Research Statement

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My research lies at the intersection of behavioral economics and information economics. Information has always been important component of economic activity, but given the veritable explosion in data availability and product complexity, individuals now face an overwhelming amount of information when making decisions both big and small. While much of the information economics literature considers fully rational decision-makers who have no constraints on processing information, there is increasing evidence from the psychology, economics, and neuroscience literatures that cognitive limitations and behavioral biases can strongly impact the way that information is understood and the way that information is communicated. The aim of my research is to help bridge the gap between behavioral economics and information economics, with the hope this will allow us to better understand how information works in markets and the impact that information has on the welfare of individuals.

I study three key forces: inattention, imperfect perception, and biased beliefs. Because these forces are hard to directly observe, I uncover them by identifying patterns in the choices that people make. This approach requires creating a tight connection between data and theory. I use data to test the predictions of models of inattention, imperfect perception, and biased beliefs, and I use theory to generate predictions that are well suited to be tested empirically. When I find a model that makes accurate predictions, I leverage it to make welfare assessments for individuals, and when a model fails to predict accurately, I use these departures to build new models.

Of my thirteen completed research papers, nine are focused on inattention and imperfect perception:

[1] *Search and Satisficing* (AER 2011) with Andrew Caplin and Mark Dean
[2] *A Testable Theory of Imperfect Perception* (EJ 2015) with Andrew Caplin
[4] *The Dual-Process Drift Diffusion Model* (EI 2016) with Andrew Caplin
[5] *Strategic Pricing with Rational Inattention to Quality* (GEB 2017)
[6] *Defaults and Attention* (RE 2017) with Andrew Caplin
[9] *Complex Disclosure* (MS R&R) Ginger Jin and Michael Luca
[10] *Comparison of Decisions Under Unknown Experiments* (JPE R&R) with Andrew Caplin
[11] *Contingencies, Framing, and Informativeness* with Edwin Munoz-Rodriguez
[13] *Misperceiving Mechanisms* with Edwin Munoz-Rodriguez

Five of these papers are now published, and one was published in a “top 5” economics journal (*American Economic Review*). One completed paper is currently under revision in a “top 5” economics journal (*Journal of Political Economy*) and another is now under revision at a top management journal (*Management Science*).

I have a second line of research in which my co-authors and I measure the welfare impacts of behavioral biases and limitations in perception and attention. One of my two completed papers on this topic is now published, and the other (*Predictive Power in Behavioral Welfare Economics*) is forthcoming at a top economic journal (*Journal of the European Economic Association*).

[3] *Measuring Rationality* (ReStat 2016) with Mark Dean
[8] *Predictive Power in Behavioral Welfare Economics* (JEEA forthcoming) with Elias Bouacida

I have a third line of research that examines the disclosure of information. Two of my completed papers on information disclosure are:

[7] *Is No News (Perceived As) Bad News?* (AEJ Micro forthcoming) with Ginger Jin and Michael Luca
[12] *What Do Consumers Learn from Regulator Ratings?* (JEBO R&R) with Tami Kim

There is a fair amount of overlap between these three lines of research. For example, *Complex Disclosure* looks at the implications of inattention and imperfect perception for how information is disclosed, and *Comparison of Decisions Under Unknown Experiments* sits at the intersection of all three areas.

For the foreseeable future, I plan to continue actively working at the intersection of behavioral economics and information economics. For example, I have one work-in-progress that investigates how to assess welfare in a way that accounts for the cognitive costs of trying to understand complex information and another work-in-progress that shows how to detect prejudice when decision-makers have private information that can differ across demographic groups.

Research Impact

My most cited paper is *Search and Satisficing*, which has over 300 Google Scholar citations. It has been taught in the PhD field classes on experimental and behavioral economics at several top economic programs, including Stanford University, University of Pittsburgh, Brown University, Columbia University, New York University, University of California, Santa Barbara, University of California, San Diego, University of Michigan, Carnegie Mellon, University of Chicago, Northwestern University, University of California, Berkeley, and the Paris School of Economics. Over the past few years, other researchers have adopted experimental designs from this paper. Agranov, Caplin, and Tergiman (JESA 2015) use the techniques from *Search and Satisficing* to

study the evolution of play in games; Samek, Hur, Kim, and Yi (JEBO 2016) to study the use of digital tools; and Kessler, Kivimaki, and Niederle (2017) to study generosity.

Is No News (Perceived As) Bad News? An Experimental Investigation of Information Disclosure, which has over 85 Google Scholar citations, has also been taught in the PhD field classes on experimental and behavioral economics at several schools, including New York University, Northwestern University, and the University of Toronto. In addition, Montero and Sheth (2020) use techniques from this paper to study how groups react to non-disclosure.

