INF1-CG 2016
Lecture 30

Some philosophical choices within cognitive modelling (2)

Richard Shillcock

Today's goals

"*Now* that desk looks better. Everything's squared away, yessir, squaaaaaared away."

To look at some of the choices that are made in cognitive modelling and the implications that flow from them.

Today's reading

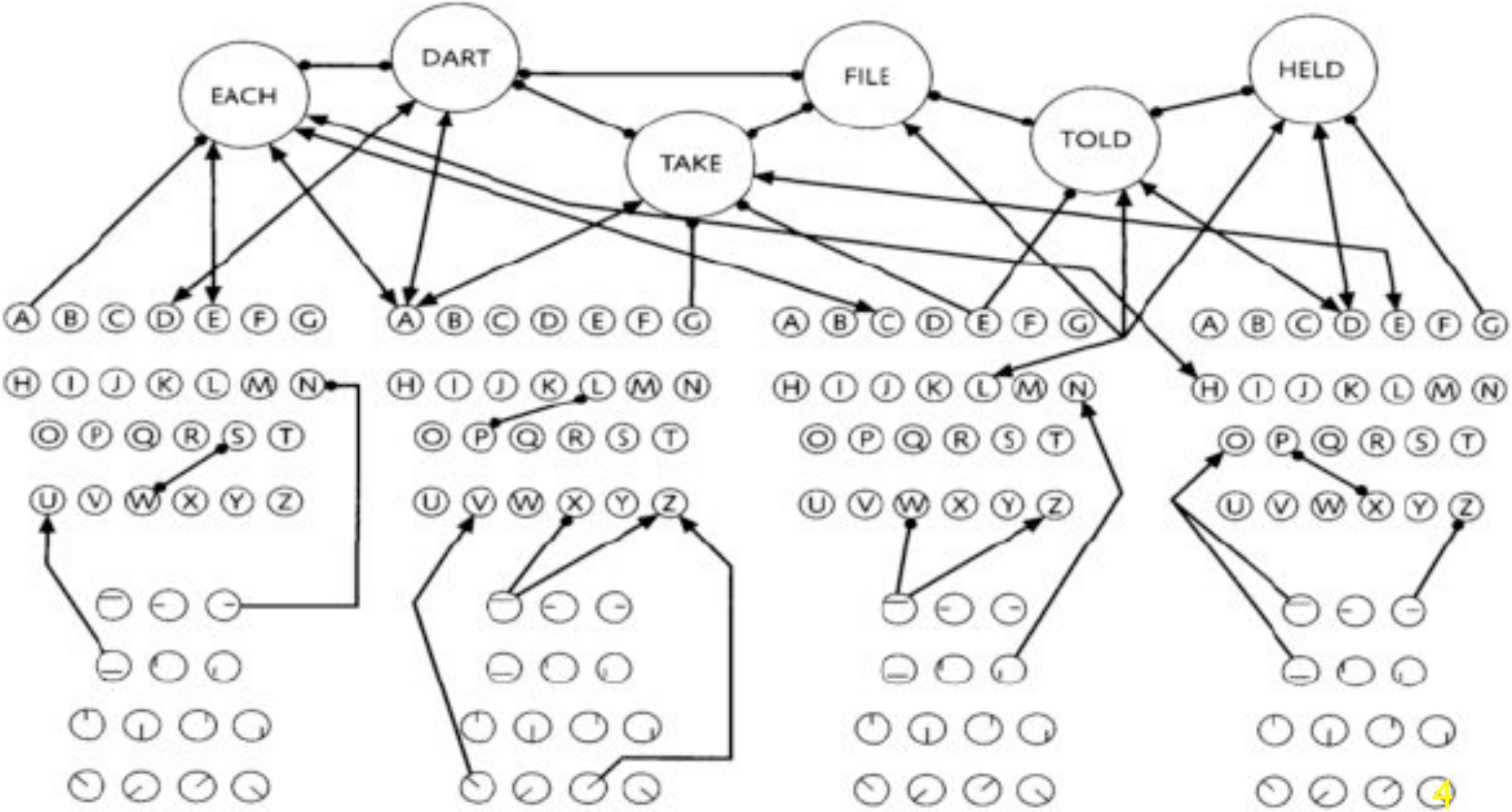
Shillcock, R. (2013). The concrete universal and cognitive science. *Axiomathes*. DOI 10.1007/s10516-013-9210-y.

