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Compatibility Effects in the Prescriptive Application of Psychological Heuristics

Individual Differences in MCDM Choice: The interplay between attentional control, selection strategy and information structure

Shashwat M. Pande, K. Nadia Papamichail & Peter Kawalek

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‘Fast and Frugal’ Heuristics

- Contingent/adaptive decision making (Beach & Mitchell, 1978; Payne, Bettman & Johnson, 1993).

- Strategy selection is based on task complexity and cognitive ability.
  - Compensatory → Non-compensatory.

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‘Fast and Frugal’ Heuristics

- 1) Decision strategies depend on the structure of task environments.
- 2) Decision makers are parsimonious in their expenditure of scarce cognitive resources.
- 3) Decisions are often based on relative salience rather than an integration of information

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‘Fast and Frugal’ Heuristics

- Gigerenzer, Todd, & The ABC Research Group (1999).
- *Simple heuristics that make us smart.*
- Can be prescriptively useful in a number of circumstances – ‘ecological rationality’
  - Information acquisition costs are high (Bröder, 2000)
  - Extreme time pressures (Payne et al., 1993; Rieskamp & Hoffrage, 1999)
  - Criterion information is obfuscated/be retrieved from memory (Bröder & Schiffer, 2006)

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‘Fast and Frugal’ Heuristics

- 1) Decision strategies *should* depend on the structure of task environments.

- 2) Decision makers *should be* parsimonious in their expenditure of scarce cognitive resources if…

- 3) Decisions *should be* based on relative salience rather than an integration of information if…

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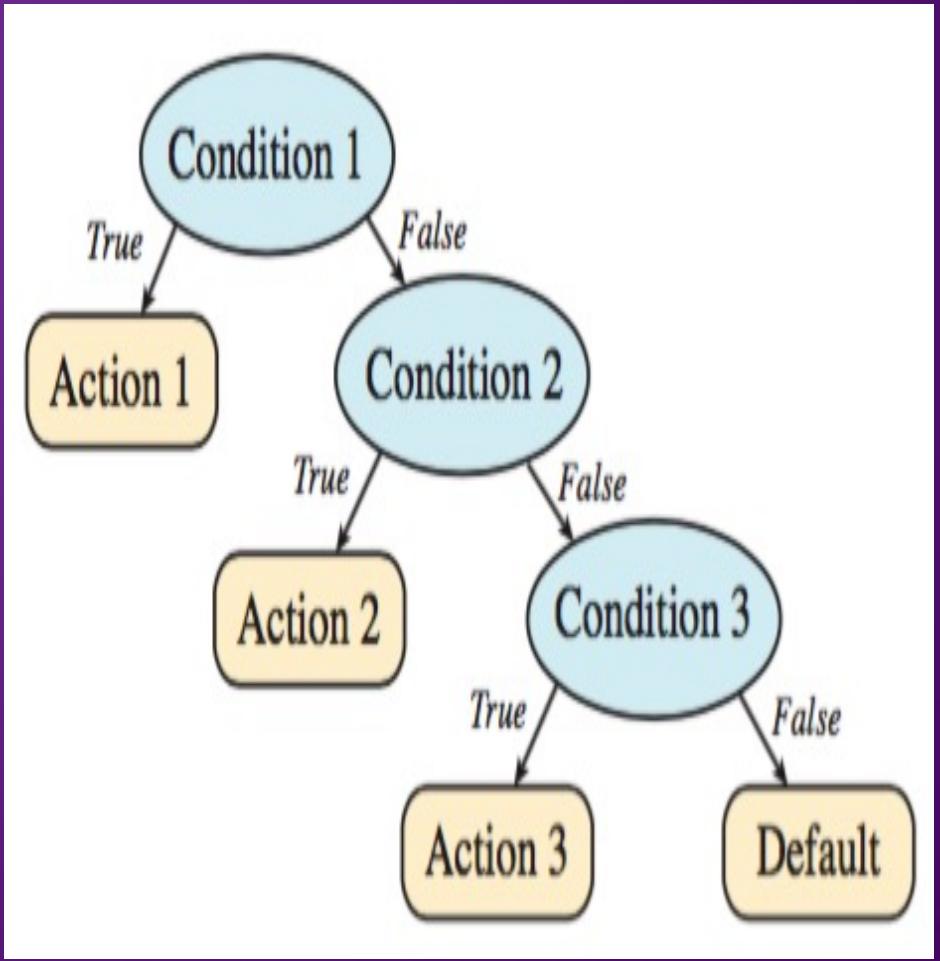
Applications for Decision Support and B-OR

- (Near) Costless to execute
- More transparent
- Conform with intuition
- Easy to understand



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E.g. – Where's Wally?

- Martin Handford
- Objective – Where's Wally?
- Highly non-compensatory but…
- Costless?

