Statement of Research

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We want to understand how humans make predictions. Predictions are often self-referential, e.g., housing prices may rise simply because people expect them to. As an individual forecaster, knowing how others form expectations provides insight into how the price of your target stock might move. As a policymaker, understanding how people make predictions helps identify when to intervene to prevent excessive bubbles or crashes, so that crises like that of 2008 do not happen again.

Economists typically assume that people make predictions to minimize forecast errors, which we call the *efficiency* concern. This is like assuming that students always aim for a perfect score. While that may be their intention, it is not what they can achieve every time. More broadly, this mirrors the standard economic assumption that individuals always act to maximize utility: they would want that, but it is hard to achieve in reality, since there are too many factors to consider in every situation.

My research examines how real people make predictions. We conduct laboratory experiments to observe behavior directly. Like other sciences, economics uses controlled experiments. But our subjects, humans, vary across individuals and over time. Therefore, we aim to design clean experimental environments and identify consistent behavioral patterns across participants and settings.

Using data from 801 participants across 18 experimental settings, we find a consistent pattern: people do not aim to minimize prediction errors when making forecasts. This finding challenges the utility-maximization assumption in economics. Instead, people appear to care about robustness. They begin with a strategy, maintain it when its performance exceeds expectations, and revise it when it performs worse than expected. In other words, they compare current performance to a benchmark and adapt when results fall below it. They tolerate a certain level of mean-zero noise rather than chasing every small deviation. By not aiming for zero prediction error, they conserve cognitive effort and avoid reacting to randomness or chasing the pure noise.

The idea that people expect some uncertainty rather than striving for perfect accuracy aligns with many real-world observations. In Singapore, for example, people often complain that life feels "boring" because of the unchanging and highly predictable weather. Across the world during COVID-19 lockdowns, many also felt trapped in a predictable routine, leading some to seek riskier activities simply to experience some uncertainty. Of course, too much uncertainty is also undesirable, as in the UK's famously variable weather. Ultimately, humans seem to seek control of uncertainty, which we call *robustness* concern.

Engineers recognized the importance of robustness long before economists did. Since the late 20th century, engineering design has increasingly prioritized robustness over efficiency. A striking example is NASA's Robonaut 2, used on the International Space Station to assist astronauts in complex tasks. Such systems were developed after crashes of high-performance aircraft that had prioritized efficiency but lost stability when faced with mixed types of noise in the last century.

Evidence from neuroscience also supports the centrality of robustness in human wellbeing. Among them, Ecstatic Epileptic Seizures (EES) provide perhaps the most striking example. During these episodes, patients report feelings of "complete serenity, total peace, no worries," often described as nirvana or bliss. Recent studies suggest that EES can be induced by stimulating the dorsal anterior insula (dAIns), a brain region associated with monitoring risk and uncertainty, not with reward processing. This finding implies that the control of uncertainty, rather than reward maximization, plays a crucial role in the human sense of wellbeing.

Replacing the assumption that humans prioritize efficiency with the idea that they prioritize robustness has broad implications.

- In asset allocation, it helps explain why people invest in risky assets even when expected returns are low. In one sentence, it is because the "error" they accept is the price paid for readiness in case the environment changes suddenly.
- In machine learning, common algorithms such as Pearce-Hall Prediction-Error Learning focus on efficiency. Yet, mathematically, such models are not robust when "outliers" are merely noise, that is, when they are frequent and revert quickly.

My future work will test whether humans prioritize robustness over efficiency across a wide range of contexts, starting with asset allocation. As an economist researching questions that cross disciplinary boundaries, I collaborate closely with the Leverhulme International Professorship in Neuroeconomics (LIPNE) Lab at the University of Cambridge, composed of a team of computer scientists, mathematicians, neuroscientists, and psychologists. Our research provides insights into how real people behave. The contrasts with research looking at how rational agents behave, with its applications being able to extend beyond economics to e.g., cybersecurity.