Reframing rationality: exogenous constraints on controlled information search.

Target Article: Rational Framing Effects: A Multidisciplinary Case - José Luis Bermúdez

Word Counts:
Abstract: 60; Main text: 1000; References: 814; Total: 2046

Commentary Title: Reframing rationality: exogenous constraints on controlled information search.

Authors: Yi Yang Teoh[1], Ian D. Roberts[2] & Cendri A. Hutcherson[2,3]

Institutions
[1]Department of Psychology, University of Toronto, Toronto, ON M5S 1A1, Canada
[2]Department of Psychology, University of Toronto Scarborough, Scarborough, ON M1C 1A4, Canada
[3]Department of Marketing, Rotman School of Management, University of Toronto, Toronto, ON M5S 3E6, Canada

Email:
Yi Yang Teoh: yang.teoh@mail.utoronto.ca
Ian D. Roberts: iandavidroberts@gmail.com
Cendri A. Hutcherson: c.hutcherson@utoronto.ca

Abstract
Bermúdez argues that framing effects are rational because particular frames provide goal-consistent reasons for choice and that people exert some control over the framing of a decision-problem. We propose instead that these observations raise the question of whether frame selection itself is a rational process and highlight how constraints in the choice environment severely limit the rational selection of frames.

Main Text
Classical theories of rationality often assume complete knowledge of decision-relevant factors. However, this assumption contradicts apparent constraints on decision-making in the real world, where people need to simultaneously search for information and determine its relevance for choices at hand. Because the quantity of information in many decisions far outstrips an individual's information processing capacity, selective attention is required to maintain representations of information one piece at a time, essentially highlighting different frames at different times during choice (Kiyonaga & Egner, 2013; Moore & Zirnsak, 2017; Myers et al., 2017; Smith & Krajbich, 2019). While this can theoretically result in a process of sequential frame selection using rational goal-driven attention, attention is also frequently exogenously constrained by the environment: what is attended is as often as not stimulus-driven as opposed to goal-directed (Corbetta & Shulman, 2002; Vanunu et al., 2021). Importantly, these attentional processes may interact in dynamic ways over time: the decision context primes particular frames of evaluation (Diederich & Trueblood, 2018; Maier et al., 2020), prior frames differentially enhance and constrain the accessibility of subsequent framings (Johnson et al., 2007; Nook et al., 2021), and executed decisions frame and bias post-choice evaluation (Chaxel et al., 2013; Navajas et al., 2016). We argue here

This is an Author Accepted Manuscript version of the following article: Teoh, Y. Y., Roberts, I. D., & Hutcherson, C. A. (2022). Reframing rationality: Exogenous constraints on controlled information search. Behavioral and Brain Sciences, 45, e242. The final authenticated version is available online at: https://doi.org/10.1017/S0140525X22001030

that determining when, and if, framing effects are rational requires a thorough consideration of these components of frame selection.

First, we argue that the external environment may disproportionately impact initial frames compared to internally represented goals, because attention tends to be drawn first towards salient information in the environment. Indeed, this is the mechanism for most framing studies, which induce frames by highlighting specific information in the decision problem itself (Kühberger, 1998; Levin et al., 1998; McDonald et al., 2021). This is true not only in classical framing studies, but even in the studies that Bermudez cites as evidence for the potential rationality of framing effects. For example, studies showing that framing marshmallows as "puffy clouds" facilitates rational choice and self-regulation work by explicitly encouraging participants to adopt these frames. It is not clear that people would typically select such "cool" frames in real-world contexts, particularly as the initial frame. Instead, research suggests that foods' appetitive qualities (e.g., sweet and tasty) are the most immediately salient dimension of evaluation (i.e. "hot frames"; see Maier et al., 2020; Sullivan et al., 2015), and that these appetitive frames may be rapidly represented regardless of people's efforts to refocus on healthy frames (HajiHosseini & Hutcherson, 2021). Effortful attentional control is thus usually required to re-focus attention away from initially appetitive frames in order to regulate one's choice (Papies et al., 2008; Rangel, 2013). Studies like the ones Bermudez cites circumvent the need for regulatory control by presenting 'cool' frames in advance, effectively off-loading the work of controlled attention onto the environmental context.

