Research Statement

Modibo Camara, Ph.D. Candidate, Northwestern University

I am a microeconomic theorist, doing research at the intersection of economics and computer science. Much of my work incorporates methodologies from different fields – like computer science and statistics – with the ultimate goal of bringing economic theory closer to practice. Here, I discuss my job market paper, working papers, works in progress, and future directions.

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My job market paper, "Computationally Tractable Choice", provides theoretical foundations for behavioral heuristics by bringing powerful models of computation to decision theory. Specifically, I propose a new kind of axiom – computational tractability – and apply it to a model of choice under risk. This axiom is quite weak: it only rules out behaviors that are thought to be implausible for *any* algorithm to exhibit in a reasonable amount of time. If a decisionmaker could make intractable choices, we could convert those choices into efficient solutions to problems of significant importance to science and industry, for which no efficient solutions are known.

First, I use this framework to show that, under standard rationality assumptions, computational constraints necessarily lead to forms of choice bracketing (a common behavioral heuristic, see e.g. Tversky and Kahneman 1981; Rabin and Weizsäcker 2009). If a decisionmaker's choices are rational (i.e. maximize expected utility) and tractable, I show that her utility function must satisfy a separability property. Choice bracketing is optimal if and only if the separability property holds. Otherwise, expected utility maximization is intractable.

Second, I use these results to give a formal justification for behavior that violates the expected utility axioms. Consider a decisionmaker who wants to maximize the expected value of an objective function that happens to be intractable. For many such objective functions, I show that a computationally-constrained decisionmaker *cannot* simultaneously (i) guarantee any non-zero fraction of her optimal payoff and (ii) have revealed preferences that satisfy the expected utility axioms. Then I show that the decisionmaker *can* guarantee a reasonable payoff, but only by using heuristics that an outside observer would not recognize as rational.

This framework could be used to explore other behavioral heuristics, like mental accounting and correlation neglect, or to motivate new definitions of rationality. But there is another exciting next step: I show that the separability conditions that make expected utility maximization tractable also mitigate a curse of dimensionality that arises in demand estimation for settings with many products or many product characteristics. This result raises the intriguing possibility that computational tractability can be used to replace stronger parametric assumptions in econometrics.

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My two working papers develop a theory of data-driven mechanism design. Both consider incomplete information games between a policymaker who sets a policy, an agent who responds, and a hidden state of nature. In line with the longstanding Wilson critique, these papers take the position that neither policymakers nor agents are likely to have a perfect understanding of the world. But, in contrast to more conservative approaches in robust mechanism design, they do not insist on mechanisms that are entirely detail-free. Instead, they observe that any available data can be used by the policymaker to (i) learn about the world and (ii) make more credible assumptions about the agent's beliefs. Formalizing this requires new ideas from statistics and machine learning.

In "Mechanisms for a No-Regret Agent: Beyond the Common Prior" (with Jason Hartline and Aleck Johnsen), we replace common knowledge with common history: data accumulated over time through repeated interaction between the policymaker and agent. The state is revealed after every period, but we make no other assumptions on the state-generating process. We develop calibrated policies that adapt to historical data over time, assuming the agent does the same, even if the data is highly non-stationary. This requires new behavioral assumptions that build on prior work on learning in games and capture ideas like "rationality" and "unpredictability" in a fully ex post sense. I presented this work at the peer-reviewed "Symposium on Foundations of Computer Science" (FOCS 2020) and at the 2021 "Highlights Beyond EC" plenary session.

In "Mechanism Design with a Common Dataset", I replace common knowledge with a common dataset: a random sample of states. The high-level idea is straightforward: if the data convincingly demonstrates some fact about the world, the agent should believe that fact. To formalize this, I rely on tools from statistical learning theory that characterize the complexity of learning an optimal response to a given policy. I propose a penalized policy that performs well under weak assumptions on how the agent learns from data, where policies that are too complex are penalized if they lead to unpredictable responses by the agent. This leads to new insights in models of vaccine distribution, prescription drug approval, performance pay, and product bundling.

The long-term goal of this work is to develop mechanisms that (i) address the Wilson critique, (ii) are not excessively conservative, and (iii) are designed to be used with real-world data. The best way to validate this goal is through applications. I am especially interested in the design of teacher pay-for-performance schemes as an application area where rich value-added data is available, as well as price regulation that adapts to changing market conditions over time.

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My ongoing work focuses on applied theory, including projects on incentives in voting systems, school admission policies, and disclosure in labor markets.

In "Incentives for Informed Voting" (with Nicole Immorlica and Brendan Lucier), we study markets for votes. There is substantial interest in how markets can disincentivize strategic voting, but empirical research in political science (e.g. Bartels 1996; Gilens 2001) suggests that uninformed voting is also a major concern. To address this, we consider a model of social choice with costly information acquisition. In large populations, typical voting rules only have uninformed equilibria because voters are extremely unlikely to be pivotal. We propose a subsidized political betting market, run independently of the vote itself. If the efficient outcome depends on the costly information, only informed equilibria survive an unraveling argument: agents can profit off being informed as long as others are too. Otherwise, uninformed equilibria are already efficient.

In "Fair Mechanism Design" (with Hedyeh Beyhaghi, Jason Hartline, Aleck Johnsen, and Sheng Long), we study school admission policies and related mechanism design problems. One important source of unfairness is that underprivileged students face constraints in achieving good performance that their privileged peers may not. We formalize the school's problem in a model where students of high or low skill put in effort to showcase their quality, but differ in their effort budget. We characterize optimal admission policies, without assuming that schools have explicit fairness objectives, and find that lower-performing students are admitted (albeit at lower rates). Schools tolerate some privileged low-skill students in order to attract underprivileged high-skill students.

In "Signaling through Non-Disclosure" (with Ian Ball, Sid Banerjee, and Nicole Immorlica), we consider why non-disclosure of germane information, like test scores or salary history, appears so prevalent in labor markets (e.g. Agan et al. 2020). This may occur if non-disclosure is a positive signal of quality. We take a model of disclosure with quadratic costs and add a new ingredient: the receiver can acquire additional information about the sender at some private cost. By not disclosing, receivers can signal their belief that they are more qualified than the disclosed information would suggest. This incentivizes senders to acquire additional information, but can backfire if the sender's costs are too high. We formalize this idea by proving the general existence of equilibria with partial disclosure, in sharp contrast to the standard unraveling result.

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Going forward, I will pursue research on the economics of search engines and their cousins, recommender systems. These systems are critical economic infrastructure: they match consumers with the products and content that they value, whether through general web search like Google, online marketplaces like Amazon, or social media platforms like Facebook. They address fundamental economic questions – how can we use behavioral data to infer what consumers want? – but do not always succeed (e.g. Fleder and Hosanagar 2009). They compete in extraordinarily concentrated markets and benefit from a new source of market power: user data. And, at their core, these systems are about bounded rationality: we cannot process huge volumes of unfiltered information, and so allow algorithms to filter that information for us (e.g. De Los Santos et al. 2012).

In these observations, I see a long-term research agenda on the economics of search and recommendation. It applies my training in microeconomics, computer science, and econometrics to problems that are critically important to economics, our economy, and our society.

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