available at:

https://sites.google.com/site/rcspplsinf/publications

[This reading is just if you're interested in what I do …]

Interactive-Activation Model
model of reading
McClelland & Rumelhart (1981)



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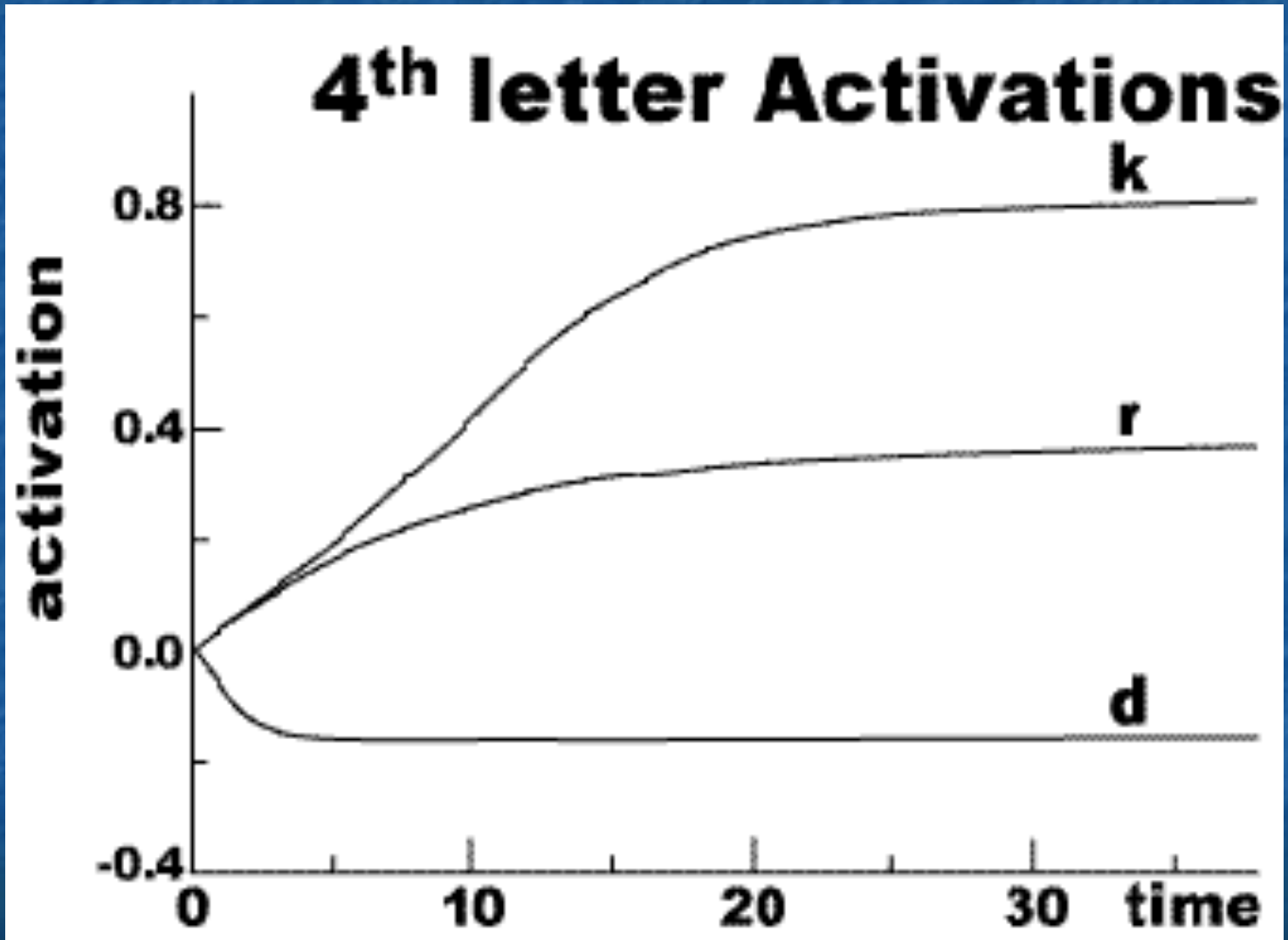

Figure 3. Activation functions for letters over time in the Interactive Activation Model.

