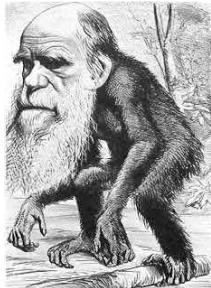


What is evolution?



Variation

Heritability

Differential survival

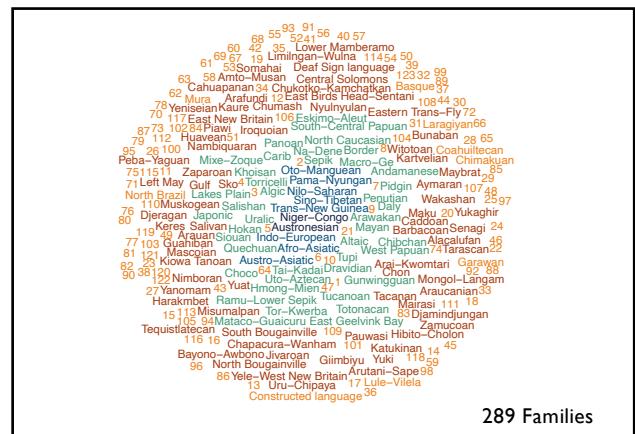
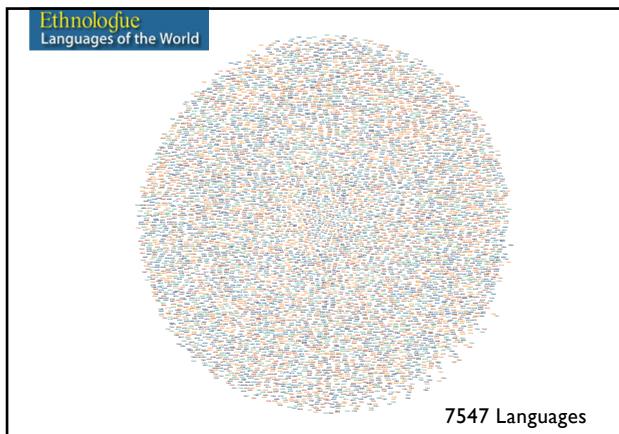
Lewontin 1970. The units of selection. Ann. Rev. Ecol. Syst.

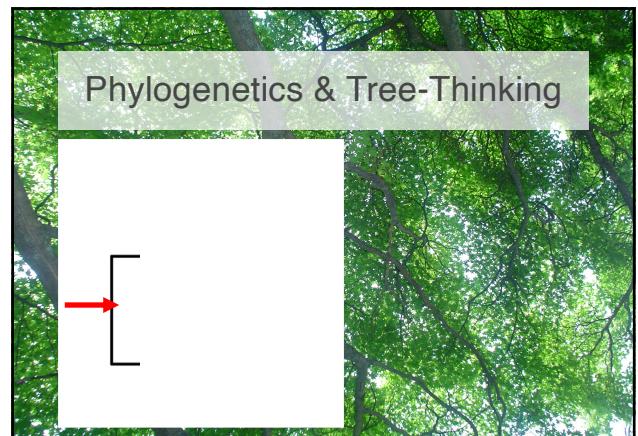
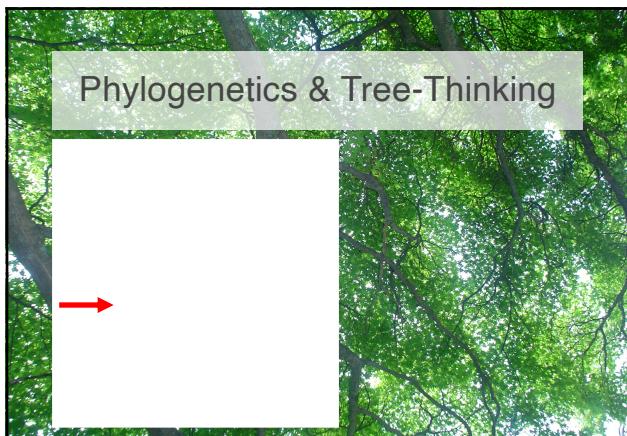
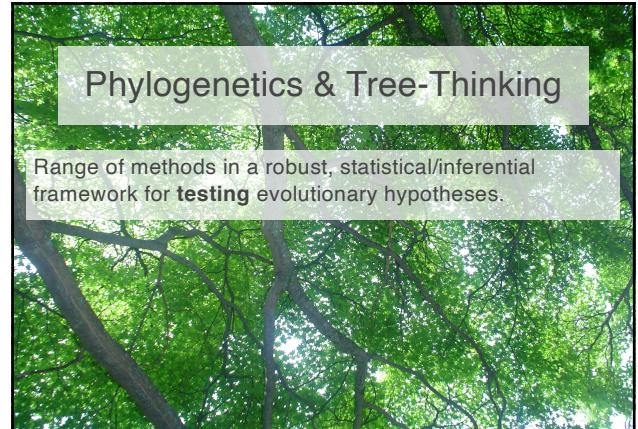
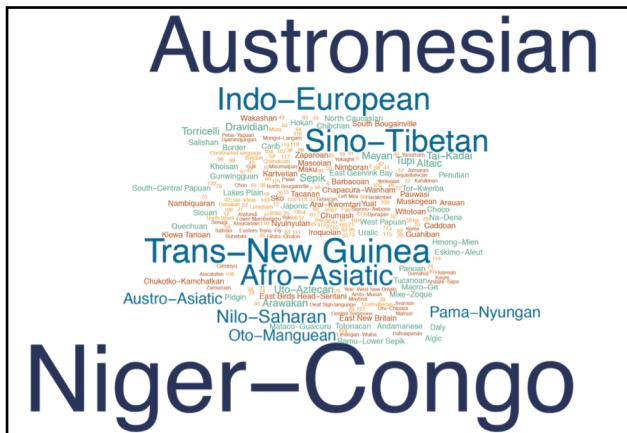
When and where did 🦴🌟💬 originate?

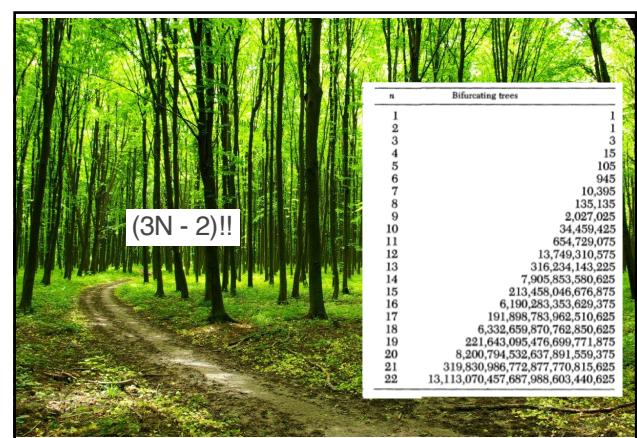
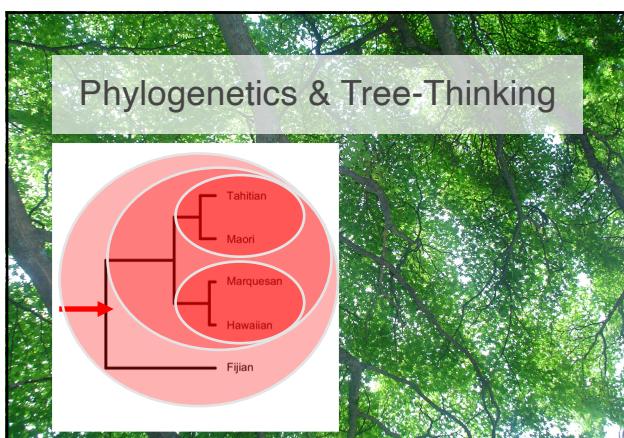
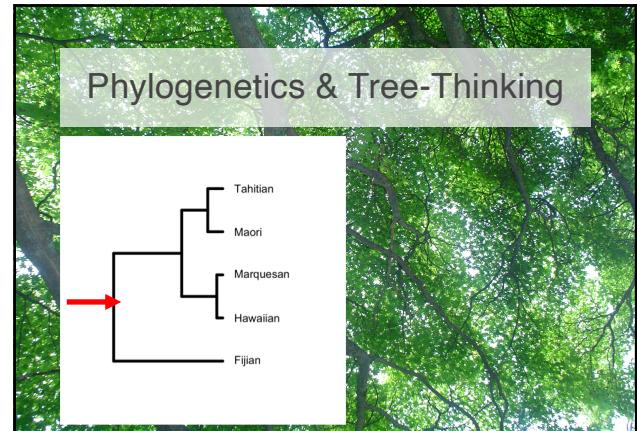
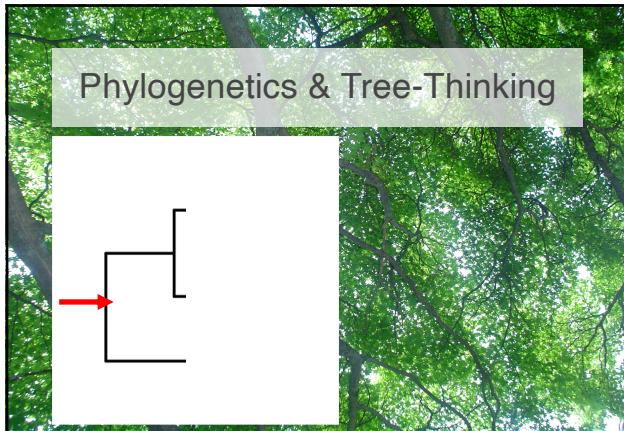
What **differences** are there between 🧑‍🤝‍🧑’s?

