Cognitive Neuroscience of Language

Richard Shillcock

Lecture 1
Introduction to the problem, and some meta-theoretical issues

About the course

Me: rcs@inf.ed.ac.uk 4.24 Informatics Forum

Course website:
http://www.inf.ed.ac.uk/teaching/courses/cnl

Lectures

Readings

Assessment: a 4000-word essay

What *you* do

Turn up for all the lectures

Read the readings

Take your own notes

Select a topic you're enthusiastic about, for the essay

Mail me your email address if you aren't on the list

Goal

Understand some of the principles and metatheoretical issues at stake when we talk about language and the brain

Readings for this lecture

MacWhinney, B. (2005). Language evolution and human development. In Bjorklund, D. and Pellegrini, A. (Eds.). *Origins of the Social Mind: Evolutionary Psychology and Child Development*, New York, Guildford Press. (20 pages)

Meta-theoretical issues

Materialism

The real world in all its complexity, interconnectedness and specificity

Beware of abstractions!

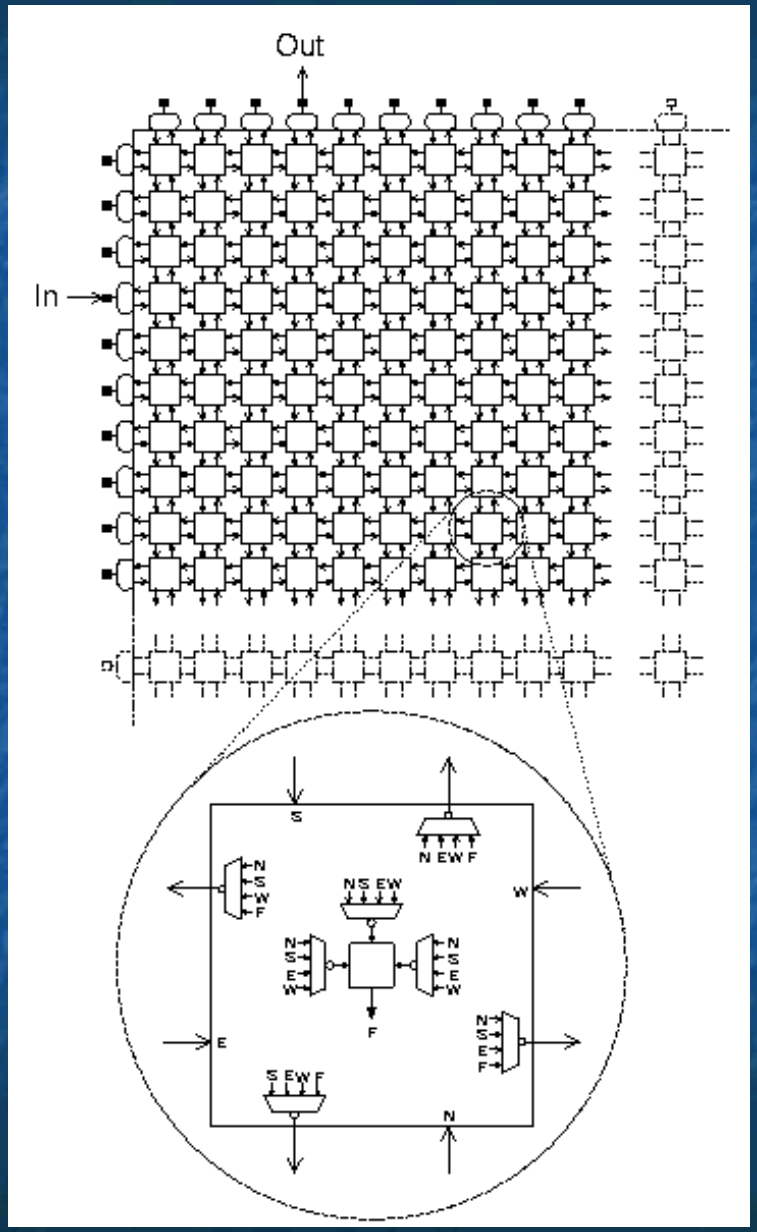
Reductionism and levels

Functionalism, green cheese and software

MacWhinney (2005)

The importance for language emergence of ... breathing, upright posture, group structure and social cohesion, neural pathways, opposing thumb, bipedalism, birth process, hairlessness, dentition, habitat change, vocal tract, facial musculature, affective relations, vocal folds, brain size and functional connectivity, brain evolution, female anatomy, human migration, eye contact, gesture, mirror neurons and body image, extended juvenile period, planned action sequences, *tool use*, *control of the environment* ...