Interactive-Activation Model
model of reading
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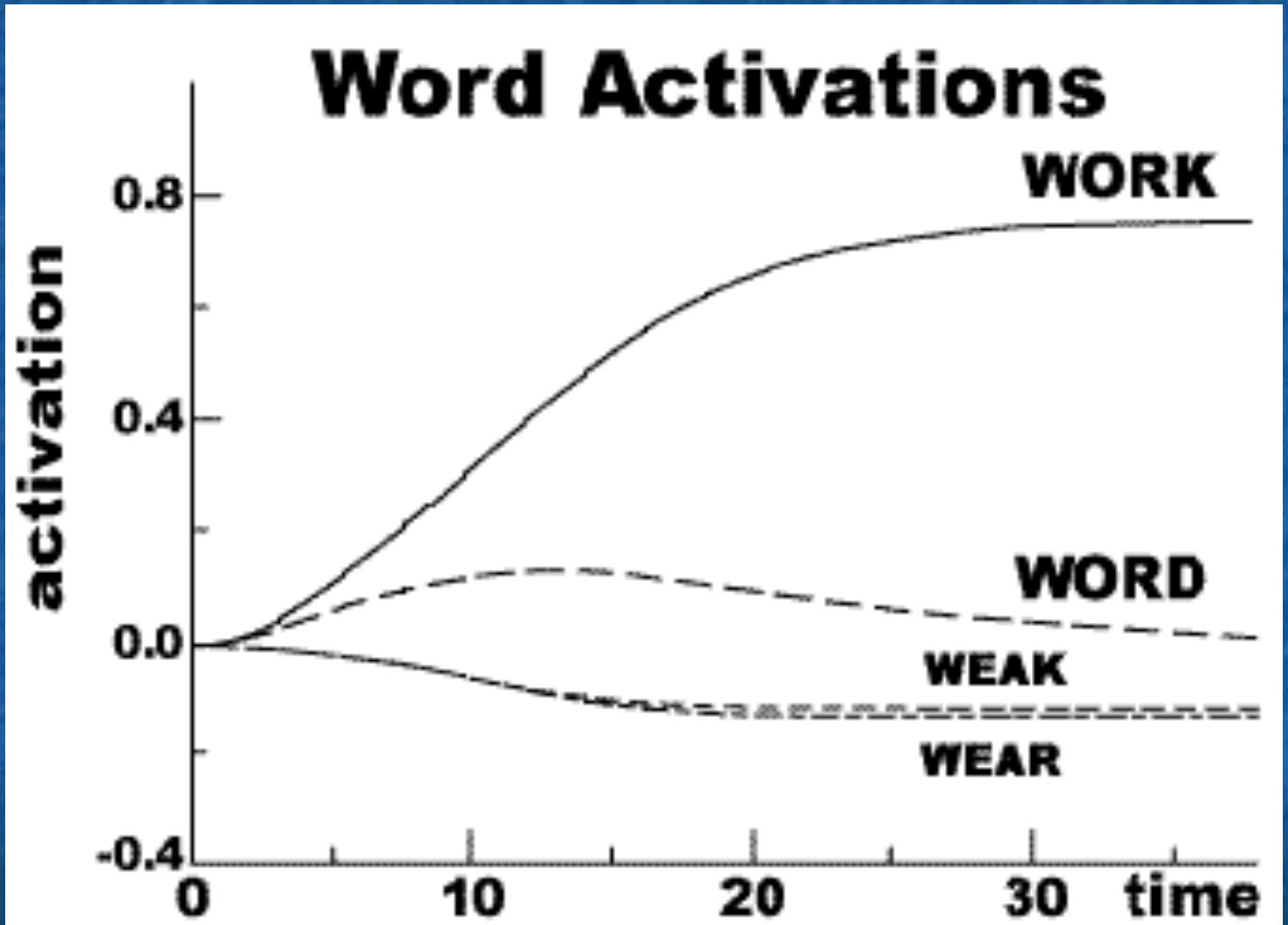


Figure 2. Activation functions for words over time in the Interactive Activation Model.

Limitations of cognitive modelling

A model like the interactive-activation model (IAM) is *partial*, *abstract*, an *idealization*.

It does not take a lot of the real detail of reading words into account (e.g. longer words).

Its behaviours are interesting and humanlike, but far from the whole story.

No part of the IAM is intended to be a real, material thing.

It is intended to capture the *essence* of the reading of 4-letter words. Its authors see competition between candidate words as the essence of the processing.