Second, although we fully agree that self-control may facilitate the decision-maker's ability to re-frame decision problems in alignment with their goals, we note that exogenously-determined initial frames can also constrain the accessibility of subsequent frames. For example, query theory accounts of the endowment effect show that framing a mug first as being owned by the decision-maker led people to consider its value-enhancing aspects more than when the mug was first framed as one of two possible choice options (Johnson et al., 2007). Moreover, certain frames of evaluation may be even more strongly constrained by sequence due to their emergent nature. For example, Bermúdez discusses two frames of evaluation in a strategic interpersonal interaction where people can cooperate for maximal joint outcomes or selfishly choose to minimize potential losses for themselves. Here, the "I-frame" provides strategic reasons for selfish behavior by emphasizing self-relevant outcomes of options while the "We-frame" provides reasons for cooperative behavior by emphasizing joint outcomes of options. Yet Bermúdez's discussion does not consider that the sequence of frames in this decision problem is directionally constrained: people have to first separately acquire information about their own outcomes ("I-frame") and their partner's outcomes ("You-frame") in order to evaluate joint outcomes ("We-frame"). This is highly consequential for decisions because recent work suggests that the information search necessary to adopt a frame incurs a cost (i.e. time and effort; see Callaway et al., 2021; Jang et al., 2021). Construction of the complex "We-frame" incurs a greater cost by requiring two separate information samples. People may thus be less inclined to spontaneously adopt this frame, especially under time constraints that limit the number of possible frames and increase the cost of each frame (Roberts et al., 2022; Teoh et al., 2020; Teoh & Hutcherson, *accepted*).

This is an Author Accepted Manuscript version of the following article: Teoh, Y. Y., Roberts, I. D., & Hutcherson, C. A. (2022). Reframing rationality: Exogenous constraints on controlled information search. Behavioral and Brain Sciences, 45, e242. The final authenticated version is available online at: https://doi.org/10.1017/S0140525X22001030

Finally, we highlight that constraints on frame-selection extend beyond the immediate choice and into processes of post-choice evaluation. Evidence suggests that people may continue to acquire more information about forgone options and sometimes reframe the chosen option in light of new information (Shani & Zeelenberg, 2007; Teodorescu et al., 2018). This process could promote more rational choice, by providing decision-makers with the opportunity to pre-emptively frame future decisions in service of rational goals (see Braver, 2012; Brick et al., 2016 for discussions of proactive and reactive control). However, just as prior frames constrain the accessibility of subsequent frames during choice, frames adopted during the decision process may also continue to bias post-choice framing of the decision problem. For example, research finds that people tend to seek out confirmatory information to justify the decisions they made (Brehm & Wicklund, 1970; Qin et al., 2011; Scherer et al., 2013), diminishing the potential for goal-directed attention to explore alternative frames that would promote more rational framings in future decisions.

Therefore, while different frames may provide different reasons that lead to distinct choices and people may strategically re-frame choices in alignment with their goals, we emphasize here that exogenous environmental and contextual factors strongly constrain these strategies. We have highlighted thus far how these constraints gate the accessibility of particular frames during and after choice. Understanding these constraints on frame-selection will prove critical to any theoretical account of how framing effects can be strategically used to promote human rationality.

Financial Support / Funding Statement:
Y.Y.T. is supported by funding from the Social Sciences and Humanities Research Council of Canada. I.D.R. is supported by funding from a Silvio O. Conte Center Grant to C.A.H. from the National Institutes of Mental Health. C.A.H. is supported by funding from the Social Sciences and Humanities Research Council and Natural Science and Engineering Research Council of Canada, as well as funding from the Canada Research Chairs program. All views expressed in this article represent the views of the authors, and not of SSHRC or NSERC.

