# WHY ONLY US LANGUAGE AND EVOLUTION



#### Robert C. Berwick • Noam Chomsky

January 2016 The MIT Press

#### "Wallace's Problem" (1869)



Alfred Russel Wallace



**Charles Darwin** 

#### typical French cry

#### typical German cry







Source: Mampe, Friederici, Christophe & Wermke, Current Biology, 2009

#### WHAT?



Brains of Nonvocal Learners

Science

MAAAS



Source: Pfenning et al. Science, 12 Dec. 2014

# WHAT? <u>Common</u> gene toolkit for vocal learning / production



**Identifying molecular brain similarities across species.** Brain region gene expression specializations were hierarchically organized into specialization trees of each species (blue lines), including for circuits that control learned vocalizations (highlighted green, purple, and orange regions). A set of comparative genomic algorithms found the most similarly specialized regions between songbird and human (orange lines), some of which are convergently evolved.

SCIENCE sciencemag.org

Science

MAAA!

Source: Pfenning *et al. Science*, 12 Dec. 2014



### WHO?





give orange me give eat orange me eat orange give me eat orange give me you



### **Original Sin?**





"the apple is in the drawer next to the knife"

Neandertals

Neandertal-Denisovan split 500 kya

Last Anatomically Modern Humans Out of Africa 60 kya

#### WHEN? WHERE?

≈ 250-200 kya Anatomically
Modern humans

H. Heidelbergensis?

950 kya split/

1см

mya *H. erectus* 80-90 kya Blombos carving earliest <u>unambiguous</u> symbolic



### WHERE & WHEN?



Blombos Cave artefact, 90-80,000 years ago





Mammoth ivory horse from Vogelherd cave, 32,000 years ago

Slide courtesy Ian Tattersall

### HOW?





# HOW? Deep(er) nets....?



Suzana Herculano-Houzel, 2016: brain "fractionater"

#### HOW?



TRENDS in Cognitive Sciences

Berwick et al., 2013

### HOW?

#### newborns







Source: Perani, Saccuman, Scifo, Anwander, Spada, Baldoli, Poloniato, Lohmann & Friederici, Proc Nat Acad Sci USA, 2011





Macaque brain, white fiber tracts, Frey et al., Brain and Language, 2014

# WHY? The Tree M's Merge = Mental Models for stories



FIG. 2. Schematic diagram of the chamber used in the present experiments

Universal "cross-bar" inter-lingua for all other abilities

### WHY? Merge $\Rightarrow$ Mathematics



Fig. 5. Human and nonhuman animals exhibit the capacity to compute numerosities, including small precise number quantification and large approximate number estimation. Humans may be unique, however, in the ability to show open-ended, precise quantificational skills with large numbers, including the integer count list. In parallel with the faculty of language, our capacity for number relies on a recursive computation. [Illustration: John Yanson]

Source: Chomsky, Hauser, Fitch, 2002. Science



Prolongational reduction of opening of Mozart's piano sonata K. 331, from Pesetsky, 2007 "Music Syntax IS Language Syntax"

A Mystery Story: The Answers WHAT? Merge WHO? Only us: Anatomically modern humans WHEN? 200,000-100,000 yrs ago WHERE? Southern Africa HOW? Relatively rapid, small  $\Delta$  in neural plasticity & targeted growth WHY? The 3 M's: internal "mental models" for stories; math; music