Evolutionary Explanations of Communication

(ABRIDGED) COURSE OUTLINE

Detailed Course Description.

> A new word can be added to an existing language by a mere convention, as is done, for instance, with new scientific terms. But the basis of a language is not conventional, either from the point of view of the individual or from that of the community. … We can hardly suppose a parliament of hitherto speechless elders meeting together and agreeing to call a cow a cow and a wolf a wolf. The association of words with their meanings must have grown up by some natural process, though at present the nature of the process is unknown. (189-190)
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> - Bertrand Russell, 1922. *Analysis of Mind*.

How do we communicate? *Meanings* are, more often than not, arbitrary. So, communicative signals have their meaning through *conventional use*. But, if meanings are conventional, then how might informative signalling arise in the first place if we do not already have a language to agree upon the conventional meanings of that language? The skeptical position is that conventions cannot be deferred to as an explanation for meaning, since this will lead either to circularity or infinite regress. However, communication systems abound in nature. In this case we might ask, how could conventional communication evolve, or be learned? In this course, we will seek answers to these questions by looking at the *signalling game* framework, introduced by David Lewis (1969), and extended to an evolutionary setting by Brian Skyrms (1996/2010). Some questions we will discuss include:

- What is the distinction between 'natural' and 'non-natural' meaning?
- How do solutions to coordination problems come to bear on questions concerning communication?
- Under what conditions is simple signalling guaranteed to evolve?
- What is the relation between learning and evolution?

Once we have understood how meaning arises naturally in a signalling context, we can then ask questions about how *complex* signals might arise. This leads to questions about *how possibly* language evolved in humans.

Learning outcomes.

Upon successful completion of this course, students should be able to:

- Understand some recent conceptual issues in the evolution of signalling and simple communication;
- Articulate some philosophical dimensions of those issues; and
- Accomplish some evaluation and adjudication of those issues.

GRADING DETAILS

Participation. (10 marks total) Timely arrival, attendance, and engagement in class will count toward the participation mark. It is expected that your contributions will be respectful and constructive.

Weekly Reading Responses. (20 marks total) Students should either (1) ask a novel question about the required reading for that week or (2) provide a substantive and thoughtful response to another student's question in the online discussion forum on the course webpage. The responses should be no more than 250 words. Ten submissions will be necessary (but not sufficient) for obtaining full marks on this assignment. The responses will be graded on a pass/fail basis.

Short Paper. (20 marks) The short paper will be due immediately before the term break. The short paper should be no more than 1000 words, on one of the topics covered up to the due date (i.e., through week 6, inclusive). It is permissible, but not obligatory, to email me with a proposal for a paper topic and a brief description of the main idea.

Long Paper. (50 marks total) The term paper will be broken up into several components, including a proposal (5 marks), a first draft of the paper (15 marks), a peer-review (5 marks), and a final draft of the paper (25 marks - 5 for the abstract and 20 for the paper). More details for each of these components will be given on the course webpage, but a short explanation is given below.

> *Proposal*. (5 marks) A proposal for your paper topic should consist of two essential parts: (1) the topic which you want to discuss, which should related to one of the 10 topics we will be discussing in class (see course schedule); and, (2) a rough outline of what you want to say about this topic. This could be in the form of a question, or a thesis statement (for example). Some structure should be given for how you are planning on approaching the topic. It is possible for you to choose to extend the short paper into a long paper, if you wish. In this case, the proposal should explain what details were missing from the short paper, and how you plan to fill in those details in your final paper. One way to think of this assignment is as though you are submitting a 500-word abstract to a conference. In order for the organisers of the conference, you must provide sufficient detail to display the topic of your proposal, and a sense of what your main argument will be.

> *First Draft*. (15 marks) The first draft of your paper should be around 2000 words and it should be on the topic that you proposed in the first part of this assignment. (Although, this is not, strictly speaking, necessary: you are allowed to change your mind about the topic of your paper between submitting the proposal and submitting the first draft of the paper.)

> *Peer Review*. (5 marks) You will be assigned two anonymised papers for peer review. A rubric for peer review will be provided. On the final day of class, you should submit your peer review for the two papers that you were assigned. You will receive feedback from your peers which should be considered when writing your final paper. More details about the peer review process will be

given in class. One way to think about this assignment is as though you are providing a referee report for a journal.

Final Draft. (25 marks) The final draft of the long paper will be due on the last day of the exam period. The final paper should be a concise research paper of around 3000 words (no more than 3500) on a topic of your choosing; and, it should include an abstract of around 250 words (no more than 300 words). 5 marks will be allocated to the abstract, and the remaining 20 marks will be allocated to the rest of the paper. One way to think of this assignment is as though you are submitting a short research paper to the *American Philosophical Association*.

Bonus Marks. There will be two opportunities for obtaining bonus marks in this course. One bonus mark will be awarded for a perfect score on a quiz on the content of this syllabus (completed on the first day of class). A second bonus mark will be awarded to everyone registered just in case a quorum (at least 2/3) of students completes the year-end course evaluations. More details will be given in class.

