Language polygenesis : What type of evidence?

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Overview

❑ Definitions and primary considerations

❑ Archeological and paleo-anthropological evidences

❑ Cognitive potentials and polygenesis of cultural innovations

❑ Mathematical modeling and computational simulations

Definition and primary considerations

Definitions

❑ Basic definitions:
  - Monogenesis: emergence of language once at a single location
  - Polygenesis: emergence of language independently at several locations

❑ May be considered for the emergence of
  - a communicative system as a whole
  - some features or strategies existing in modern languages (syntactic, prosodic, …)

❑ The only way to attest polygenesis of language is to show that for two populations at a given time, one exhibits language, but not the other

Arguments for the monogenesis of language

❑ Linguistic reconstructions pointing to a single mother tongue (dangerous assumption…)?

- After a polygenesis, only one language may have survived and given rise to all current languages

❑ A « probabilistic » argument: language is the unique attribute of the human species; if it hardly emerged at one site, the probability for several independent emergences is even smaller

❑ The emergence of our language is correlated with the emergence of a species (especially *Homo sapiens*) and some biological changes

Archeological and paleo-anthropological evidences

Evidence for a « modern » language at 70,000 BP

□ Intentional (motivated) sea-crossings to Australia and to the Andaman islands; coastal migrations

120,000 BP – 90,000 BP
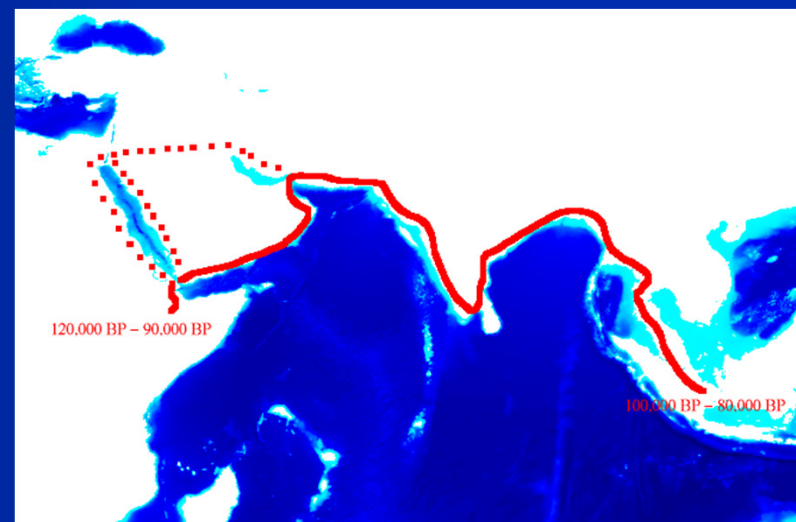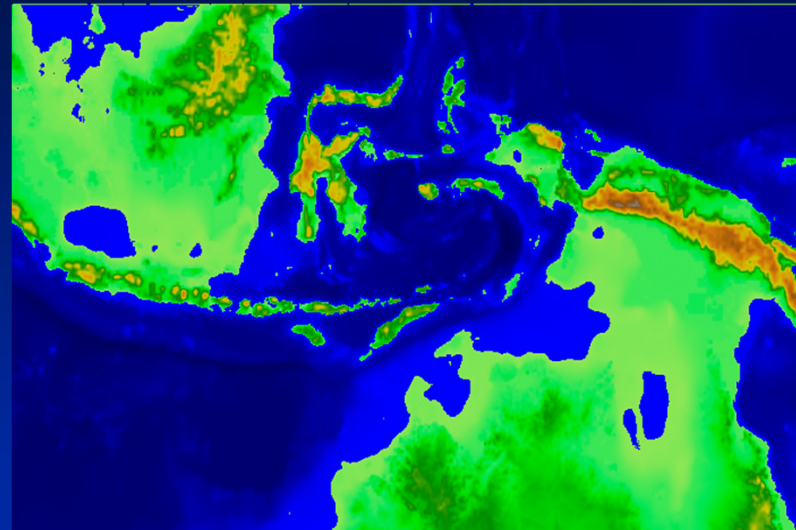
100,000 BP – 80,000 BP

Homo sapiens presence in Middle East

❑ *Homo sapiens* attested in the Middle East 100,000 years ago

❑ A cultural revolution around 45,000 BP, followed by migrations towards western Europe

❑ No strong evidence of modern language in the Middle East before 45,000 BP:

- Lithic industries
- Reality of the symbolic aspect of the sepultures (no offerings?)
- No clear advantage of *sapiens* over *neandertalensis* before 45,000 BP

An archaeological scenario supporting polygenesis?

❑ If one considers that *Homo sapiens* populations in the Middle East did not have a modern language before 45,000 BP, and some other groups had one in southeastern Asia earlier, polygenesis of language would have occured.