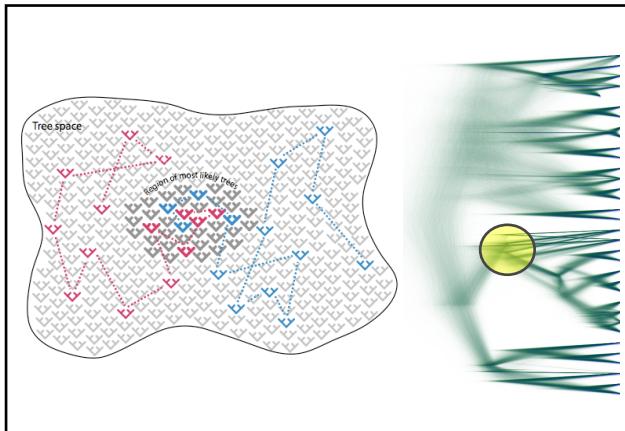
How are 🐒😊💬 related to other 🐒😊💬's?

Can we infer what 🦴头晕💬 were in the **past**?

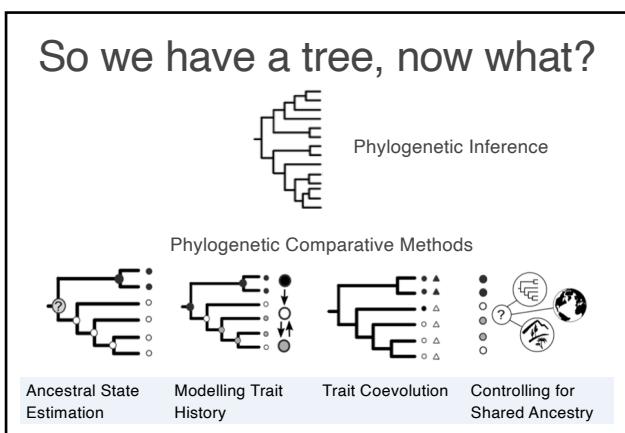
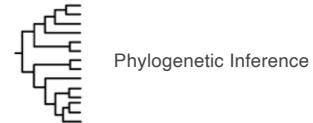








So we have a tree, now what?



Case Studies

1. Language Phylogeny & Human Prehistory
Building a Tree, Using a Tree
2. Political Complexity
Inferring Ancestral States
Estimating Sequences of Evolution
3. Human Sacrifice
Correlated Evolution

Case Study 1: Language phylogenies & Human Prehistory in the Pacific

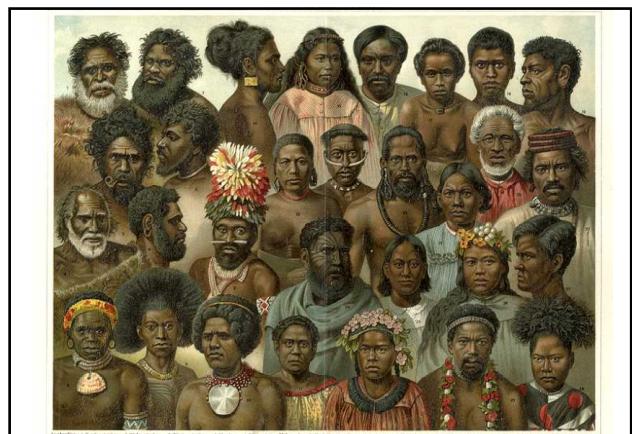
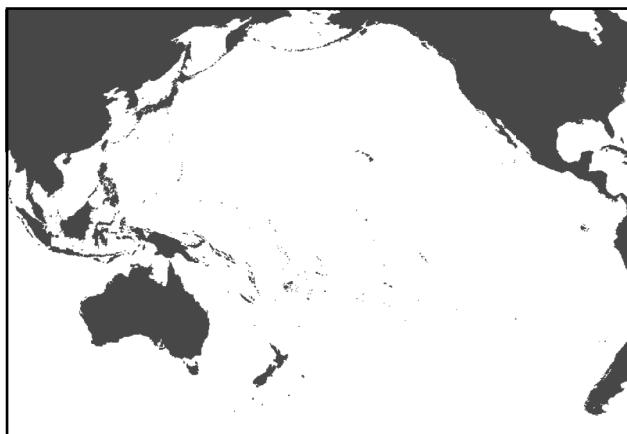


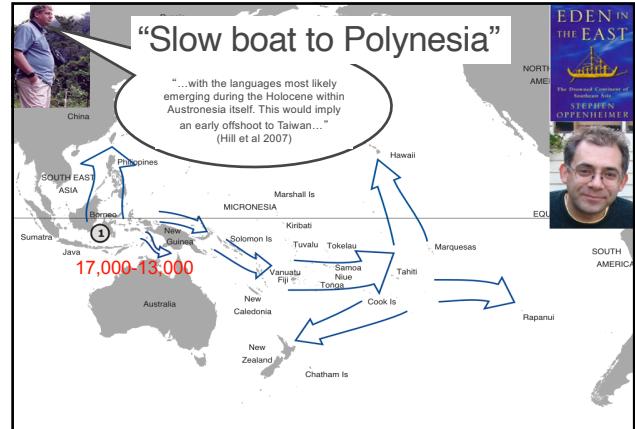
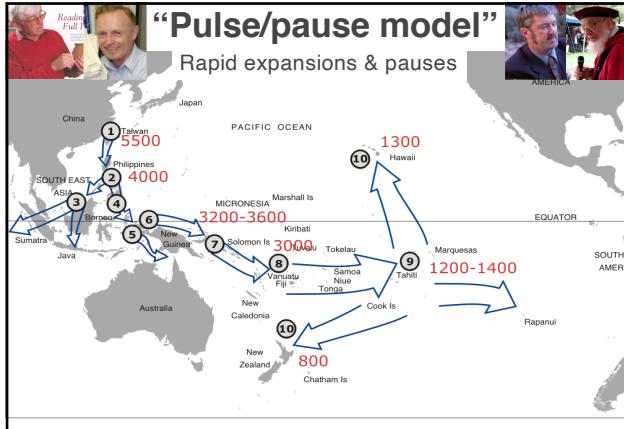
Gray, Greenhill & Drummond. 2009. Language Phylogenies Reveal Expansion Pulses and Pauses in Pacific Settlement. *Science*.

