Language evolution: enlarging the picture

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[a]This is very much joint work with Michiel van Lambalgen

Two prominent example positions on language evolution

- *Chomsky*: Recursion is the magic bullet of human language evolution but one cannot see language as an adaptation and its function is not communication
- *Pinker and Prince*: There's more to language than recursion, and each discrete bit is an adaptation selected under pressure for communication

In biology these ideas are now unrecognisable

- 'bean bag genetics' : a 1930s debate (Fisher/ Wright), though with continuing ramifications in biology [1])
- the lampooned position of 'bean bag genetics' is alive and well among non-biologists
- in biology, we now have 'EvoDevo'—evolutionary developmental biology
- macro-evolution happens by changes to developmental processes (a 19C idea) through modular genetic elements controlling timing/rate/place of gene expression (20C molecularisation)
- e.g. Waddington [10] and *Antennaepedia* (NB: 1957)

A liberal democrat position?

- Chomsky is right that language is not an (bundle of) adaptation(s) but he's wrong that recursion is new, and that there is one magic bullet. And language evolution *was* driven by communication
- Pinker and Prince are right that there's more than recursion to language but don't have a theory of communication that would enable us to understand relevant functions, nor a biology in which changes are often exaptations
- EvoDevo has exciting new perspectives to offer if we can only find a more biological description of the phenotype of 'human language capacity' than 'grammar'
- *One candidate*: human 'discourse capacity' is the capacity to create novel micro-languages interpreted on the current context—sentence 'codes' are a secondary by-product

The next slide

"It's an ordered construction on a foundation of context, knowledge and belief . Languages are pairings of sentences and meanings. Witness they are how we judge understanding. Situation models are what is communicated. A discourse isn' t a bag of sentences. This is encapsulated in a 'situation model' or 'discourse model' . Half a century of psycholinguistics has shown this isn't how language works. "

Language as code vs. language as discourse

- a code of sentences: pairings of sentences and meanings
- half a century of psycholinguistics has shown this isn't how language works
- a discourse isn' t a bag of sentences: it's an ordered construction on a foundation of context, knowledge and belief which is encapsulated in a 'situation model' or 'discourse model'
- situation models are what is communicated—witness they are how we judge understanding
- evolutionarily discourse comes first—how we can deal with sentences 'out of context' is a fascinating question (to which the answer is largely "As mini-discourses")

The situation model might be viewed as a code

- There is cat 1. There is Mat 1. Cat 1 is on Mat 1.
- There is cat 2. There is Mat 2. Cat 2 $\neq$ Cat 1. Mat 1 $\equiv$ Mat 2.
- Cat 1 likes whiskas. Cat2 is biggest.

Numerous equivalences between phrases are generated within this new micro-language: 'The cat first introduced' $\neq$ 'The largest animal on the mat'. NB These are not equivalences in English—they might be equivalences in the interpretation of the newly created microlanguage. And of course the next sentence may remove some of them.

So, a new phenotypic description: 'Human discourse capacity'

- the cognitive capacity for producing and comprehending discourses of one or more sentences
- interpreted on the context which is partially constructed by the discourse itself
- from non-linguistic elements: perception, knowledge, belief, . . . as well as a bit of language too

Related ideas: syntax as planning

- Greenfield [2] made one of the best known proposals that language should be conceived as planning
- she observed that children acquire the stategies of different difficulty for planning recursive motor action (nesting cups) in the same order as they acquire the strategies for nesting clauses
- several authors notably [7] have taken up this proposal analogising producing sentences to planning complex actions
- our proposal is of the same kind but at different levels—above all about defeasible discourse semantics and pragmatics
- planning discourse (or recognising discourse plans) is defeasible planning for the creation of situation models by hearers (or recreating the situation model planned by the speaker)
- can be modelled in 'Planning Logic'
- e.g. logic programing with negation as failure—'closed-world reasoning'

And, we propose, syntax developed from discourse

- *John pushed Max. He fell.*
- *Max fell. John pushed him.*
- *Max fell* because *John pushed him*
- *because* distinguishes two possible discourse relations between what are now clauses within a sentence, and introduces recursive syntax
- NB. one-sentence discourses are also discourses.

