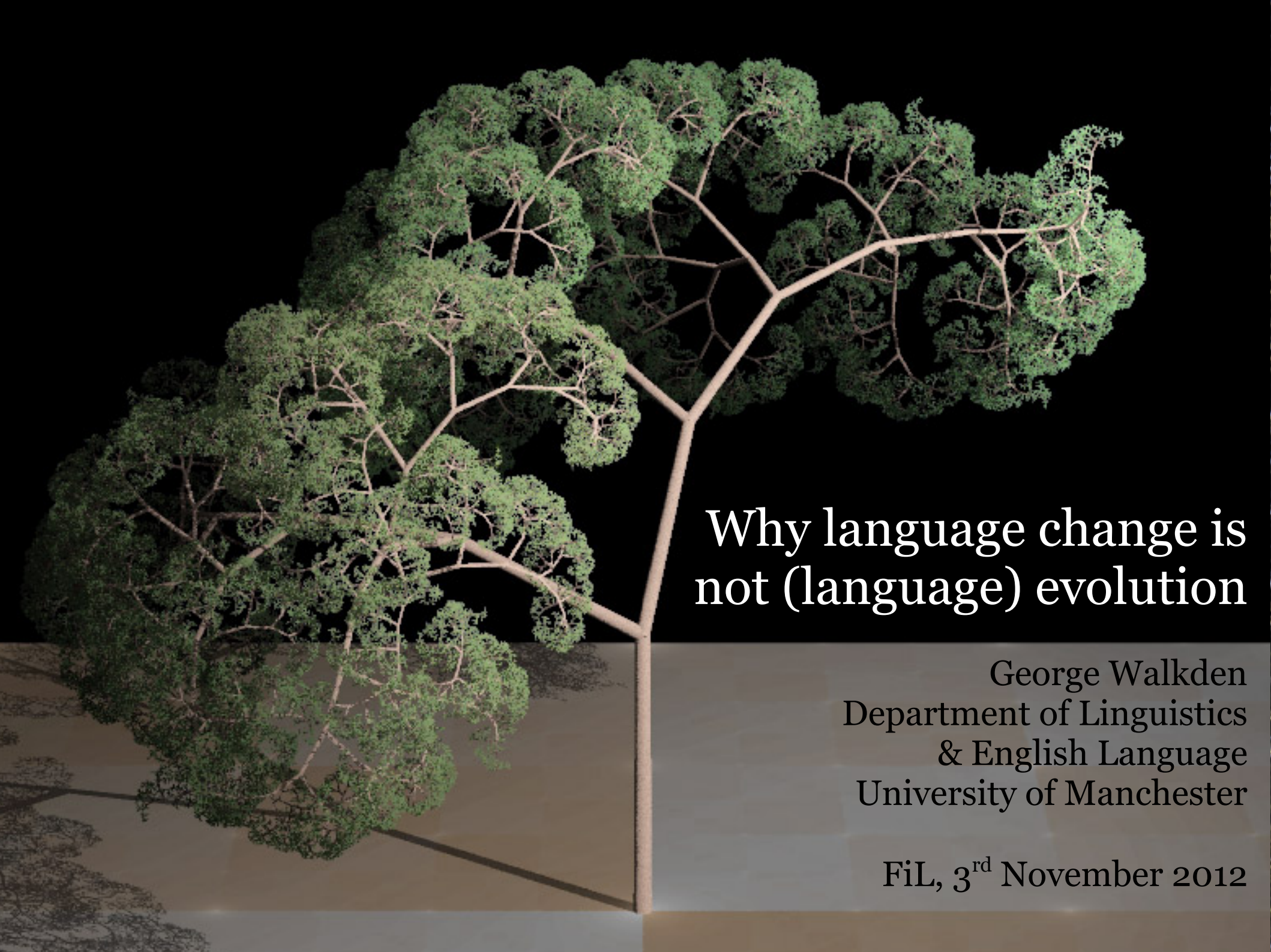

Why language change is not (language) evolution

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Language change as evolution

