

**Game Theory and the Evolution of Signaling**  
Carnegie Mellon University  
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**Instructor**

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The evolution of simple languages, known as signaling systems, has received a lot of recent attention from game theorists in philosophy, biology, and economics; this will be the focus of our course. In the first half, we will look at several evolutionary and learning models of “costless” signaling. In addition to analyzing the plausibility of these as models for the evolution of proto-languages, we will consider the ways this model has been applied to some old philosophical problems (convention, meaning, natural kinds, and the descriptive/normative distinction). One handy feature of signaling games is that many different modeling strategies have been applied to them. This will give us an opportunity to see the variety of strategies used in this fast expanding literature.

In the second half of the course we will turn to different models of the evolution of language which relax the pure common interest assumption. Here we will look at the problem of “signal cost” (e.g. “handicaps”) and attempt to determine the extent to which this feature expands the set of explanations available for the evolution of simple languages. Costly signaling has been used primarily by both biologists and economists and we will have a look at the similarities between these two approaches.

The course requirements will consist in (possibly) a presentation of some material during a given week and (certainly) a final paper. Some ideas for paper topics include (1) a report on a replication of some of the simulation studies presented here, (2) a report of a new simulation, (3) development of new mathematical results, or (4) an application or argument rejecting an application of material discussed in class. Of course other paper topics are fine, but they should be discussed with me in advance.

**Week 1:** Introduction to evolutionary game theory

No reading

**Week 2:** In the beginning, there was David Lewis

Required:

Lewis Chapter 1 and 4 of *Convention*

Additional reading:

Quine “Truth by convention”

Crawford and Sobel “Strategic Information Transmission”

**Week 3:** Intro to Evolution

Required:

Skyrms *Signals* Chap 1 - 3

Maynard Smith and Harper *Animal Communication* Chapter 1

Nowicki and Searcy *The Evolution of Animal Communication* Chapter 1

Additional reading:

Blume et al. “Experimental evidence on the evolution of meaning”

Snowdon, “Language capacities of non-human animals”

**Week 4: Evolutionary Dynamics**

Required:

Skyrms Chap 4 &amp; 5

Huttegger “Evolution and the Explanation of Meaning”

Huttegger, Smead, Skyrms, and Zollman “Evolutionary Dynamics of Lewis Signaling Games”

Additional Reading:

Pawlowitsch “Why Evolution Does Not Always Lead to a Signaling System”

Blume, Kim, and Sobel “Evolutionary Stability in Games of Communication”

Warneryd, “Cheap Talk, Coordination and Evolutionary Stability”

**Week 5: Learning**

Required:

Skyrms Chap 6 -8

Barrett “Numerical Simulations...”

Zollman and Barrett “The Role of Forgetting in the Evolution and Learning of Language”

Additional Reading:

Argento et al “Learning to Signal: Analysis of a Micro-Level Reinforcement Model”

**Week 6: Primitive Content and the Shift to Human Language**

Required:

Millikan “On Reading Signs” in *Evolution of Communication Systems*Harms “Primitive Content” in *Evolution of Communication Systems*

Huttegger “Indicatives and Imperatives”

Additional Reading:

Nowak and Krakauer “The Evolution of Language”

**Week 7: Signaling Games and Natural Kinds**

Required:

Skyrms Chapter 9

Goldman, *Fact, Fiction and Forecast* Chapter 4

Barrett “The Evolution of Coding in Signaling Games”

Barrett “Dynamic Partitioning and the Conventionality of Kinds”

**Week 8: Signaling in games with partial common interest**

Required:

Skyrms, “Transient information”

Zollman “Taking to neighbors”

Warneryd “Evolutionary Stability in Unanimity Games with Cheap Talk”

Kim and Sobel “An Evolutionary Approach to Pre-Play Communication”

Additional Reading:

Robson “Secret Handshake”

**Week 9: Intro to costly signaling**

Required:

Zahavi “Mate Selection – A Selection for a Handicap”

Hurd “Communication in Discrete Action-Response Games”

Gibbons *Game Theory for Applied Economists* Chapter 4 to page 210

Additional Reading:

Spence “Job Market Signaling”

**Week 10:** Relaxing pure coordination and signal cost

Required:

Maynard Smith and Harper Chapter 2

Searcy and Nowicki *The Evolution of Animal Communication* Chapter 2 through pg 53

Bergstrom and Lachmann “Signaling among relatives III”

Additional Reading:

Bergstrom and Lachmann “Signaling among relatives I”

Bergstrom and Lachmann “Signaling among relatives II”

**Week 11:** Common Interest and Alarm Calls

Required:

Searcy and Nowicki *The Evolution of Animal Communication* Remaining part of Chapter 2

Zahavi *The Handicap Principle* Chapter 1

Bergstrom and Lachman “Alarm Calls”

**Week 12:** Partial overlapping interests

Required:

Searcy and Nowicki *The Evolution of Animal Communication* Chapter 3

Kim “Status Signaling Games in Animal Contests”

Hurd “Resource Holding Potential, subjective resource value, and game theoretic models of aggressive signaling”

**Week 13:** Divergent interests

Required:

Searcy and Nowicki *The Evolution of Animal Communication* Chapter 4

Hurd “Is Signaling of Fighting Ability Costlier for Weaker Individuals?”

Hurd and Enquist “Conventional Signaling in aggressive interactions”

**Week 14:** Networks

Required:

Searcy and Nowicki Chapter 5-6

Skyrms Chapters 10-11

Skyrms and Huttegger “Emergence of Information Transfer by Inductive Learning”