Ancestral motor planning is primitively recursive and defeasible

- whenever there is a range of routines which are combinable, and interruptable
- Lashley on serial order: Sherrington on how cows stand up
- there may or may not be special features of human syntactic recursion
- defeasible planning is everywhere: animals act with respect to their best guess model of their situation, constantly revised, in hierarchically organised units
- recursion is often obscured by tactical smearing of units in efficient execution
- McGonigle's [3] showed that monkeys' working memories are hierarchically organised with remarkable homologies to human WM

. . . and much enhanced in primates

- primates evolved accuracy of grasp and binocular vision in response to arboreal living
- humans evolved bipedalism in coming down from the trees, genuinely opposable thumbs in response to tool manufacture, and social planning in response to the deviousness of their colleagues

What was ape-ancestor planning like?

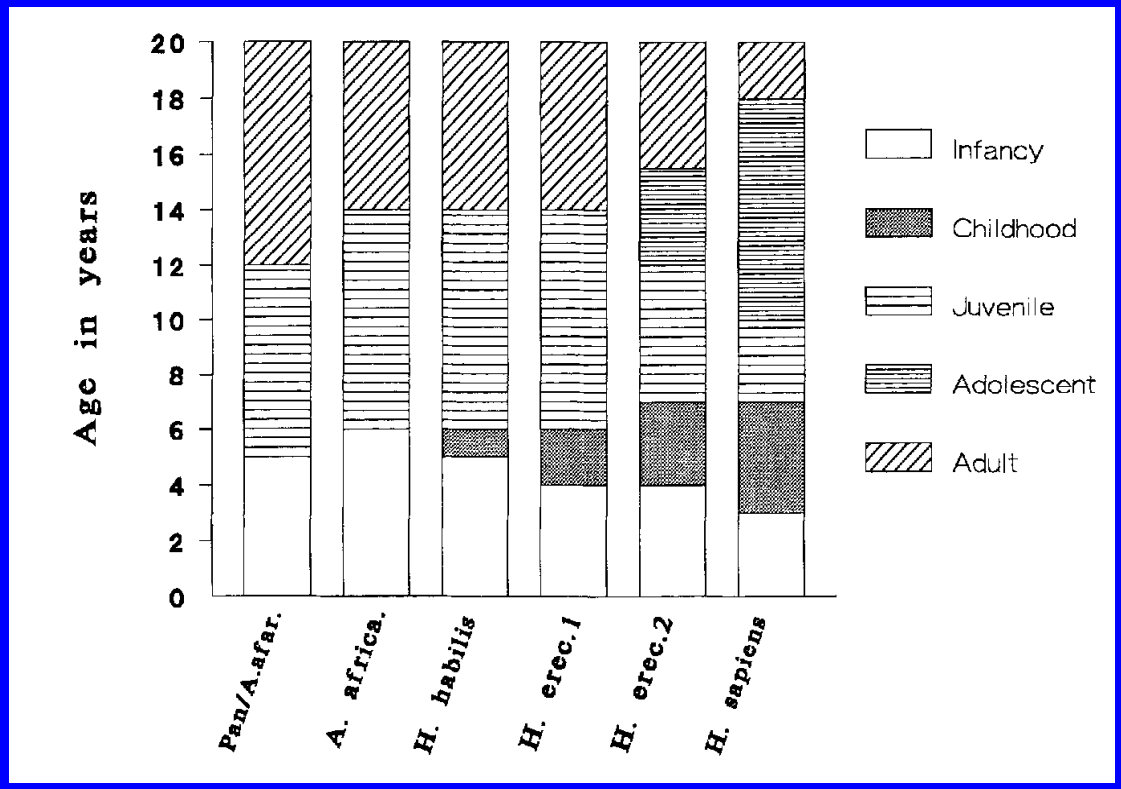
- not terribly much studied, and easy to underestimate out of context
- Kohler's apes failed to innovate in fetching boxes to reach bananas
- but then 'cognitively modern humans' failed to invent the wheel for a long time
- in more conducive environments apes do seem to have some foresight
- ape language learning experiments demonstrate various things that aren't hard: arbitrary reference, distant reference, systematicity of recombination of signs, ...
- but less attention has been paid to their learning discourse
- the two sentence stage of discourse?