Limitations of cognitive modelling

The goal of modelling is the *virtuous spiral* between simulation and experimentation …

… but this ultimately means seeing the real-world phenomena through the model …

… we focus on the model not the real world.

We *do* find out more about word recognition but mostly in an *operationalized* way (e.g. reading isolated words).

Even when studying the reading of text, we import the idealizations we have seen in IAM.

Two types of things in models

(1) An *abstract universal* …

Verb

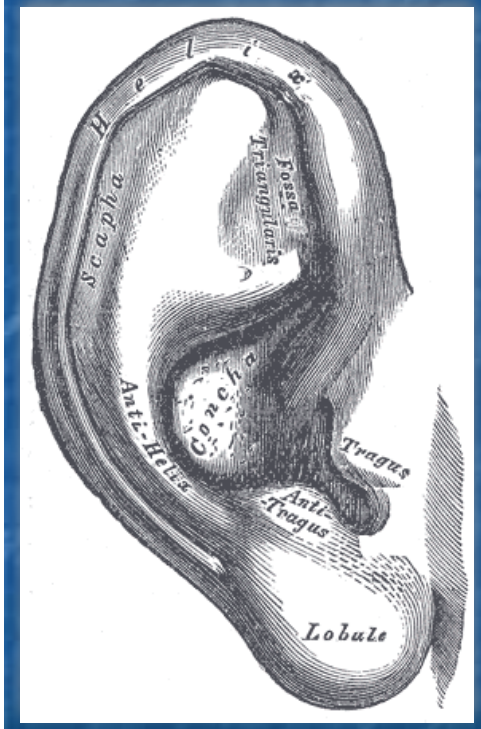
{ breathe, sneeze, inhabit, invest, speak ... }

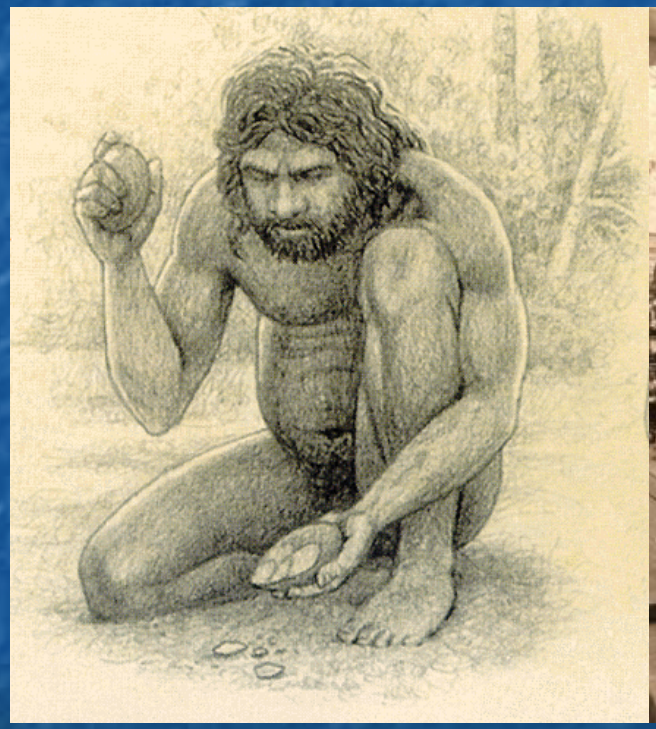
… is *created*, it doesn't *participate*.
… gives us *traction* on the domain.
… expresses *ordered relations* in the domain.
… is *limited*, is always *defeated* by certain data.
… doesn't provide *conceptual* understanding.

Finding a concrete universal

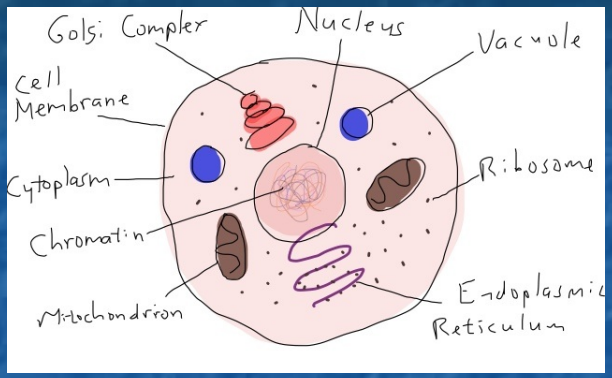
How do we find the *essence* of a domain.?

