

Debiasing Thinking, Fast and Slow

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Outline

- Biased thinking
- Dual process theory
- Dual process theory revisions
- Debiasing thinking
 - Dual process debiasing
 - Predicting debiasing
- Applied and theory implications



1. BIASED THINKING

Biased thinking



So it introduced the "Third-of-a-Pound Burger." **It was priced the same as the Quarter Pounder but with a third of a pound of beef, instead of just a quarter pound.** It even outperformed the Quarter Pounder in taste tests. But nobody bought it. When A&W did focus groups to try and figure out why, the reason was simple. 08 Apr 2021



1	1
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4	3

<https://www.cbc.ca> > radio > undertheinfluence > how-fail... ⋮

How failing at fractions saved the Quarter Pounder | CBC Radio

Biased thinking



NEWSLETTER

THE SCIENCE OF EVERYTHING
COSMOS



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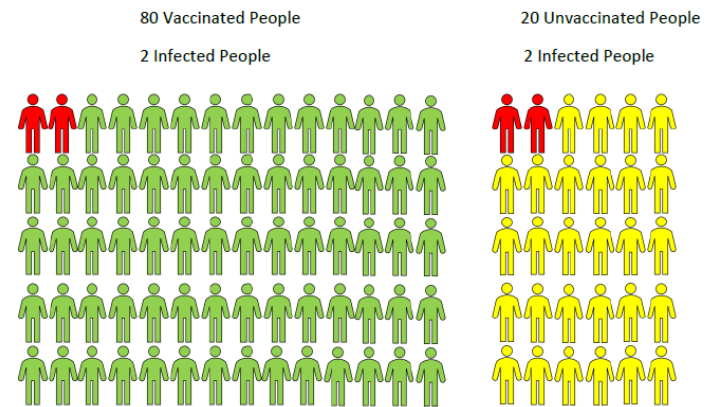
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[Cosmos](#) » [COVID](#) » Why are there so many vaccinated people in hospital?

20 September 2021 / Deborah Devis

Why are there so many vaccinated people in hospital?

It may be confronting to hear there are more vaccinated people than unvaccinated people in hospital – but it's actually a good thing.



Base rate neglect

A psychologist wrote thumbnail descriptions of a sample of 1000 participants consisting of 995 democrats and 5 republicans. The description below was chosen at random from the 1000 available descriptions.

Russell is 67 and lives in Georgia. He used to work in the oil business and owns a ranch. He believes in traditional marriage.

Which one of the following two statements is most likely?

- a. Russell is a democrat
- b. Russell is a republican

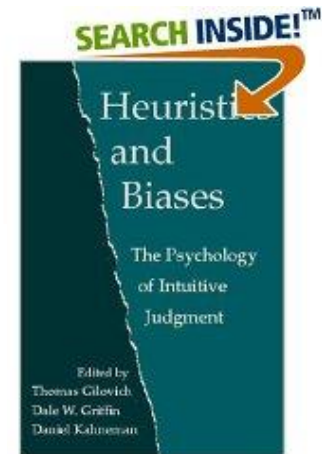
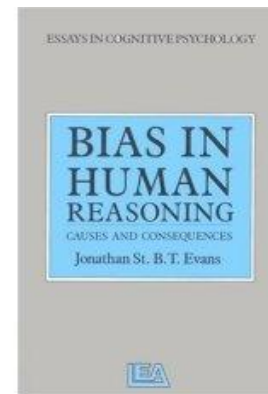
Base Rates: 995/1000 → a

Typical Response: b +/- 80%



Reasoning psychology 101

- 50 years of reasoning and decision making research
 - People often fail to reason logically
 - ... On many reasoning tasks, many educated people fail to give the correct response ...
 - Intuitive bias
 - stereotypical beliefs
 - Intuitive feelings



2. DUAL PROCESS THEORY

Dual Process framework

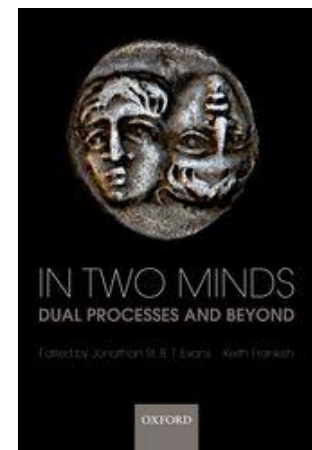
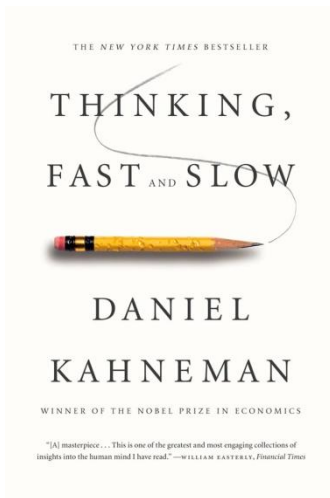
- Two reasoning modes

System 1 (“intuitive, heuristic, Type 1”)

- fast – automatic

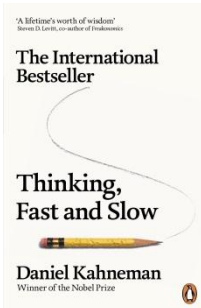
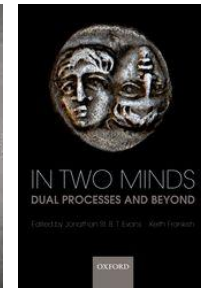
System 2 (“deliberate, analytic, Type 2”)

- slow – effortful



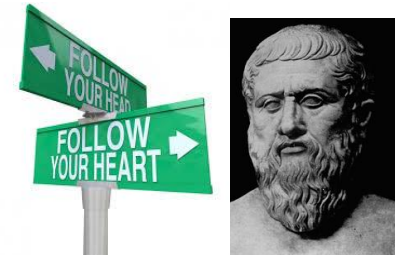
Dual process theories 101

- Two reasoning systems
 - **System 1 – fast, automatic**
 - **System 2 – slow, effortful**
- Intuitive power
 - Allows fast decisions
- Sometimes conflict
 - Both systems cue different response
 - System 2 needs to correct intuition
- “Cognitive misers” ... BIAS



Dual process theory popular ...