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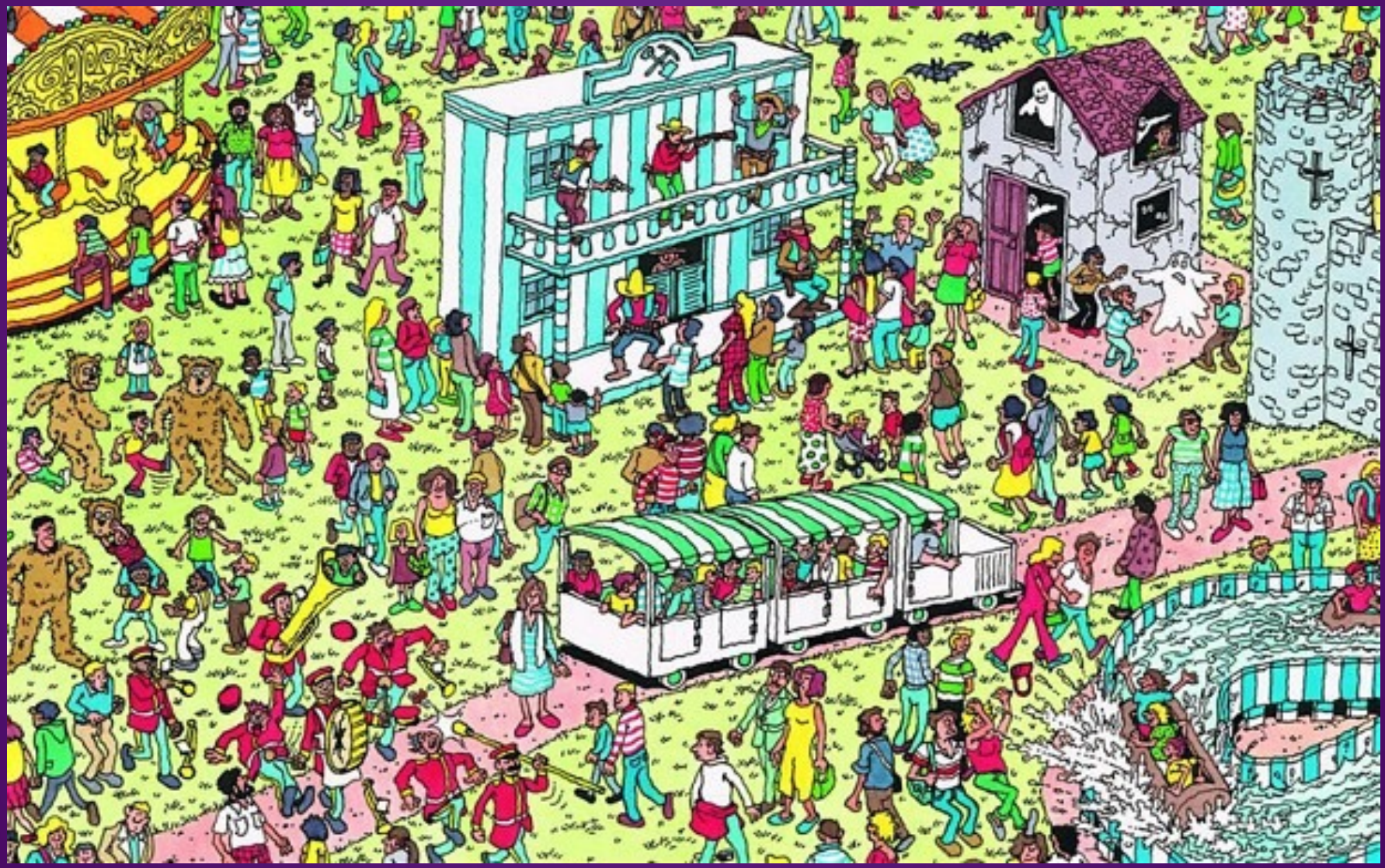