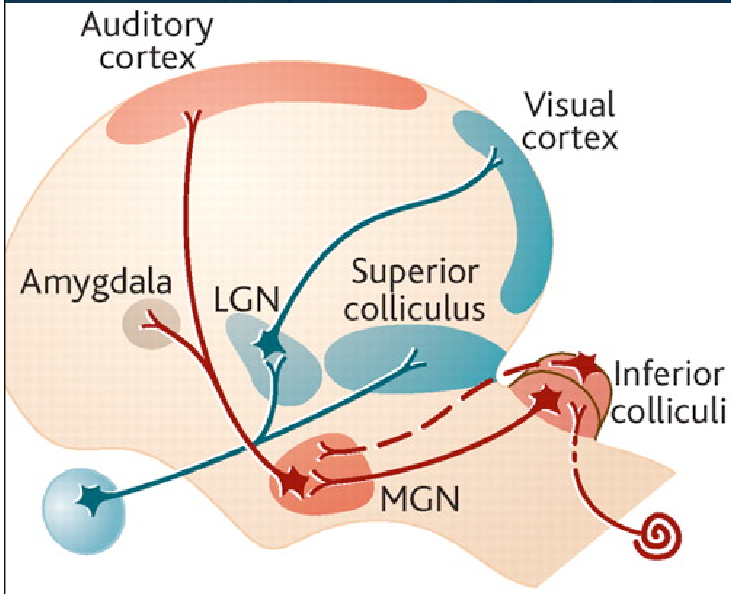
Cautionary tale 1

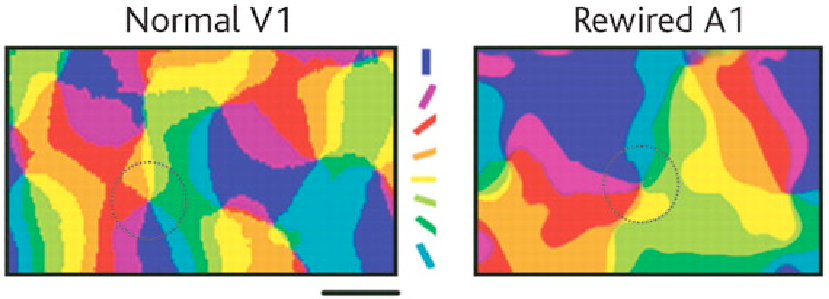


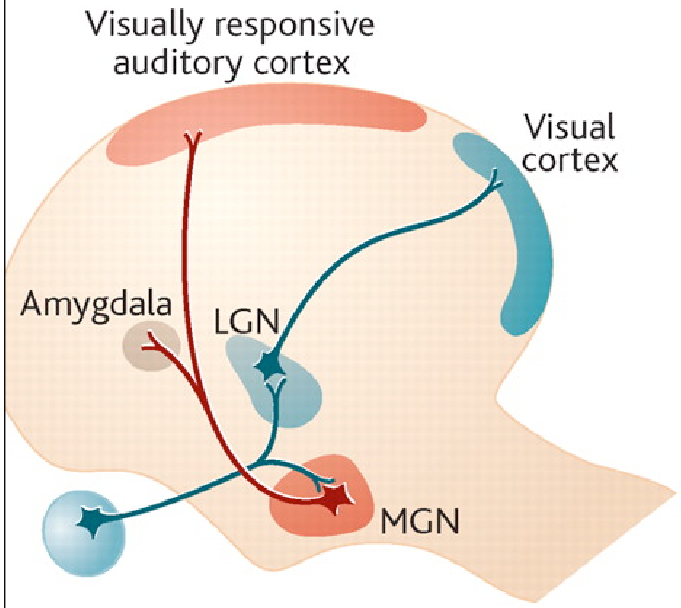
Thompson (1996, 1997), field programmable gate arrays (FPGAs), and the "leakage" between ideal entities and levels (see, also, Andy Clark and Dan Dennett)