- Treating language change as evolution has become extremely popular in the last two decades.
  - Cf. Clark & Roberts 1993; Keller 1994; Croft 1996, 1999, 2000, 2008; Deacon 1997; Lass 1997, 2003; Kirby 1999a; Nettle 1999; Yang 2000, 2002; Mufwene 2001, 2008; Briscoe (ed.) 2002; Blevins 2004; Ritt 2004; Mendívil-Giró 2006; Niyogi 2006; Christiansen & Chater 2008; Evans & Levinson 2009, *inter alia.*

Language change as evolution

- In the media:

Language change as evolution

- Drawing parallels between biological evolution and language change is not a new idea.
  - Darwin (1981 [1871]: 59): 'the formation of different languages and of distinct species, and the proofs that both have been developed through a gradual process, are curiously the same' [revised edition: 'curiously parallel'] (1989 [1874]: 94)
  - See Alter (1999, 2008) on this paragraph.
  - Pre-Darwin: Schleicher (1873); Müller (1873: 662): 'In the Science of Language, I was a Darwinian before Darwin'

Outline of this talk

- In this talk, I will suggest that the enterprise is largely unhelpful, and that language change is best understood on its own terms.
  - Cf. also McMahon (1994: chapter 12); Dahl (1999); Itkonen (1999); Andersen (2006).
- Structure of the talk:
  - Languages and species
  - Languages, uniformity, and 'progress'
  - Language evolution: defining the basic notions

Two crucial distinctions

- Language evolution: metaphor or reality?
  - Metaphor: Lass (2003), Blevins (2004), *inter alia*
  - Reality: Lass (1990, 1997); Croft (2000); Mufwene (2001, 2008); Ritt (2004), *inter alia*
- It is essential to make a distinction between:
  - The biological emergence of the capacity for language in humans (*literal* biological evolution)
  - Language change ('glossogeny'; Hurford 1990)
    - I will be dealing with language change.

Languages and species

- A common starting point for evolutionary accounts of language change is to compare languages to species.
  - Lyell (1863: chapter 23); Schleicher (1873: 13)
  - Croft (2000, 2008)
  - Mufwene (2001, 2008)
    - 'languages are analogs of parasitic species' (2001: 179)
  - Mendívil Giró (2006)
  - Implicit in all family trees (from Schleicher 1873 on)

Languages and species

- The crucial questions: if a language is (like) a species,
  - how do we define ‘language’?
  - how do we define ‘species’?
- The dominant (and only serious) definition of species in the biological literature is the biological species concept (BSC; Dobzhansky 1937; Mayr 1942).

The biological species concept

- ‘Species problem’ (Mayr 2004: 171–193):
  - ‘How can we reach meaningful conclusions in this research if one does not know what a species is and, worse, when different authors talk about different phenomena but use for them the same word – species?’ (Mayr 2004: 171)
  - Darwin did not have a satisfactory theory of speciation (Mayr 2004: 106–107)
- Biological species concept:
  - Species recognition is based on **reproduction**.

The biological species concept

- Outline of the BSC:
  - Biological species are 'groups of interbreeding natural populations that are reproductively (genetically) isolated from other such groups' (Mayr 2004: 177).
  - Actual geographic separation is not important (*pace* Croft 2000: 13); what matters is propensity.
  - If languages are (like) species, then we need a definition of language analogous to the BSC.

Some candidates

- Structural definition?
  - NO: too static.
- Social (Chambers & Trudgill 1980) definition?
  - NO: based on speaker perceptions.
- Mutual intelligibility?
  - NO: mutual intelligibility can be asymmetric (Norwegian Bokmål vs. Standard Danish), unlike reproduction.