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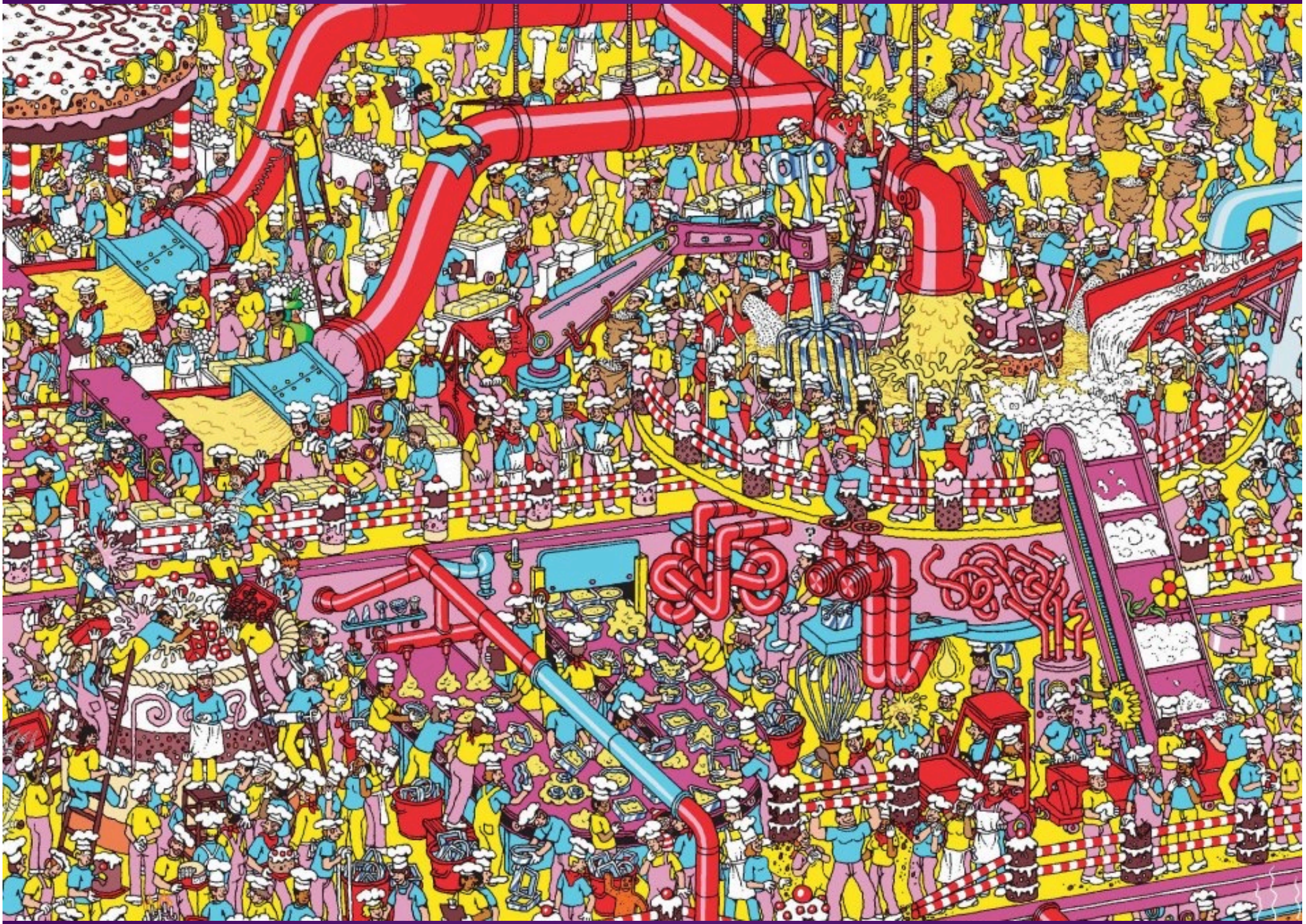