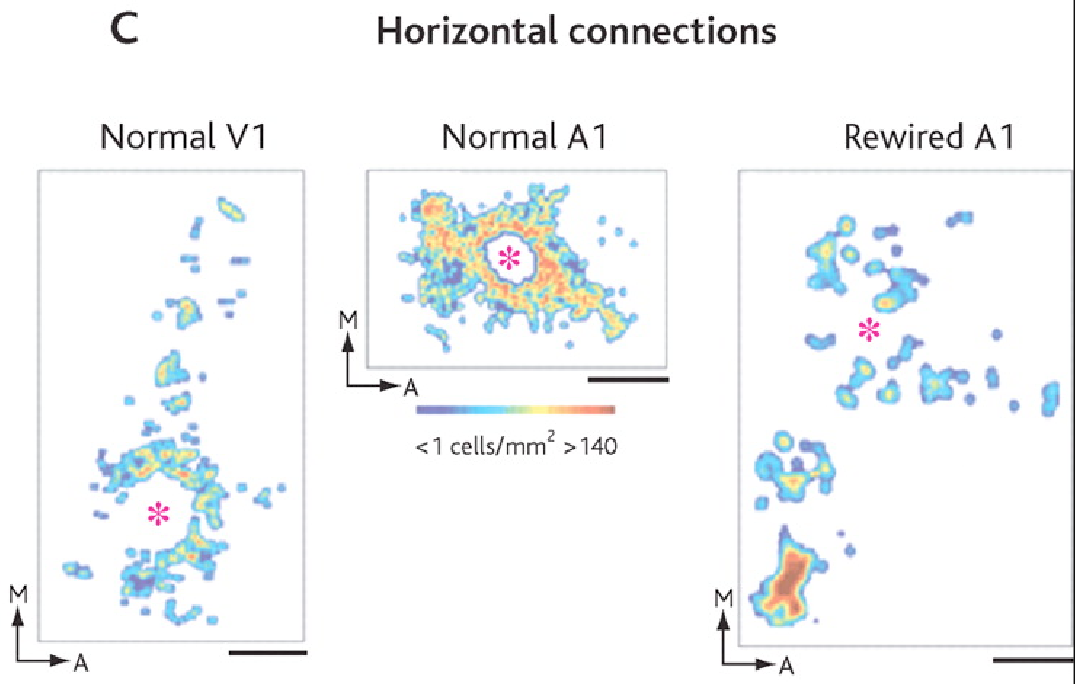
Cautionary tale 2

Sur *et al.* (1988) rewire some of the visual pathways of a juvenile ferret so that they go to the auditory rather than the visual areas ...


Auditory cortex
Visual cortex
Amygdala
LGN
Superior colliculus
Inferior colliculi
MGN


Orientation maps
Normal V1
Rewired A1


Visually responsive auditory cortex
Visual cortex
Amygdala
LGN
MGN


C
Horizontal connections
Normal V1
Normal A1
Rewired A1
M
A
<1 cells/mm² >140

Cautionary tale 2

Sur *et al.* (1988) rewire some of the visual pathways of a juvenile ferret so that they go to the auditory rather than the visual areas ...

... meaning that the evolutionarily later parts of the brain (cortex) is surprisingly multipurpose during the juvenile period, at least.

Cautionary tale 3

Boatman *et al.* (1999) show recovery of higher-level receptive language functions in children with left hemispherectomy ...