Grading Overview. The grading for this course is broken down as follows (more details about the specific assignments are given in the next section):

Participation	10 %
Weekly Reading Responses	20 %
Short Paper (1000 words)...	20 %
Final Paper (see below for breakdown)	50 %
Bonus Marks	2 %
TOTAL	**100 %**

The final paper has several components, and the grade for the final paper will be broken down as follows:

Proposal (500 words)	5 %
First Draft (2000 words)...	15 %
Paper Presentation (in Class)	5 %
Abstract of the Final Paper (250 words)	5 %
Revised final Draft (3000 words)	20 %
TOTAL	**50 %**

Topic Overview

Week 1: Course Introduction

Part I: Classical Game Theory (Signalling)

Week 2: Coordination and Convention

Week 3: Convention and Communication

Part II: Evolutionary Game Theory

Week 4: EGT and Signalling Games

Week 5: Learning How to Signal

Week 6: Signals in Nature

Week 7: Generalisations

Part III: Complex Signals

Week 8: Information & Propositional Content

Week 9: Signalling Networks I

Week 10: Signalling Networks II

Week 11: Compositionality I

Week 12: Compositionality & Reflexivity

Week 13: Summing Up

Detailed Course Schedule

Week 1   **Course Introduction**

Req. Reading   *Syllabus*

W. V. Quine. 2002/1969. 'Foreword' in David Lewis *Convention: A Philosophical Study*. Oxford: Blackwell.

David Lewis. 2002/1969. 'Introduction' in *Convention: A Philosophical Study*. Oxford: Blackwell.

PART I: Classical Game Theory and the Lewis Signalling Game

Week 2   **Coordination and Convention**

Req. Reading   David Lewis. 2002/1969. 'Coordination and Convention', Ch. 1 in *Convention: A Philosophical Study*. Oxford: Blackwell.

David Lewis. 2002/1969. 'Convention Refined', Ch. 2 in *Convention: A Philosophical Study*. Oxford: Blackwell.

Reading Questions
- What does Lewis mean by 'coordination problem'? What are some examples of a coordination problem (in a non-formal sense)? What does this have to do with communication?
- What are 'equilibrium solutions'? Why might such solution be or not be helpful for solving a (symmetric) coordination problem?
- What is the difference between a game of 'pure cooperation' and one of 'pure conflict'? Where on the spectrum between these two does Lewis think communication lies?
- What are the three main ways that Lewis thinks coordination problems can be solved? How might each of these come to bear on questions concerning *communication* as it is understood as a coordination problem?
- What role does 'common knowledge' play in Lewis' definition of convention? Why is it important?

Week 3	**Conventions and Communication**
Req. Reading	David Lewis. 2002/1969. 'Convention Contrasted', Ch. 3 in *Convention: A Philosophical Study*. Oxford: Blackwell.
	David Lewis. 2002/1969. 'Convention and Communication', Ch. 4 in *Convention: A Philosophical Study*. Oxford: Blackwell.
Reading Questions	• What are some key differences, as Lewis sees it, between *conventions* and *social contracts*? *norms*? *rules*? *imitation*? • What is the distinction that Lewis makes between *two-sided* and *one-sided* signalling. Can you think of other example of each of these (i.e., in nature). • Lewis suggests that two actions are ideally suited to be signals. Are these exhaustive? Are there other things that might be ideal signals? • On Lewis' account, meaning is *conventional*. What does he mean by this? • What is the distinction that Lewis highlights between natural and non-natural meaning? Why is this important?

PART II: Evolutionary Game Theory and the Lewis-Skyrms Signalling Game

Week 4	**Evolutionary Game Theory and Signalling Games**
Req. Reading	Brian Skyrms. 2010. 'Signals', Ch. 1 in *Signals: Evolution, Learning, and Information*. Oxford: Oxford University Press. 5-19.
	Brian Skyrms. 2010. 'Evolution', Ch. 4 in *Signals: Evolution, Learning, and Information*. Oxford: Oxford University Press. 48-62.
	Brian Skyrms. 2010. 'Evolution in Lewis Signalling Games', Ch. 5 in *Signals: Evolution, Learning, and Information*. Oxford: Oxford University Press. 63-72.
Reading Questions	• What is the intuitive idea behind an *evolutionarily stable strategy*? • How does differential fitness (e.g., the replicator dynamic) extend this notion? • Under a particular set of starting assumptions, signalling systems are guaranteed. What are these assumptions? How do the outcomes change if we alter these assumptions? • What are partial-pooling equilibria in the context of a signalling game? What two mechanisms does Skyrms highlight that destabilise pooling equilibria?