So what is novel about human discourse planning?

- multi-level planning in narrative:
  - the plot of a narrative presents the plans and actions of the characters
  - but the discourse itself has to be planned so that the hearer will reconstruct the right situation model
- audience and protagonists provide a curious duality — have to plan how to get the plan of the character into the mind of the audience

The larger biological context: how does EvoDevo change things?

- human ontogeny diverges from the ancestors' dramatically [?]
- humans are born motorically useless and slowly grow large brains
- these are outrageously expensive changes
- with all sorts of social ramifications, and dramatic changes in the learning environment
- human infants' first grasp of causality is almost entirely mediated through control of other agents
- the temporal contingencies of third-party mediated causality (agency) are completely different (mother is quick, but not as quick, or quite as consistent, as physics)
- long temporal contingencies are a nightmare for learning complexity—requiring radical (social) solutions


Age in years
20
18
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14
12
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4
2
0
Pan/A.afar.
A. africa.
H. habilis
H. erec.1
H. erec.2
H. sapiens
Infancy
Childhood
Juvenile
Adolescent
Adult

EvoDevo requires the large picture

- Evodevo: large-scale reconfigurations and selection pressures on them
- there will be adaptations, but functions change, and many changes are not adaptations: first byproducts and then repurposings
- e.g. growing large brains might have been driven by social cognition. The obstetric problems of large brains drive infant dependency, requiring more social reasoning and bigger brains . . .
- discourse perhaps started as a byproduct of prolonged helplessness and an immature brain dumped into the external world, forced to act through others

The economics of the madhouse: evolution in flagrante delicto

- psychiatric developmental syndromes reveal prominent departures from 'normal' developmental timings
- e.g. autism—dramatic deceleration then acceleration of perinatal head growth [5]
- e.g. attention deficit hyperactivity disorder (ADHD)—overall delay of especially frontal cortical development [5]
- the discourse strategies of children with autism and ADHD are distinctive and can be given comprehensible defeasible logical expression ([4];[9])
- these are extremes of normal variation and even they bestow benefits as well as costs