Some candidates

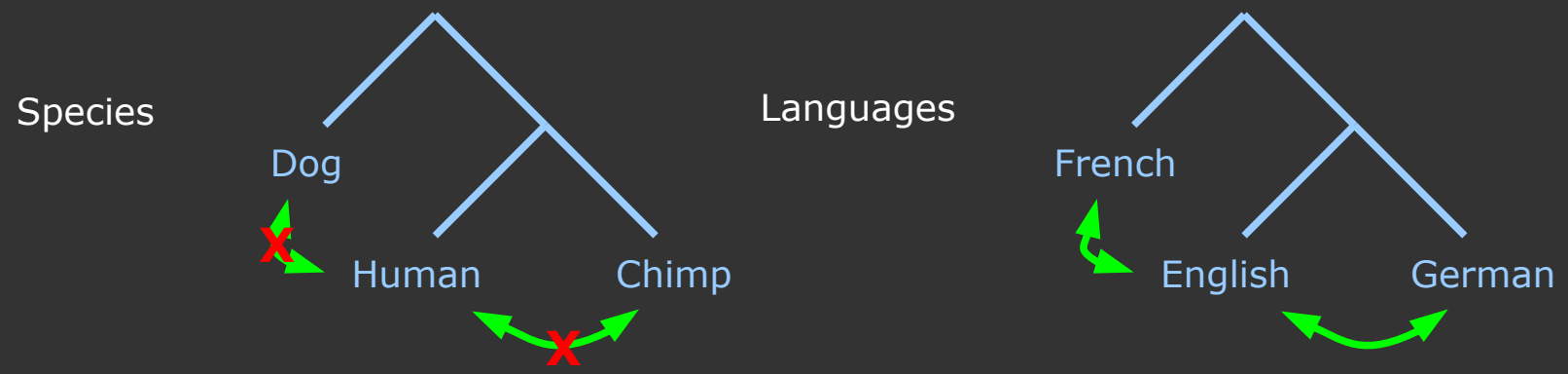
- Croft (2000: 17): potential for actual communicative interaction.
  - Croft (2000: 19) rejects mutual intelligibility because it is based on potential rather than actual interaction.
    - But so is the BSC (Mayr 2004: 177–178)!
  - NO:
    - Communicative interaction is language-independent.
    - Like mutual intelligibility, can be asymmetric.

A false analogy in Croft (2000)

- **Sibling species**: species that are structurally very similar, but reproductively isolated.
  - Croft (2000: 16): 'SIBLING LANGUAGES are two linguistic varieties that are so similar that they are considered to be "dialects of the same language", yet are perceived by the speakers … as distinct languages.'
  - But:
    - this analogy does not follow from Croft's model, because speaker perception, not communicative interaction, is taken as primary here.

A further problem

- Transmission between sexually reproducing species is (essentially) always **vertical**.
- But transmission of features between languages can be horizontal (**contact**).
  - Cf. Lass (1997), Croft (2000: 197), Mufwene (2001:126).



Zoöcentricity?

- One way round this glaring disanalogy: maybe languages aren't like *animal* species (or aren't like sexually reproducing species).
  - Mufwene (2001: 179): 'languages are analogs of parasitic species'
  - Croft (2000: 8): 'language "speciation" is more like plant speciation than animal speciation'

Zoöcentricity?

- BUT:
  - Grant (1981: 64), Hull (1988: 215): asexually reproducing species are inherently reproductively isolated, and so **do not form species**.
  - Mayr (2004: 182): 'the BSC is inapplicable to asexual organisms, which form clones, not populations'
  - So language CANNOT be analogous to plant, virus or other asexual species, because these do not exist.

The only way out

- A linguistic species concept?
  - Mufwene (2001):
    - 'the linguistic species need not be a clone of any biological species, despite the fact that it shares several properties with the parasitic species' (2001: 145)
    - 'there is no particular reason why every structural notion applicable to a biological species should be applicable to a linguistic species' (2001: 30)
    - 'I gave up unsuccessful attempts to clone the linguistic species on the biological species ... and developed my own notion of a linguistic species' (2001: xiv)
  - This is not unreasonable, but...

Languages are not (like) species

- … if languages and species have so little that is meaningful in common, why use the word ‘species’ at all?
- Mufwene’s position essentially concedes the great dissimilarity between languages and species that I have argued for here.
- Conclusion to this segment: **languages are not (like) species.**
  - cf. also Lightfoot 2002: 116; Dalby 2002: chapter 1.

Uniformity and 'progress'

- In the 19th century it was common to view the history of languages as a story of progress:
  - 'Progressive improvement in language is a necessary consequence of the progress of the human mind from one generation to another. As civilisation advances, a greater number of terms are required to express ... ideas and things, which a single word had before signified, though somewhat loosely and imperfectly.' (Lyell 1963: chapter 23)
  - See also Jespersen (1922).

