Advanced Topics in Cognition, 2017
Graduate Course, HBCSE, TIFR
2016-2017 – Semester 2

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<u>Credits</u>: 4
<u>Duration</u>: 15 weeks, class starts 13 January
<u>Time</u>: Tuesdays and Fridays, 2 to 4 PM (Saturday classes will make up for any holidays).
<u>Location</u>: Room 104, Main Building, Homi Bhabha Centre for Science Education

Summary

The mind emerges from an extremely complex and many-layered system (neurotransmitters, neurons, synapses, cerebrospinal networks, the cortex, the enteric [gut] nervous system, attention, perception, memory, action, motivation, emotion, language, reasoning, imagination, intuition, consciousness, self...). And it constantly changes its nature, in interaction with many layers of itself and the environment (chemicals, signals, cellular structures, symbols, materials, actions, people, society, norms, culture...).

Then there are feedback systems, both between the layers and the rapidly changing interactions. A further complication is that any attempt to study the mind is a highly recursive process, as the mind is trying to understand itself, and this process changes it. This complex, dynamic and recursive nature makes the mind the most complicated machinery known to mankind, and it defies our attempts to systematically study the mind.

Despite this daunting complexity and the methodological challenges involved, a range of theoretical and empirical approaches have been developed in the last hundred years to scientifically understand the mind. These approaches help hold down the shadowy and shape-shifting beast, allowing us to develop ways to understand its workings.

This course will examine a subset of this range of theoretical and empirical approaches, focusing on just the nature of cognition (symbolic cognition, connectionism, distributed cognition, dynamic systems, ecological psychology, situated cognition, embodied cognition). The focus will be on recent theoretical approaches, particularly distributed and embodied perspectives, and the cognitive and brain mechanisms that support these approaches.

Learning Objectives

The primary objectives of the course are:

1) provide alternatives to the standard model while thinking about cognition
2) explore what these views suggest about the nature of learning and education
3) develop a mechanism account of imagination, particularly in science and engineering

For participants who do not intend to pursue advanced research in cognition and related topics, the course would be useful in developing critical skills needed to pursue social science research in general. Particularly:

1) how to pull out key arguments from complex text
2) how to evaluate the merits of an argument
3) how to relate a theoretical perspective to a given topic, and understand its implications
4) how to critique an established view, and develop and defend an alternate thesis

Reading Material

The course requires significant reading (60-100 pages a week; ~60 papers). The readings will be a mix of philosophical, experimental and modeling papers, as well as popular articles. Some papers will be technical, but the discussion will focus on theoretical issues rather than technical details. The title for each week in the course plan below indicates the general gist of the articles.

All readings are available (pdf) from the link below. Each week's readings are in a separate folder, with 4 (sometimes 5) core readings. These are given numbers 1 to 4-5, at the end of the filename. The key points would be easier to grasp if the papers are read in this order. This ordering is also provided in the course plan below. Most folders have a subfolder named "Extra". This contains a few other papers and material to pursue if the topic is found interesting.

The readings are difficult, and may require more than one pass. Previous students have found discussing the material once among themselves before coming to class quite helpful. This possibility should be explored.

http://lsr.hbcse.tifr.res.in/courses/Advanced_Cognition_2017

Class Structure

The class will be participant-driven and discussion-based, with some group work. Class strength will be limited to around 15 active participants. Each week's readings would be presented by a team of two participants. This cycle will continue throughout the course. All participants are requested to read the text beforehand, so that there is a common base to discuss and critically analyse the issues raised by the papers.

All participants have to turn in a "Comments and Queries" (C&Q) document to the TA before the class, focusing on the week's/session's readings. See Note 1 below for guidelines on what is expected in this document. The Comments and Queries are expected to be used to frame the discussion in the class. Participants who are presenting the material in a given week need not submit this document for that week, but generating these would be useful in guiding the discussion. The TA will provide feedback on your C&Q documents and the presentations. See Note 2 below for guidelines on the structure of presentations.

Assessment

Students taking the course for credit will be graded on the basis of a final term paper (50%) as well as the Comments and Queries document, presentations and class participation (50%). Each C&Q/presentation carries 10 marks. Your C&Qs and presentations together should total a minimum of 10 submissions.