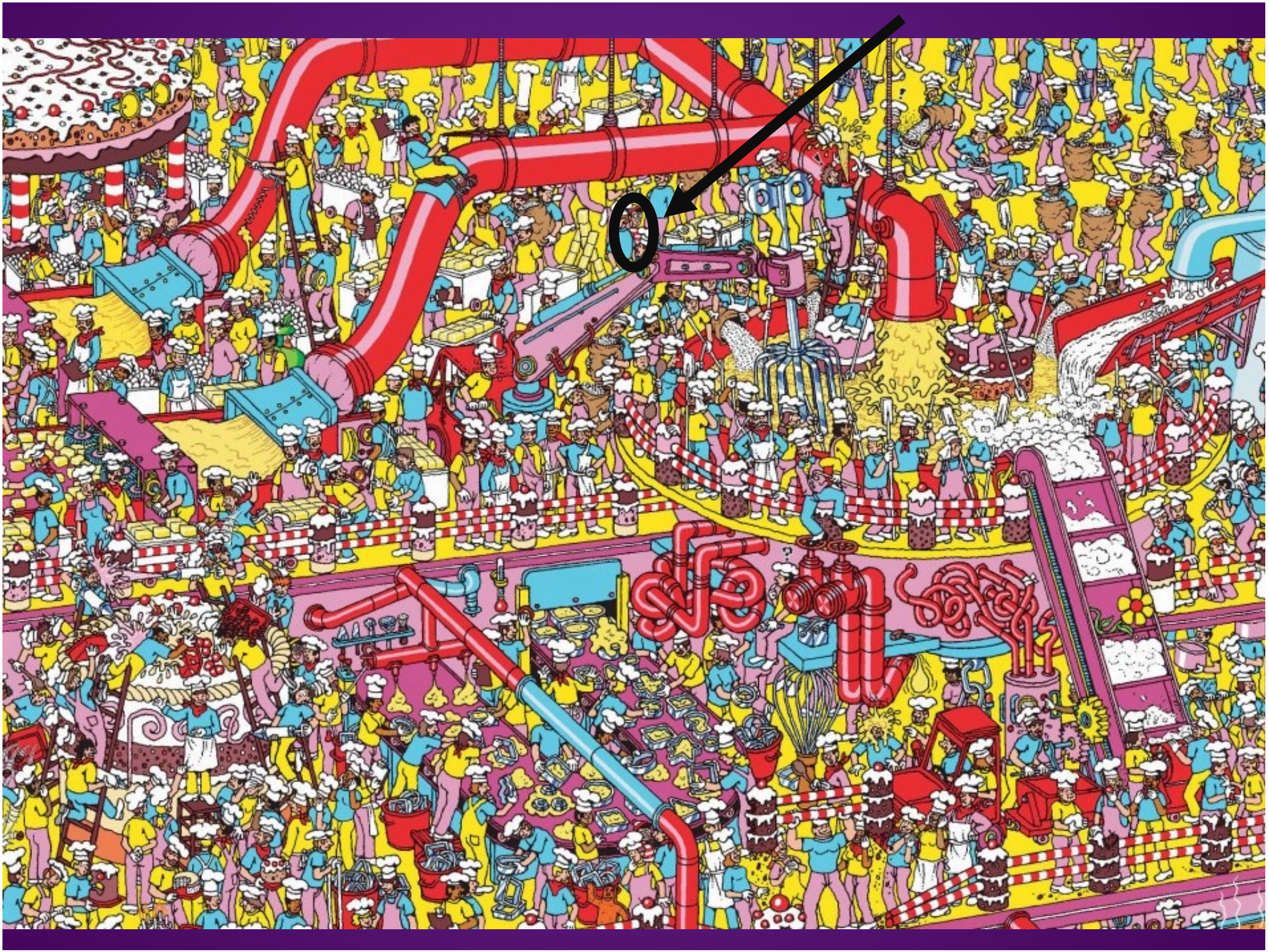

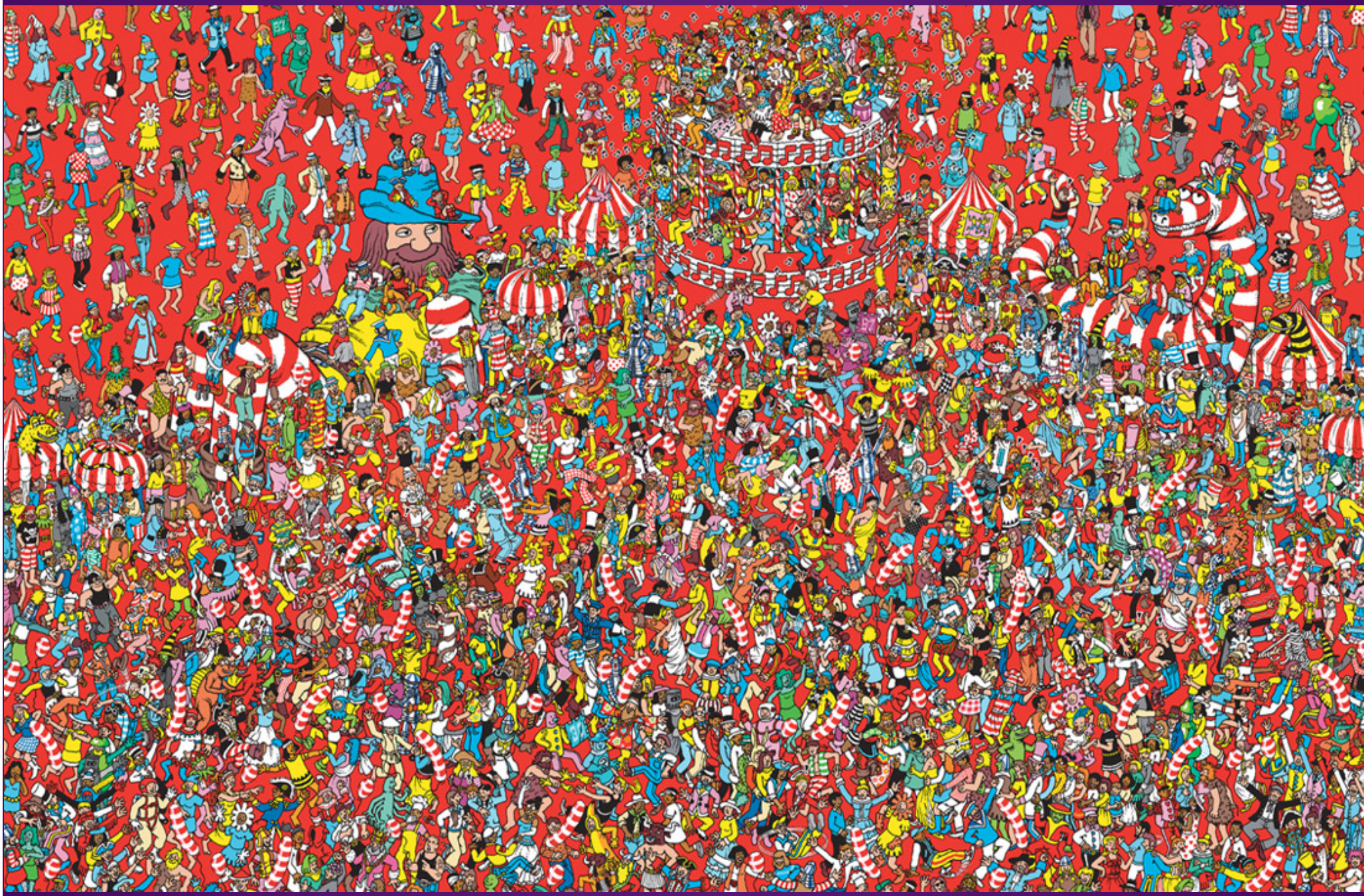

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What factors might improve strategy execution?

- Complexity (Information handling – PBJ, 1993, ABC group, 1999)
  - Information load (no. of alternatives, no. of attributes)
- Ability (Inhibitory Control – Efficient allocation of attention)
  - "…if information is abundant the resource that becomes scarce is…the attention of its recipients" (Simon, 1971)
- Tendency (Compensatory style – Basic disposition)
  - Do decision makers generally prefer confronting trade-offs?

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The Experiment

- 48 participants
- Prescriptive application of simple psychological heuristics (EQW, FRQ, DEBA and SAT)
- Contrast between compensatory (integrative) and non-compensatory (selective) strategies