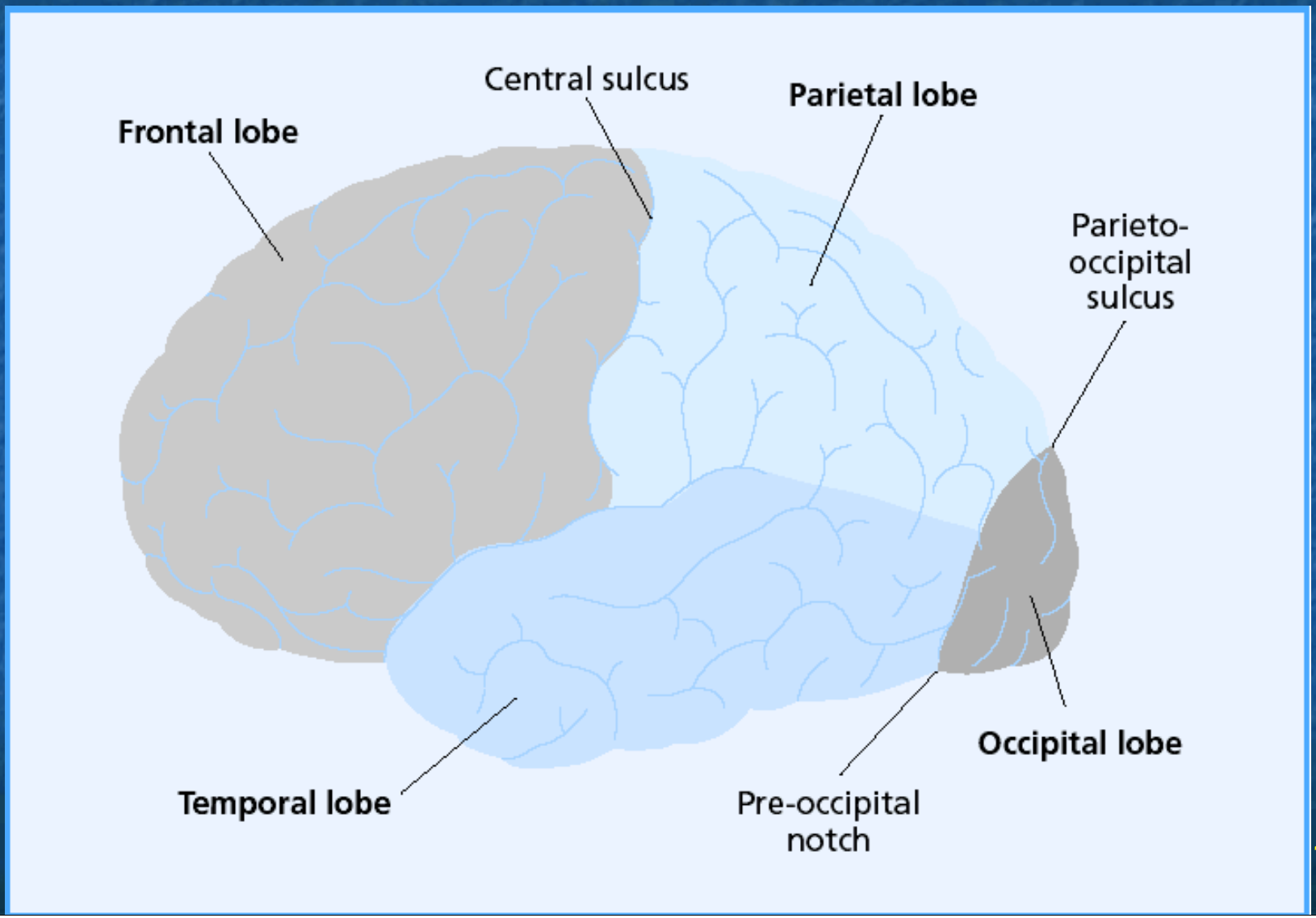
Cautionary tale 4

There are substantial individual differences, based on sex, birth order, developmental differences, life experience ...

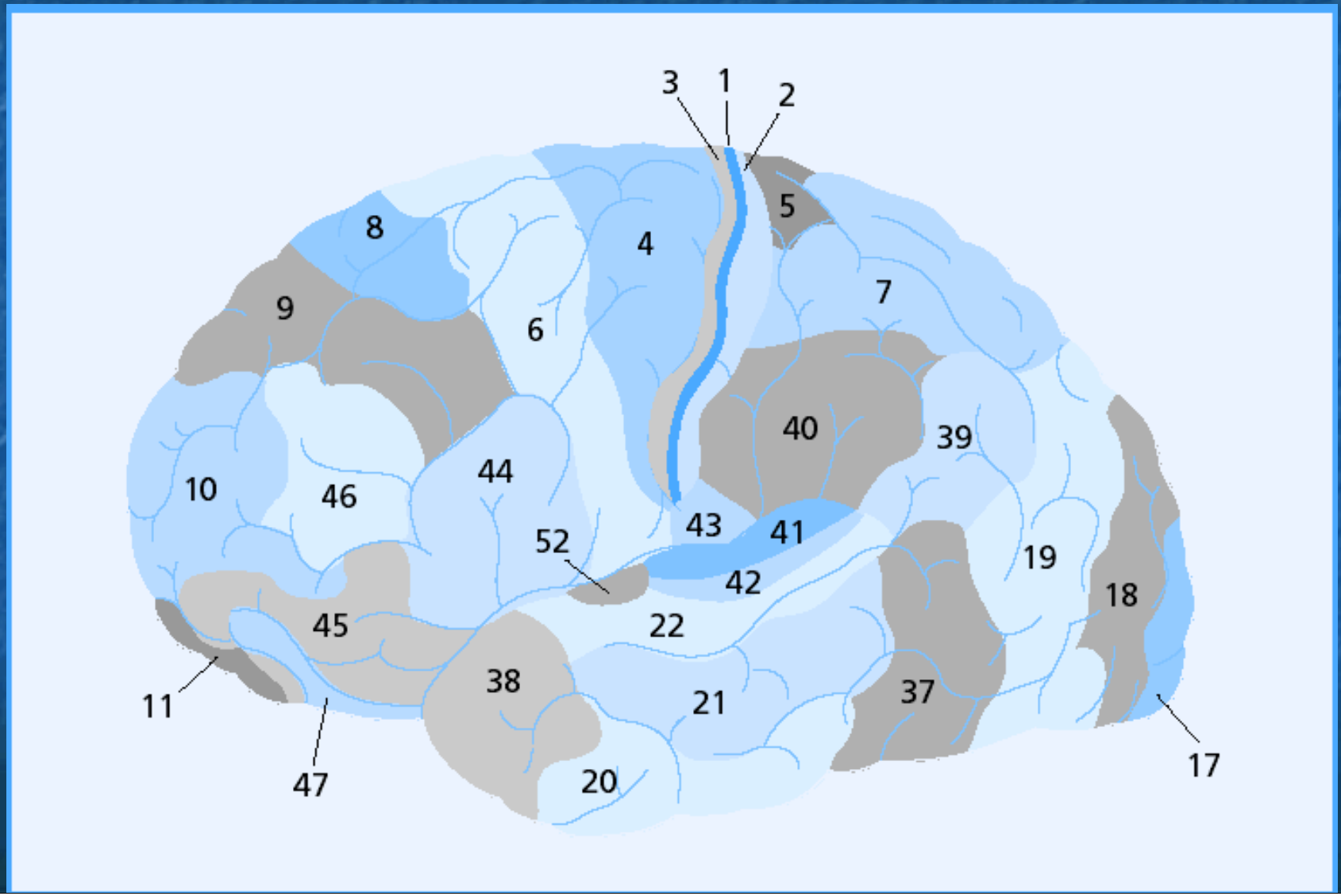
Cautionary tale 5

There are substantial differences between languages ...