Language change is not progress

- Schleicher (1850) and Steinthal (1860) held the opposite view: languages decayed over time.
  - Neither view was ever seriously argued for.
  - Both views were abandoned with the Neogrammarians (see Morpurgo Davies 1998: 233), and have never been returned to.
  - Modern linguistics rejects the notion of either progress or decay; see Lass (1980), McMahon (1994: 324–325), Goldberg (2008: 523).

Uniformitarianism in linguistics

- Labov (1972: 161):
  - ‘the same mechanisms which operated to produce the large-scale changes of the past may be observed operating in the current changes taking place around us’
- Lass (1997: 26):
  - ‘Nothing that is now impossible *in principle* was ever the case’
- Croft (2003: 233):
  - ‘the languages of the past … are not different in nature from those of the present’
- Roberts (2007: 264):
  - ‘all languages at all times … reflect the same basic UG’

Uniformitarianism in biology

- Slightly more complicated. Four different hypotheses (Gould 1965, 1987):
  - Uniformity of law across time and space
  - Uniformity of process
  - Uniformity of rate
  - Uniformity of state
    - 'the history of our earth … follows no vector of progress in any inexorable direction. Our planet always looked and behaved just about as it does now.' (Gould 1987: 123)

Uniformitarianism contrasted

- In biology, uniformity of state is patently false.
  - In the Palaeozoic there were no mammals. There are now.
  - Cf. Gould (1987: 167–173) on Lyell's about-face. Logically independent of progress.
- In linguistics, by contrast, there is no evidence against uniformity of state.
  - Conclusion to this segment: we thus see another disanalogy between biological evolution and language change.

What is evolution anyway?

- Difficult to define even within biology (Sober 1993: 2–5)
- Darwin's theory of evolution was actually five logically independent theories (Mayr 2004: chapter 5)
- Sober (1993: 209): evolution is change of frequencies within a population. Two key characteristics:
  - Differential fitness (survival/reproduction)
  - Heritability (offspring must resemble parents)

What is evolution anyway?

- Hull's (1988: 408–409) generalized approach:
  - **Replicator**: entity that passes on structure largely intact
  - **Interactor**: entity that acts as cohesive whole with its environment
  - **Selection**: differential extinction and proliferation of interactors causing differential perpetuation of replicators
  - **Lineage**: entity that persists indefinitely as a result of replication

What is evolution anyway?

- For metaphorical/analogical approaches:
  - ‘The fundamental issue is whether the terms of the metaphor actually have referents, or at least can point to some ontologically specifiable domain’ (Lass 2003: 48)
- For literal approaches:
  - Can a suitable level of abstraction be found at which identity is attained?

Some views

Author	Replicator	Interactor	Selection	Lineage
Biology (standardly)	Genotype	Phenotype	Adaptation to environment	Species
Schleicher (1873)	n/a (languages as organisms)			
Clark & Roberts (1993)	Grammar	Speaker?	To input text, + elegance	Language?
Haspelmath (1999)	Features	Speaker	Functional	Language
Croft (2000)	Lingueme (via utterances)	Speaker	Sociolinguistic (community)	Language
Yang (2002)	Grammar	Grammar?	To input text	Language?

Cynic's response

- Linguists are unable to agree on how even the basic notions of biological evolution can be cashed out in linguistic terms.
- Serious internal problems and disanalogies arise on all of these accounts.
- See also Dahl (1999), Dresher & Idsardi (1999), McMahon (1994: chapter 12).

Meme

- Dawkins (1976): a meme is an entity subject to selection in cultural evolution.
  - Cf. Croft's (2000) 'lingueme'.

Problems with memes

- Lewens (2007):
  - ‘memetics merely offers a cosmetic re-packaging of a familiar set of stories about cultural change’
- Dawkins (1976) maintained that the gene was the unit of selection.
  - But Sober & Lewontin (1982); Gould (1990: 72–78); Eldredge (2004); Mayr (2004: 141–144): the phenotype rather than the gene is the unit of selection.
  - Memetics (and linguemes) therefore of little value.