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Measures

- 2 x 2 x 2 within subjects
  - No. of alternatives = 3 or 5
  - No. of attributes = 5 or 9
  - Prescribed strategy = compensatory or non-compensatory
- Between subjects measures for inhibitory control and compensatory style.
  - Eriksen Flanker Task
  - Compensatory style questionnaire

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Compensatory style questionnaire

- Zakay (1990)
- Bi-polar and self-reported construct measuring tendency (stated preference) for a more compensatory style
- 40-items
- *"When making a decision I always try to treat the advantages and disadvantages of different alternatives as counterbalancing each other."*

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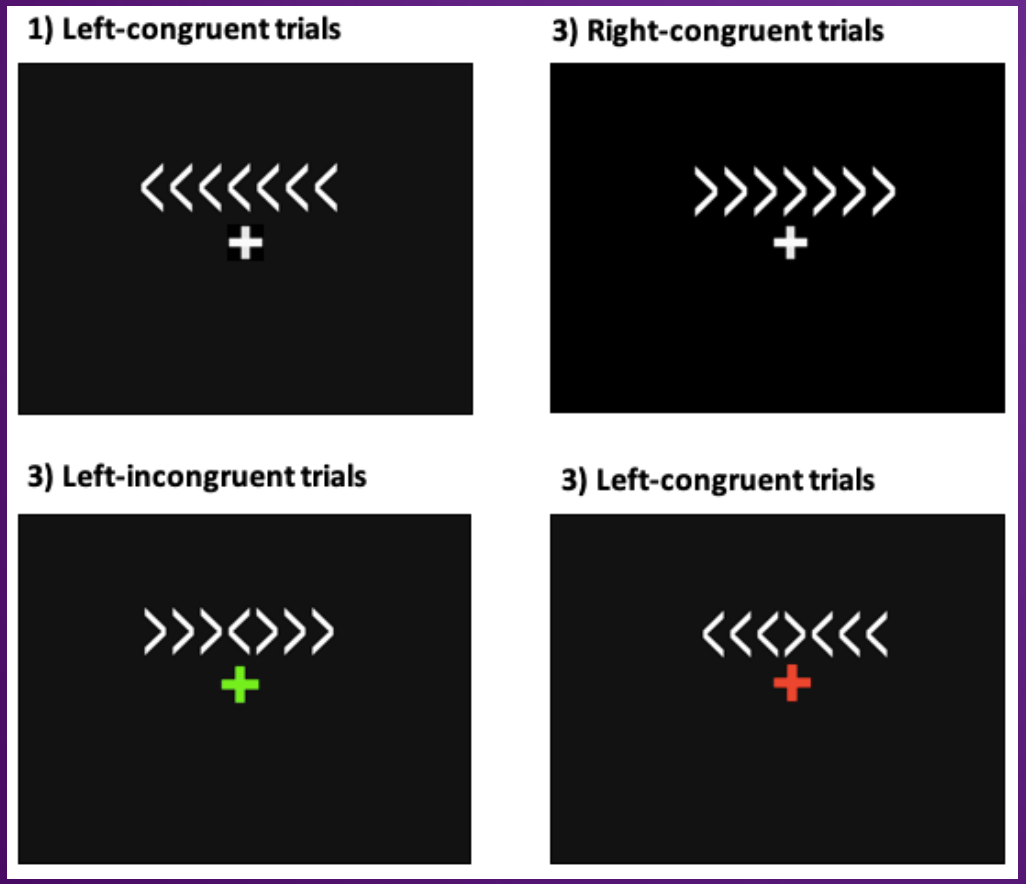
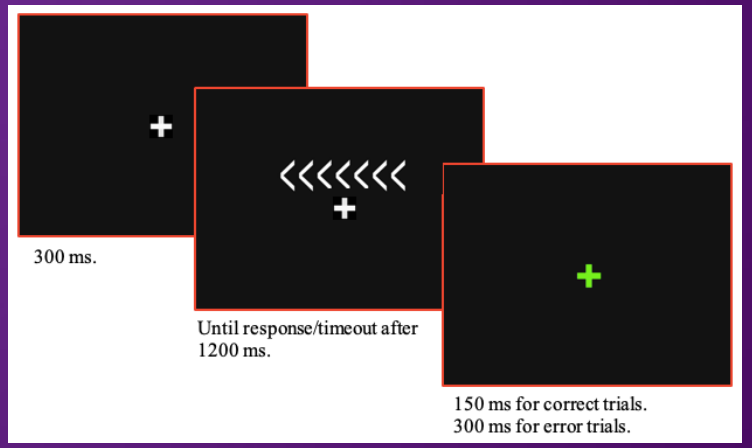
Eriksen (1974) ‘flanker’ task – Inhibitory Attentional Control