On the theoretical side of my research, the framework and testable conditions introduced in *A Testable Theory of Imperfect Perception* have been extended by several other researchers. Caplin and Dean (AER 2015) use our condition in their characterization of rationally inattentive behavior; Caplin, Dean, and Leahy (2017) use it in their characterization of Shannon entropy attentional costs; Chambers, Liu, and Rehbeck (JET 2020) in their characterization of non-separable attentional costs; Denti (2020) in his characterization of separable information costs; and Caplin and Martin (2020) in comparing the value of decisions. Recently, it has been incorporated into Machine Learning algorithms by Hoiles, Krishnamurthy, and Pattanayak (JMLR 2020) and Pattanayak, Krishnamurthy, and Blasch (IEEE 2020).

Topic: Inattention and Imperfect Perception of Information

All of these projects aim to answer the same question: do individuals act as if they systematically trade off the psychological costs of trying to better understand information with the benefits from improved decision-making? To help answer this question, we investigate how attention and perception appear to change as the incentives change, either because the returns have changed or because the underlying psychological costs have changed.

The challenge in studying this question is that attention, perception, and psychological costs are unobservable, so we must look for a reflection of them on those things that we can observe, such as choices, response times, eye tracking, neural activation, and so on. In my research, I determine whether observable choices and response times are consistent with different models of attention: costly sequential search in [1]; general inattention/perception in [2], [10], and [11]; the drift diffusion model in [4]; the Sims (2003) rational inattention model in [5] and [13]; and a distinct separable attentional cost model in [6].

These projects are inherently interdisciplinary, as papers from the cognitive psychology and neuroscience literature (such as Ratcliff 1978), motivated several of the models of attention featured my work. In addition, the rational inattention model that I have used draws heavily from the information theory literature (Shannon 1948).

[1] ***Search and Satisficing***

In this paper, we study how individuals choose among options that are described in a complex way, so that costly attentional effort is required to learn their value. The novelty in this paper is that we elicit "Choice Process Data," which is the sequence of intermediate choices before a final option is chosen. We accomplish this by recording the choice that will be used for payment at a random time that is unknown to the participant, so that the participant is incentivized to always have his or her most preferred option selected at any time until the time limit for a given choice problem is reached.

Using this data, we are able to distinguish whether choices are the outcome of costless utility maximization or costly sequential search, something that is impossible with standard choice data. When people search item-by-item and searching each item has a cost, the optimal procedure is to search until you find something that is "good enough" and then stop searching. With Choice Process Data, you can see when someone has changed their choice, which means that they have abandoned an option was not good enough.

As a result, we are able to provide the first clean test of the "satisficing" theory of Simon (1955), which is a seminal theory in the field of behavioral economics. In this theory, agents think through a problem until they have found an option that will make them satisfied. In other words, they stop thinking when they have found something that is good enough. Because this theory has been widely applied, but is difficult to test, our paper has been cited as evidence of satisficing across a wide array of fields.

[2] ***A Testable Theory of Imperfect Perception***

In many fields, such as economics, cognitive psychology, and neuroscience, individuals are often modeled as choosing optimally given some private information about which option is best. This is particularly true for most approaches to limited attention and imperfect perception, such as rational inattention theory, signal detection theory, and the baseline drift diffusion model.

In this paper, we develop a test, called the NIAS condition, for whether it is appropriate to assume from a set of choices that the decision-maker is choosing optimally given some private information. Because we do not know anything about the private information of the individual, the surprise in this paper is that it is possible to fail such a test.

The key to producing restrictions on behavior is to consider a novel and rich set of data, which we call "state-dependent stochastic choice data." This data set is the probability of choosing each action in each state of the world. For example, we could ask how likely a person is to buy a coffee when the price is $6 and the coffee is from Brazil. The idea is that the individual may not

know the price or origin every time he or she makes a purchase, but the individual should account for how likely the price is to be $6 and the origin is to be Brazilian when he or she does.

We also show that the NIAS condition can be used to make robust predictions about choices, recover information about the utility of options, and to classify models as having this property or not. However, the real value of the NIAS condition is that it must be passed to even consider most models of limited attention and imperfect perception. As a result, several authors have built upon the NIAS condition to create tests for specific models of information processing.

[5] ***Strategic Pricing with Rational Inattention to Quality***

In this paper, I apply the rational inattention model of Sims (2003) to a classic pricing game in economics. In this game, the seller sets a price for a product, and the buyer decides whether or not to buy it, even though he or she is uncertain of the quality. As with many consumers in the real world, the buyer in my model attempts to infer something about the quality of the product from the price, but this can lead to mistakenly buying low quality products at high prices.