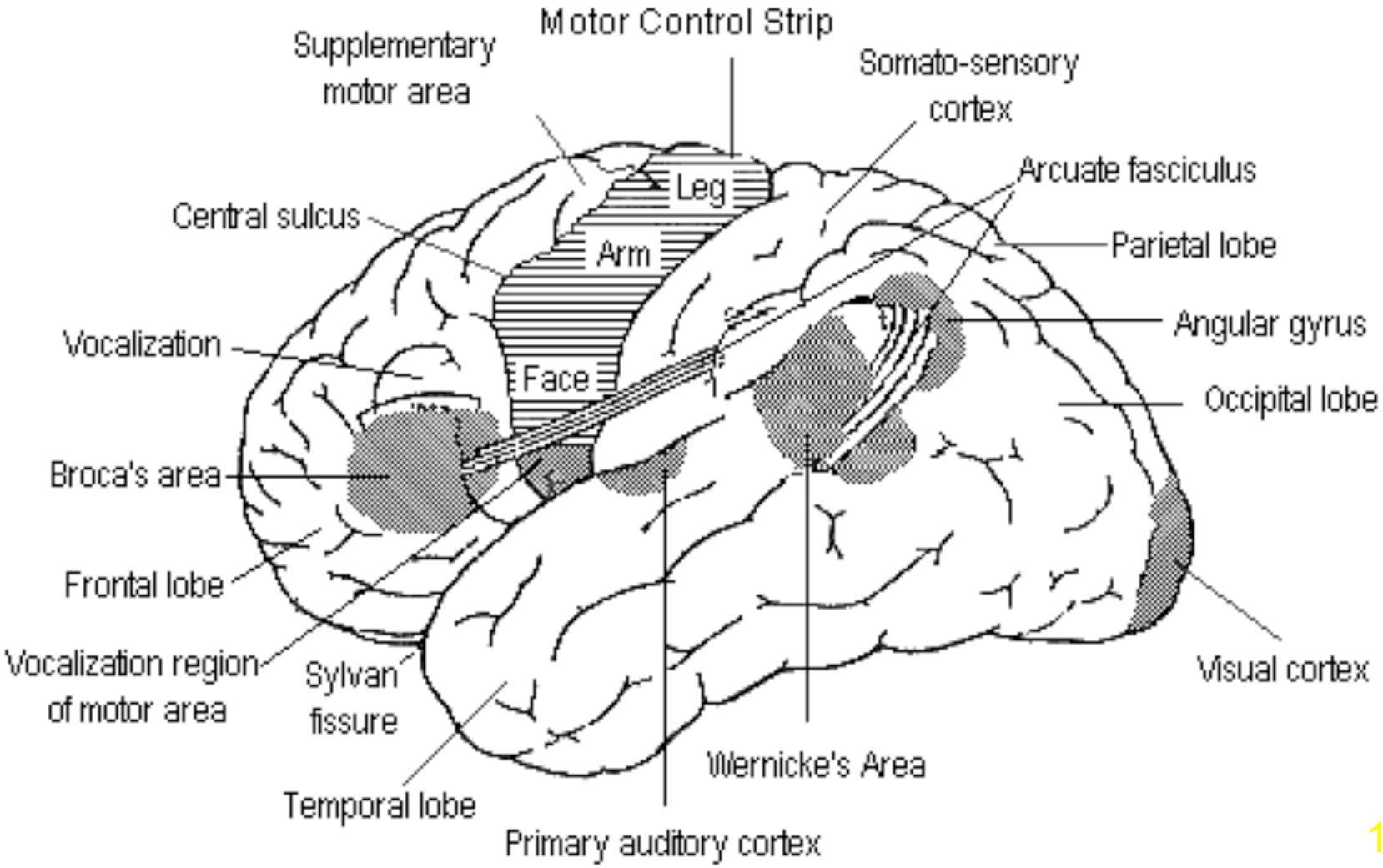
A tour of the brain



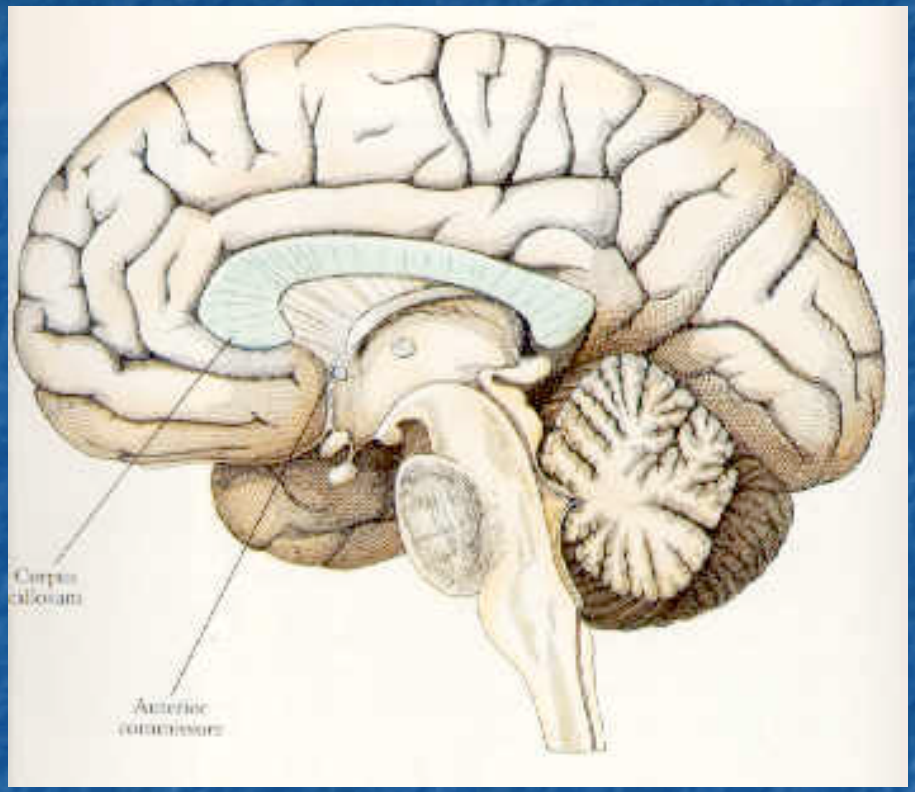
A tour of the brain

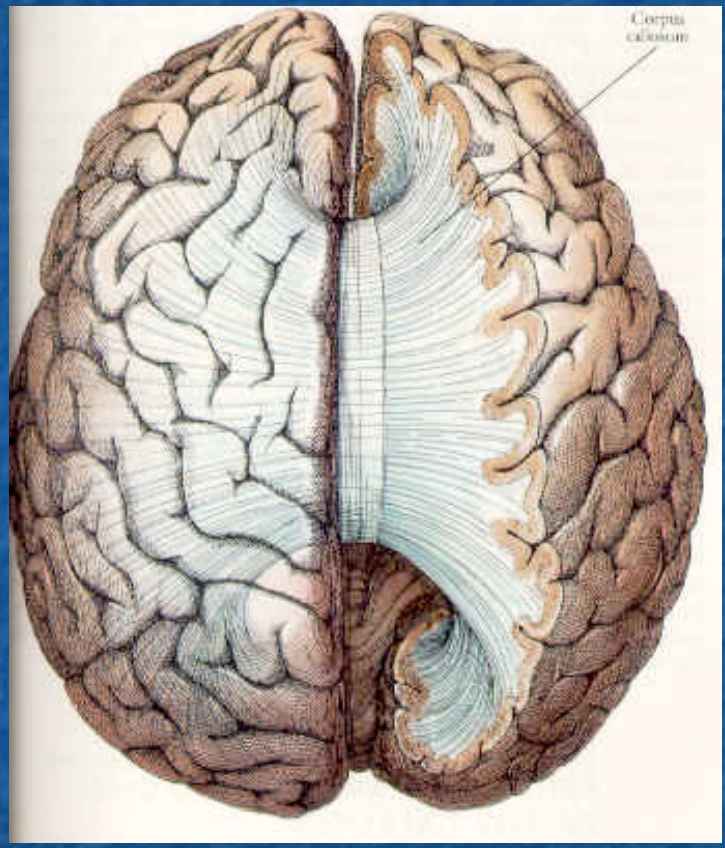


A tour of the brain

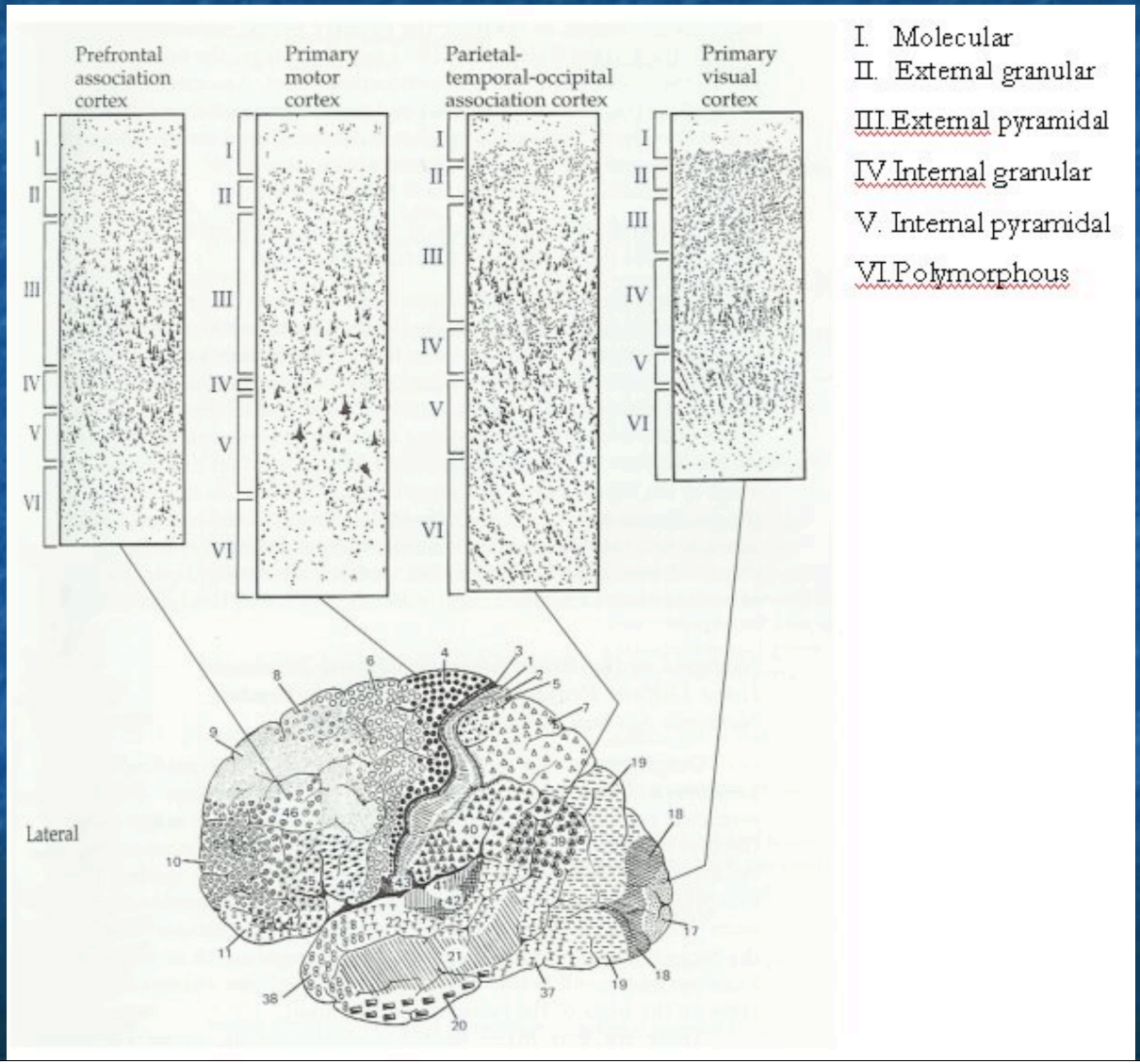


A tour of the brain



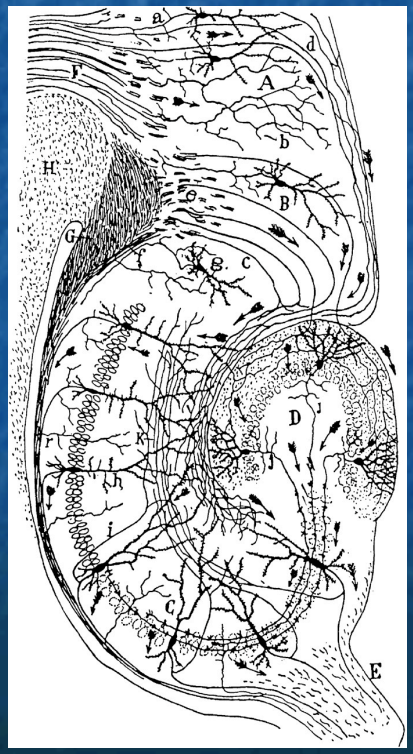


A tour of the brain

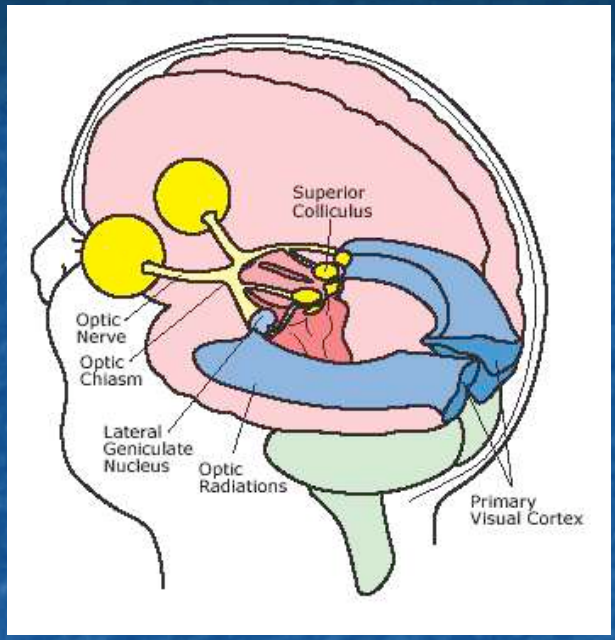


Levels of analysis

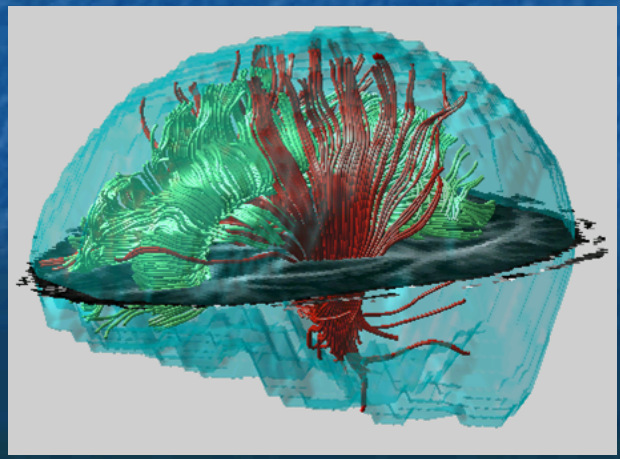