>50,000
BP

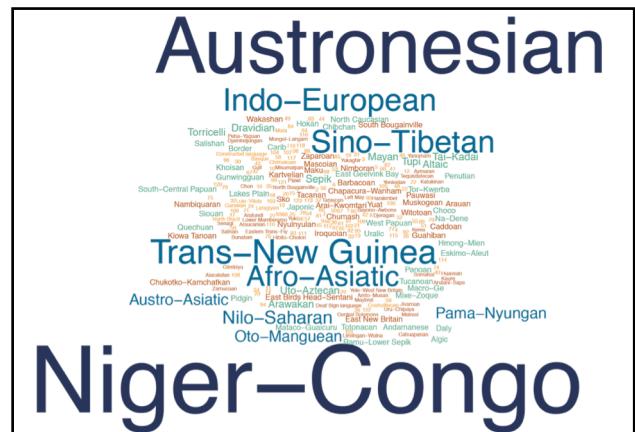


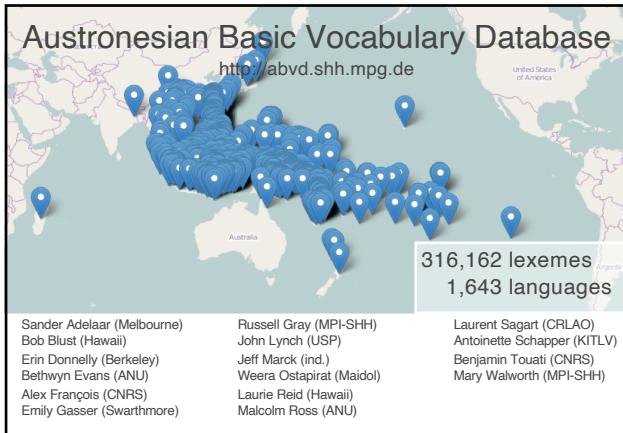
Figure 1 The Sunda and Sahul landmasses at about 50,000 years ago when people first came to Sahul. Notes: Some modern islands were connected to the two large landmasses and others, such as New Britain, New Ireland, and the Solomon chain, were always separate. Source: Cartographic Services, ANU.





Pulse-Pause vs. Slow Boat		
Predictions	Pulse-Pause	Slow Boat
1. Root	Taiwan	ISEA
2. Sequence	Chained	Two Pronged
3. Age	~5,500BP	~13 -17,000BP
4. Pattern	Pulse/Pause	?





notes: 1. marker
2. non-penultimate stress
3. date: 1980
4. completed by: John Lynch
language/dialect: Lemakel

SWADESH 200-WORD BASIC VOCABULARY (MODIFIED)

1. hand	nelm-	26. hair (of the head) nouanu-
2. left	mul	27. nose nspwengnha?
3. right	mwatu	28. to breathe amig
4. leg/foot	nelk-	29. to snif, smell arout
5. to walk	aliuok	30. mouth nhul-
6. road/path	sautu	31. teeth nelu
7. to come	va	32. tongue nana-
8. to turn (e.g. to alsi'in left or right in turning)	alsi'in	33. to laugh alihie'elh
9. to eat	rik	34. to cry asak
10. dirty	ankamak	35. to drink eva
11. dust	namoulul	36. to spit aoh
12. skin	navig-	37. to eat kan
13. back (body part)	namujatan-	38. to chew (e. general amai term; for food general betel
14. belly	netp-	39. to cook (e. general viin term; for food general food
15. bone	aswut naksikali?	40. to drink amvuumw
16. intestines	nsogaa-	41. to bite kac
17. liver	nakanmop-	42. to suck tam
18. breast	naha-	43. ear namuwatelly-
19. shoulder	navuk-	44. to hear aroo *
20. to know (changes), hinatin'	nsiki-n rhu?	45. eye namsra
21. to think	nsiki-n rhu?	46. to see oan
22. to fear	ogn	47. to swim ouag-taaf (= open- bad)
23. blood	nataa-	48. to sleep apul
24. head	-kapwa	49. to lie down (to sleep) amel
25. earth	-vuu	

Data

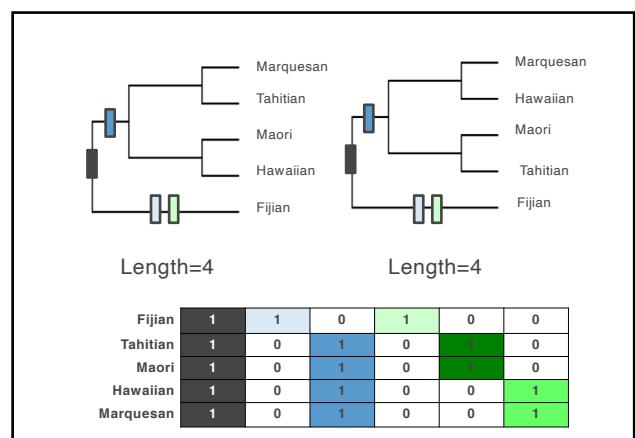
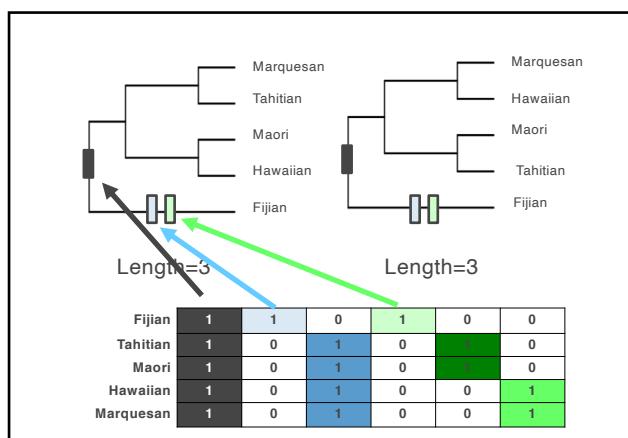
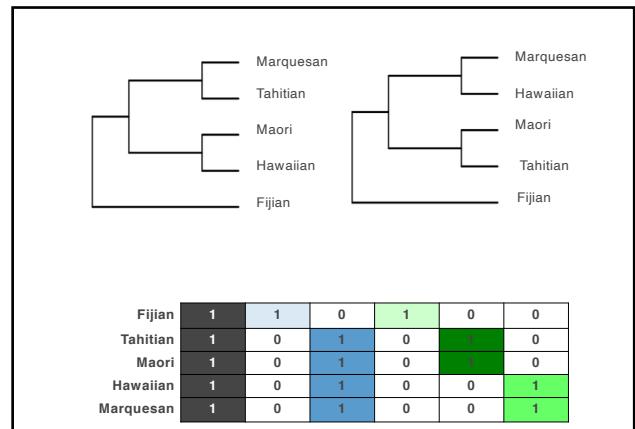
- 400 well-attested languages
 - No creoles
 - Know loanwords removed
- Outgroup
 - Old Chinese (controversial)
 - Bu Yang (less controversial)
- Binary Coding
 - presence/absence of cognates
 - 34,440 cognate sets
 - 6436 parsimony informative

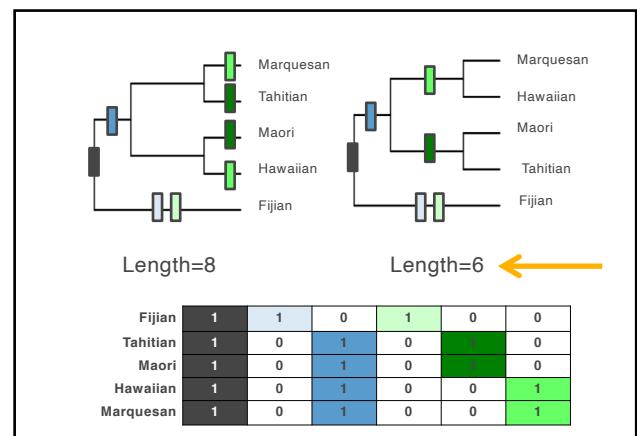
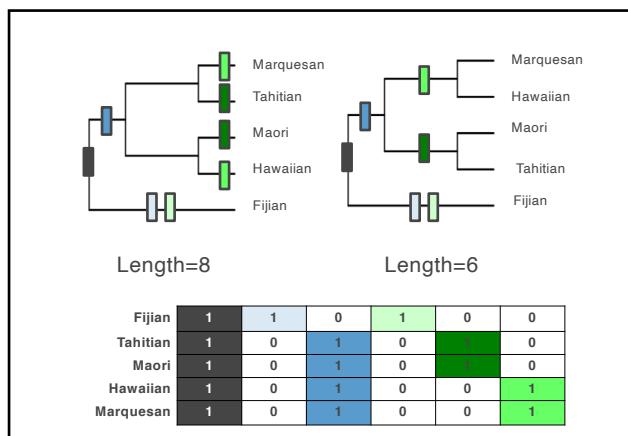
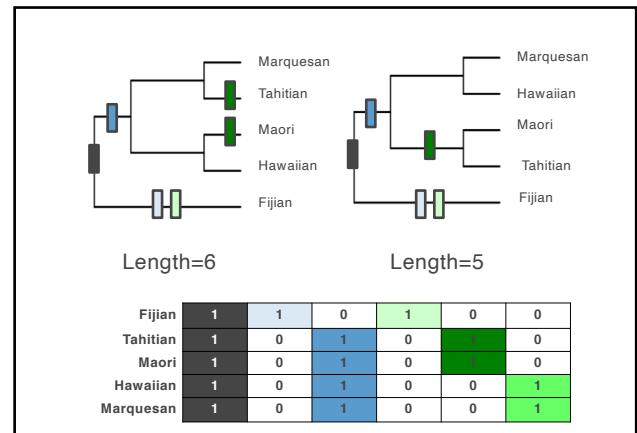
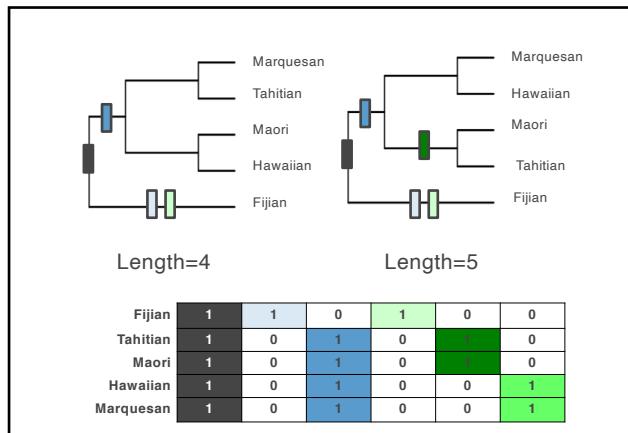
	Taboo	Blood	To Suck
Fijian	tabu	dra	sucu-ma
Tahitian	tapu	toto	ngote
Maori	tapu	toto	ngote
Hawaiian	kapu	koko	omo
Marquesan	tapu	toto	omo

