Symposium: When Cognition Shapes its Own Environment

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Introduction

Cognitive mechanisms are shaped by their environments, both through evolutionary selection across generations and through learning and development within lifetimes. But by making decisions that guide actions which in turn alter the surrounding world, cognitive mechanisms can also shape their environments in turn. This mutual shaping interaction between cognitive structure and environment structure can even result in coevolution between the two over extended periods of time. In this symposium, we explore how simple decision heuristics can exploit the information structure of the environment to make good decisions, how simple language-learning mechanisms can capitalize on the structure of the "spoken" environment to develop useful grammars, and how both sorts of cognitive mechanisms can actually help build the very environment structure that they rely on to perform well.

Programme

There will be three talks, as follows:

1. Peter Todd, "Simple Heuristics that exploit environment structure",

   Traditional views of rational decision making assume that individuals gather, evaluate, and combine all the available evidence to come up with the best choice possible. But given that human and animal minds are designed to work in environments where information is often costly and difficult to obtain, we should instead expect many decisions to be made with simple "fast and frugal" heuristics that limit information use. In our study of ecological rationality, we have been exploring just how well such simple decision-making heuristics can do when they are able to exploit the structure of information in specific environments. This talk will outline the research program pursued by the Center for Adaptive Behavior and Cognition as developed in the book, *Simple Heuristics That Make Us Smart* (Oxford, 1999), and highlight how the match between cognitive mechanism structure and environment structure allows the Recognition heuristic and Take The Best heuristic to perform on par with traditionally rational decision mechanisms.

2. Simon Kirby, "The Iterated Learning Model of Language Evolution",

   The past decade has seen a shift in the focus of research on language evolution away from approaches that rely solely on natural selection as an explanatory mechanism. Instead, there has been a growing appreciation of languages (as opposed to the language acquisition device) as complex adaptive systems in their own right. In this talk we will present an approach that explores the relationship between biologically given language learning biases and the cultural evolution of language. We introduce a computationally implemented model of the transmission of linguistic behaviour over time: the Iterated Learning Model (ILM). In this model there is no biological evolution, natural selection, nor any measurement of the success of communication. Nonetheless, there is significant evolution. We show that fully syntactic languages emerge from primitive communication systems in the ILM under two conditions specific to Hominids: (i) a complex meaning space structure, and (ii) the poverty of the stimulus.

3. Peter Todd, Simon Kirby and Jim Hurford, "Putting the Models Together: how the environment is shaped by the action of the recognition heuristic",

   To explore how cognitive mechanisms can exert a shaping force on their environment and thus affect their own performance, we begin by considering the actions of a very simple cognitive mechanism, the recognition heuristic for making choices. This heuristic specifies that when choosing between two options, one of which is recognized and one not, the recognized option should be selected. The recognition heuristic makes good choices, in environments where recognition is correlated with the choice criterion. Many natural environments have this structure, but such structure can also be "built": By using the recognition heuristic, agents can create an environment in which some objects are much more often and "talked about" and recognized than others. An agent-based simulation is used to show what behavioral factors affect the emergence of this environmental structure.