Week 5	**Learning to Signal**
Req. Reading	Brian Skyrms. 2010. 'Learning', Ch. 7 in *Signals: Evolution, Learning, and Information*. Oxford: Oxford University Press. 83-92.
	Brian Skyrms. 2010. 'Learning in Lewis Signalling Games', Ch. 8 in *Signals: Evolution, Learning, and Information*. Oxford: Oxford University Press. 93-105.
Reading Questions	• What is the *Law of Effect*? • What is the main difference between Roth-Erev (Herrnstein) reinforcement learning and Bush-Mosteller Reinforcement? • In what way are learning dynamics related to evolutionary dynamics? • Roth-Erev reinforcement can be usefully modelled by a simple urn-learning process. What sort of assumptions are being made about the players (e.g., their cognitive capacities, components of the game to which they have epistemic access, etc.)?
Week 6	**Signals in Nature**
Req. Reading	Brian Skyrms. 2010. 'Signals in Nature', Ch. 2 in *Signals: Evolution, Learning, and Information*. Oxford: Oxford University Press. 20-32.
	Brian Skyrms. 2010. 'Deception', Ch. 6 in *Signals: Evolution, Learning, and Information*. Oxford: Oxford University Press. 73-82.
	Handout on Hockett's (1960, 1963) 'design features' of language.
Reading Questions	• Skyrms gives several example of communication systems in nature. Which of these are best modelled by the (simple) signalling game framework? • Hockett's 'design features' were meant to help distinguish between animal communication and language; however, many animal communication systems possess many of these features. Give an example. • Why does deception cause difficulties for understanding communication with respect to signalling?
Week 7	**Generalisations**
Req. Reading	Brian Skyrms. 2010. 'Generalising Signalling Games: Synonyms, Bottlenecks, Category Formation', Ch. 9 in *Signals: Evolution, Learning, and Information*. Oxford: Oxford University Press. 106-117.
	Brian Skyrms. 2010. 'Inventing New Signals', Ch. 10 in *Signals: Evolution, Learning, and Information*. Oxford: Oxford University Press. 118-135.
	PART III: Complex Signals
Week 8	**Information and Propositional Content**
Req. Reading	Brian Skyrms. 2010. 'Information', Ch. 3 in *Signals: Evolution, Learning, and Information*. Oxford: Oxford University Press. 33-47.
	Nicholas Shea, Peter Godfrey-Smith and Rosa Cao. 2017. 'Content in Simple Signalling Systems'. *British Journal for the Philosophy of Science*, 69(4): 1009-1035.

Week 9	**Signalling Networks I**
Req. Reading	Brian Skyrms. 2010. 'Networks I: Logic and Information Processing', Ch. 11 in *Signals: Evolution, Learning, and Information*. Oxford: Oxford University Press. 136-144.
	Brian Skyrms. 2010. 'Networks II: Teamwork', Ch. 13 in *Signals: Evolution, Learning, and Information*. Oxford: Oxford University Press. 149-160.
	Brian Skyrms. 2010. 'Learning to Network', Ch. 14 in *Signals: Evolution, Learning, and Information*. Oxford: Oxford University Press. 161-177.
Week 10	**Signalling Networks II**
Req. Reading	Kevin Zollman. 2005. 'Talking to Neighbors: The Evolution of Regional Meaning'. *Philosophy of Science* 72(1): 69-85.
	Elliott Wagner. 2009. 'Communication and Structured Correlation'. *Erkenntnis* 71(3): 377-393.
	Jeffrey A. Barrett, Brian Skyrms, and Aydin Mohseni. 2019. 'Self-Assembling Networks'. *British Journal for the Philosophy of Science*, 70(1): 301-325.
Week 11	**Complex Signals and Compositionality**
Req. Reading	Brian Skyrms. 2010. 'Complex Signals and Compositionality', Ch. 12 in *Signals: Evolution, Learning, and Information*. Oxford: Oxford University Press. 145-148.
	Michael Franke. 2016. 'The Evolution of Compositionality in Signaling Games'. *Journal of Logic, Language and Information* 25(3-4): 355-377.
	Shane Steinert-Threlkeld. 2016. 'Compositional Signaling in a Complex World'. *Journal of Logic, Language, and Information*, 25(3-4): 379-397.
Week 12	**Compositionality and Reflexivity**
Req. Reading	Shane Steinert-Threlkeld. 2020. 'Toward the Emergence of Nontrivial Compositionality' *Philosophy of Science* 87(5): 897-909.
	Jeffrey A. Barrett, Brian Skyrms, and Calvin Cochran. 2020. 'On the Evolution of Compositional Language'. *Philosophy of Science* 87(5): 910-920.
	Travis LaCroix. Forthcoming (2021). 'Reflexivity, Functional Reference, and Modularity: Alternative Targets for Language Origins'. *Philosophy of Science*.
Week 13	**Summing Up**
Req. Reading	David Lewis. 2002/1969. 'Conventions of Language', Ch. 5 in *Convention: A Philosophical Study*. Oxford: Blackwell. 160-202.