Conflicts of Interest:
None

References:

Braver, T. S. (2012). The variable nature of cognitive control: A dual-mechanisms framework. *Trends in Cognitive Sciences*, *16*(2), 106–113. https://doi.org/10.1016/j.tics.2011.12.010

Brehm, J. W., & Wicklund, R. A. (1970). Regret and dissonance reduction as a function of postdecision salience of dissonant information. *Journal of Personality and Social Psychology*, *14*(1), 1–7. https://doi.org/10.1037/h0028616

Brick, N. E., MacIntyre, T. E., & Campbell, M. J. (2016). Thinking and Action: A Cognitive Perspective on Self-Regulation during Endurance Performance. *Frontiers in Physiology*, *7*. https://www.frontiersin.org/article/10.3389/fphys.2016.00159

Callaway, F., Rangel, A., & Griffiths, T. L. (2021). Fixation patterns in simple choice reflect optimal information sampling. *PLOS Computational Biology*, *17*(3), e1008863. https://doi.org/10.1371/journal.pcbi.1008863

Chaxel, A.-S., Russo, J. E., & Kerimi, N. (2013). Preference-driven biases in decision makers' information search and evaluation. *Judgment and Decision Making*, *8*(5), 561–576.

Corbetta, M., & Shulman, G. L. (2002). Control of goal-directed and stimulus-driven attention in the brain. *Nature Reviews Neuroscience*, *3*(3), 201.

Diederich, A., & Trueblood, J. S. (2018). A dynamic dual process model of risky decision making. *Psychological Review*, *125*(2), 270.

HajiHosseini, A., & Hutcherson, C. A. (2021). Alpha oscillations and event related potentials reflect distinct dynamics of attribute construction and evidence accumulation in dietary decision making. *Elife*, *10*, e60874.

Jang, A. I., Sharma, R., & Drugowitsch, J. (2021). Optimal policy for attention-modulated decisions explains human fixation behavior. *ELife*, *10*, 1–31. https://doi.org/10.7554/eLife.63436

Johnson, E. J., Häubl, G., & Keinan, A. (2007). Aspects of Endowment: A Query Theory of Value Construction. *Journal of Experimental Psychology: Learning Memory and Cognition*, *33*(3), 461–474. https://doi.org/10.1037/0278-7393.33.3.461

Kiyonaga, A., & Egner, T. (2013). Working memory as internal attention: Toward an integrative account of internal and external selection processes. *Psychonomic Bulletin & Review*, *20*(2), 228–242.

Kühberger, A. (1998). The Influence of Framing on Risky Decisions: A Meta-analysis. *Organizational Behavior and Human Decision Processes*, *75*(1), 23–55. https://doi.org/10.1006/obhd.1998.2781

Levin, I. P., Schneider, S. L., & Gaeth, G. J. (1998). All Frames Are Not Created Equal: A Typology and Critical Analysis of Framing Effects. *Organizational Behavior and Human Decision Processes*, *76*(2), 149–188. https://doi.org/10.1006/obhd.1998.2804

Maier, S. U., Raja Beharelle, A., Polanía, R., Ruff, C. C., & Hare, T. A. (2020). Dissociable mechanisms govern when and how strongly reward attributes affect decisions. *Nature Human Behaviour*, *4*(9), 949–963. https://doi.org/10.1038/s41562-020-0893-y

McDonald, K., Graves, R., Yin, S., Weese, T., & Sinnott-Armstrong, W. (2021). Valence framing effects on moral judgments: A meta-analysis. *Cognition*, *212*(March), 104703. https://doi.org/10.1016/j.cognition.2021.104703

Moore, T., & Zirnsak, M. (2017). Neural Mechanisms of Selective Visual Attention. *Annual Review of Psychology*, *68*, 47–72. https://doi.org/10.1146/annurev-psych-122414-033400

Myers, N. E., Stokes, M. G., & Nobre, A. C. (2017). Prioritizing Information during Working Memory: Beyond Sustained Internal Attention. *Trends in Cognitive Sciences*, *21*(6), 449–461. https://doi.org/10.1016/j.tics.2017.03.010