Constant environment

- If the analogue of natural selection is functional selection (e.g. Haspelmath 1999), then adaptation is simply to considerations of functional optimality.
- But these considerations (the ‘environment’) are **definitionally** constant.
- Therefore, this model is entirely unable to explain the ‘speciation’ of languages, or even the existence of different languages.

Replication and transmission

- Walkden (2012: 898): 'like grammars, DNA is not transmitted directly from individual to individual or from cell to cell'; the process 'can be taken to be analogous to language acquisition'.
- BUT Kirby (1999b): 'We must … be careful of analogies such as these … whereas grammars have to be reconstructed every generation through learning or acquisition, DNA sequences do *not* (they are physically passed on and copied).'
- Croft (2000: 45): 'It is difficult to describe the language learning process as a replication of the grammar of the parent by the child' because the process is 'very indirect'.

Lamarckian evolution

- Jean-Baptiste Lamarck (1744–1829):
  - Pre-Darwinian evolutionist.
  - Proposed that acquired traits can be inherited.

- Cf. also Comte de Buffon, and Darwin's 'pangenesis'.
- Example: man becomes blacksmith, gets strong, therefore if he has children they will also be strong.
- Now known to be false: heritability is based on genotype, which is not modified during life.

Lamarckian evolution

- But if grammars/sets of features are the linguistic analogue of the genotype, then...
- Linguistic 'evolution' **is** Lamarckian.
  - Inheritance in language is based on actual data ('E-language'), not genes (or 'I-language').
  - 'Acquired' characteristics, such as changes over the lifespan (cf. e.g. Sankoff 2008), are reflected in this data, ***even if*** they do not constitute a grammar change *per se* (as argued by Meisel 2011).
  - Cf. Haspelmath (1999: 193), Mufwene (2001: 12).

Getting defensive

- ‘This difference does not mean that linguistic evolution cannot be regarded as an evolutionary process’ [sic] (Haspelmath 1999: 193)
- ‘such differences … need not discourage the population genetics approach’ (Mufwene 2001: 17)
- Croft (2000: 38–40) mentions ‘two significant disanalogies between biological and linguistic evolution’, but argues that these ‘do not weaken the generalized theory’ proposed by Hull, because ‘Hull’s generalized theory of selection stands above disciplinary boundaries’.

More abstraction?

- It's worth focusing on Croft's model, because:
  - it's one of the more biologically informed models out there
  - it claims to be largely immune to disanalogies
  - it is a literal (rather than metaphorical) interpretation
- A different line of argument is needed to critique Croft's approach: is the model **interesting**?

Explanation?

- ‘the generalized theory of selection can in fact subsume any theory of language change. The simplest and least interesting alternative theory is that language change is totally random. This theory can easily be subsumed under the generalized theory of selection.’ (Croft 2000: 42)
  - Is this a good thing?

Critiques of cultural evolution

- In a critique of the model of cultural evolution proposed by Cavalli-Sforza and Feldman (1981), Sober (1993: 213) makes the same point:
  - 'The model describes the *consequences* … not the *cause* … Historians, on the other hand, will see the real challenge to be the identification of causes.'
- Abstract models of cultural evolution are causally neutral.
  - 'if the qualitative assumptions are correct, historians will have little incentive to take the details of these models into account.'

Critiques of cultural evolution

- Lewens (2007):
  - ‘We gain no real explanatory insight if we are told that ideas spread through populations, some more successfully than others. We want to know what makes some ideas fitter than others. And it is not clear that there will be any general rules that can help us to answer this question.’
- So models like Croft’s are not explanatory. They make no predictions. The bulk of his 2000 book (chapters 4–7) attempts to develop a theory of change within an evolutionary model.

Cultural evolution: a waste of time

- Conclusion to this segment:
  - 1. Linguists cannot agree on how to cash out the basic terms.
  - 2. However one does so, there appear to be important disanalogies.
  - 3. If one abstracts away from the disanalogies, the resulting ‘generalized theory’ is non-explanatory and non-predictive in the domains of both culture and biology.