For instance, what makes us *essentially* human?

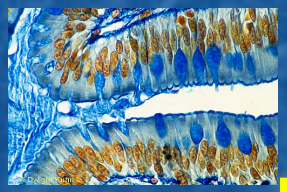
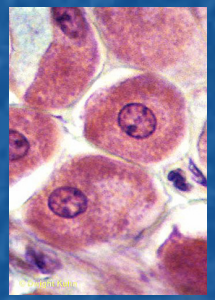
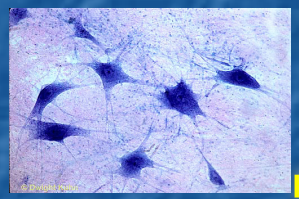
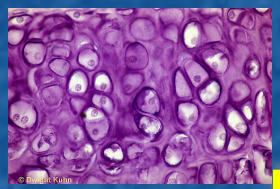
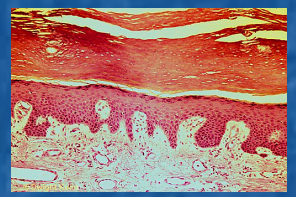




Finding a concrete universal



'the cell' is an abstract universal

{  intestine,  stomach,  brain,  trachea,  skin, ... }

The *stem cell* is a concrete universal with respect to the domain of bodily tissue

A concrete universal ...

… needs to be *identified.*

… is *self-participating.*

… is the simplest, *paradigm example, the 'cell form'.*

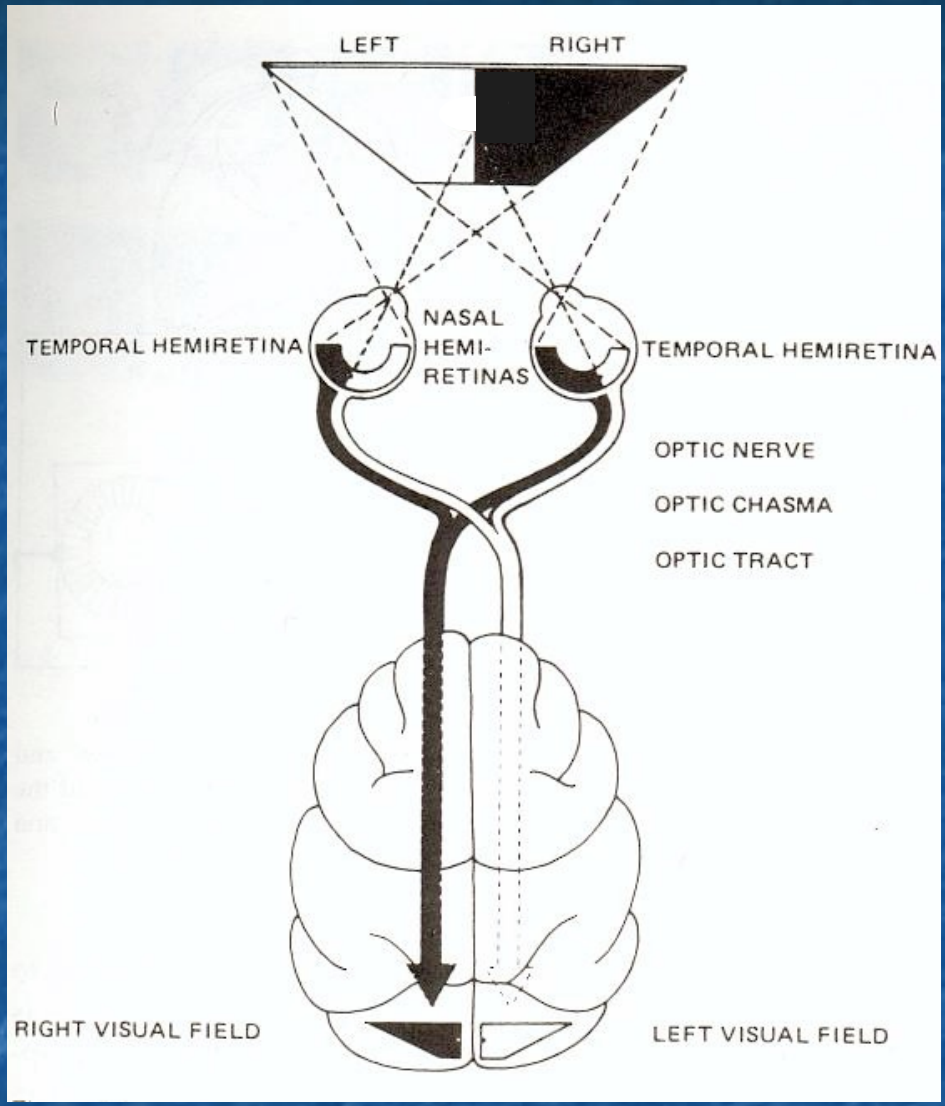
… *mediates* everything else in the domain.