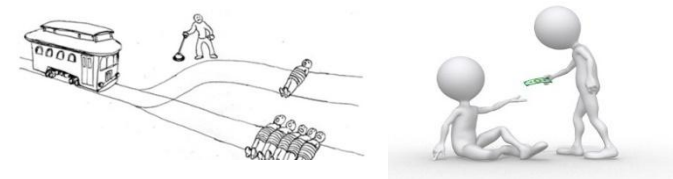
- Appealing story
 - Reasoning with heart/mind, passion/ratio ..



- Nobelprize
 - Daniel Kahneman (2002)



- Applications
 - Moral reasoning (Greene et al.)
 - Cooperation (Rand et al.)



- Google scholar > 4,68 million hits!

Dual process theory popular but ...

- Criticized ...

- Processing specifications?
- Untested assumptions?



- Recent empirical approach

- Test core assumptions of traditional models

- I. Bias blind spot assumption
 - Bias results of conflict detection failure?
- II. Corrective assumption
 - Sound reasoning requires deliberate correction of initial intuition?



3. DUAL PROCESS REVISION

I. Bias blind spot assumption

- Why are we biased?
 - Failed conflict detection
 - Default System 1 response
 - Cognitive misers, lax monitors
 - “We don’t know we’re wrong”



- Data?
 - Do “biased” reasoners detect conflict?

General study design

- “Classic Bias tasks”
 - Base-rate neglect, conjunction fallacy, syllogisms, ...

A psychologist wrote thumbnail descriptions of a sample of 1000 participants consisting of 995 democrats and 5 republicans. The description below was chosen at random from the 1000 available descriptions.

Russell is 67 and lives in Georgia. He used to work in the oil business and owns a ranch. He believes in the right to bear arms and in traditional marriage.

Which one of the following two statements is most likely?

- a. Russell is a democrat
- b. Russell is a republican



- Conflict and no-conflict versions
 - Classic conflict: Intuitive and correct response conflict
 - Control no-conflict: Intuitive = correct response



(“ ... response traditionally considered normative or correct according to standard logic or probability theory” ...)

Example base-rate

- Classic (Conflict version)

A psychologist wrote thumbnail descriptions of a sample of 1000 participants consisting of **995 democrats and 5 republicans**. The description below was chosen at random from the 1000 available descriptions.

Russell is 67 and lives in Georgia. He used to work in the oil business and owns a ranch. He believes in the right to bear arms and in traditional marriage.

Which one of the following two statements is most likely?

- a. Russell is a democrat
- b. Russell is a republican

- Control (No-conflict version)

A psychologist wrote thumbnail descriptions of a sample of 1000 participants consisting of **5 democrat and 995 republicans**. The description below was chosen at random from the 1000 available descriptions.

Russell is 67 and lives in Georgia. He used to work in the oil business and owns a ranch. He believes in the right to bear arms and in traditional marriage.

Which one of the following two statements is most likely?

- a. Russell is a democrat
- b. Russell is a republican

Empirical approach

- Evidence for bias detection?
 - Do biased reasoners show logical sensitivity?
 - Classic reasoning tasks
 - Syllogisms, base-rate, conjunction fallacy, bat&ball ...

A psychologist wrote thumbnail descriptions of a sample of 1000 participants consisting of 995 democrats and 5 republicans. The description below was chosen at random from the 1000 available descriptions.

Russell is 67 and lives in Georgia. He used to work in the oil business and owns a ranch. He believes in the right to bear arms and in traditional marriage.

Which one of the following two statements is most likely?

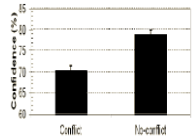
- a. Russell is a democrat
- b. Russell is a republican

- Classic conflict and control no-conflict versions
- Range of processing measures
 - RT, confidence, eye-movements, brain activation,
 - Different cognitive treatment?

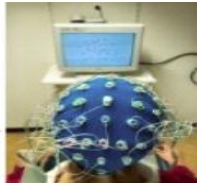
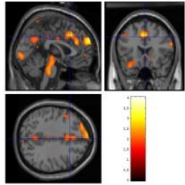
Summary empirical findings



– When biased reasoners solve conflict problems:



Echelle de confiance



- Response Time
 - They reason longer (e.g., Bonner & Newell, 2010; De Neys & Glumicic, 2008; Pennycook et al., 2014; Stuppel et al., 2011)
- Eye movements
 - They fixate logically critical problem parts longer (e.g., Purcell et al., 2021, 2023; Ball et al., 2008; De Neys & Glumicic, 2008; Morsanyi & Handley, 2012)
- Confidence
 - They are less confident that their response is correct (e.g., De Neys, Cromheeke, & Osman, 2011; De Neys, Rossi, & Houdé, 2013; Thompson & Johnson, 2014)
- Brain activation
 - Conflict detection region in the brain is activated (e.g., Bago et al., 2018; De Neys, Vartanian, & Goel, 2008; Mevel et al., 2018; Vartanian et al., 2018, 2021)

Empirical conflict detection

- Different methods

- **Latencies** (De Neys et al., 2008; Stuppel et al., 2011; Pennycook et al., 2013), **recall** (De Neys et al., 2008), **eye movements** (Ball et al., 2006; De Neys et al., 2008a), **fMRI** (De Neys et al., 2008b; Simon et al., 2015; Vartanian et al., 2018), **SCR** (De Neys et al., 2010a), **EEG** (Bago et al., 2018), **lexical decisions** (De Neys & Franssen, 2009), **confidence** (De Neys et al., 2011, 2013; Mevel et al., 2015; Thompson & Johnson, 2014)

- Different tasks

- **Base-rate neglect** (De Neys et al., 2008; Morsanyi & Handley, 2012), **conjunction fallacy** (De Neys et al., 2011; Villejoubert, 2009), **sylogisms** (De Neys & Franssen, 2009; Stuppel & Ball, 2008), **ratio bias** (Bonner & Newell, 2010; Mevel et al., 2015), **bat&ball** (De Neys et al., 2013; Rossi et al., 2013; Gangemi et al., 2014), **number conservation** (De Neys, Lubin, Houdé, 2014), **math reversal errors** (Lubin, Houdé, De Neys, 2015), **attraction errors** (Lanoë et al., 2017), **fractions** (Van Hoof et al., 2020), **risky choice** (Voudouri et al., 2024), **semantic illusions** (Beucler et al., 2025), **insight** (Beucler et al., 2026)...