Summary

- I have argued that:
  - Languages are not (like) species
  - Biological change exhibits progression; there is no evidence for this in linguistic change
  - The basic notions of evolutionary theory cannot be cashed out unproblematically in linguistic terms
  - Generalized theories of evolution are contentless
- These points are the backbone of my contention that treating language change as (language) evolution is unhelpful.

Where do we go from here?

- Should we abandon all attempt to compare evolutionary biology and historical linguistics?
  - I think not. Both are retrospective sciences in which the construction of historical narrative is crucial (Sober 1993: 14; Lass 1997: 5–20; Mayr 2004: 32–33).
  - Comparisons can usefully be drawn without a wholesale importation of obscurantist terminology.
    - Cf. Lass's (1997) use of *synapomorphy* for *shared innovation*!
  - One useful biological notion is *population thinking*.

Population thinking

- ‘any effort to abstract from a characterisation of individual psychological profiles, in a way that allows an exploration of the consequences of these individual-level dispositions for population-level properties’ (Lewens 2007).
- Sober (1991: 492): models of cultural evolution are only useful to the extent that social scientists [or linguists – GW] are **not** ‘good at intuitive population thinking’.

Mathematical models

- Mathematical and computational models borrowed from biology may be useful (see e.g. Yang 2000, Niyogi 2006, Bouckaert *et al*. 2012)...
- ...if the foundational assumptions they make are appropriate to the domain of language. (On a case where they aren't, see Lewis & Pereltsvaig 2012.)

Linguistics at an advantage?

- Case where historical linguistics actually has it better: the **regularity of sound change**.
  - The (non-trivial) notion that regular sound changes exist is a robust empirical discovery.
  - Regular sound change has no obvious analogue in the biological domain.

Final thoughts

- In sum, I don't suggest that no comparisons should be drawn between biology and language.
- But rather than adopting ideas from biology uncritically, we should think about **what we stand to gain** by doing so in any individual case.
- In many cases the comparisons generate more confusion than insight, indicating that language change is best understood on its own terms.

Thank you!

References (1)

- Alter, Stephen G. 1999. *Darwinism and the linguistic image: language, race and natural theology in the nineteenth century*. Baltimore: Johns Hopkins University Press.
- Alter, Stephen G. 2008. "Curiously parallel": analogies of language and race in Darwin's *Descent of Man*. A reply to Gregory Radick. *Studies in History and Philosophy of Biological and Biomedical Sciences* 39, 355–358.
- Andersen, Henning. 2006. Synchrony, diachrony, and evolution. In Ole Nedergaard Thomsen (ed.), *Competing models of linguistic change: evolution and beyond*, 59–90. Amsterdam: John Benjamins.
- Blevins, Juliette. 2004. *Evolutionary phonology: the emergence of sound patterns*. Cambridge: Cambridge University Press.
- Bouckaert, Remco, Philippe Lemey, Michael Dunn, Simon J. Greenhill, Aleksandr V. Alekseyenko, Alexei J. Drummond, Russell D. Gray, Marc A. Suchard, & Quentin D. Atkinson. 2012. Mapping the origins and expansion of the Indo-European language family. *Science* 24, 957–960.

References (2)

- Briscoe, Edward J. (ed.). 2002. *Linguistic evolution through language acquisition*. Cambridge: Cambridge University Press.
- Cavalli-Sforza, Luigi L., & Marcus W. Feldman. 1981. *Cultural transmission and evolution: a quantitative approach*.
- Chambers, Jack K., & Peter Trudgill. 1980. *Dialectology*. Cambridge: Cambridge University Press.
- Christiansen, Morten H., & Nick Chater. 2008. Language as shaped by the brain. *Behavioural & Brain Sciences* 31, 489–558.
- Clark, Robin, & Ian Roberts. 1993. A computational approach to language learnability and language change. *Linguistic Inquiry* 24, 299–345.
- Croft, William. 1996. Linguistic selection: an utterance-based evolutionary theory of language change. *Nordic Journal of Linguistics* 19, 99–139.
- Croft, William. 1999. Adaptation, optimality and diachrony. *Zeitschrift für Sprachwissenschaft* 18, 206–208.