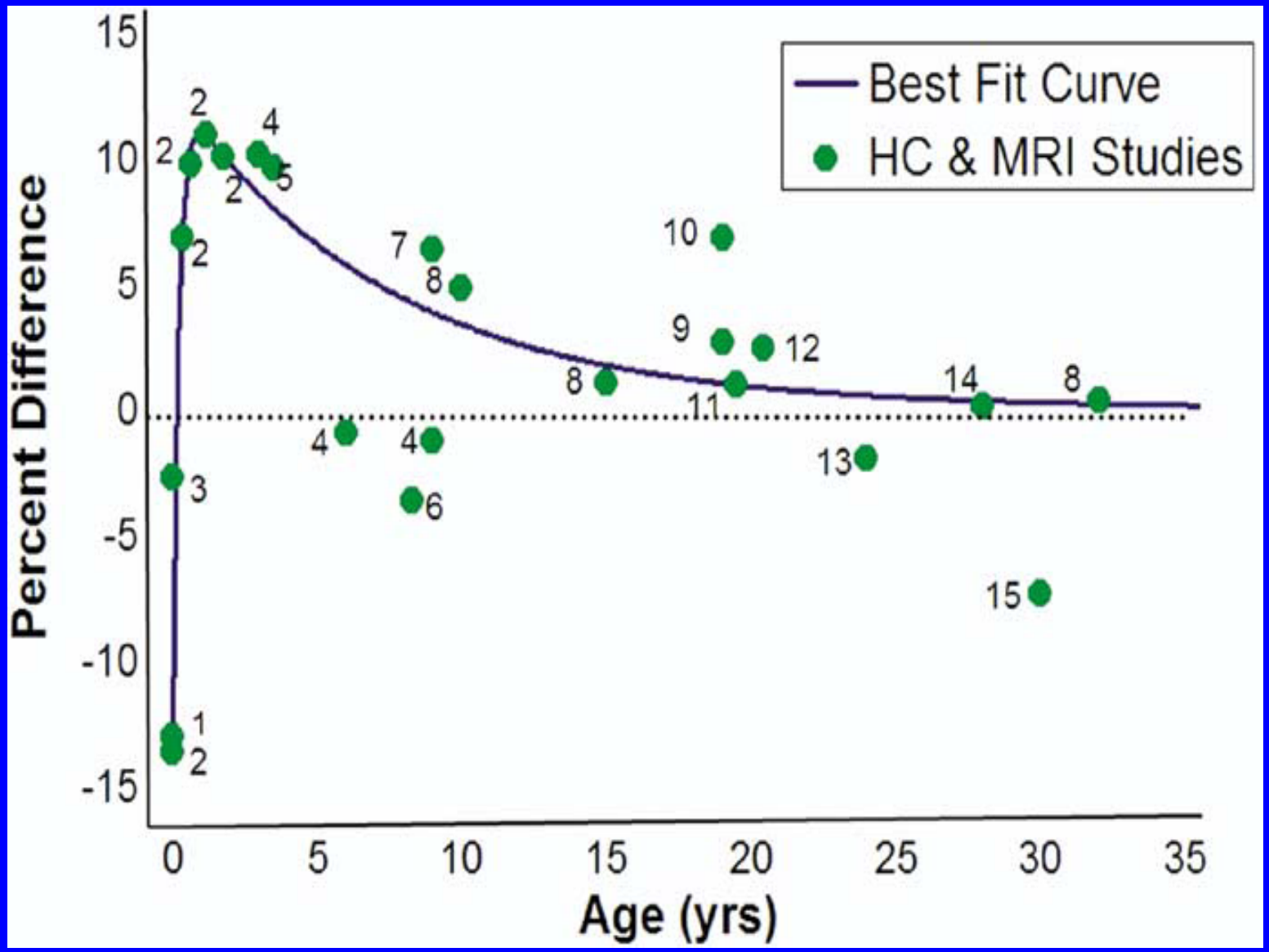

Figure 2: Autism: perinatal head growth [5]

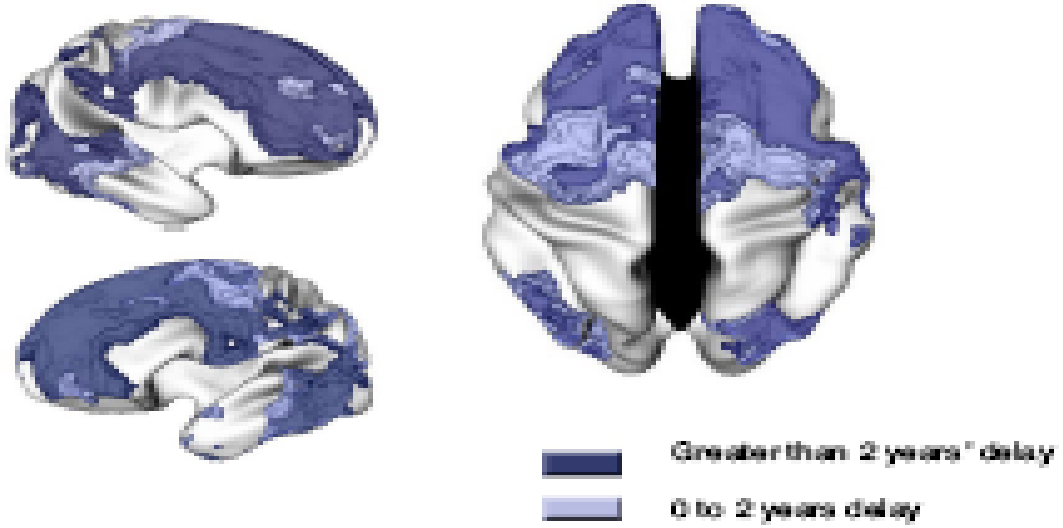

Figure 3: ADHD: Cortical development [6]