❑ However, a lack of evidence is not the evidence of the lack... although fairly recent occupation of Mediterranean islands is coherent with our hypothesis of lack of sophisticated communication system for the western migration

Cognitive potentials and polygenesis of cultural innovations

Some major human cultural innovations

❑ Several key steps in human cultural evolution:

- The use and domestication of fire (~500,000 BP?)
- The development of agriculture (~10,000 BP)
- The invention of writing (~5,000 BP)

- The emergence of language (depends on the definition of language)

Polygenesis of key innovations

❑ Several locations for the development of agriculture:

- Middle-East, Papua New Guinea, Mexico, Andes, China (Huang He river)

❑ Independent developments of several writing systems

- Sumerian, Chinese and Egyptian ideograms

❑ Bipedalism

→ Polygenesis is assumed for some of the major steps in human evolution, why not for language ?

- language as a cultural device

Cognitive potential

❑ A cognitive potential appears once a modification in the neural circuitry has taken place

❑ « Potential » means that individuals can develop a specific capacity at some later time after neural circuitry change

❑ Regarding language emergence, no direct link between the linguistic strategies and the cognitive functions underlying them; our cognitive apparatus evolved and became (or to become) able to learn languages and linguistic strategies, not to produce them readily.
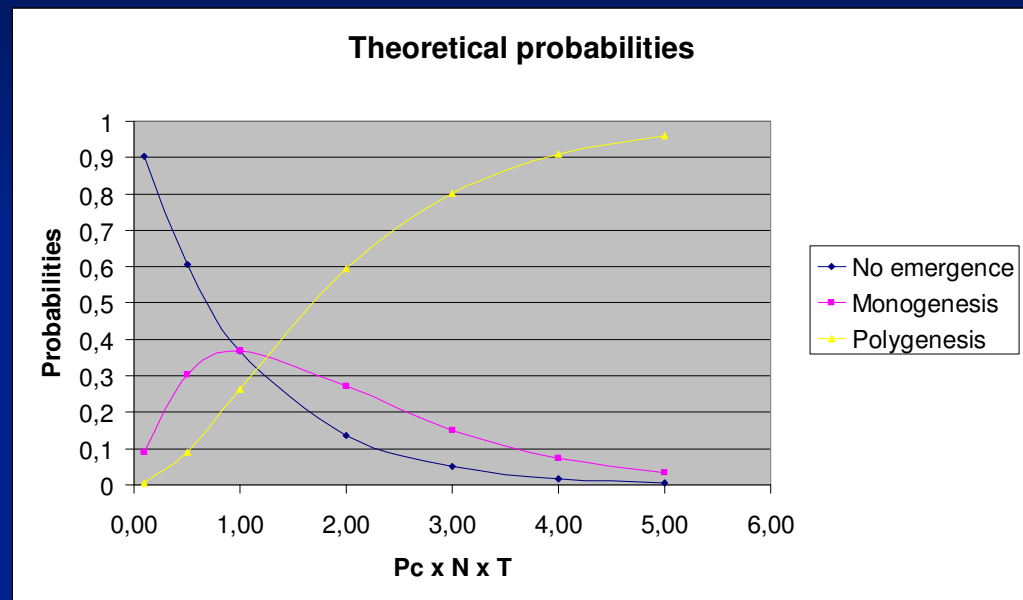
Cognitive and cultural potentials

❑ Concerning modern languages, the development of the brain in neandertal and sapiens led to the development or the better shaping of different cognitive functions: working memory, phonological loop, symbolization, …

❑ These cognitive abilities opened the way for new forms of language to emerge and be transmitted culturally.

❑ What then triggered the emergence of these forms? Other inter-related events, contingent events

❑ To compare with cultural potentials: some human groups never developped agriculture, even if they were capable of doing it

Mathematical modeling and computational simulations

Mathematical arguments for the polygenesis of language

❑ **Wang and Freedman 1996:**

- The probability of emergence of language at p sites is NOT the product of the probabilities of emergence at each site

- Polygenesis is more likely than monogenesis, as soon as the probability of emergence at one site increases slightly

Theoretical probabilities

Legend:
- No emergence
- Monogenesis
- Polygenesis

Y-axis: Probabilities (0, 0,1, 0,2, 0,3, 0,4, 0,5, 0,6, 0,7, 0,8, 0,9, 1)
X-axis: Pc x N x T (0,00, 1,00, 2,00, 3,00, 4,00, 5,00, 6,00)

Adapted from Freedman & Wang, 1996

Polygenesis and « language contacts »

❑ Invention and transmission

- Some linguistic features may be invented at one site
- But they may also be transmitted by contacts between human groups
- Similar to other cultural innovations (Chatelperronian industries in Europe in *Neandertal* populations)

❑ Did the density of population, the frequencies of contacts and the easiness of transmission play a role in language emergence?

