

Economics and Computation Meets Cognitive Biases: A (Biased) Annotated Reading List

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This is an annotated reading list on papers in the intersection of economics and computation and behavioral economics.

General Terms: Economics, Theory

Additional Key Words and Phrases: Behavioral Economics, Mechanism Design, Present Bias

A recently growing line of works aims to bridge the gap between Economics and Computation and Behavioral Economics. Works in this space often come in one of these two flavors: (1) using tools from theoretical computer science to devise and study general models of cognitive biases and (2) considering players with cognitive biases in well-studied settings from Algorithmic Game Theory. This reading list is composed of some typical papers for each of these flavors as well as related papers from Behavioral Economics. The list is intended to serve as a starting point for researchers interested in this line of work and is not comprehensive.

First, we consider works about planning for the future when the agents exhibit some planning-related biases. Such biases include present bias, sunk-cost bias and projection bias. These biases are well studied in the behavioral economics literature in experimental and empirical settings. However, the theoretical models suggested to capture them are often quite specific to the setting. This line of work demonstrates that by harnessing tools from theoretical computer science and graph theory, we could obtain a much more general model and use it to ask and answer questions otherwise impossible. Our focus on this list will be on present bias.

The second type of works we list takes settings well-studied in Algorithmic Game Theory and aims to make them more applicable to real-life by considering some cognitive biases that the players exhibit. While planning-related biases, we previously discussed, have negative implications, here, there are settings in which taking the biases into account may have positive implications. In this reading list, we focus on works of this type situated in the field of algorithmic mechanism design.

- (1) [O'Donoghue and Rabin 1999] - Individuals exhibiting present bias focus more on the present than on the future. According to the hyperbolic discounting model such agents will multiply the cost (or utility) they get now by a factor of β and the utility at any future step t by a factor of $\beta\delta^t$. This classic paper in behavioral economics studies simple planning settings (e.g., “which day of the week should I complete the review?”) for agents exhibiting present bias.
- (2) [Kleinberg and Oren 2014] - This paper suggests a general graph-theoretic

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model for capturing the planning behavior of agents that exhibit present bias. The generality of the model enables it to capture different scenarios that previously each required a different specific model and compare them. For example, it allows a characterization of the types of scenarios in which the loss of the agent due to its bias is large.

- (3) [Gravin et al. 2016] - While most papers assume that the present bias parameter of the agent is fixed, the current paper assumes that the parameter is sampled each step independently from a given distribution. The paper identifies graphs in which the loss of the agent due to its bias is bounded and constructs for each bias-distribution a graph maximizing the agent's loss. The latter is done by identifying surprising connections to optimal pricing theory.
- (4) [Albers and Kraft 2021] A high-level question in the setting of [Kleinberg and Oren 2014] is how could we make changes in the task graph in order to help the agent mitigate the effects of its bias. Previous papers on this question consider setting deadlines; this corresponds to computing a subgraph where the agent will reach the target. The current paper takes a different approach. It sets penalties on some tasks to deter the agent from completing them and proves that this approach is quite effective.
- (5) [Strack and Taubinsky 2021] The last paper we mention on this topic is a bit of an outlier that offers a different perspective on planning behavior. Present bias (or as it is often termed these days *present focus*) often leads to time-inconsistent behavior in which agents keep changing their plan. The paper suggests an alternative explanation, which essentially says that we cannot distinguish between an agent that behaves inconsistently and an agent that behaves consistently but has some uncertainty regarding the future.
- (6) [Kahneman et al. 1991] - This paper describes a classic experiment demonstrating and estimating the endowment effect (i.e., an individual values items more once he owns them.). The rough idea is to give half of the subjects some object (e.g., a coffee mug) and ask them how much they are willing to sell it, and compare it with the price that the other half of the subjects are willing to pay for it.
- (7) [Babaioff et al. 2018] - In a combinatorial auction, Walrasian equilibrium is only guaranteed to exist if the players' valuations are gross substitutes. The paper suggests a model of endowment effect for combinatorial auctions and shows that if we assume that the players have a (mild) endowment effect, we can considerably extend the class of valuations for which a Walrasian equilibrium exists to sub-modular valuations.
- (8) [Ezra et al. 2020] - This paper considers different ways to model the endowment effect in combinatorial auctions and studies the implications of the different modeling assumptions on the class of valuations in which a Walrasian equilibrium exists. The paper highlights the need for more experimental work on the endowment effect in combinatorial auctions to understand which assumptions are more plausible.
- (9) [Gneezy 2005] - The paper belongs to a line of work in behavioral economics, arguing that people facing an opportunity to increase their payoff by lying do

not always choose to lie. The paper presents experiments demonstrating that people tend to lie less when their benefit from the lie is smaller with respect to the loss of another person, even a stranger, from the lie.

- (10) [Dobzinski and Oren 2022] - The paper builds on literature on lying behavior in behavioral economics to challenge a fundamental paradigm of mechanism design: bidders that could lie to increase their payoff will always do so. Based on behavioral assumptions extracted from this literature, the paper studies an auction model in which to determine whether to report their valuations truthfully, the bidders compare their gain from lying against the loss of the others. The paper asks whether an auctioneer can take advantage of bidders behaving this way to increase its revenue.

REFERENCES

- ALBERS, S. AND KRAFT, D. 2021. On the value of penalties in time-inconsistent planning. *ACM Transactions on Economics and Computation (TEAC)* 9, 3, 1–18.
- BABAIOFF, M., DOBZINSKI, S., AND OREN, S. 2018. Combinatorial auctions with endowment effect. In *Proceedings of the 2018 ACM Conference on Economics and Computation*. 73–90.
- DOBZINSKI, S. AND OREN, S. 2022. Mechanism Design with Moral Bidders. In *13th Innovations in Theoretical Computer Science Conference (ITCS 2022)*. Vol. 215. 55:1–55:17.
- EZRA, T., FELDMAN, M., AND FRIEDLER, O. 2020. A general framework for endowment effects in combinatorial markets. In *Proceedings of the 21st ACM Conference on Economics and Computation*. 499–500.
- GNEEZY, U. 2005. Deception: The role of consequences. *American Economic Review* 95, 1, 384–394.
- GRAVIN, N., IMMORLICA, N., LUCIER, B., AND POUNTOURAKIS, E. 2016. Procrastination with variable present bias. In *Proceedings of the 2016 ACM Conference on Economics and Computation*. EC '16. ACM, New York, NY, USA, 361–361.
- KAHNEMAN, D., KNETSCH, J. L., AND THALER, R. H. 1991. Anomalies: The endowment effect, loss aversion, and status quo bias. *5*, 1, 193–206.
- KLEINBERG, J. AND OREN, S. 2014. Time-inconsistent planning: A computational problem in behavioral economics. In *Proceedings of the Fifteenth ACM Conference on Economics and Computation*. EC '14. ACM, New York, NY, USA, 547–564.
- O'DONOGHUE, T. AND RABIN, M. 1999. Doing it now or later. *American Economic Review* 89, 1 (Mar.), 103–124.
- STRACK, P. AND TAUBINSKY, D. 2021. Dynamic preference “reversals” and time inconsistency. Tech. rep., National Bureau of Economic Research.