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Choice Problems

- Loosely adapted from A-DMC subscale measuring strategy execution (Bruine de Bruin et al., 2007).
  - 3x5, 3x9, 5x5, 5x9 alternatives by attributes
  - Absence of strict dominance
  - Balanced number of compensatory (8) and non-compensatory (8) choice problems

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Choice Problems

Non-Compensatory

		Features				
		Picture Quality	Sound Quality	Programming Options	Reliability of Brand	Ease of Use
DVD	A	5	4	5	1	5
	B	**5**	**5**	**3**	**3**	**5**
	C	4	5	2	5	2
	D	4	5	3	3	2
	E	5	3	3	3	5

Jimmy first selects the DVD players with the best Ease of Use. From the selected DVD players, he then selects the best on Picture Quality. Then, if there is still more than one left to choose from, he selects the one best on Sound Quality. Which **one** of the presented DVD players will Jimmy choose?

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Choice Problems

Compensatory

		Features				
		Picture Quality	Sound Quality	Programming Options	Reliability of Brand	Ease of Use
DVD	A	5	4	2	1	1
	B	5	5	1	3	3
	C	**4**	**5**	**2**	**5**	**3**
	D	4	5	3	3	2
	E	5	3	3	4	3

Julia wants a DVD player with the highest average rating across all features. Which **one** of the presented DVD players will Julia choose?

