

INFI-CG 2016  
Lecture I

# Cognitive Science: An Introduction

Richard Shillcock

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## Course details

*Lecturers:*

Mirella Lapata, Chris Lucas, Richard Shillcock

*Tutors:*

Mario Tabry, Xingxing Zhang, Ramsey El-naggar

<http://www.inf.ed.ac.uk/teaching/courses/inf1-cg/>

Sign up for it (and a DICE account) on the 4th floor of Appleton Tower.

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## Course details

Credits: 20 (one-third of your academic time)

Total Hours: 200

Lectures 30 – *you must take notes!*

*Lecture slides are not notes!*

*We will say important things that are not on the slides!*

*Those things may come up in the exam!*

*The lectures are filmed, but films aren't the real thing!*

*Note-taking is a crucial skill!*

*[Now I'm telling you something of psychological interest that isn't on the slide; if you don't write it down you'll forget it!]*

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**YOU  
MUST  
TAKE  
NOTES!**

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### Course details

Credits: 20 (one-third of your academic time)

Total Hours: 200

Lectures: 30 hours

Tutorials: 10 hours (check your group; start Week 2)

Supervised Labs: 20 hours (ditto)

Directed and independent learning: 137 hours, or  
*about 14 hours a week of reading and working for this course; about 40–60 pages of reading a week.*

This is a demanding, engaging course, not an easy option!

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### Course details

Handwrite your notes and tidy them up onto a computer later.

There will be paper and pencil quizzes in Mirella's part of the course.

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### Course details

If you're just curious about the course you're very welcome to 'audit' it – just attending lectures.

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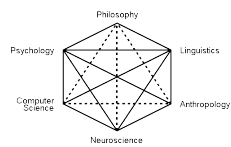
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### Today's goals

We will look at the overall landscape of Cognitive Science and see some examples of the data and the approach.

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## Today's readings

Maguire, E. A., Gadian, D. G., Johnsrude, I. S., Good, C. D., Ashburner, J., Frackowiak, R. S., & Frith, C. D. (2000). Navigation-related structural change in the hippocampi of taxi drivers. *Proceedings of the National Academy of Sciences*, 97(8), 4398-4403.

Frank, M. C., Everett, D. L., Fedorenko, E., & Gibson, E. (2008). Number as a cognitive technology: Evidence from Pirahã language and cognition. *Cognition*, 108(3), 819-824.

Jones, N. (2014). Computer science: The learning machines. *Nature*, 505, 146-148.

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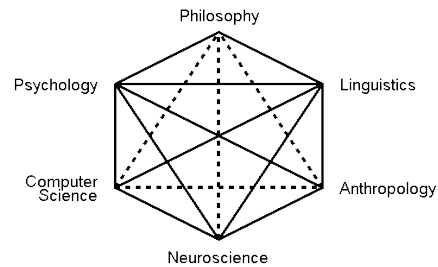
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## Origins



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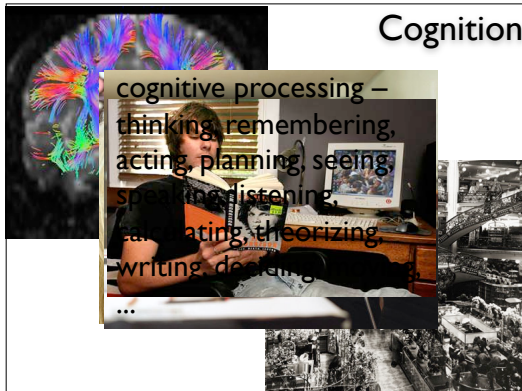
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## Cognition



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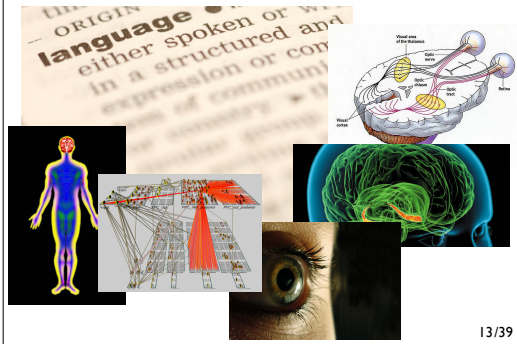
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## This course and Edinburgh research



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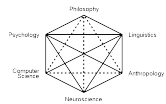
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## Linguistics



I like the large green chair.

\* I like the green large chair.

Adjectival ordering (Vendler, 1968).

We can make abstract generalizations about language use and package them into *rules*.

*Syntax* has been the paradigm case.