- Different teams

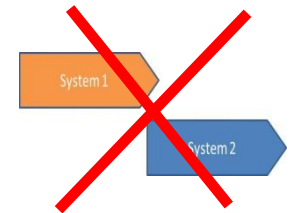
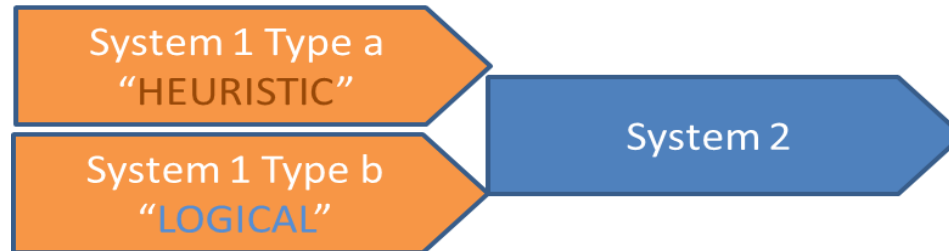
- Pennycook, Fugelsang, & Koehler (2015); Bonner & Newell (2010); Villejoubert (2009); Stuppel & Ball (2008); Thompson & Johnson (2014); Handley & Trippas (2015); Gangemi, Bourgeois-Gironde, & Mancini (2014); Hoover & Healy (2019) **But see also** Singmann et al. (2015), Mata et al., (2017); Aczel et al., (2015); Travers et al., (2016)



Conflict detection is *often* successful!

I. Bias blind spot conclusion

- Empirical Evidence
 - Successful, automatic conflict detection
- Theoretical implication
 - Evidence for revised dual process model “2.0”
 - Upgrade System 1
 - Postulation of “logical intuitions” (De Neys, 2012)



2. Corrective DPT assumption

- Core classic dual process assumptions
 - 1. Bias blind spot assumption
 - Nature biased reasoning?
 - 2. Corrective assumption
 - Nature sound reasoning?
 - Corrective nature of System 2
 - » Correct responding requires correction of initial intuitive response

A bat and a ball together cost \$1.10. The bat costs \$1 more than the ball.

How much does the ball cost? _____

System 1

"10 cents"

System 2

"5 cents"

Design: Two-response paradigm

A bat and a ball together cost \$1.10. The bat costs \$1 more than the ball.

How much does the ball cost? _____

- Two-response paradigm (Thompson et al., 2012)
“Give first answer that comes to mind as fast as possible. Next, you can take all the time you want to deliberate and give a final response”
- Method
 - First response really intuitive?
 - Knock out System 2 with deadline and load (Bago & De Neys, 2017, Cognition)

+

	X	
		X
X		X

The bat and the ball cost 1.10 euros together.

The bat cost 1 euro more than the ball. How much does the ball cost?

Please indicate your very first, intuitive answer.

10 cents

5 cents

1 cent

15 cents

(5 s response deadline = reading time pretest)

From the following pictures, which one was the presented pattern?

A)

X	X	
X	X	

B)

X	X	
	X	X

C)

	X	
		X
X		X

D)

	X	X
X		X

A

B

C

D

The bat and the ball cost 1.10 euros together.

The bat costs 1 euro more than the ball. How much does the ball cost?

Please indicate your final answer.

10 cents

5 cents

1 cent

15 cents

Two-response paradigm

A bat and a ball together cost \$1.10. The bat costs \$1 more than the ball.

How much does the ball cost? _____

- **Instruction**

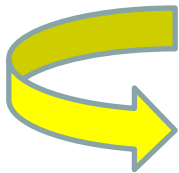
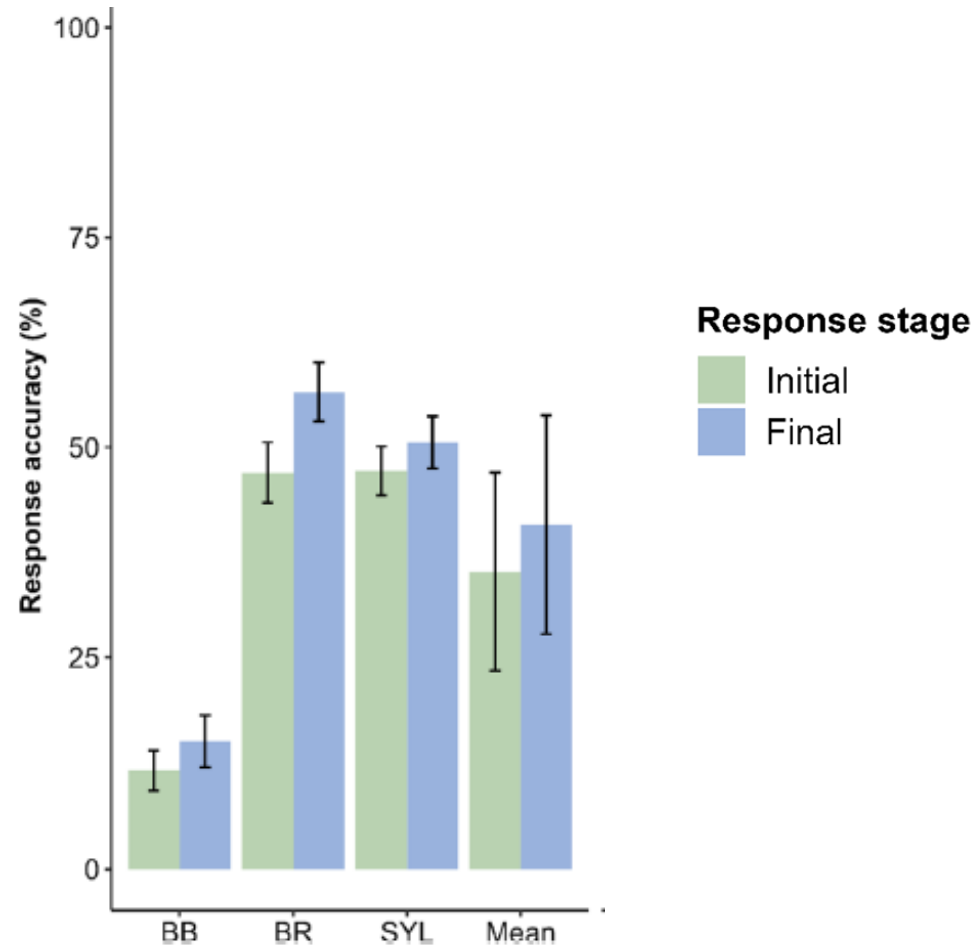
“Give first answer that comes to mind as fast as possible. Next, you can take all the time you want to deliberate and give a final response”