References (3)

- Croft, William. 2000. *Explaining language change: an evolutionary approach*. London: Longman.
- Croft, William. 2003. *Typology and universals*. Cambridge: Cambridge University Press.
- Croft, William. 2008. Evolutionary linguistics. *Annual Review of Anthropology* 37, 219–234.
- Dahl, Östen. 1999. Does adaptation really help us to explain language change? *Zeitschrift für Sprachwissenschaft* 18, 209–211.
- Dalby, Andrew. 2002. *Language in danger*. London: Penguin.
- Darwin, Charles. 1981 [1871]. *The descent of man, and selection in relation to sex*. 2 vols. Princeton: Princeton University Press.
- Darwin, Charles. 1989 [1874]. *The works of Charles Darwin*, vols. 21 and 22, *The descent of man, and selection in relation to sex*. Revised edn. New York: New York University Press.
- Dawkins, Richard. 1976. *The selfish gene*. Oxford: Oxford University Press.

References (4)

- Deacon, Terrence W. 1997. *The symbolic species: the co-evolution of language and the human brain*. London: Penguin.
- Dobzhansky, Theodosius. 1937. *Genetics and the origin of species*. New York: Columbia University Press.
- Dresher, B. Elan, & William J. Idsardi. 1999. Prerequisites for a theory of diachronic adaptation. *Zeitschrift für Sprachwissenschaft* 18, 212–215.
- Eldredge, Niles. 2004. *Why we do it: rethinking sex and the selfish gene.* New York: Norton.
- Evans, Nicholas, & Stephen C. Levinson. 2009. The myth of language universals: language diversity and its importance for cognitive science. *Behavioural & Brain Sciences* 32, 429–448.
- Goldberg, Adele E. 2008. Universal Grammar? Or prerequisites for natural language? *Behavioural & Brain Sciences* 31, 522–523.
- Gould, Stephen J. 1965. Is uniformitarianism necessary? *American Journal of Science* 263, 223–228.

References (5)

- Gould, Stephen J. 1987. *Time's arrow, time's cycle: myth and metaphor in the discovery of geological time.* Cambridge, MA: Harvard University Press.
- Gould, Stephen J. 1990. *The panda's thumb: more reflections in natural history*. London: Penguin.
- Grant, Verne. 1981. *Plant speciation*. 2nd edn. New York: Columbia University Press.
- Haspelmath, Martin. 1999. Optimality and diachronic adaptation. *Zeitschrift für Sprachwissenschaft* 18, 180–205.
- Hull, David L. 1988. *Science as a process: an evolutionary account of the social and conceptual development of science*. Chicago: University of Chicago Press.
- Hurford, James R. 1990. Nativist and functional explanations in language acquisition. In I. M. Roca (ed.), *Logical issues in language acquisition*, 85–136. Dordrecht: Foris.

- Hull, David L. 1988. *Science as a process: an evolutionary account of the social and conceptual development of science*. Chicago: University of Chicago Press.

References (6)

- Itkonen, Esa. 1999. Functionalism yes, biologism no. *Zeitschrift für Sprachwissenschaft* 18, 219–221.
- Jespersen, Otto. 1922. *Language: its nature, development and origin.* London: George Allen and Unwin.
- Keller, Rudi. 1994. *Language change: the invisible hand in language*. London: Routledge.
- Kirby, Simon. 1999a. *Function, selection and innateness: the emergence of language universals*. Oxford: Oxford University Press.
- Kirby, Simon. 1999b. The role of I-language in diachronic adaptation. *Zeitschrift für Sprachwissenschaft* 18, 222–225.
- Labov, William. 1972. *Sociolinguistic patterns.* Philadelphia, PA: University of Pennsylvania Press.
- Lass, Roger. 1980. *On explaining language change*. Cambridge: Cambridge University Press.