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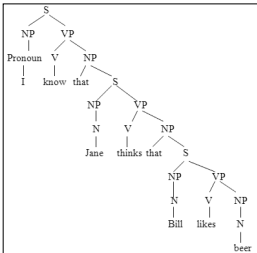
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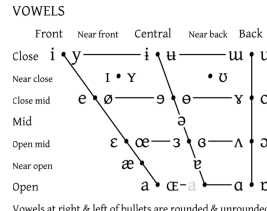
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## Linguistics



theoretical syntax

### theoretical phonology



Vowels at right & left of bullets are rounded & unrounded

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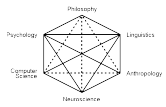
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## Anthropology



See today's readings for details.



The brain and cognition develop within a culture. <sup>16/39</sup>

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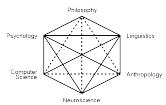
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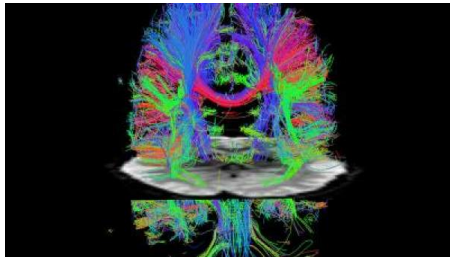
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## Neuroscience



We have increasingly detailed understanding of the structure of the brain.



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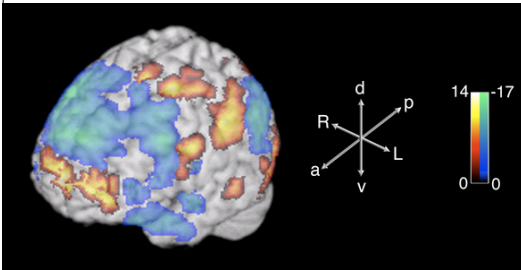
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## Neuroscience

We can look at patterns of activation within the functioning brain.



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## Neuroscience

We can intervene in the functioning brain in increasingly sophisticated ways.



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## Neuroscience



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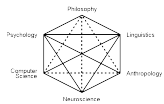
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## Computer Science (or Artificial Intelligence, AI)

Computers can carry out large numbers of calculations very quickly – searching, optimizing, learning, generating probabilities, ...

Unsuspected behaviours can *emerge* from large, complex bodies of processing.

*Simulating* an intelligent behaviour can produce insights about that behaviour.

Perhaps 'intelligence' or 'cognition' and all that goes with them can exist without live brains.

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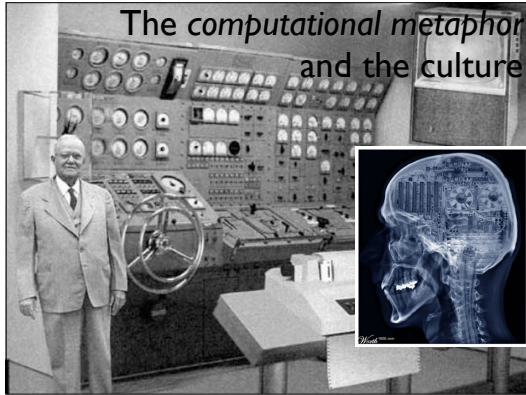
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## The computational metaphor and the culture

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**Psychology**

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Psychologists measure observed behaviours (typically in controlled conditions) very accurately and infer from times and errors things about unseen cognitive processing.

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**Psychology**

Psychologists also record unseen aspects of processing using advanced technologies, such as electroencephalography (EEG).

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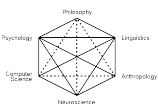
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**Philosophy**



At some level, *all* the issues involved in studying cognition have been considered by philosophers over the last three millennia ...



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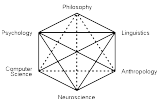
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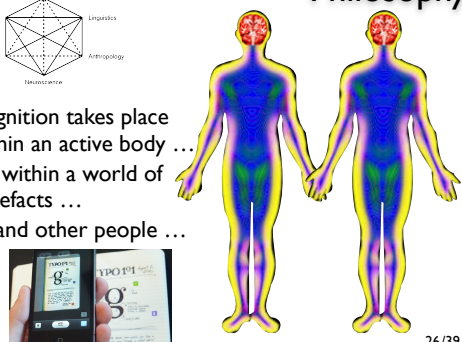
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**Philosophy**



Cognition takes place within an active body ...  
 ... within a world of artefacts ...  
 ...and other people ...



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**Subject matter of the course**

Language and vision are primary foci.  
 Language is definitional of human cognition.  
 Language is the *intersection* of many other activities and processes.