- **Method**

- **First response really intuitive**

- Knock out System 2 with deadline and load
- Check for familiarity and modified content
- Check for guessing with multiple problems and format
- Reliability: Total of 15+ studies, different reasoning tasks (base-rate, bat-and ball, ...)

Two-response results

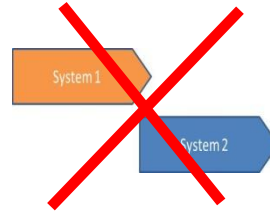


Correct answers are often intuitive!

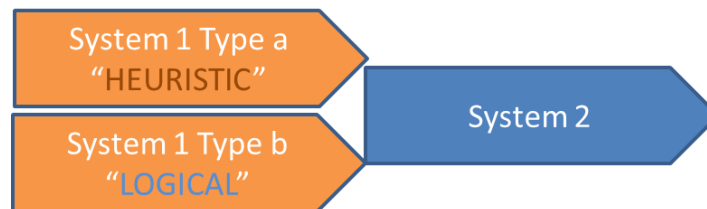
(Bago & De Neys, 2017, *Cognition*; Newman et al., 2017, *JEP:LMC*; Raelison et al., 2020, *Cognition*; Boissin et al., 2021, *Cognition*; Franiatte et al., 2024, *L&I*; Voudouri et al., 2024, *Cognition*; Beucler et al., 2025, *JEP:LMC*)

II. Corrective assumption conclusion

- Classic model

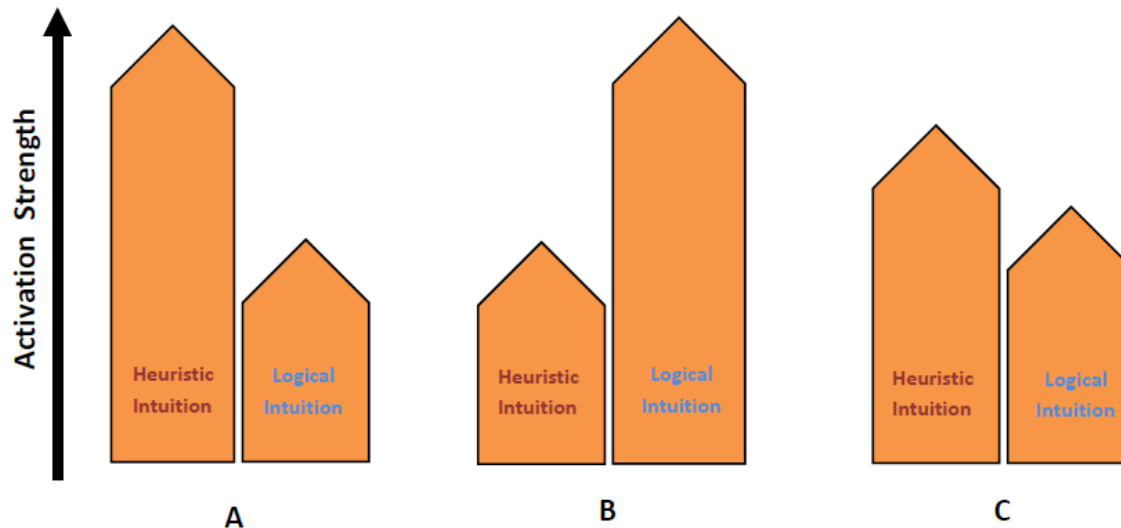


- Corrective nature System 2?
 - No, System 1 can generate correct logical response intuitively ...
 - Need to upgrade view of System 1
 - “Logical intuitions in System 1” ...



Fleshing it out

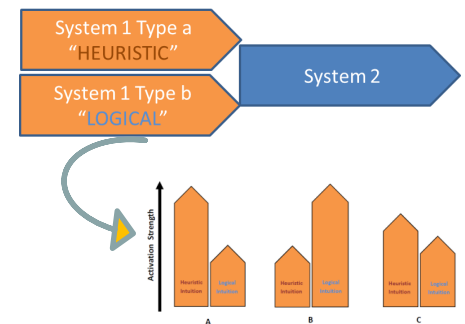
- Variance within System 1
 - Different types of intuitions can vary in strength



- New predictions (e.g., Bago et al., 2020, TAR; Voudouri et al., 2023, TAR)

Dual process theory revision

- Empirical findings
 - ⇔ Bias blind spot assumption
 - Incorrect responders often show conflict detection
 - ⇔ Corrective assumption
 - Correct responses often generated intuitively
- Implications
 - Revise classic dual process models
 - “Upgrade” System 1
 - A case for revised “DPT 2.0” models



4. DEBIASING THINKING

Debias interest

PERSPECTIVES ON PSYCHOLOGICAL SCIENCE

Giving Debiasing Away

Can Psychological Research on Correcting Cognitive Errors Promote Human Welfare?

