How well can humans perform: Testing human cue integration across multiple systems

Berichterstattung

Projektinformationen

CUE INTEGRATION

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Projekt abgeschlossen

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Dieses Projekt findet Erwähnung in ...

Periodic Report Summary - CUE INTEGRATION (How well can humans perform: Testing human cue integration across multiple systems)

Humans and all other animals are constantly engaged in making decisions based on partial, uncertain, noisy, and in some cases, expensive, cues. A central paradox in the study of decision making is the divergence between our extraordinary facility at perceptually posed decisions and our very ordinary incompetence at cognitively posed ones. In this project we are studying the spectrum joining these extremes, along with other, critical, characteristics for decision-making. Our investigation is based on, and contributes to, a range of quantitative models based on different computational and informational trade-offs.

A range of ideas within economics, psychology and related fields has coalesced into the field of Bayesian optimal decision making. To an impressive degree, at least when confronted with simple perceptual stimuli, humans and other animals are frequently Bayes-optimal, utilising and manipulating sensory information in a statistically optimal way (Ernst and Banks, 2002; Koerding, Beierholm et al., 2007).

However, the non-Bayes optimal nature of cognitive decision-making has been a popular target for investigation in cognitive psychology and economics. Notably, Tversky and Kahneman performed a number of experiments showing how subjects instead tend to use certain heuristics (Tversky and Kahneman, 1974), apparently simplifying methods for problem solving to an extent that produces severely sub-optimal behaviour.

We are conducting a series of model-based experiments to probe the continuum between perceptual and cognitive decision-making, asking how subjects learn about the statistical characteristics of cues from samples, and whether sub-optimal performance is based on inadequate learning, inferential failures, incompetent combination of evidence, or all three.

In short, the objective of this study is to examine the constraints on human cognitive decision making. In what way is it constrained and is it possible, given the right training, presentation and incentives, for subjects to break these restrictions? This is a highly multidisciplinary study, involving statistics,

economics, and control theory to determine the optimal decision-making, reinforcement learning for a neurally-credible model of learning, all embedded in a rich psychological context.

Given the premise of the grant, there are two strategies by which to design experiments: taking a cognitive probabilistic task and adorning it with perceptual features; or taking a perceptual probabilistic task and adding cognitive components. In the first period of the grant we concentrated on the former, by adapting a well-known task from cognitive psychology called the weather prediction task (WPT). We designed a perceptual variant of the WPT, and conducted an extensive series of pilot and then full experimental studies into both to see if performance could be improved. Our preliminary results are substantially weaker than we expected - this task has apparently not allowed us to explore sufficiently far along the spectrum towards perceptual processing. However, the data do provide interesting information and constraints as to how subjects solve such probabilistic tasks.

In the next phase of the project, we therefore plan to explore the spectrum from the other direction, by taking perceptual tasks and rendering them in cognitive terms. We are confident that, using what we have learned from the previous experiment, and the ever increasing volume of data in the literature on Bayes optimal decision making, we will be able to find intermediate points.

These results would have the potential to change our understanding of human decision making and unite research fields that have previously had surprisingly little interaction.

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