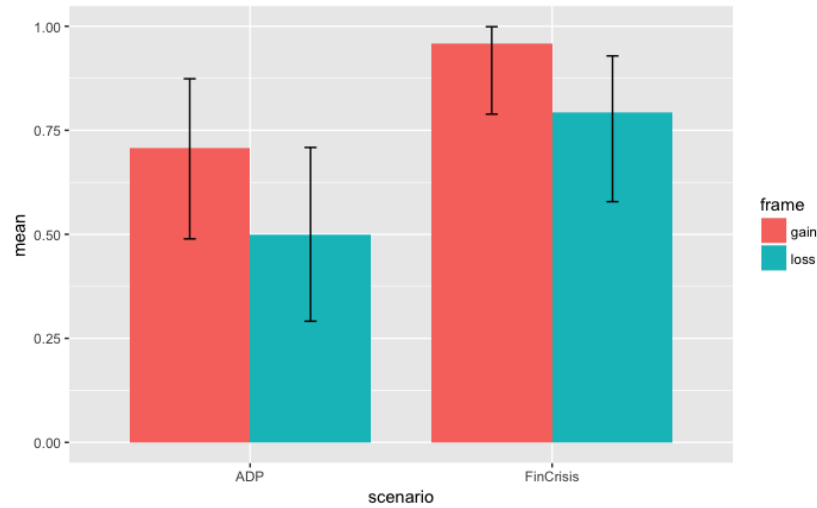
- Cognitive bias argument assumes $A=C$, $B=D$
- Majority pattern of choice rational if 200 and 400 are attracting lower-bound interpretations, and zero and 600 (“all”) punctual interpretations, for instance
 - (and, of course, entirely irrational if the numbers are attracting upper-bound interpretations)
- Mandel (2014) demonstrates that the choice of interpretation influences the framing effect
 - He’s focusing just on punctual vs. lower-bound interpretations of 200 and 400, though, and there’s potentially more going on...

Attempting to replicate/develop

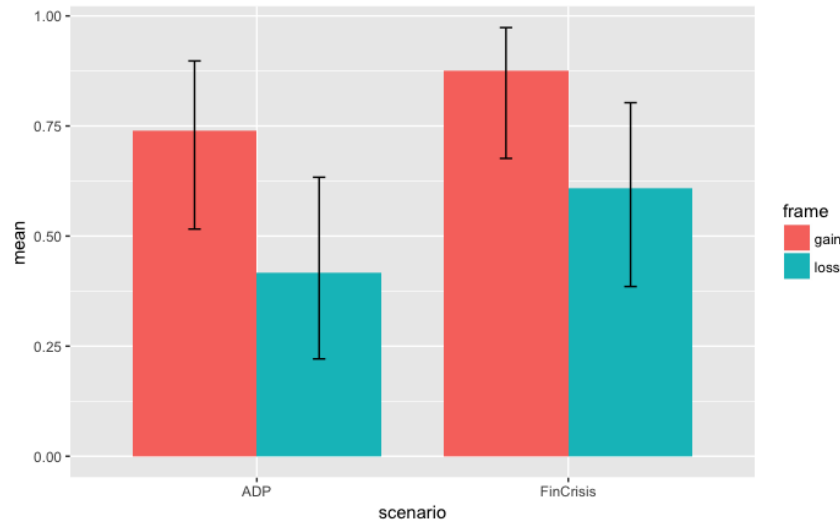
- Ongoing work with Zoe Schlueter, Antonella Sorace; funded by the Leverhulme Trust
- Initially running this online (Ibex) with English L1 speakers (n=48) and Spanish L1/English L2 (n=47)
 - ADP and logically similar “Financial Crisis Problem” (FCP)
 - Other decision-making tasks, following Costa et al. (2014) – Allais paradox, cognitive reflection task
 - All preceded by language background questionnaire (self-rating proficiency, impact of taboo words in L1/L2 as index of emotional connection to languages)
 - All followed by elicitation of their interpretation (punctual, lower bound, upper bound?)

Results

- L1



- L2



Interpretation?

- Main finding: highly proficient L2 users exhibit framing effects just like L1 users
 - Perhaps not wholly unexpected – convergence on L1 with higher proficiency – but suggests that L2 rationality boost doesn't necessarily get retained
 - Thus, perhaps we should make our investment decisions in a language we don't understand properly...
- Trend towards a stronger preference for punctual interpretation among L2 users
 - Not enough variation to draw clear conclusions here
 - Note that this wouldn't explain the cross-linguistic patterns, unless this interpretative preference varies among L1/L2 pairs

Seeking exact interpretations

- Disease “expected to kill 633 people...”