Scott O. Lilienfeld, Rachel Ammirati, and Kristin Landfield

Emory University

Short Report

PSYCHOLOGICAL SCIENCE

Debiasing Training Improves Decision Making in the Field



Anne-Laure Sellier¹, Irene Scopelliti², and
Carey K. Morewedge³

¹Marketing Department, HEC Paris; ²Faculty of Management, Cass Business School, City, University of London; and ³Department of Marketing, Questrom School of Business, Boston University

Abstract

Evaluating and Mitigating Risk

Debiasing Decisions: Improved Decision Making With a Single Training Intervention

Carey K. Morewedge¹, Haewon Yoon¹, Irene Scopelliti²,
Carl W. Symborski³, James H. Korris⁴, and Karim S. Kassam⁵

Policy Insights from the
Behavioral and Brain Sciences
2015, Vol. 2(1) 129–140
© The Author(s) 2015
DOI: 10.1177/2372732215600886
bbs.sagepub.com



Abstract

From failures of intelligence analysis to misguided beliefs about vaccinations, biased judgment and decision making contributes to problems in policy, business, medicine, law, education, and private life. Early attempts to reduce decision biases with

Psychological Science
2019, Vol. 30(9) 1371–1379
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DOI: 10.1177/09567976198614
www.psychologicalscience.org



De-bias studies

- Successful de-bias training in literature

- Short “plain English” explanation

(Claidière et al., 2017; Hoover & Healy, 2017; Morewedge et al., 2015; Purcell et al., 2020; Trouche et al., 2014)

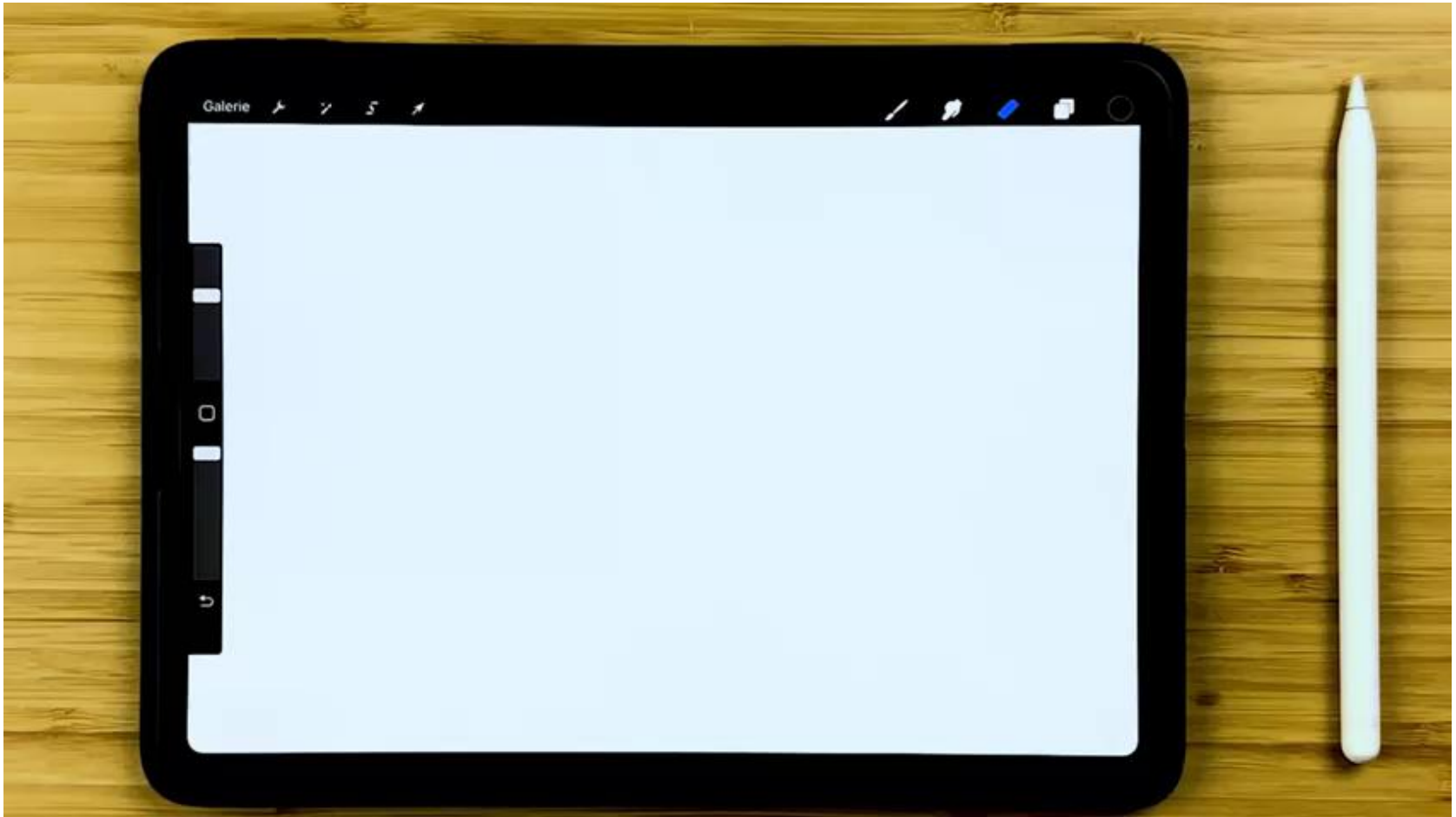
A bat and a ball together cost \$1.10. The bat costs \$1 more than the ball.