… goes beyond *ordered relations.*

… is simultaneously *material* and an *explanatory principle.*

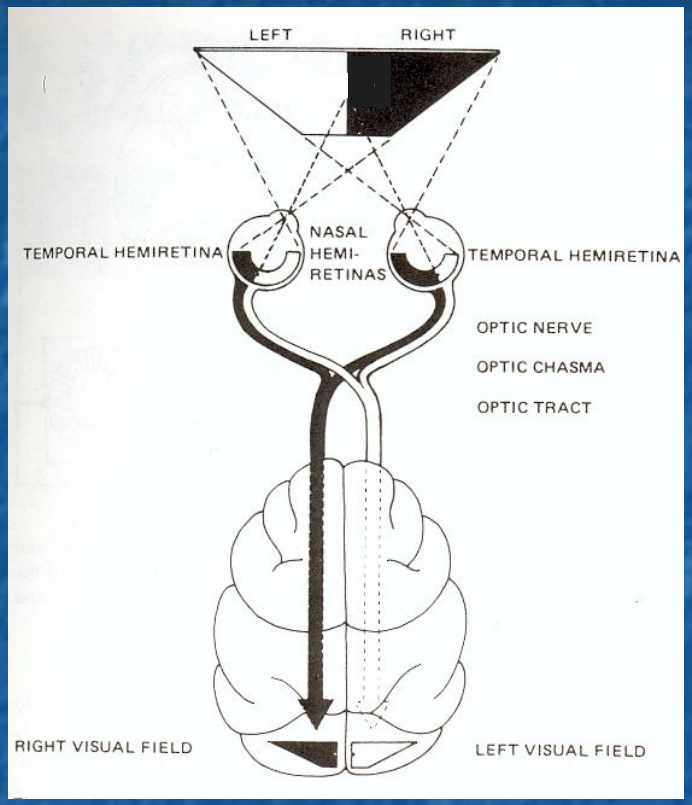
… cannot be defeated by new data.

A concrete approach



The division of the visual projection to the cortex and sub-cortex is an attractive candidate for a concrete universal in reading.

A concrete approach



It means that visual word recognition is *essentially* the problem of coordinating the two parts of the fixated word across the hemispheres. Solving that problem speaks to everything else in reading.

The concrete universal

It is the point in the model at which we can keep pouring in *new, material detail.*

A concrete universal

… provides a *conceptual* understanding of the domain in question.

… is a material thing, reached by taking away a lot of detail from the domain.

… still has content, itself.

… has all the richness of the particular.

Completeness and explanation

We can *analyze* down to the concrete universal.

We can *synthesize* other aspects of the real world around it, in *necessary* ways.

Explanation resides in this dialectical view of analysis $\leftrightharpoons$ synthesis.

The goal is also *completeness*, not just simplicity.

Parsimony increases with each move towards completeness.

A concrete approach

Fixed Effects

	Parameter	Predict	Mdl.Coeff.	Std.Err.	z value	
0	Contralateral; Male; Syll.Brk=Mid; Singular	3.6669	3.6669	0.0873	41.9942	
1	Ipsilateral	3.6500	-0.0169	0.0041	-4.1583	***
2	Male:HQ	4.2047	0.5378	0.2611	2.0598	*
3	Contralateral; Female	3.6330	-0.0339	0.1191	-0.2848	(ns)
4	Male:BeginScore	4.0951	0.4282	0.0774	5.5301	***
5	Male:EndScore	3.3783	-0.2886	0.0444	-6.5037	***
6	Syll.Brk!=Mid	3.6528	-0.0141	0.0049	-2.8517	**
7	Plural	3.6403	-0.0266	0.0067	-3.9910	***
8	log(BNCFreq)	3.7047	0.0378	0.0012	31.4008	***
9	res(log(SbtlFreq))	3.7021	0.0352	0.0017	20.3770	***
10	Female:HQ	4.0271	-0.1437	0.2943	-0.4882	(ns)
11	Male:HQ:BeginScore	3.3082	-1.3247	0.2225	-5.9548	***
12	Male:HQ:EndScore	4.8334	0.9174	0.1108	8.2774	***
13	Female:BeginScore	4.3528	0.2916	0.1045	2.7888	**
14	Female:EndScore	3.5643	0.2199	0.0520	4.2327	***
15	Female:HQ:BeginScore	4.6058	1.1837	0.2714	4.3612	***
16	Female:HQ:EndScore	4.1398	-0.7360	0.1359	-5.4156	***