References (7)

- Lass, Roger. 1990. How to do things with junk: exaptation in language evolution. *Journal of Linguistics* 26, 79–102.
- Lass, Roger. 1997. *Historical linguistics and language change*. Cambridge: Cambridge University Press.
- Lass, Roger. 2003. Genetic metaphor in historical linguistics. *Alternation* 10, 47–62.
- Lewens, Tim. 2007. Cultural evolution. *Stanford Encyclopedia of Philosophy*. Accessed online 2nd Nov 2012.
- Lewis, Martin W., & Asya Pereltsvaig. 2012. Linguistic phylogenies are not the same as biological phylogenies. *GeoCurrents*, 17th October 2012. Accessed online 3rd Nov 2012.
- Lightfoot, David W. 2002. Myths and the prehistory of grammars. *Journal of Linguistics* 38, 113–136.
- Lyell, Charles. 1863. *The geological evidence of the antiquity of man*. London: J. M. Dent & Sons.

References (8)

- Mayr, Ernst. 1942. *Systematics and the origin of species from the viewpoint of a zoologist*. New York: Columbia University Press.
- Mayr, Ernst. 2004. *What makes biology unique? Considerations on the autonomy of a scientific discipline*. Cambridge: Cambridge University Press.
- McMahon, April M. S. 1994. *Understanding language change*. Cambridge: Cambridge University Press.
- Meisel, Jürgen M. 2011. Bilingual acquisition and theories of diachronic change: bilingualism as cause and effect of grammatical change. *Bilingualism: Language and Cognition* 14, 121–145.
- Mendívil Giró, José-Luis. 2006. Languages and species: limits and scope of a venerable comparison. In Joana Rosselló & Jesús Martín (eds.), *The biolinguistic turn: issues on language and biology*, 82–118. Barcelona: Publicacions Universitat de Barcelona.
- Morpurgo Davies, Anna. 1998. *History of linguistics*, vol. 4: *Nineteenth-century linguistics*. London: Longman.

References (9)

- Mufwene, Salikoko S. 2001. *The ecology of language evolution*. Cambridge: Cambridge University Press.
- Mufwene, Salikoko S. 2008. *Language evolution: contact, competition and change*. London: Continuum.
- Müller, Friedrich Max. 1873. Lectures on Mr. Darwin's philosophy of language. *Fraser's Magazine* 7, 659–678.
- Nettle, Daniel. 1999. *Linguistic diversity*. Oxford: Oxford University Press.
- Niyogi, Partha. 2006. *The computational nature of language learning and evolution*. Cambridge, MA: MIT Press.
- Osthoff, Hermann, & Karl Brugmann. 1878. *Morphologische Untersuchungen auf dem Gebiet der indogermanischen Sprachen*, vol. 1. Leipzig: Hirzel.
- Ritt, Nikolaus. 2004. *Selfish sounds and linguistic evolution: a Darwinian approach to language change*. Cambridge: Cambridge University Press.
- Roberts, Ian G. 2007. *Diachronic syntax*. Oxford: Oxford University Press.

References (10)

- Sankoff, Gillian. 2008. Lifespan change and language change: real-time evidence for three trajectory types. Paper presented at the Colloquium on Language Acquisition and Change across the Lifespan and across Generations, Hamburg.
- Schleicher, August W. 1850. *Die Sprachen Europas in systematischer Übersicht*. Bonn: König.
- Schleicher, August W. 1873. *Die darwinsche Theorie und die Sprachwissenschaft*. 2nd edn. Weimar: Böhlau.
- Sober, Elliott. 1991. Models of cultural evolution. In Paul Griffiths (ed.), *Trees of life: essays in philosophy of biology*, 477–492. Dordrecht: Kluwer.
- Sober, Elliott. 1993. *Philosophy of biology*. Oxford: Oxford University Press.
- Sober, Elliott, & Richard Lewontin. 1982. Artifact, cause, and genic selection. *Philosophy of Science* 49, 157–180.
- Spencer, Herbert. 1864. *Principles of biology*. 2 vols. London: Williams & Norgate.

References (11)

- Steinthal, Heymann. 1860. *Charakteristik der hauptsächlichsten Typen des Sprachbaues*. Berlin: Dümmler.
- Walkden, George. 2012. Against inertia. *Lingua* 122, 891–901.
- Yang, Charles. 2000. Internal and external forces in language change. *Language Variation & Change* 12, 231–250.
- Yang, Charles. 2002. *Knowledge and learning in natural language*. Oxford: Oxford University Press.