How much does the ball cost? _____

- “It can’t be 10 cents. Otherwise, bat \$1.10 (dollar more). Total would be \$1.20. Needs to be less than 10 cents. With 5 cents it works”

- Similar problems correct after training

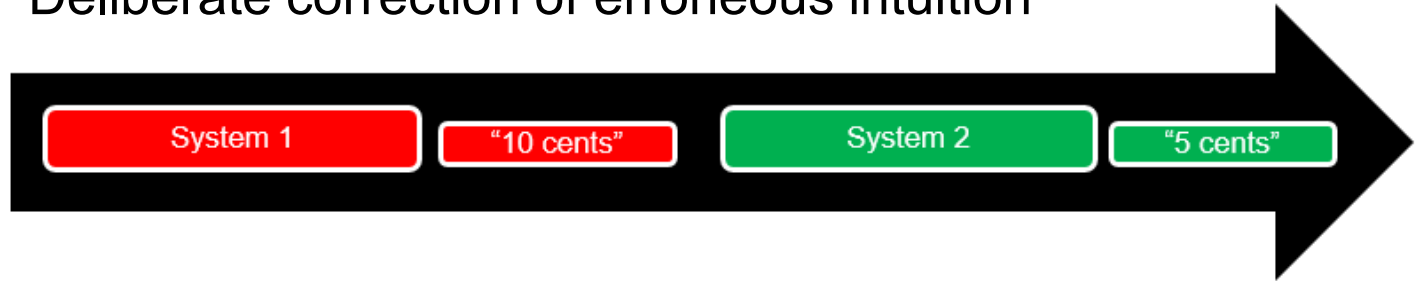
Demo



5. DEBIASING THINKING, FAST & SLOW

Nature de-bias training?

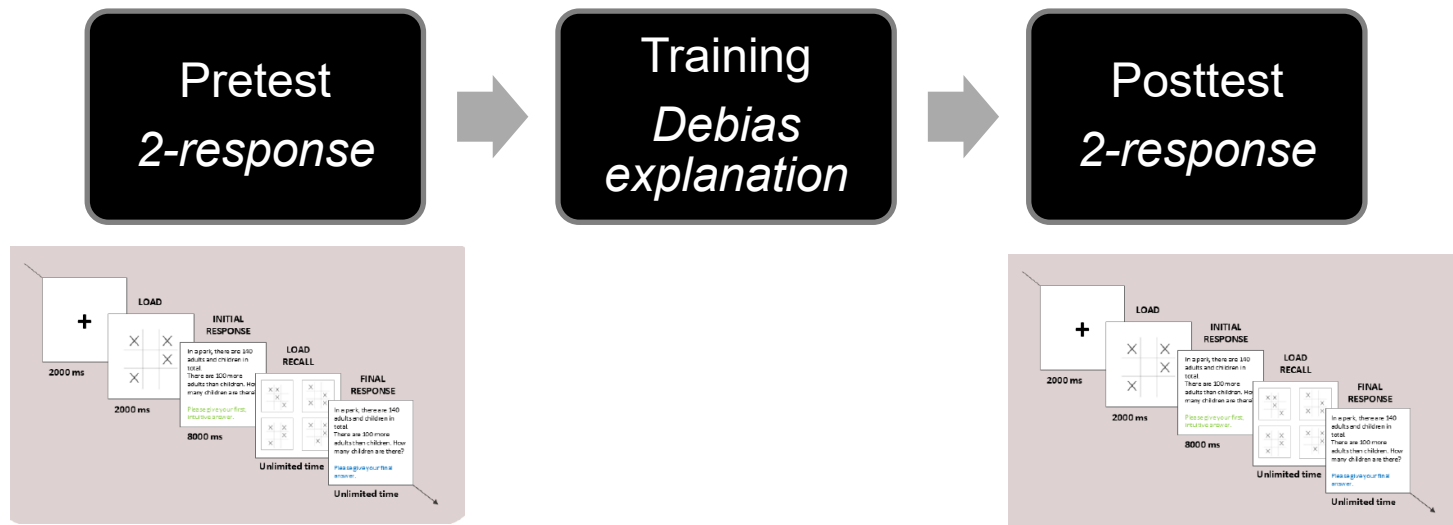
- Why does it work?
 - Boosting System 2
 - Deliberate correction of erroneous intuition



- Or, boosting System 1?
 - Generating correct response intuitively?
 - Prior dual process revision work:
 - » spontaneous correct responses often intuitive (Bago & De Neys, 2017, Cognition; De Neys & Pennycook, 2019, CDPS; Newman et al., 2017, JEP:LMC; Thompson et al., 2018, JEP:Gen)
 - Theoretical and applied implications

Two-response de-bias

- Prior dual process two-response work:
 - correct responders intuit correctly (Bago & De Neys, 2017, Cognition; Raelison et al., 2020, Cognition; Thompson et al., 2018)
 - ... but most people biased
- Current: After de-bias training?

