

1. Introduction

Metacognition and reasoning are among key factors to good decision making (e.g., Bruine de Bruin, Parker & Fischhoff, 2007; Kahneman & Tversky, 2013; Kleitman & Stankov, 2007). Based on the meta-reasoning model (Ackerman & Thompson, 2017), these two factors are inherently linked, allowing individuals to evaluate feelings of certainty and uncertainty during decision processes.

The current study extends this research by investigating feelings of certainty and uncertainty and their factor structure. Following previous metacognitive framework, we examined these feelings in combination with metacognitive control threshold, the confidence level required to commit to a decision. Furthermore, we investigated whether these metacognitive factors as well as reasoning factors would mediate the existing relationships between heuristics and biases decision-making and real-life behavioural outcomes.

2. Hypotheses

H1. Uncertainty, confidence, and control threshold variables will converge onto separate factors

H2. Uncertainty will positively predict heuristics and biases task performances after controlling for Confidence, Intelligence and other variables

H3. Reasoning and metacognitive variables will mediate the relationship between heuristics and biases task performances with a) the Decision Outcomes Inventory and b) academic performance

3. Methods

- 177 university students (132 females, mean age = 20.3) were tested in-lab on University premises.
- Task battery included
 - reasoning/decision-making tasks embedded with confidence ratings (certainty) and control thresholds
 - perceptual tasks embedded with opt-out options (uncertainty)
 - measures of other constructs (executive function, decision-making styles, personality)
 - demographics

Uncertainty



Is the pixel density in the box sparse or dense?

Use the letters S, U or D to answer

S U D
Sparse Uncertain Dense

Intelligence/ Confidence/ Control Threshold

STATUE is to SHAPE as SONG is to:

Beauty Piano Tune Note
1 2 3 4

Please use the numbers 1 to 4 to choose the best fitting answer.

Please type a number between 25 (just guessing) and 100 (certain), then press the enter key.

If given the chance, would you bet \$10 that your answer is correct?

4. Results

H1. Exploratory Factor Analysis with 3-factor solution: As expected, uncertainty, confidence and control threshold variables converged onto separate factors

	F1	F2	F3	h ²
Berlin Numeracy Test Confidence	.80	-.05	.15	.61
Applying Decision Rules Confidence	.76	.10	-.01	.64
Cognitive Reflection Test Confidence	.89	-.05	-.02	.77
Cube Comparisons Uncertainty	-.36	.04	.61	.54
Sparse-Uncertain-Dense Task Uncertainty	.14	-.02	.84	.69
Visual Search Task Uncertainty	.12	.09	.53	.30
Esoteric Analogies Test Control Threshold	-.07	.88	.07	.75
Raven's APM Control Threshold	.05	.81	-.04	.68
Medical DM Task Control Threshold	.01	.62	-.11	.40

H2. Uncertainty had no significant correlations with any heuristics and biases task performances.

However, following past findings, the Competence factor (combination of Confidence and Intelligence) positively predicted Applying Decision Rules and Cognitive Reflection Test accuracy whilst controlling for personality, decision-making styles, age, gender and English as a first language.

H3. Hierarchical regression analyses on each real-life outcome with three blocks

	Decision Outcomes Inventory	Academic Performance		
		2019	2019	2020
Block 1: Heuristics and Biases Tasks				
Block 2: Age, Extraversion, Conscientiousness, Decision-Making Styles				
Block 3				
Applying Decision Rules Accuracy	-.08	.51	.52	.51
Risky Gambles Score	-.03	-.09	-.09	-.15
Resistance to Framing Score	-.04	.03	.03	-.04
Cognitive Reflection Test Accuracy	.08	-.06	-.10	.00
Consistency in Risk Perception Score	-.08	.05	.05	-.05
Age	-.27**	-.07	-.15	-.04
Mini-IPIP Extraversion	-.19*	.03	-.04	-.01
Mini-IPIP Conscientiousness	.21*	-.04	.01	.17
Irrational Decision-Making Style	-.10	-.24*	-.18	.07
Impulsive Decision-Making Style	-.19*	-.19*	-.20*	-.19*
Executive Function Factor	-.11	.03	.05	.09
Competence Factor (Confidence and Intelligence)	.17	.33*	.40**	.32*
Control Threshold Factor	.14	.03	-.02	.04
Uncertainty Factor	-.03	-.19*	.13	-.18*
ΔR ² from Block 3	.04	.09*	.09*	.09*
Total R ²	.32	.23	.23	.29

5. Discussion

Uncertainty appears to be a **unique metacognitive construct** which diverges from previously known metacognitive constructs of Confidence and Control Thresholds. Heuristics and biases decision-making did not predict any real-life performance outcome after controlling for individual difference and demographic variables. Instead, metacognitive and reasoning factors (Uncertainty and Competence) positively predict academic performance over and above heuristics and biases decision-making, decision-making styles, personality, and age.

Current directions: We are examining Uncertainty with other metacognitive constructs within the metacognitive framework (Solvability Judgements)

References

- Bruine de Bruin, W., Parker, A. M., & Fischhoff, B. (2007). Individual differences in adult decision-making competence. *Journal of Personality and Social Psychology*, 92(5), 938–956.
- Kahneman, D., & Tversky, A. (2013). Prospect theory: An analysis of decision under risk. In *Handbook of the fundamentals of financial decision making: Part I* (pp. 99–127). Kleitman, S., & Stankov, L. (2007). Self-confidence and metacognitive processes. *Learning and individual differences*, 17(2), 161–173.
- Ackerman, R., & Thompson, V. A. (2017). Meta-reasoning: Monitoring and control of thinking and reasoning. *Trends in Cognitive Sciences*, 21(8), 607–617.

Zoom link:

<https://uni-sydney.zoom.us/j/86842365827>

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