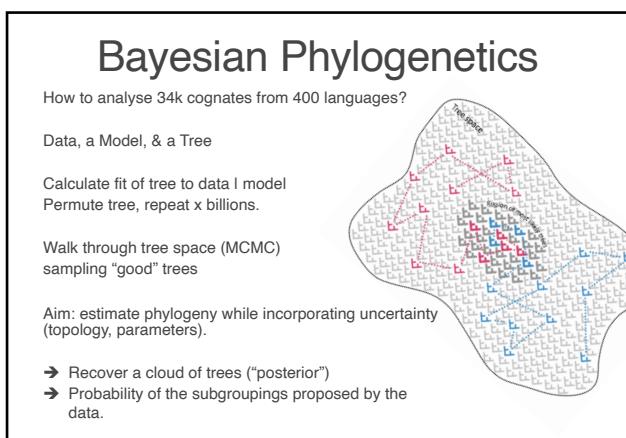
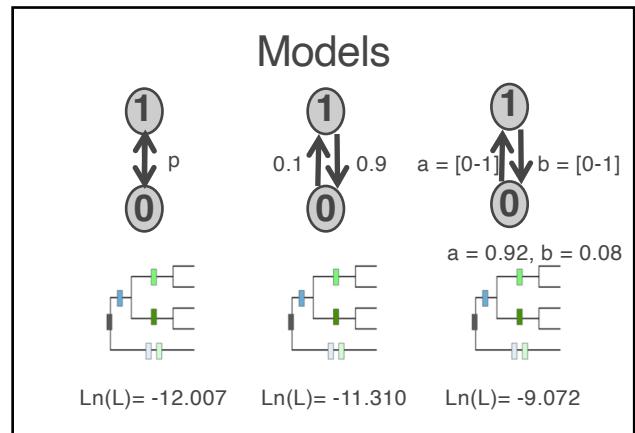
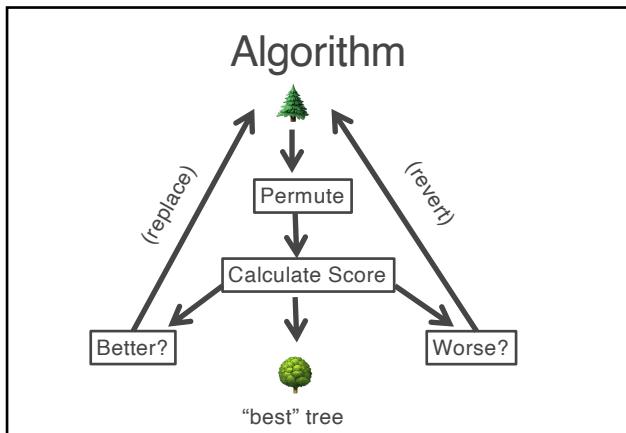
Identified **cognates** (homologies) by looking for Systematic Sound Correspondences
 e.g. Tahitian /t/ → /k/ in Hawaiian.

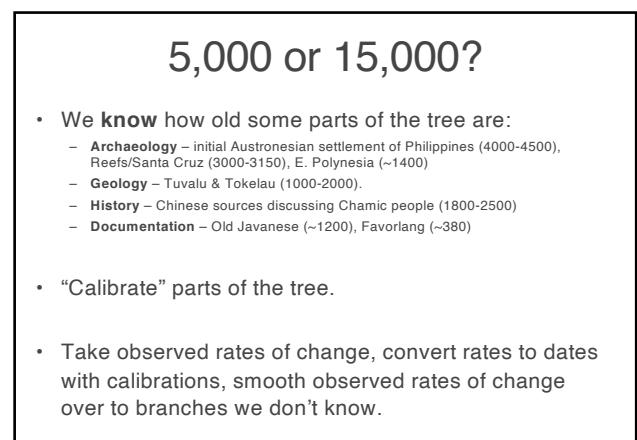
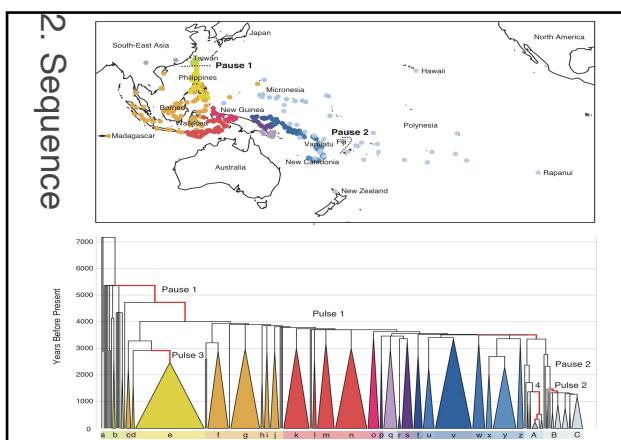
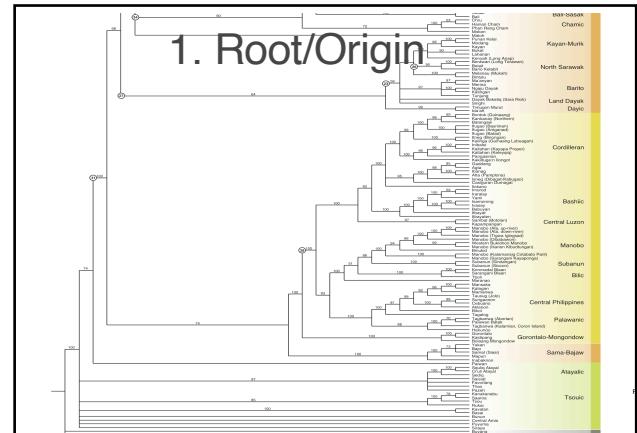
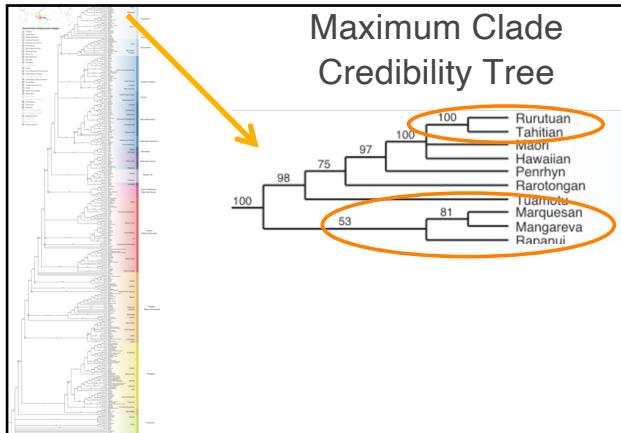
	Taboo	Blood	To Suck			
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Hawaiian	kapu	koko	omo			
Marquesan	tapu	toto	omo			