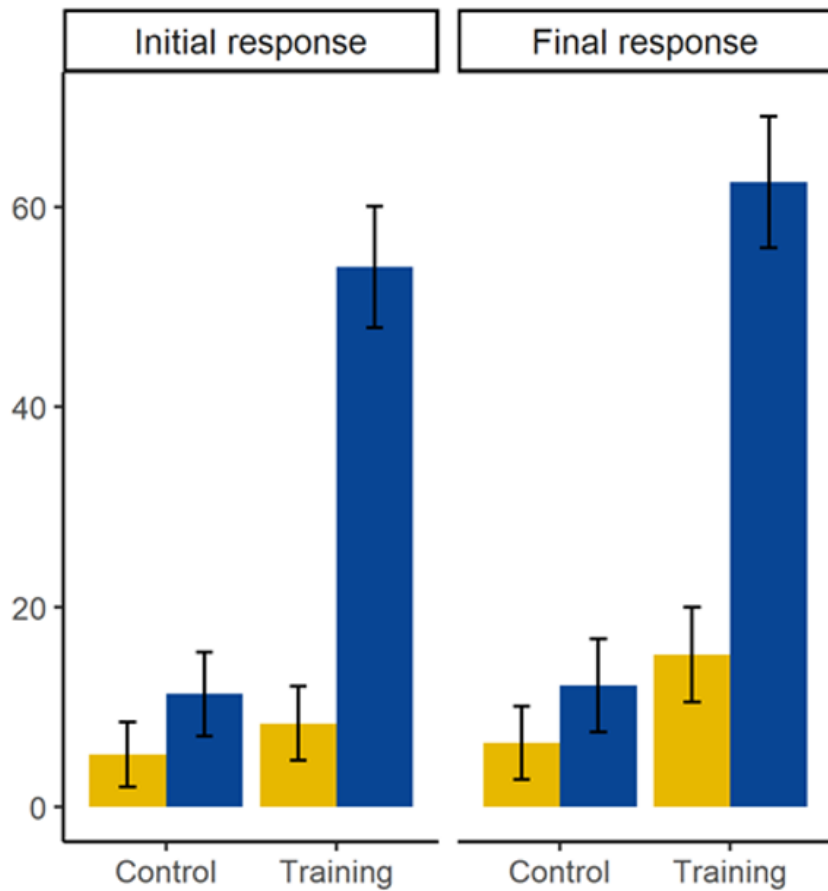


General Design



- Pre-test & post-test
 - Multiple trials: 8 trials pre and post
 - Unique content
 - Control group & training group (5 min)
- Different studies
 - Different types of reasoning tasks
 - Bat-and-ball, base-rate, syllogisms ...

Key result



■ Pre-intervention ■ Post-intervention

(Boissin et al., 2021, 2022, Cognition, JDM;
Franiatte et al., 2024, 2025, L&I, Acta)

Control studies

- Control studies
 - Generalized intuition distrust? “Take-half” heuristic?
 - No-conflict control problems: +95% throughout!

A bat and a ball together cost \$1.10. The bat costs \$1.

How much does the ball cost? _____

- No transfer
 - No general better intuiting, people intuit trained principle
- Robust?
 - Re-test after 2 month: persistent training effect

6. CONFLICT DETECTION AND DEBIASING

Conflict and debiasing

- Debiasing results:
 - System 1 debiasing: After training correct intuiting
- But, some remain biased
 - 60% biased reasoners benefit
 - Why?
- Dual process revision
 - Conflict detection
 - (Most) biased reasoners show conflict detection (De Neys & Bonnefon, 2013, TICS)

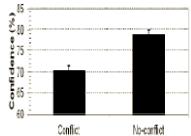


Conflict detection findings

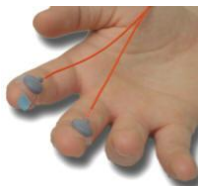
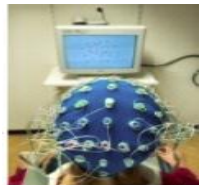
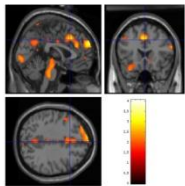


– When biased reasoners solve conflict problems

- Response Time
 - They reason longer (e.g., Bonner & Newell, 2010; De Neys & Glumicic, 2008; Pennycook et al., 2014; Stuppel et al., 2011)
- Eye movements
 - They fixate logically critical problem parts longer (e.g., Ball et al., 2008; De Neys & Glumicic, 2008; Morsanyi & Handley, 2012)
- Confidence
 - They are less confident that their response is correct (e.g., De Neys, Cromheeke, & Osman, 2011; De Neys, Rossi, & Houdé, 2013; Thompson & Johnson, 2014)
- Brain activation
 - Anterior Cingulate Cortex is activated (e.g., De Neys, Vartanian, & Goel, 2008; Simon, Lubin, Houdé, & De Neys, 2015; Vartanian et al., 2018, 2021)



Echelle de confiance



Conflict detection is *often* successful!