I adapt this game in two ways to account for limited attention. First, I imagine that the buyer has access to outside information about the quality of the good, but faces cognitive costs in processing this information. Second, I imagine that the buyer does not have access to outside information about the quality of the good, but faces cognitive costs in figuring out what price implies about quality. Understanding the relationship between prices and quality can be challenging for consumers because of the cognitive difficulties in forming correct strategic beliefs.

My aims for this paper were to establish testable predictions for behavior in this game and to show that rational inattention theory can be useful for producing testable predictions in a wider class of games. One prediction for behavior in this setting is that sellers with high quality products will price high and that sellers with low quality products will price low sometimes and price high at other times. A more demanding prediction is that the rate at which sellers of low quality products price high should match the rate at which buyers mistakenly buy low quality products at high prices and mistakenly reject high quality products.

One of the primary innovations in this paper is that I use rational inattention to model individuals who have cognitive difficulties in forming correct strategic beliefs. In the literature on behavioral game theory, it is typical to assume that individuals have a fixed limitation in forming strategic beliefs, but my approach allows these limits to be the outcome of trading off the costs and benefits to thinking through a strategic interaction.

[9] ***Complex Disclosure***

In this paper, we explore the option to disclose information in a complex way. While there has been a recent proliferation of theoretical papers in economics and finance on why firms might benefit from strategically choosing to make disclosures complex, there has been a dearth of empirical evidence. In our experiment, senders use complex disclosure frequently. Most of this obfuscation is profitable because receivers make systematic mistakes in assessing complex reports that appear to be driven by naivete and overconfidence. This highlights the incentives for firms to strategically complexify information disclosed to consumers, potentially harming consumers and undermining the effectiveness of disclosure.

The patterns we observe have policy implications as well. For example, many obfuscation theories assume naivete in (a fraction of) consumers, hence consumer education that reduces naivete should alleviate the seller's incentives to obfuscate. But sophistication does not save them from obfuscation if they are overconfident about their ability to comprehend complex reports. Policy tools that target overconfidence can be different from education efforts that target consumer naivete. Given this, our results suggest that overconfidence might be worth exploring in follow-up lab experiments, field studies on complex disclosure, and theoretical models of complex disclosure.

[10] ***Comparison of Decisions Under Unknown Experiments***

Here we show how to assess the welfare of individuals when we do not know the information that was disclosed to them or how well they understood that information. This approach can be used to determine, for example, whether the advice from one financial advisor helped decision-makers make better portfolio allocations than the advice provided by a different advisor, whether watching one news program helped decision-makers choose better health behaviors than watching another news, or whether one description of fees lead to better health plan choices made than a different description of fees.

In these settings, it is often challenging to know what an advisor said to their clients if there are privacy concerns, advice is proprietary, or it is challenging to codify the advice provided. Further, even if we know exactly the information they provided to their clients, it might be challenging to know what the clients understood about the facts based on that information. Instead, our approach is based on the resulting choices, which are easier to observe. For instance, many data sets contain the stocks that were bought, the vaccines that were taken, the health plans that were selected, and so on.

Our primary contribution is to provide a condition, which if satisfied by the choice data, reveals that one way of presenting information provided higher welfare than another. We also provide

computer programs that can quickly and easily test for whether a data set satisfies this condition, which opens up this area for further study.

Other Papers

In [11] and [13], we propose a new form of inattention: being inattentive to the contingent payoffs of a mechanism. In these papers, we use online experiments to vary aspects of the BDM mechanism, we find evidence in [11] that framing information about payoffs contingency-by-contingency can substantially reduce choice mistakes, and we measure how much better informed subjects are about contingent payoffs under this frame. In [13], we that participants misperceive the mechanism and that their misperceptions responds as rational inattention theory would suggest. If individuals do trade off the costs and benefits of understanding the payoffs of the mechanisms they face, this has substantial implications for research in several fields, as the BDM mechanism is widely used to elicit values, and for policy, as mechanisms are now being used widely to allocate school slots, medical jobs, organs, and so on.

Finally, I have two other papers on attention that are shorter in length and less ambitious in scope than the others. In [4] and [6], we test models of information processing that allow for partial consideration of options, which is in contrast to the stark model of costly sequential search that we study in [1]. We find evidence broadly in line with both models using the same choice objects from [1].

In both cases, the projects were very exploratory, and I am unlikely to work with these models of information processing in the future. However, these papers make a methodological contribution by demonstrating that response times can be useful in identifying when individuals have decided to pay no attention at all. From this, we learn that individuals often decide to pay no attention at all, that there is heterogeneity in this behavior both across and within individuals, and that individuals appear to incorporate information about the quality of options into their decision of whether or not to pay attention at all.