Fijian	1	1	0	1	0	0
Tahitian	1	0	1	0	1	0
Maori	1	0	1	0	1	0
Hawaiian	1	0	1	0	0	1
Marquesan	1	0	1	0	0	1

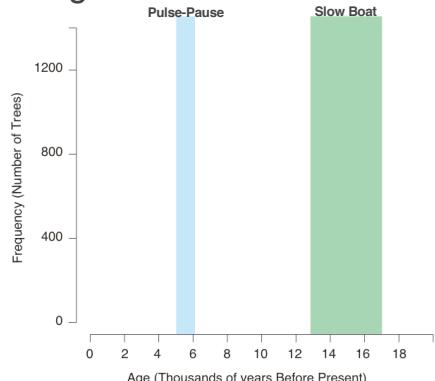




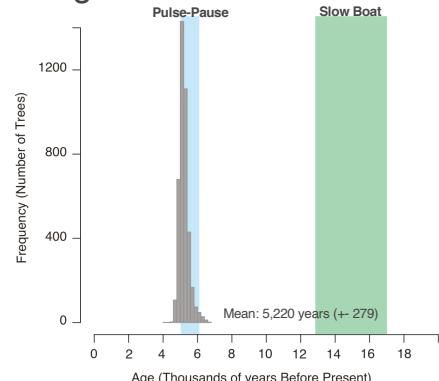




3. Age of Proto-Austronesian



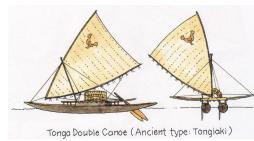
3. Age of Proto-Austronesian



Pulses & Pauses

Blust 1999, Green 2002, Pawley 2002

1. “First Long Pause” - Before Philippines (5,500-4,500BP)
 - Development of proto-Malayo-Polynesian stage
 - Lack of sailing technology to cross 350km Bashii channel?
 - Outrigger Canoe complex (Pawley and Pawley 1994)



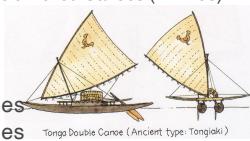
Pulses & Pauses

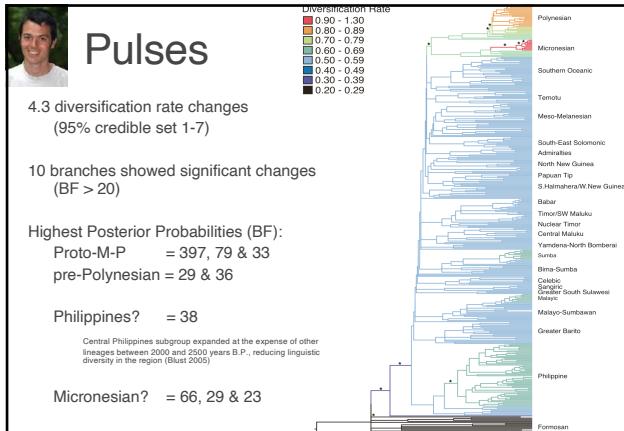
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 - Lack of sailing technology to cross 350km Bashii channel?
 - Outrigger Canoe complex (Pawley and Pawley 1994)
2. “Second Long Pause” - West Polynesia (~2800-1800BP)
 - Development of pre-Polynesian society
 - Better sailing techniques, Double-Hulled Canoes (Irwin 98)
 - Social Strategies

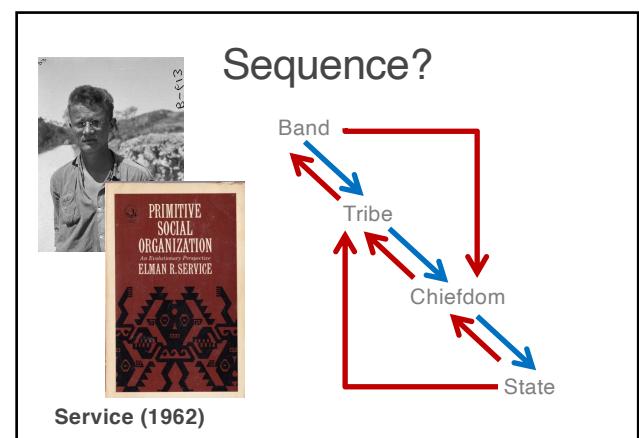
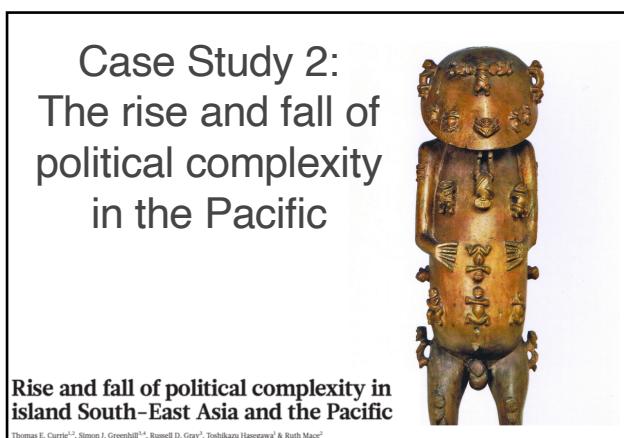
Trees:

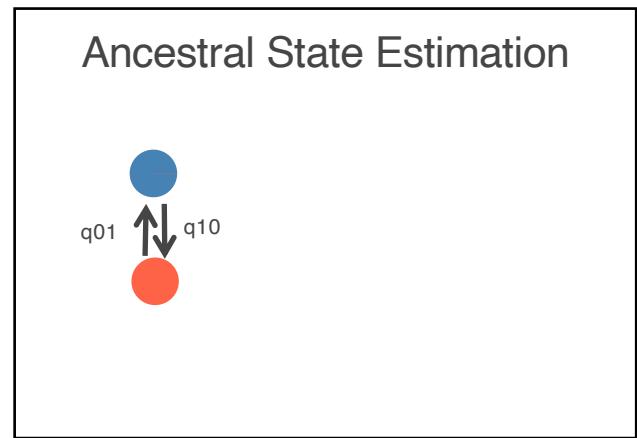
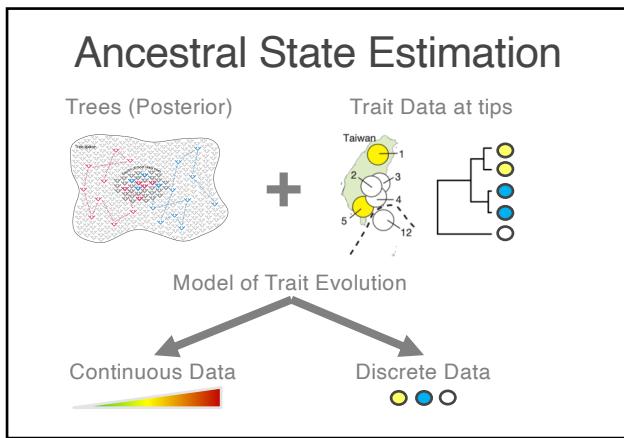
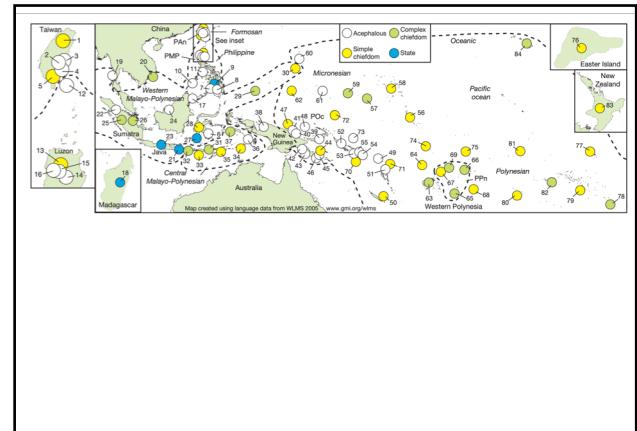
Pauses - long branches
Pulses - short branches



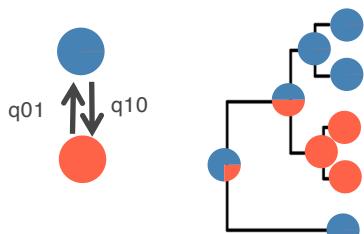


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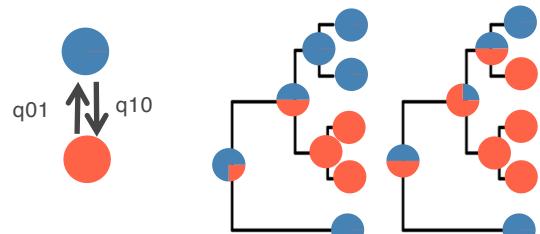




Ancestral State Estimation



Ancestral State Estimation



Equal Rates (ER)

Only one rate = change between states

●	.	1	1
●	1	.	1
●	1	1	.