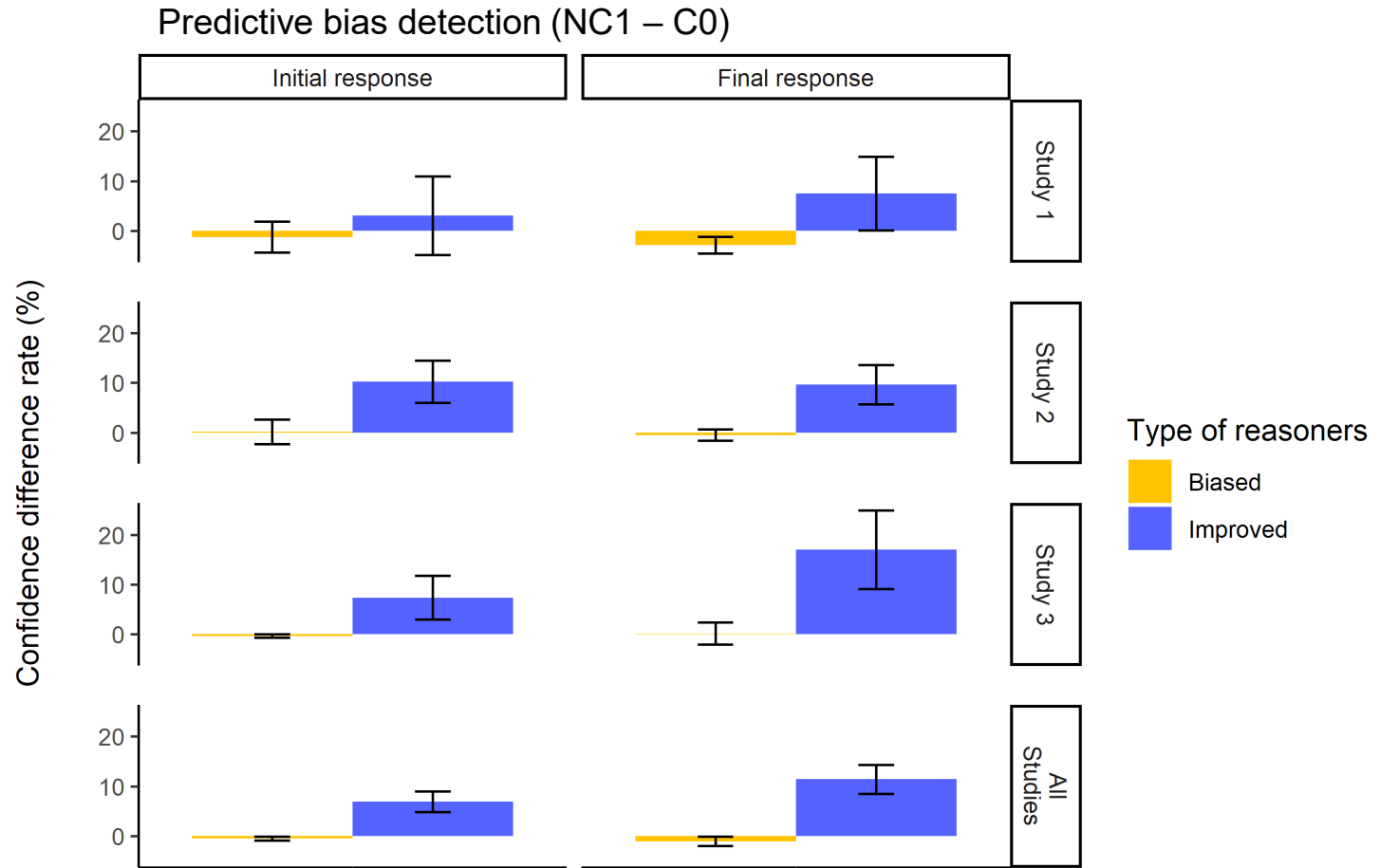
Conflict and debiasing

- Conflict detection and bias
 - Biased reasoners show conflict detection
 - But, individual differences (Mata et al., 2017; Pennycook et al., 2015) ...
- Debiasing results
 - System 1 debiasing: After training correct intuiting
 - But, some remain biased ...
- Conflict detection predicts debiasing effect?



Key results

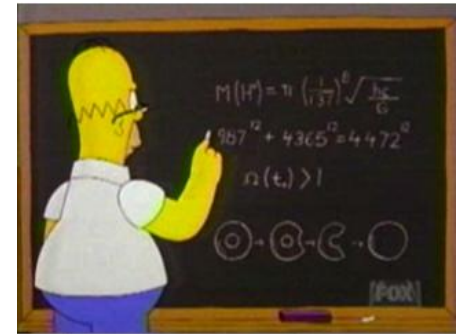
- Metacognition predicts debiasing efficiency?



7. CONCLUSIONS

Wrap-up debiasing fast and slow

- System 1 debiasing
 - After training correct intuiting
 - Applied implications
- Theoretical implications
 - Functional role conflict detection
 - Reflects “Medium” knowledge state
 - Nature modal bias: contra mindgap
 - “Most people are smarter than bias suggests”
 - Support “Logical intuitions”?
- Boundary conditions ...



Wrap-up debiasing fast and slow

- Boundary conditions ...
 - “Simple” logical rules
 - Automatization hypothesis
 - Adults have been repeatedly exposed to in school ... automatized application
 - No “magic” or “free lunch”
 - Role education
 - Debiasing less efficient when less schooling
 - Himba adults (Boissin et al., 2024, Cognition)
 - WEIRD: Adults vs 7th graders

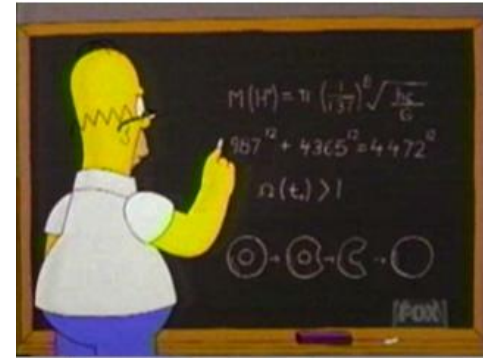


Fig. 1. A Himba in a typical Himba village (left) and Himba women and children (right).



Test your reasoning



- Free training tool COGITUM

The screenshot shows the Cogitum website interface. At the top left is the Cogitum logo (a yellow star) and the text "Cogitum". In the top right corner, there is a language selector for "Version française". The main content area features a circular profile picture of a woman with a blue headband and stars. Below the profile picture is the text "Welcome to Cogitum !" followed by the instruction "Test and improve your reasoning abilities by clicking on one of the tasks below." and a question "Many people respond in a biased manner. How about you?". There are three task cards arranged horizontally, each with an icon and a "Play" button: "Adding bias" (with a compass icon), "Base rate bias" (with a magnifying glass icon), and "Conjunction bias" (with a lightbulb icon). At the bottom of the interface, there is a social sharing prompt "Share this test, it helps us a lot!" with icons for Facebook, WhatsApp, Telegram, and X. The footer contains the text "HOST This site is hosted by Microsoft Corporation", "TERMS AND CONDITIONS OF USE Click here to read the terms and", and the logo for "LaPsyDÉ (r)".



» <https://cogitum-site.powerappsportals.com/>

Outline

- Biased thinking
- Dual process theory
- Dual process theory revisions
- Debiasing thinking
 - Dual process debiasing
 - Predicting debiasing
- Applied and theory implications



Thank you!

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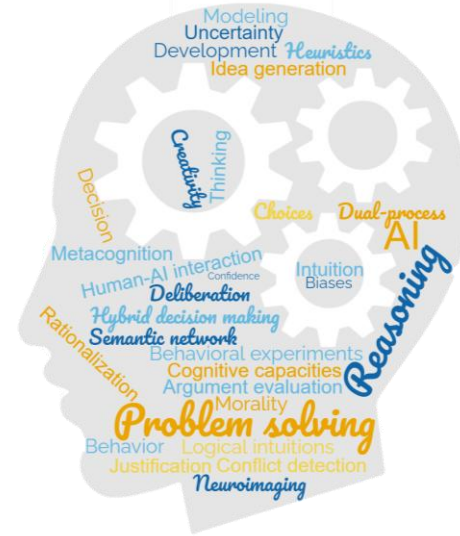
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í ÄGLÏçdFÏ



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Debiasing Thinking, Fast and Slow

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