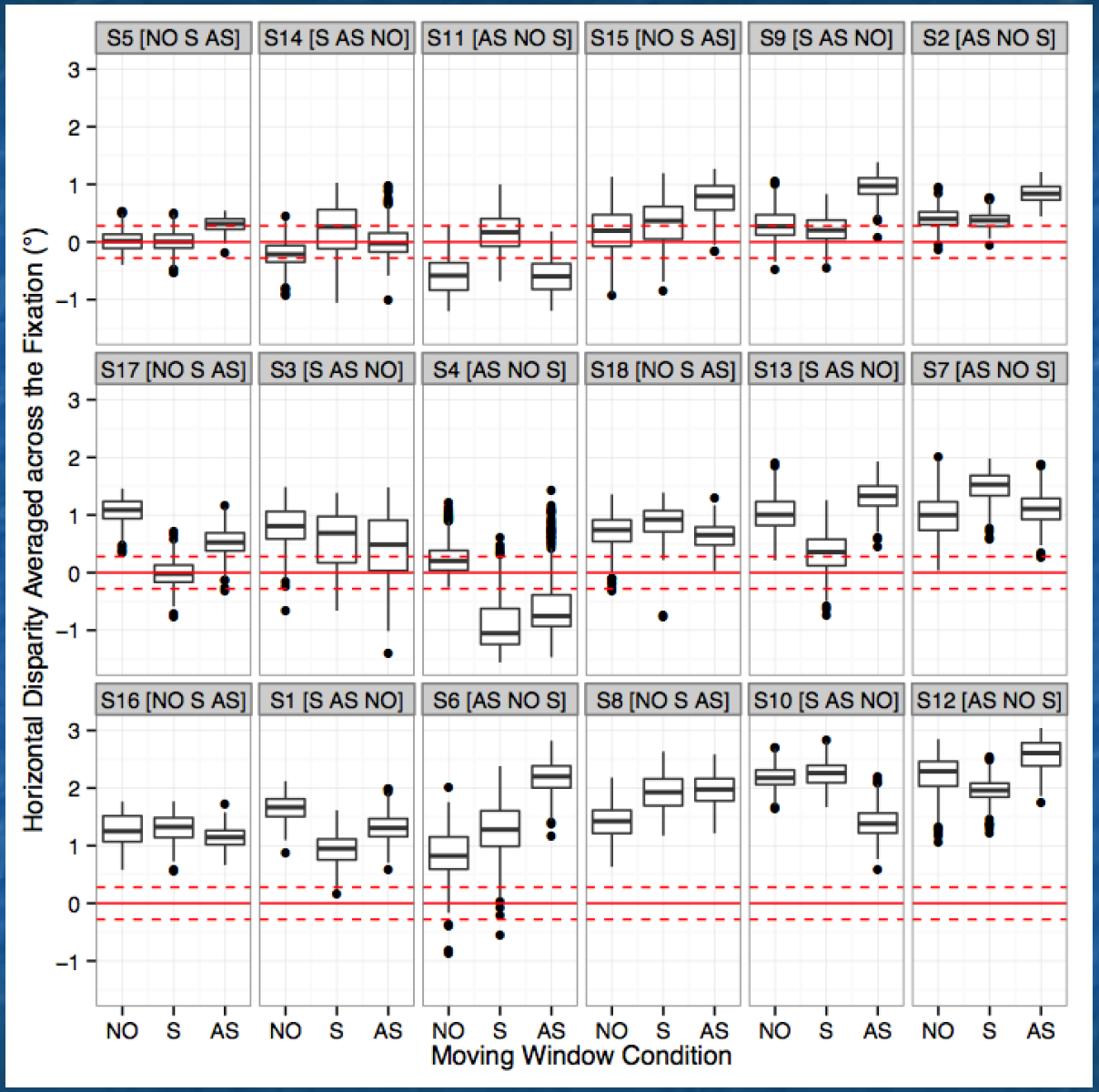
0: Intercept case. Significance levels: . < 0.1; * < 0.05; ** < 0.01; *** < 0.001