Navajas, J., Bahrami, B., & Latham, P. E. (2016). Post-decisional accounts of biases in confidence. *Current Opinion in Behavioral Sciences*, *11*, 55–60. https://doi.org/10.1016/j.cobeha.2016.05.005

This is an Author Accepted Manuscript version of the following article: Teoh, Y. Y., Roberts, I. D., & Hutcherson, C. A. (2022). Reframing rationality: Exogenous constraints on controlled information search. Behavioral and Brain Sciences, 45, e242. The final authenticated version is available online at: https://doi.org/10.1017/S0140525X22001030

Nook, E. C., Satpute, A. B., & Ochsner, K. N. (2021). Emotion Naming Impedes Both Cognitive Reappraisal and Mindful Acceptance Strategies of Emotion Regulation. *Affective Science*, *2*(2), 187–198. https://doi.org/10.1007/s42761-021-00036-y

Papies, E. K., Stroebe, W., & Aarts, H. (2008). The allure of forbidden food: On the role of attention in self-regulation. *Journal of Experimental Social Psychology*, *44*(5), 1283–1292. https://doi.org/10.1016/j.jesp.2008.04.008

Qin, J., Kimel, S., Kitayama, S., Wang, X., Yang, X., & Han, S. (2011). How choice modifies preference: Neural correlates of choice justification. *NeuroImage*, *55*(1), 240–246. https://doi.org/10.1016/j.neuroimage.2010.11.076

Rangel, A. (2013). Regulation of dietary choice by the decision-making circuitry. *Nature Neuroscience*, *16*(12), 1717–1724. https://doi.org/10.1038/nn.3561

Roberts, I. D., Teoh, Y. Y., & Hutcherson, C. A. (2022). Time to pay attention?: Information search explains amplified framing effects under time pressure. *Psychological Science*, *33*(1), 90–124. https://doi.org/10.1177/09567976211026983

Scherer, A. M., Windschitl, P. D., & Smith, A. R. (2013). Hope to be right: Biased information seeking following arbitrary and informed predictions. *Journal of Experimental Social Psychology*, *49*(1), 106–112. https://doi.org/10.1016/j.jesp.2012.07.012

Shani, Y., & Zeelenberg, M. (2007). When and why do we want to know? How experienced regret promotes post-decision information search. *Journal of Behavioral Decision Making*, *20*(3), 207–222. https://doi.org/10.1002/bdm.550

Smith, S. M., & Krajbich, I. (2019). Gaze Amplifies Value in Decision Making. *Psychological Science*. https://doi.org/10.1177/0956797618810521

Sullivan, N., Hutcherson, C., Harris, A., & Rangel, A. (2015). Dietary Self-Control Is Related to the Speed With Which Attributes of Healthfulness and Tastiness Are Processed. *Psychological Science*, *26*(2), 122–134. https://doi.org/10.1177/0956797614559543

Teodorescu, K., Sang, K., & Todd, P. M. (2018). Post-decision search in repeated and variable environments. *Judgment and Decision Making*, *13*(5), 17.

Teoh, Y. Y., & Hutcherson, C. A. (*accepted*). The games we play: Prosocial choices under time pressure reflect context-sensitive information priorities. *Psychological Science*.

Teoh, Y. Y., Yao, Z., Cunningham, W. A., & Hutcherson, C. A. (2020). Attentional priorities drive effects of time pressure on altruistic choice. *Nature Communications*, *11*, 3534. https://doi.org/10.1038/s41467-020-17326-x

Vanunu, Y., Hotaling, J. M., Le Pelley, M. E., & Newell, B. R. (2021). How top-down and bottom-up attention modulate risky choice. *Proceedings of the National Academy of Sciences*, *118*(39).

This is an Author Accepted Manuscript version of the following article: Teoh, Y. Y., Roberts, I. D., & Hutcherson, C. A. (2022). Reframing rationality: Exogenous constraints on controlled information search. Behavioral and Brain Sciences, 45, e242. The final authenticated version is available online at: https://doi.org/10.1017/S0140525X22001030