Symmetrical (SYM)

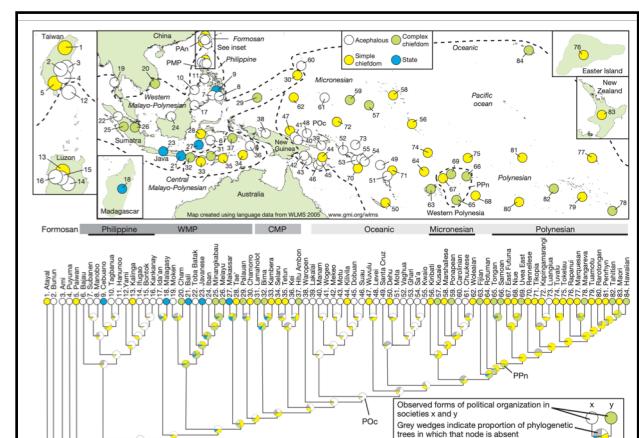
One symmetrical rate per state pair

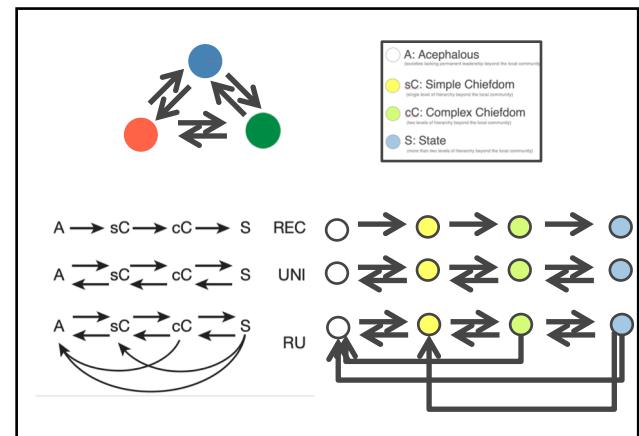
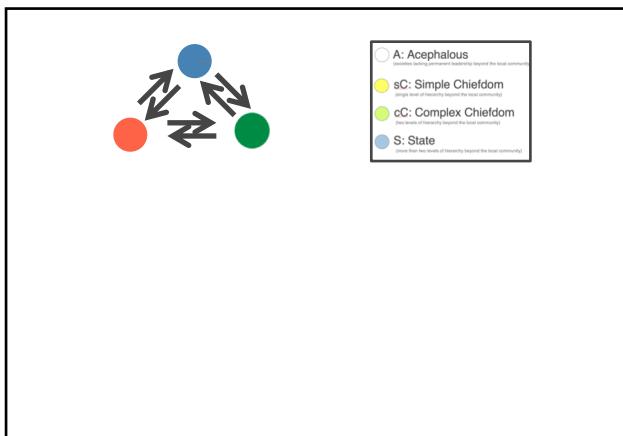
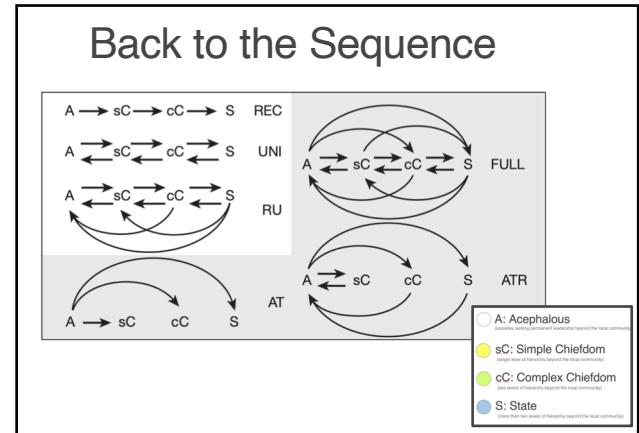
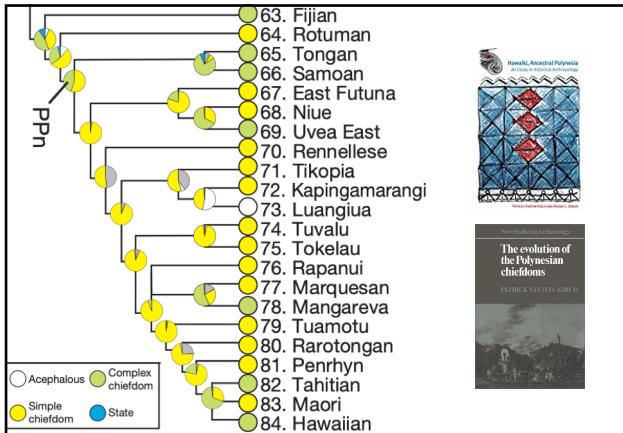
●	.	1	2
●	1	.	3
●	2	3	.

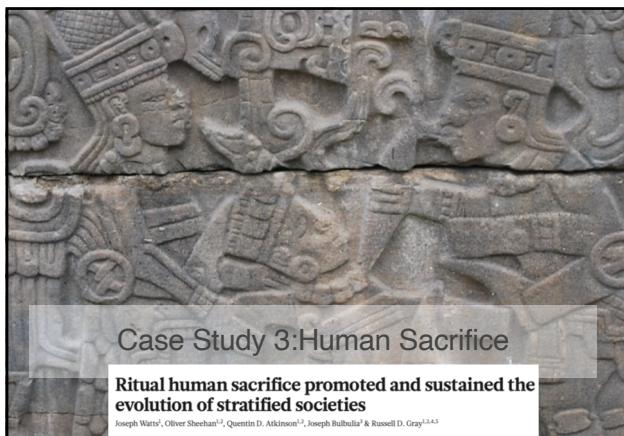
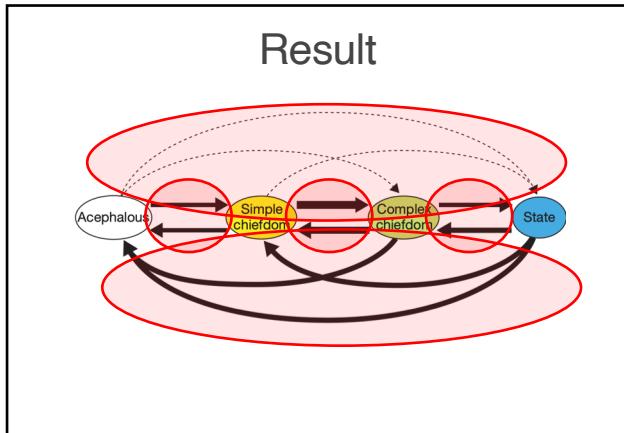
All Rates Different (ARD)