Program A:

211 people will be saved

Program B:

1/3 probability that 633 will be saved; 2/3 probability none will be

Program C:

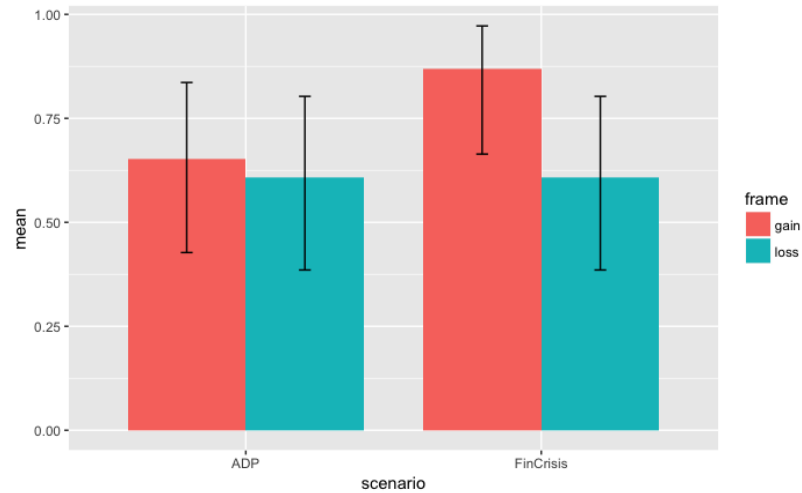
422 people will die

Program D:

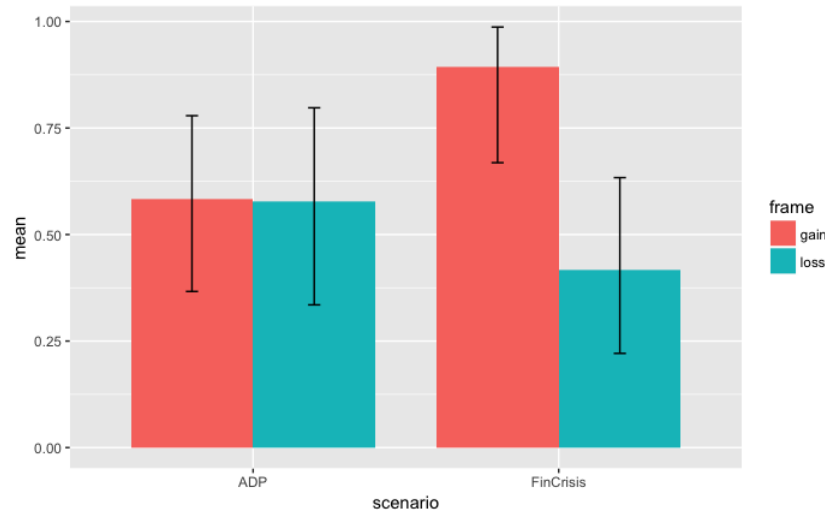
1/3 probability that no-one will die; 2/3 probability that 633 will

Results

- L1 (n=46)



- L2 (n=43)



The plot thickens...

- Still testing this in the lab, in different language combinations
- Still trying to elicit higher-resolution intuitions about interpretation
- However, we do seem to have something different to explain now – what are L1 speakers doing??
 - Difference in moral judgement, risk aversion?
 - Something to do with the numbers involved?
- All of which further fuels my interest in trying to establish what kind of information is being conveyed, and how, by the ‘speakers’ in these experiments (and in general)

Linda, yet again

“...yet a little homunculus in my head continues to jump up and down, shouting at me—“but she can’t just be a bank teller; read the description.””

- We’d like to study cases where the alternatives are not presented side-by-side, and that has been done (first, in fact)
- This should be safe, because we know that “*Linda is a bank teller*” doesn’t normally implicate that *Linda is not active in the feminist movement*
- But surely it implicates something?

Finding the alternatives

- *Linda is 31 years old, single, outspoken, and very bright. She majored in philosophy. As a student, she was deeply concerned with issues of discrimination and social justice, and also participated in anti-nuclear demonstrations.*
- Linda is a bank teller.
- We seem to expect the speaker to have selected something else from the broad class of possible alternatives
- I think this applies to numerical expressions...
- ...and that doesn't make numerical expressions unusually complicated; it actually makes them a great testbed for ideas about these more nebulous inferences

Summary

- Many unanswered questions – but hopefully worth asking
 - Because you might know the answers, or at least have insights as to whether and how these issues are addressable
 - Because we've tended to approach number in natural language largely as a simple problem of disambiguation between discrete possible meanings, and things may be more complex than this
 - Because we use number so extensively and reason with it so often, and there are important gaps in our understanding of how – but it's not clear quite where these gaps are