<u>Topic: Behavioral Welfare Economics</u>

When the choices of decision-makers are inconsistent, it is difficult for policy-makers to know how to judge the welfare implications of a policy, such as restricting the sale of tobacco or taxing sugary drinks. This has led to a large theoretical literature on how to extract information about the “true” preferences of individuals given their inconsistent choices.

However, there has been little empirical work to examine whether these methods can be useful for determining welfare in practice. To help answer this question, we have two papers that use grocery store scanner data and experimental choices to see how far individuals are from making

consistent choices ("rational" in the language of economics) and whether we can extract meaningful information about "true" preferences when choices are inconsistent. We also propose predictive power as a useful measure for whether welfare relations generate useful information.

These papers feature the first empirical applications of a measure of rationality proposed by my co-author and myself and the first empirical applications of the non-parametric welfare relation of Bernheim and Rangel (2009). While the relation of Bernheim and Rangel (2009) is well cited and often discussed, its empirical properties are not well known.

From [3], we learn that in practice, choices are not far from being rational. In addition, from [8] we learn that in practice, we do not need to assume much about the behavioral biases of individuals in order to infer a great deal about their underlying "true" preferences from the choices that they make.

Topic: Disclosure of Information

There are long and active literatures in several disciplines on the strategic incentives for firms to disclose information they possess (for example, Grossman 1981, Milgrom 1981, Verrecchia 1983, and Dye 1985). One reason this area has attracted sustained interest is that the policy implications are substantial. Firms often have private information about the quality of their goods, and if they do not disclose this information, consumers may be less informed, leading to welfare losses for consumers and the potential for market inefficiencies or even market failures.

Despite the theoretical prediction that market forces can lead firms to voluntarily provide the private information they possess, this does not always happen in reality (see Dranove and Jin 2010). However, it is hard to determine precisely what is causing failures of disclosure in the field, and these reasons might be different from industry to industry or even firm to firm. To more closely isolate the mechanisms at work, my co-authors and I have run experiments where it is possible to exercise more control over the environment. These experiments have attempted to identify the difficulties that individuals have in interpreting disclosed information and making inference about non-disclosure, and the strategic incentives that this provides for non-disclosure or complex disclosure.

Because disclosure is an important topic in many disciplines, I have been invited to present on these experiments in several cross-disciplinary settings. In 2017, I was asked to give a plenary talk in the PsyCHIC Workshop, which is an interdisciplinary conference (marketing, sociology, finance, management, economics, and psychology) hosted by Université Paris-Nord. I have also given talks at the Minnesota-Chicago Accounting Theory Conference and the KAMP speaker series of the Marketing Department at Northwestern.

[7] ***Is No News (Perceived As) Bad News?***

To cleanly test the classic predictions of disclosure theory, in [7] we designed a lab experiment in which incentives and actions were clearly specified to participants. In this setting, theory predicts that information senders should always disclose their private information, and that information receivers should always infer the worst about non-disclosed information. We find that senders disclose favorable information, but withhold less favorable information, which appears to be driven by the inability of receivers to correctly infer exactly how bad non-disclosure is: that no news is in fact bad news.

These results complement recent studies on naïveté about non-disclosed information from the field. While the field is invaluable for determining the potential size of the effect, the lab allows us to more cleanly study the mechanisms behind the effect. Our main tool in directly studying these mechanisms is to elicit the beliefs of senders and receivers about the actions of the other. From this, we learn that stated beliefs are strongly related to actions, but that sender beliefs are better calibrated than receiver beliefs.

This paper is now forthcoming at AEJ Micro. In addition, it was covered in VoxEU (http://voxeu.org/article/behavioural-economics-voluntary-disclosure) and HBS Working Knowledge (https://hbswk.hbs.edu/item/the-surprising-benefits-of-oversharing).

[12] ***What Do Consumers Learn from Regulator Ratings?***

We study the question of what firms learn from the ratings that regulators disclose about products and firms. While the strategic responses of firms to rating regulatory have been well-studied and the behavior responses of consumers to regulatory ratings have been as well, surprisingly little is known about the inferences that consumers make based on such ratings. Through an online experiment based the context of restaurant hygiene ratings, we not only show that consumers make erroneous inferences from such ratings, but also provide evidence of failures along two pathways: the relative implications of a rating and the absolute implications of a rating. We also test the effectiveness of two interventions addressing both pathways.

Our findings could have substantial ramifications for the design of regulatory rating systems. If beliefs about the distribution of ratings are heterogeneous and mis-calibrated, as they are in the setting we study, then the designers of ratings systems must care not only about the actual distribution of ratings, which they determine by setting the requirements for a particular rating, but also perceptions of the distribution of ratings.

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