behaviour



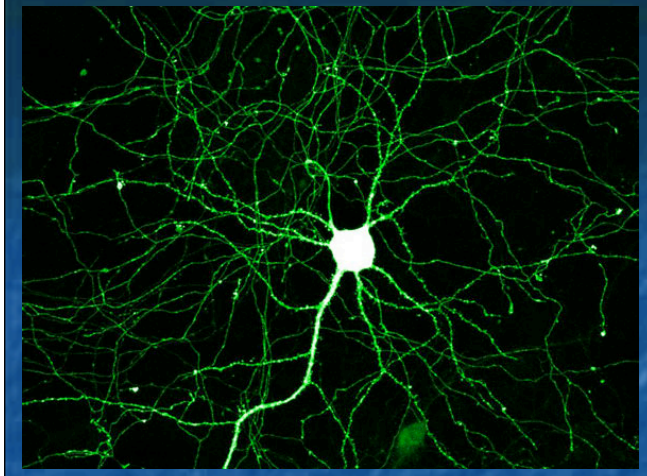
brain circuits



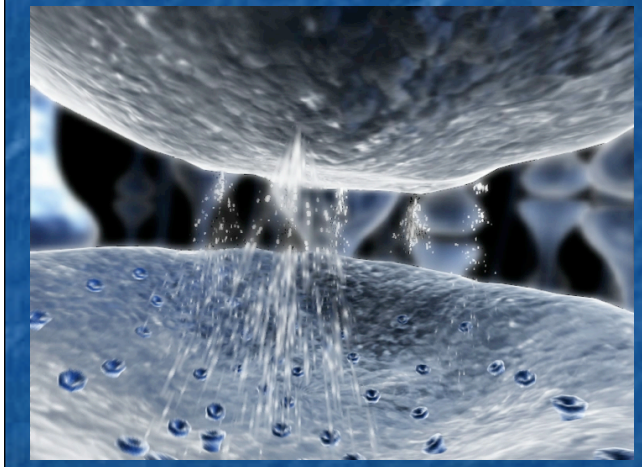
brain pathways



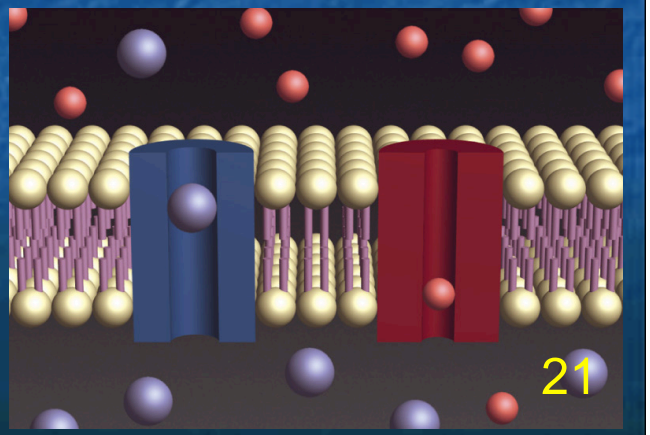
Levels of analysis



neurons



synapses, parts of neurons



subcellular, molecular

Converging disciplines

Cognitive Psychology: a largely functional analysis of cognition, based on experiments that address normal behaviour

Cognitive Neuropsychology: similar, but based on observation of impaired individuals

Cognitive Science: functional and often computational modelling of cognition

An example of impaired behaviour

Converging disciplines

Neuroscience: the investigation of the structure and organization of the nervous system

Functional Neuroimaging: imaging specialization in the active brain

Cognitive Neuroscience: "how the brain enables the mind"
(Gazzaniga & Miller, late '70s)

Converging disciplines

Psycholinguistics: the cognitive psychology of language behaviours, normal and impaired

Neurolinguistics: the neural substrates of language

Linguistics: the formal study of structure in language

Conclusions

There is a lot going on ...

The goal of the course is to give you the confidence to identify a topic within the cognitive neuroscience of language and to research it for your own purposes