For example, ADHD

- executing a plan (the plan of the character or or the plan to put the plan of the character into the mind of the audience) requires goal-maintenance in WM
- Go/NoGo tasks show that children with ADHD have difficulty with goal-maintenance in WM
- the first casualty is the plan to put the plan of the character into the mind of the audience
- children with ADHD leave out the context-setting elements and even tense-marking on verbs that would facilitate understanding on the part of the audience

Conclusions

- a grammar centred view of language is a disciplinary convenience but a biological barrier
- a language-as-discourse specification changes what is seen as new and what is ancestral
- the content of (narrative) discourse models is characters' planning, and the form of discourse is the form of planning to construct discourse models
- both are defeasible planning which can be modelled in simple neurally implementable logics
- human infant helplessness forces control through social agency
- EvoDevo offers ways of integrating the understanding of diverse changes in ontogenetic processes—and avoiding bean bag phenotypic thinking
- the time lags in disciplinary communication can be of the same order as my age . . . or *even* longer

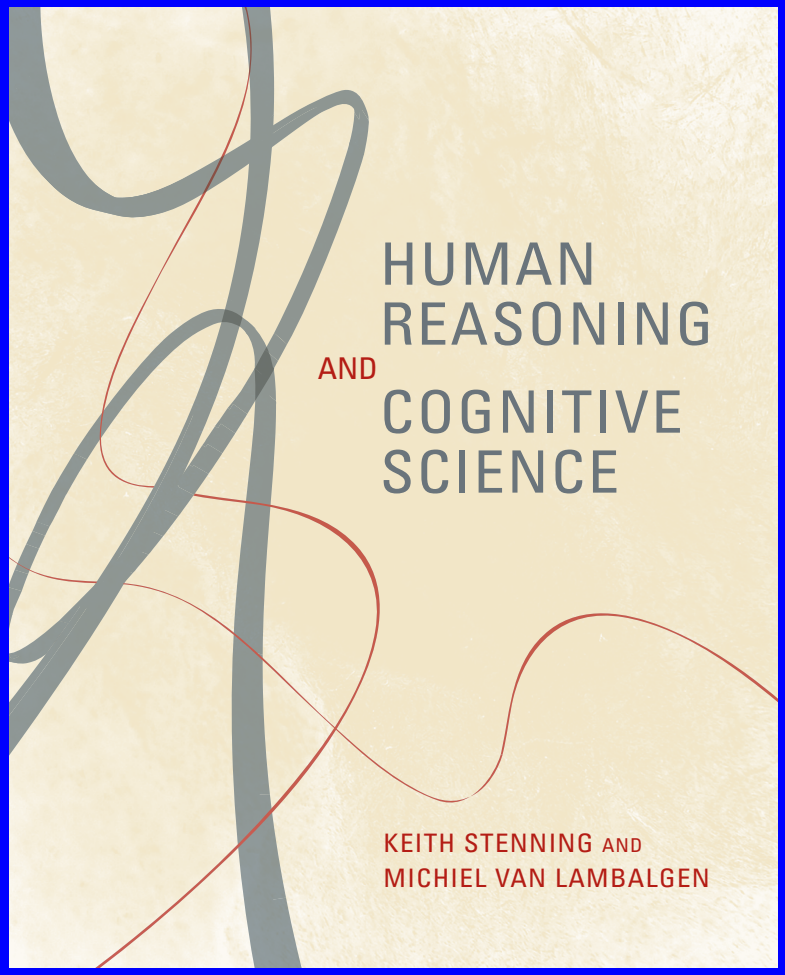

Figure 4: Pirate copies available you probably can guess where [8]

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