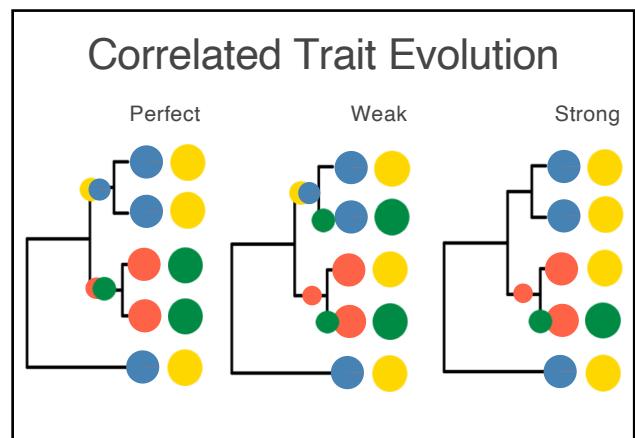
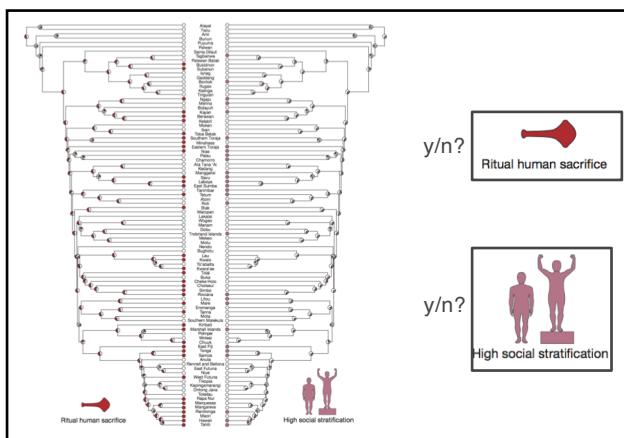
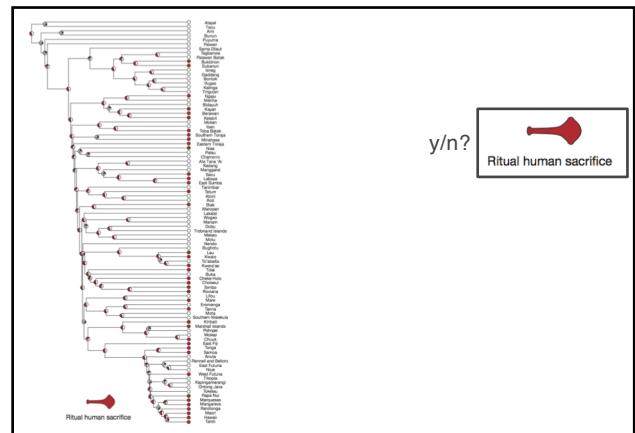
Change from and to are different

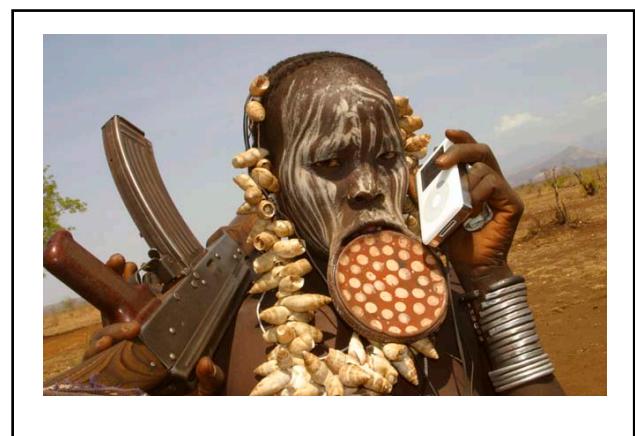
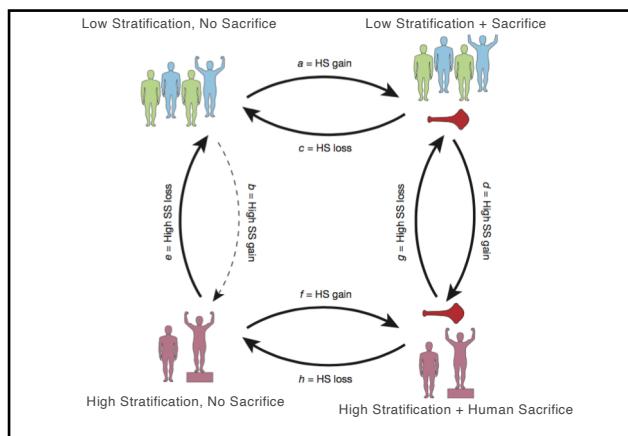
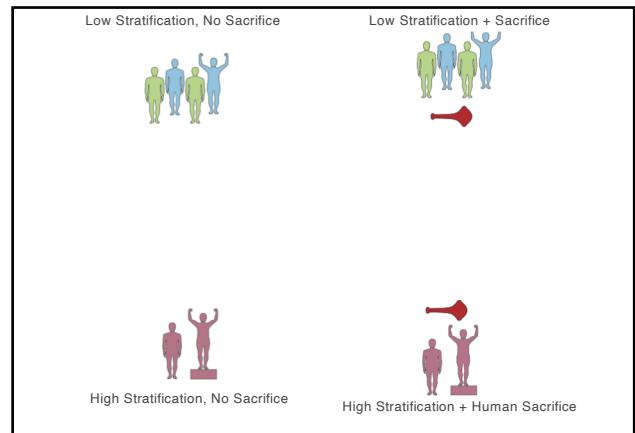
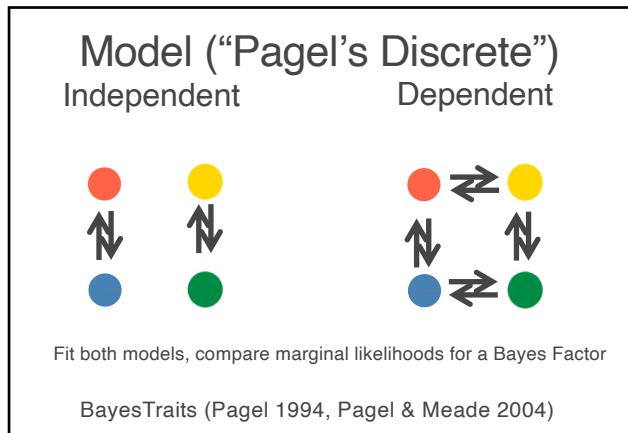
●	.	1	2
●	3	.	4
●	5	6	.











Kroeber (1952)

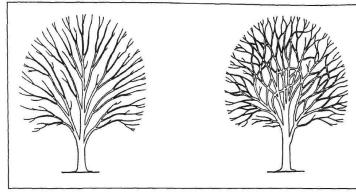


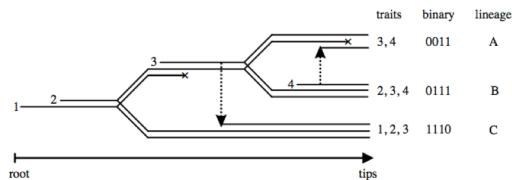
Figure 2.2. A.L. Kroeber's (1940:60, figure 18) tree of biological evolution (left) and tree of cultural evolution (right). Note the simple branching structure of the former and the reticulate (branching and intersecting) nature of the latter.

- Boyd et al. '97. Are cultural phylogenies possible?
- Gray et al. '07. The Pleasures and Perils of Darwinizing Culture using Phylogenies, Biol. Theory
- Gray et al. '10. The Shape and Fabric of Human History, Phil. Trans. B.
- Lukas et al. '21. The Potential to Infer the Historical Pattern of Cultural Macroevolution, Phil. Trans. B.
- Evans et al. '21. The uses and abuses of tree thinking in cultural evolution, Phil. Trans. B.

Borrowing & Phylogenetics

Tree Inference

Greenhill et al. '10.



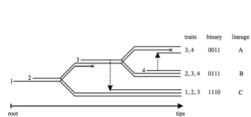
Greenhill et al. '10. Does horizontal transmission invalidate cultural phylogenies?

Comparative Methods

Borrowing & Phylogenetics

Tree Inference

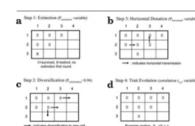
Greenhill et al. '10.



Greenhill et al. '10. Does horizontal transmission invalidate cultural phylogenies?