Random Effects

Groups	N	Variance	Std.Dev.
Participant	37	0.2292	0.4788
NxtPrDel|Pp		0.0005	0.0221

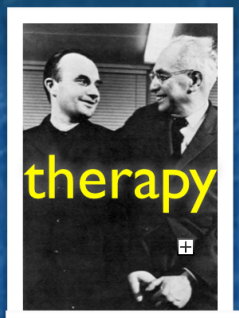
Experimental manipulations that play with the relevant concrete universal really do feel like "carving nature at its joints", as above.

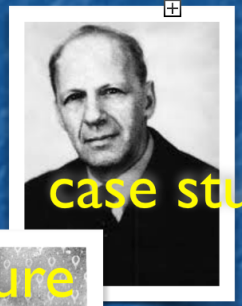
A concrete approach

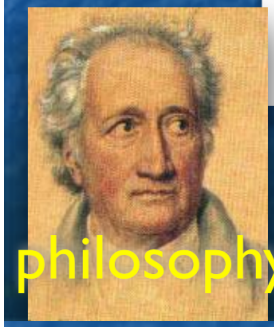


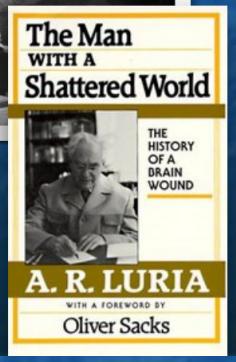
Developments in statistics reveal pervasive individual differences …

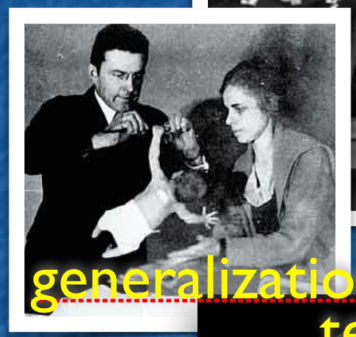
Idiographic Nomothetic

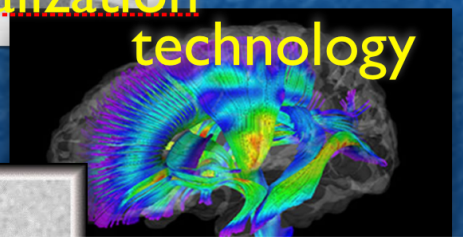


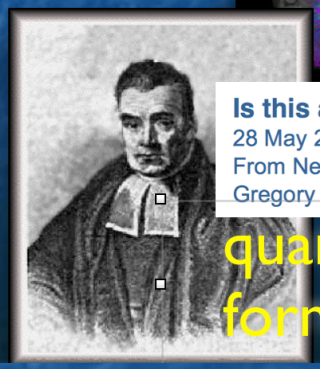












Is this a unified theory of the brain?
28 May 2008
From New Scientist Print Edition.
Gregory T. Huang

quantification, formalisms

3/xx

Philosophical advances (the concrete universal) and data-analytical advances (regression-type statistics) hold out the promise that we can move between the idiographic and nomothetic in revealing ways.

Overall challenges

Cognitive Science seems to be moving towards integrating the idiographic and nomothetic.

We may be approaching valuing complexity as much as simplicity.

More is beginning to be understood about the domains we have looked at – vision and memory.

The research paradigms we have looked at – laboratory experiments, computational modelling, impaired processing, imaging – all have something to offer to a richer, more integrated Cognitive Science.

How to revise

Short-answer questions (Mirella), two longer (sub-divided) questions (one from Chris, one from Richard).

Perhaps with one or more partners, look at the slides and your notes.

Be able to say something about the major topics in the slides.

Have a look at the films we watched (all on the www, see References). (Lectures were also filmed.)

Understand the overall points made in the readings listed at the beginning of each lecture.

The References at the end of each lecture are for if you need to check out the meaning of a lecture slide.