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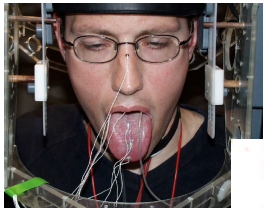
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## Language



Electropalatography

text-to-speech



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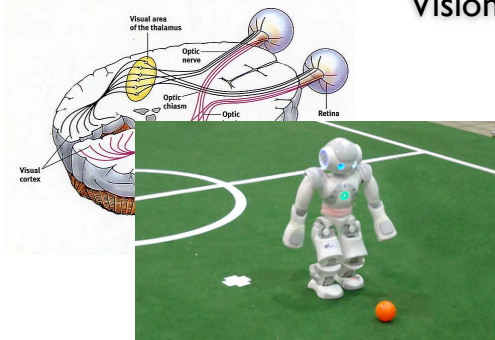
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## Vision



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## Two quick thought experiments

Think of language as a *tool* – something that we have created and that lets us do things. How is it like a tool? How is it *not* like a tool?



Think of having no vision and no hearing from birth. Such people can still become highly educated. How? Could the 'immediate' 'distance senses' in fact work like the sense of touch in some way?



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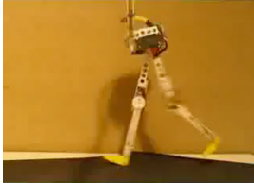
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## Modelling

We often use 'model' and 'theory' interchangeably.

Modelling is at the heart of Cognitive Science.

Modelling can have physical, mathematical and computational aspects to it, and is rich ground for philosophizing.



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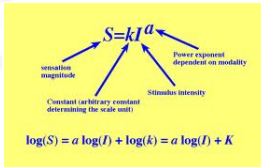
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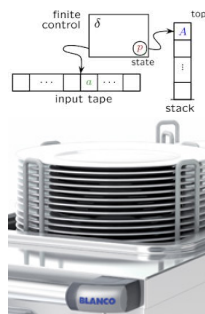
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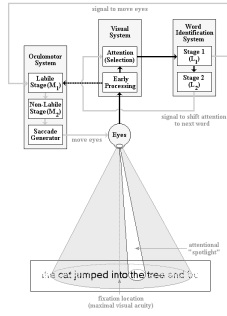
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## Modelling

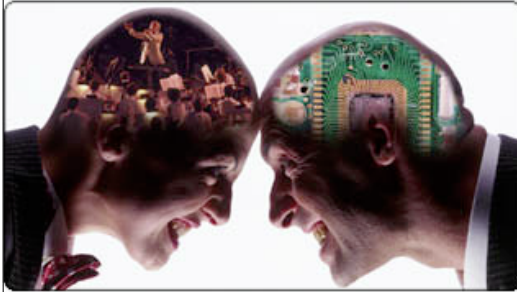
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## Two approaches



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## Two approaches

### Idiographic

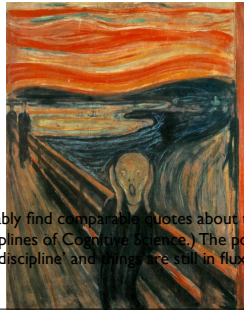
- Case studies
- Humanities oriented
- Qualitative
- Subjective
- Holistic
- Humanistic

### Nomothetic

- Group studies
- Sciences oriented
- Quantitative
- Objective
- Analytic
- Technological

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"Despite its best intentions and efforts, psychology in this century has been unable to produce a single determinate theory about anything."  
Tolman & Lemery (1990)



(We could probably find comparable quotes about the other component disciplines of Cognitive Science.) The point is, we are a relatively young 'discipline' and things are still in flux. Enjoy!

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## In conclusion ...

Cognitive scientists address critical issues about what makes us human.

Cognitive science is inherently interdisciplinary.

Read the three readings and start thinking ...

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## References

[These are papers that were incidentally referred to in the lecture. The weekly readings are something different; you are *required* to read the readings for the course and for the exams. If you wanted to find out more about an issue – like, in today's lecture, how shining a light in a mouse's brain could make it 'remember' something – then you can look up the original research paper on *Google Scholar*.]

Vendler, Z. (1968). *Adjectives and nominalizations* (No. 5). Walter De Gruyter Inc.

Liu, X., Ramirez, S., Pang, P.T., Puryear, C. B., Govindarajan, A., Deisseroth, K., & Tonegawa, S. (2012). Optogenetic stimulation of a hippocampal engram activates fear memory recall. *Nature*, *484*(7394), 381-385.

Tolman, C.W., & Lemery, C. R. (1990). How to reconcile theoretical differences in psychology. *New Ideas in Psychology*, *8*(3), 397-402.

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