The final term paper should preferably connect the student's interest in education with one of the topics covered in the course. A rough outline of the term paper should be submitted by March 15. See Note 3 below on what is expected for the term paper.

Course Plan

Introduction (January 13)
Course outline, backgrounds & interests, presentation schedule, groups, primers etc.

Week 1 (January 17, 20)
Behaviorism and The Standard Model of Cognition
Watson, Miller, Newell & Simon, Skinner

Note 1: Comments & Queries

1) A summary of the papers is not expected. If summarising helps you in understanding the material, you should still do it. But keep that part as a separate file, and refer to the summaries when you run into problems or get stuck while conceptualizing/writing your final paper/proposal/thesis.

2) Queries with the following structure are not useful: "how can we use (say) mental imagery for education/design"? There is no clear answer to this question, because it is too general. It would be better if you turn such questions into something like: "in math/science education, there is this problem of XYZ, and the author's ideas seem to imply that strategy ABC would be useful/would not work, is this right?" or something along these lines. To do this, you will have to do some focused thinking about the author's ideas, and apply it to a problem you are familiar with. If you have a question like this, other people can contribute to the discussion, and maybe even help you solve a problem.

3) Comments along the lines of "this view is interesting", "the author has done a good job" etc. are not useful. Comments should show close engagement with the ideas in the papers. So something like "the author's position seems to contradict/support the position of (another) author X in the following way" or "the data seems to be showing X, but it does not seem to support the author's claims" or "the author argues for X, but it has the following implication, which is undesirable" etc.

4) Before writing your C&Q, try to think a little more deeply about the implications of the ideas presented by the authors, and also try to connect their ideas with other things you have read, in the class or outside. This would help you come up with C&Qs that are closer to the description above.

Note 2: Presentations

All presentations should follow the structure below:

    1)What is the major claim of the paper?
    2) What design/data/arguments support the claim?
    3) How well does the design/data/argument support the claim? What are the main problems?
    4) What would be other/better ways to support the claim?
    5) What implications follow from the claim, particularly for education?
    6) Any details you would like to highlight

Using 1 slide for each of these questions would be the ideal format. Aim for a 15 minute presentation for each paper. Presentations for each day can be upto 30 minutes in total.

Note 3: Term Papers

The following points should be kept in mind while picking your topic for the term paper, and during writing of the paper.

1) The paper should be around 15-25 pages, single space. Why is this an important point? Because you should choose a topic that *requires* that much space for discussion. If you choose a very broad topic, you will not be able to do justice to it in this amount of space. If you choose a very narrow topic, you will not have enough things to say to fill that amount of space. The size of the paper is a good way to "scope" your topic.

2) The paper should have an argument. That is, it should have some clearly articulated premises, and a conclusion that follow from these, preferably with some discussion of data/results that support the conclusion. For instance, you can argue that neuroscience research is irrelevant for science education. Or you can argue that imagery research can inform physics learning. But you should give reasons for why you think this is the case. The requirement for an argument means the paper cannot be a literature review, a discussion of a new approach to science education, or an evaluation of a new technology. The argument structure makes the term paper somewhat like a miniature thesis, or a journal paper. If you write a few of these during a course work, you will be able to deal better with your research proposal and thesis.

3) Writing the paper should make you think. This is sort of implicit in the previous point, as you cannot develop an argument without thinking. However, in academic writing, particularly in humanities and social sciences, apart from the thinking needed to develop the argument, you also think *through writing*. This involves being able to see counter examples and counter arguments as you develop your argument in text, and then finding ways of countering them. This process can take a life of its own, and might lead you into many tangents that prevent you from developing your core thesis. So part of the skill here is learning how to pursue this process in a controlled fashion.

4) Ideally, you should pick a topic that is related to a possible thesis topic you have in mind. This way, you can reuse the thinking you do for the term paper while developing your research proposal.

5) The paper should have an abstract (~150 words) that summarises its key points.

6) The term paper is due on 27th April midnight. This is a hard deadline, as I have to turn in the marks by end of April.

7) Two alternatives to term papers could be: 1) Doing an experiment, 2) Reveiwing a book. Texts based on these would also need to follow the above structure. Further, you need to discuss ideas for these with the instructor beforehand, and develop a clear outline of what you will be doing.