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Results

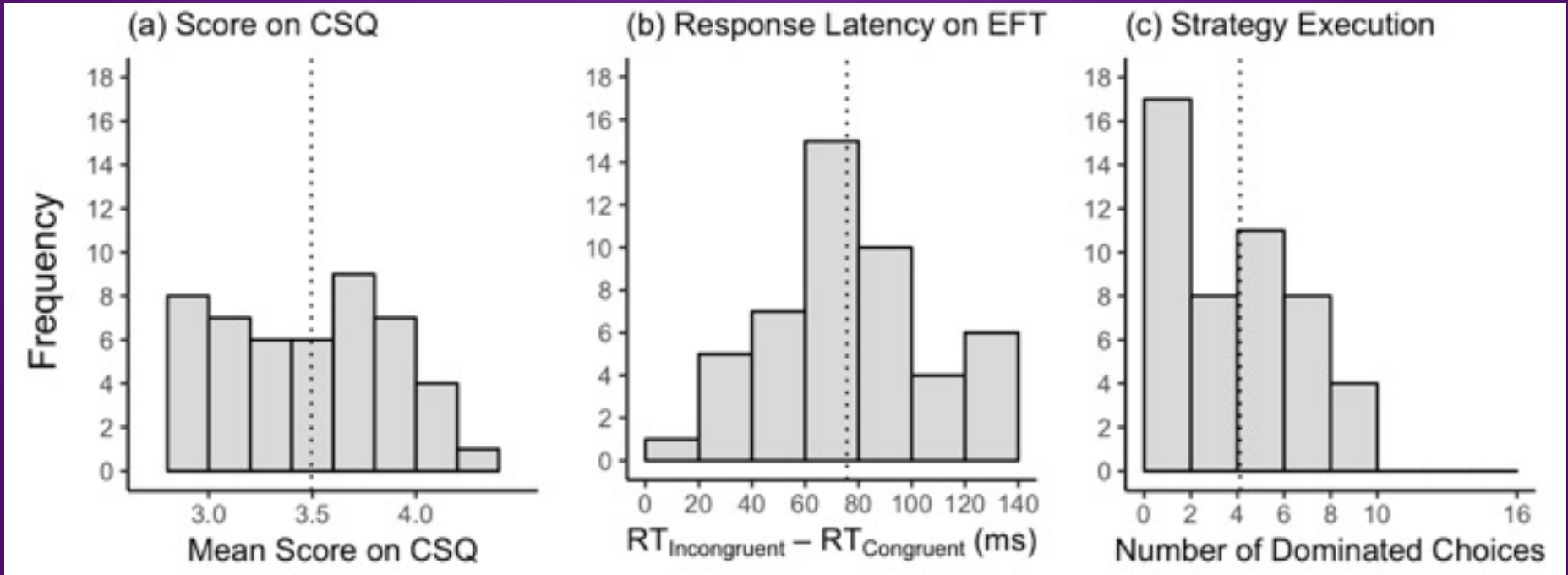

Figure A.1: Histograms for experimental variables. The dotted line represents the mean.

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Results

- No difference between strategies after accounting for other dependencies.

- Complexity
  - No. of alternatives (ALT)
  - No. of attributes (ATT)
- Tendency
  - Compensatory style (CSQ)
- Ability
  - Inhibitory Control (EFT)

Table 2. Results from multilevel logistic regression predicting the odds of selecting a dominated outcome.

	Estimates		Odds-Ratios	
Level and Variable	B (SE)	z-value	OR	95% CI for OR
(Intercept)	-2.23 (.35)	-7.08***	-	-
Task Level (n = 768)				
STRAT (ref = Compensatory)	.50 (.36)	1.38	1.65	[.81, 3.37]
ALT (ref = 3)	1.23 (.34)	3.63***	**3.42**	**[1.76, 6.63]**
ATT (ref = 5)	.87 (.34)	2.56*	**2.39**	**[1.23, 4.64]**
ALT x ATT	.09 (.38)	.24	1.10	[.52, 2.30]
ALT x STRAT	-.67 (.38)	-1.74†	.51	[.24, 1.09]
ATT x STRAT	-1.52 (.38)	-4.03***	**.22**	**[.10, .46]**
Subject Level (N = 48)				
EFT	-.09 (.14)	-.65	.91	[.70, 1.19]
CSQ	-.89 (.15)	-5.96***	**.41**	**[.30, .55]**
Cross-Level				
EFT x STRAT	.56 (.19)	2.94**	**1.75**	**[1.21, 2.55]**
CSQ x STRAT	.08 (.21)	.38	1.08	[.72, 1.63]
Variance Component				
σ_j^2		3.29		
μ_α		.11		
Fit Statistics				
Log-Likelihood		-383.6		
Marginal R^2 (Conditional R^2)		.29 (.31)		

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Results – Complexity

- Alternatives and attributes exert distinct influence.
  - Increasing alternatives degraded choice quality in both compensatory and non-compensatory environments
  - Increasing non-instrumental attributes *improved* choice quality in non-compensatory environments.

