

Shaded Rational Agents: A Structural Activation Model*

*Working Paper Summary. Full draft available upon request.

Chaeyeon Renée Eunice Xon

School of Economics

Yonsei University

Seoul, Republic of Korea

eunixon@yonsei.ac.kr

Abstract—This paper proposes a structural refinement of the Rational Agent (RA) model by introducing a conditional activation mechanism. Standard models assume agents always articulate choices, but empirical anomalies suggest this is not always the case. We introduce a binary activation function, $\mathbb{I}_{active}(x)$, governed by a latent viability threshold, $\theta(x)$. Choices are made only for "activated" options, preserving classical rationality within this expressive domain. This framework, termed the Shaded Rational Agent, reinterprets behavioral phenomena like framing effects, cognitive overload, and decision fatigue not as deviations from rationality, but as outcomes of a structurally silenced choice space. By reframing silence as a structural boundary, this minimal extension retains the logic of optimization while expanding the formal scope of rational agency to explain when and why choices fail to be articulated.

Index Terms—Rational Agent, Structural Activation, Bounded Rationality, Choice Architecture, Decision Fatigue, Framing Effects

I. INTRODUCTION: WHEN CHOICE CANNOT SPEAK

The classical Rational Agent (RA) model is foundational to economics, assuming agents select utility-maximizing options from a well-defined choice set. This framework implicitly presumes that rationality is always "on"—that all options are structurally available for evaluation at all times. However, empirical patterns like inaction, framing effects, and decision fatigue suggest that choice itself is conditional. This paper argues that such "silence" is not irrationality, but a structural feature. We propose that a choice can only be made when it is structurally permitted to be articulated.

II. THE SHADED RATIONAL AGENT MODEL

We introduce a minimal but powerful structural adjustment to the RA model. The core modification is a binary ****activation function****, $\mathbb{I}_{active}(x) \in \{0, 1\}$, that filters the choice set.

A. The Conditional Choice Function

The agent's problem is redefined as optimization over a structurally activated domain:

$$x^* \in \arg \max_{x \in X} \mathbb{I}_{active}(x) \cdot u(x) \quad (1)$$

The utility function $u(x)$ remains unchanged. The innovation is that optimization only occurs over the subset of choices for which $\mathbb{I}_{active}(x) = 1$.

B. The Activation Threshold

Activation is governed by a latent viability threshold, $\theta(x)$. An option is structurally available for consideration only if its viability crosses a context-dependent activation bound, $\hat{\theta}$:

$$\mathbb{I}_{active}(x) = \begin{cases} 1 & \text{if } \theta(x) < \hat{\theta} \\ 0 & \text{otherwise} \end{cases} \quad (2)$$

This mechanism reframes non-choice not as a failure of the agent, but as a property of the choice architecture. Rationality is preserved, but it is conditional.

III. REINTERPRETING BEHAVIORAL ANOMALIES

The Shaded Rational Agent (Shaded-RA) framework provides a unified structural explanation for a range of behavioral anomalies without altering preferences.

- **Framing Effects:** Framing does not change an option's utility, but modulates its activation threshold $\theta(x)$. A positively framed option may be activated while its logically equivalent, negatively framed counterpart remains silent.
- **Cognitive Overload & Decision Fatigue:** These states are modeled as an increase in the activation threshold $\hat{\theta}$ (or a general rise in $\theta(x)$ across options). As cognitive resources deplete, fewer options become structurally viable, leading to inaction or simplified choices.
- **Time Inconsistency:** Preference reversals over time can be interpreted as a temporal drift in the activation thresholds, $\theta(x, t)$, which changes the set of active choices without any change in the underlying utility function.

In all cases, the anomaly arises from a shift in the expressive domain of choice, not from a breakdown in rationality.

IV. STRUCTURAL AND POLICY IMPLICATIONS

This reinterpretation shifts the focus of policy and institutional design. Instead of aiming to persuade agents by altering their perceived utility (e.g., via nudges), the goal becomes enabling choice by ensuring structural activation.

- **Choice Architecture:** The objective is to design environments that lower activation thresholds for beneficial options, making them structurally possible, not just theoretically available.
- **Policy Silence as Exclusion:** If certain groups consistently exhibit non-choice, it may indicate a structural failure to activate viable options for them. Policy that ignores these latent thresholds may inadvertently create structural exclusion.

V. CONCLUSION: RATIONALITY, WHEN IT CAN SPEAK

The Shaded-RA model does not reject the rational agent; it provides a structural envelope that defines its operative boundaries. Utility maximization remains the core logic, but it only applies to the subset of alternatives that are structurally viable for articulation. This minimal extension allows the RA model to account for a wide range of behavioral anomalies in a unified manner. It reframes silence not as an error, but as a formally explainable absence. Rationality is not always absent when it is unseen; sometimes, it is simply not yet allowed to speak.

REFERENCES

- [1] K. J. Arrow, *Social choice and individual values*. New York: Wiley, 1951.
- [2] G. Debreu, *Theory of value: An axiomatic analysis of economic equilibrium*. New Haven: Yale University Press, 1959.
- [3] D. Kahneman and A. Tversky, "Choices, values, and frames," *American Psychologist*, vol. 39, no. 4, pp. 341–350, 1984.
- [4] D. McFadden, "Conditional logit analysis of qualitative choice behavior," in *Frontiers in econometrics*, P. Zarembka, Ed. New York: Academic Press, 1974, pp. 105–142.
- [5] H. A. Simon, "A behavioral model of rational choice," *Quarterly Journal of Economics*, vol. 69, no. 1, pp. 99–118, 1955.
- [6] R. H. Thaler and C. R. Sunstein, *Nudge: Improving decisions about health, wealth, and happiness*. New Haven: Yale University Press, 2008.