Comparative Methods

Nunn et al. '10



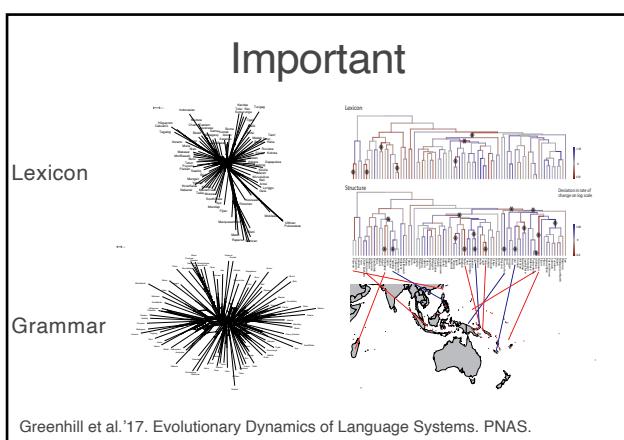
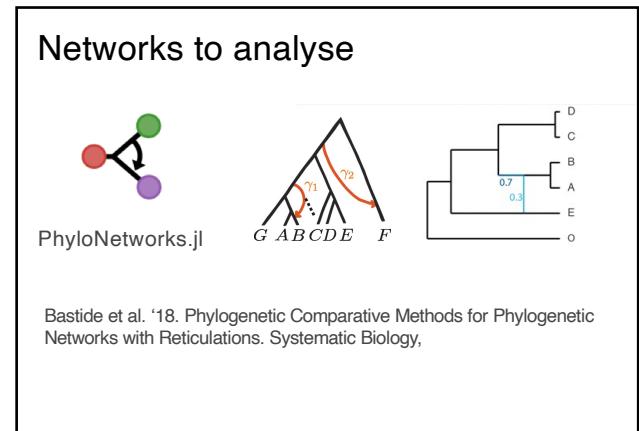
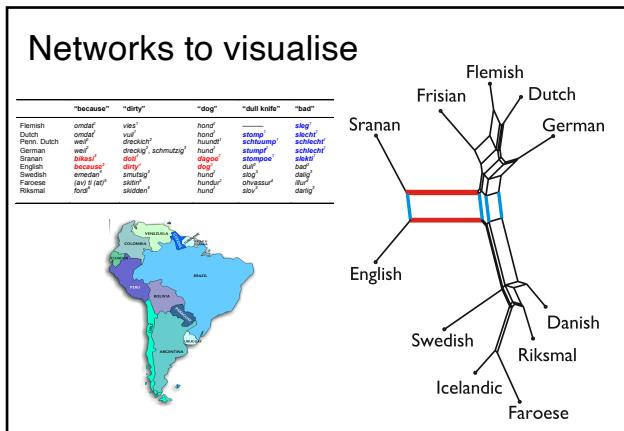
Nunn et al. '10. Simulating trait evolution for cross-cultural comparison. Phil. Trans R. Soc. B
Currie et al. '10. Is horizontal transmission really a problem for phylogenetic comparative methods? Phil. Trans R. Soc. B
Lukas et al. '21. The Potential to Infer the Historical Pattern of Cultural Macroevolution, Phil. Trans. B.

Best Practices (Evans et al. '21)



- Is this tree the right backbone to use?
- Does the data fit onto the tree?
- Use Bayesian methods
- Validate your Results!





Your turn

PLACES LANGUAGE CULTURE ENVIRONMENT

Ethnographic Atlas 1291 societies, 90 variables
Binford Hunter-Gatherer 339 societies, 34 variables
Standard Cross-Cultural Sample 186 societies, 2000 variables
Western North American Indian Database 172 societies, 429 variables

<https://d-place.org>

Kirby et al. 2016. D-PLACE: A Global Database of Cultural, Linguistic and Environmental Diversity. *PLoS One*.

The screenshot shows the D-PLACE website. At the top is a large, bold URL: "https://d-place.org". Below the URL is a navigation bar with several items: "D-PLACE" (with a logo), "About", "Societies", "Datasets", "Variables" (which has a red circle around it), "Phlogenies", "Sources", "What's new?", "Data Sources", "FAQ", "Legal", and "Download". The main visual element is a large graphic of a brain inside a circular frame, divided into colored sections (blue, green, yellow, red). Below this graphic, the word "D-PLACE" is written in a large, bold, sans-serif font. At the bottom of the page, the text "Database of Places, Language, Culture and Environment" is centered.

The figure shows a screenshot of the d-place.org website. At the top, the URL <https://d-place.org> is displayed. Below it, the title "Subsistence economy: agriculture [EA005]" is shown, along with a brief description: "Dependence on agriculture, relative to other subsistence activities". A "Codes [link for detailed code description]" button is present. The main content area features a choropleth map of the world where each country's color represents its level of dependence on agriculture. A legend titled "Dependence on agriculture: agriculture [EA005]" provides the key: 0-5% (dark blue), 5-10% (light blue), 10-20% (yellow), 20-30% (orange), 30-40% (red), 40-50% (dark red), 50-60% (purple), 60-70% (brown), 70-80% (dark brown), and 80-100% (black). The map shows a clear global gradient from high dependence in Africa, South America, and parts of Asia to low dependence in Europe, North America, and Australia.

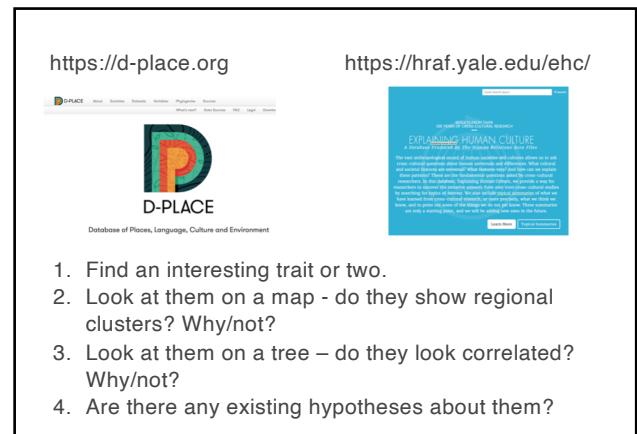
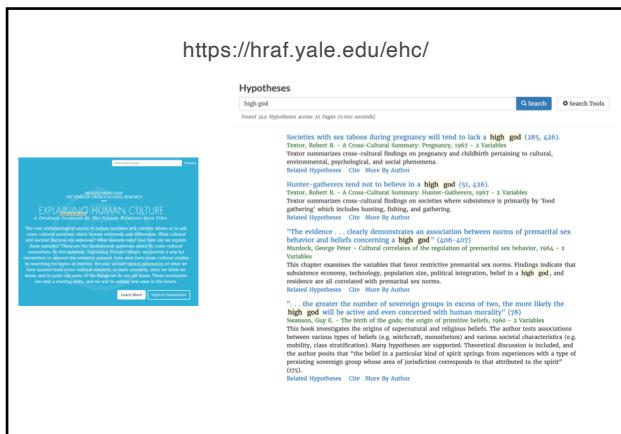
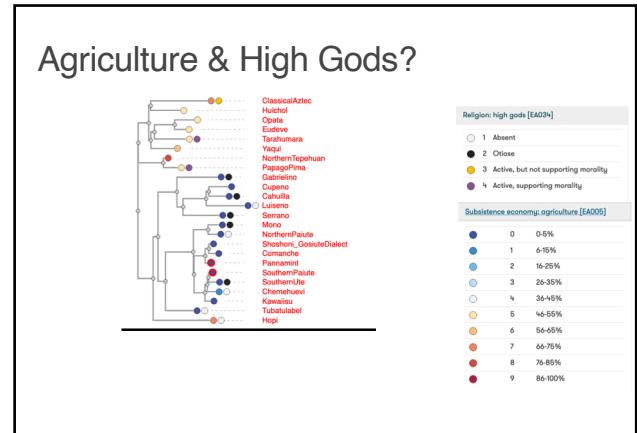
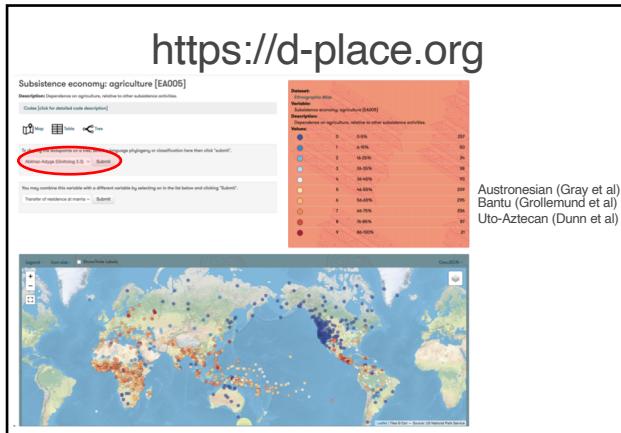
Religion: high gods [EA03n]

- 1 Absent
- 2 Oftuse
- 3 Active, but not supporting morality
- 4 Active, supporting morality

Subsistence economy: agriculture [EA001]

● 0	0-5%
● 1	6-15%
● 2	16-25%
● 3	26-35%
● 4	36-45%
● 5	46-55%
● 6	56-65%
● 7	66-75%
● 8	76-85%
● 9	86-100%

Leaflet © Esri – Source: CIO National #



Phylogenetics in R

<https://github.com/SimonGreenhill/PCMTutorial>

Clone the Repository

Open Tutorial.Rmd in RStudio