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Results – Complexity

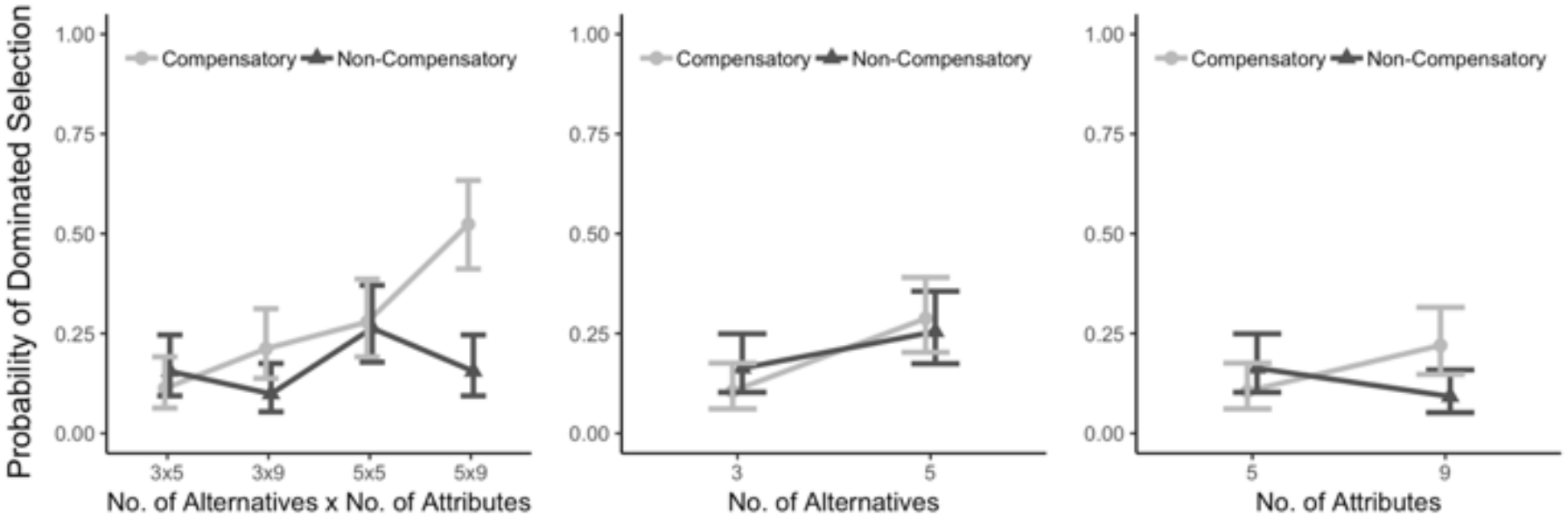

Figure 1. The effect of the number of alternatives and attributes on strategy execution in the compensatory (light-grey) and non-compensatory (dark-grey) conditions. The vertical bars represent the 95% confidence interval.

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Results – Tendency

- Most subjects reported a higher tendency for compensatory decision making.
  - A relatively more compensatory style was associated with improved task performance in general but…
  - Does not provide discriminatory information about different strategies
  - May be associated with greater flexibility or general decision making ability

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Results – Ability

- Relatively better performance on the flaker task predicts improved performance in non-compensatory environments.
  - Lower inhibitory control can mean that non-compensatory strategies are applied poorly.
  - Inhibitory control might allow individuals to screen criterion information more effectively.

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Results – Ability

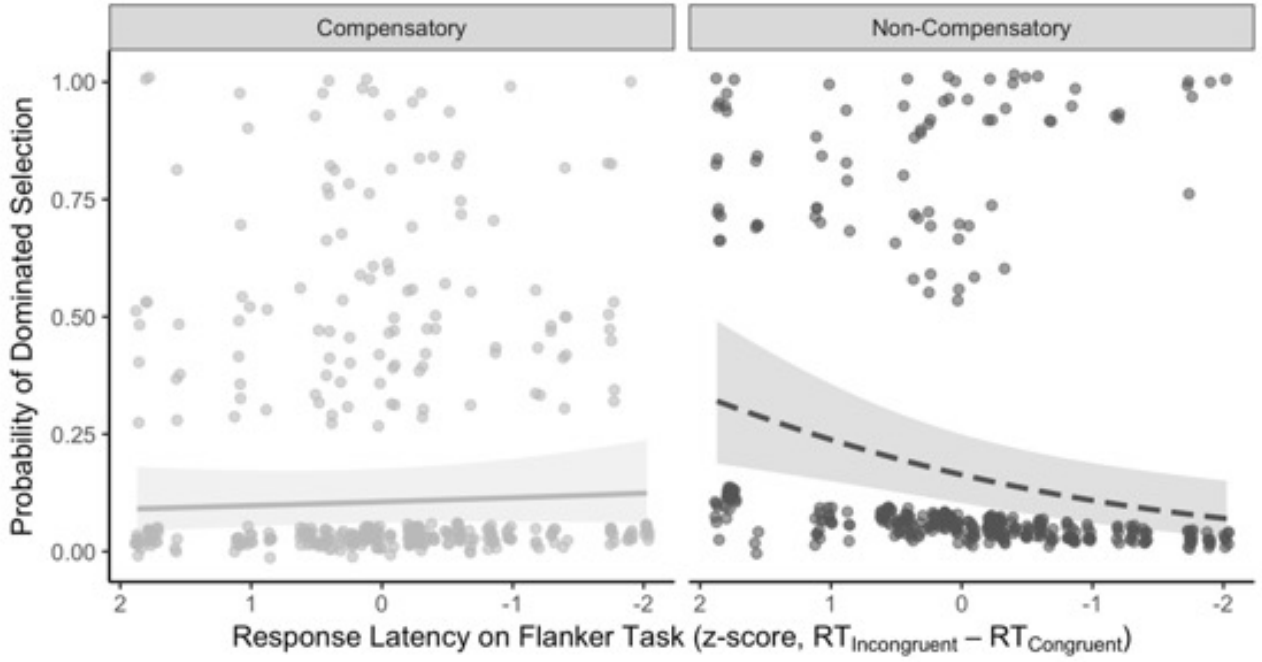

Figure 2. The effect of inhibitory control on strategy execution in the compensatory (light-grey) and non-compensatory (dark-grey) conditions. The translucent polygons represent the 95% confidence interval. The point estimates represent residual variance after accounting for the presence of other independent variables in the model. The x-axis is reversed and represents increasing inhibitory control. RTs are represented as z-scores for convenience (range = 129.85 to 16.94 *ms*).

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Implications for decision support

- Strategies should be assessed by their compatibility with both environmental and individual features.
- Fast and frugal aids might find robust applications in attribute rich environments where some attributes are heavily prioritized.
- Selective strategies are not cost-less and require effective inhibitory control
  - Training inhibition and automatizing selective processing?

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Thank you!