A computational model to investigate language polygenesis and contacts

- ❑ N agents, standing for human groups
- ❑ A square finite world of size S
- ❑ Random moves (l)
- ❑ Contact between agents if close enough (dc)
- ❑ Probability for « language creation » (Pc)
- ❑ Probability for « language transmission » (Pt)
- ❑ A period of time T, divided into discrete steps

- ❑ Trial sets by crossing (N, S, Pc, Pt) (l, dc & T fixed)
- ❑ 100 runs for each trial set to estimate probabilities of monogenesis and polygenesis

Experiment and first results

- ❑ Values of Pc chosen to observe a mean number of emergences between 0.1 and 5.0 given T and N

- ❑ Values of Pt proportional to the values of Pc, to evaluate the impact of fixed ratios of probabilities

- ❑ N and S can be conflated into a single parameter: density of human groups

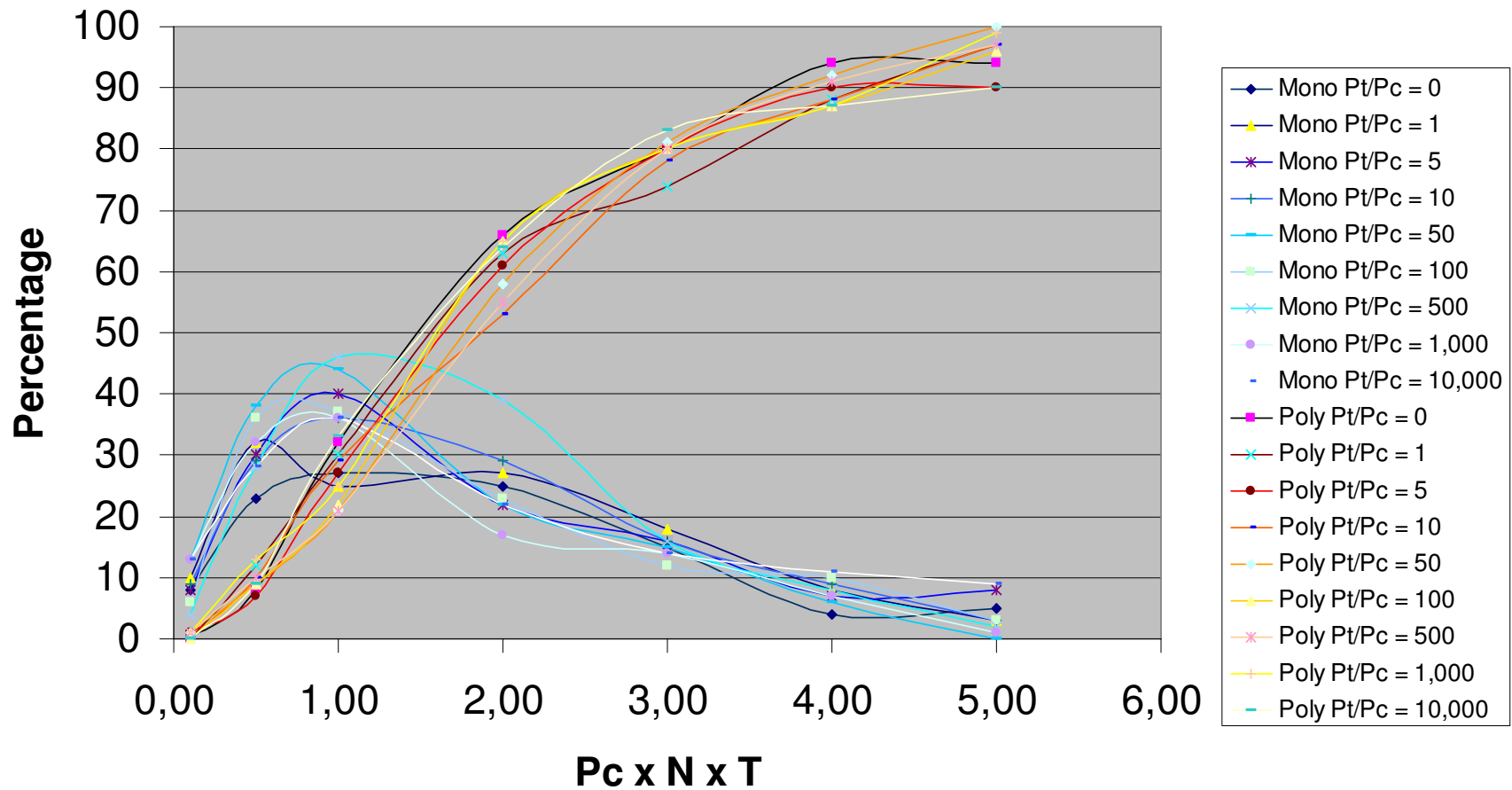- ❑ With a probability of transmission equal to 0, adequation with theoretical results

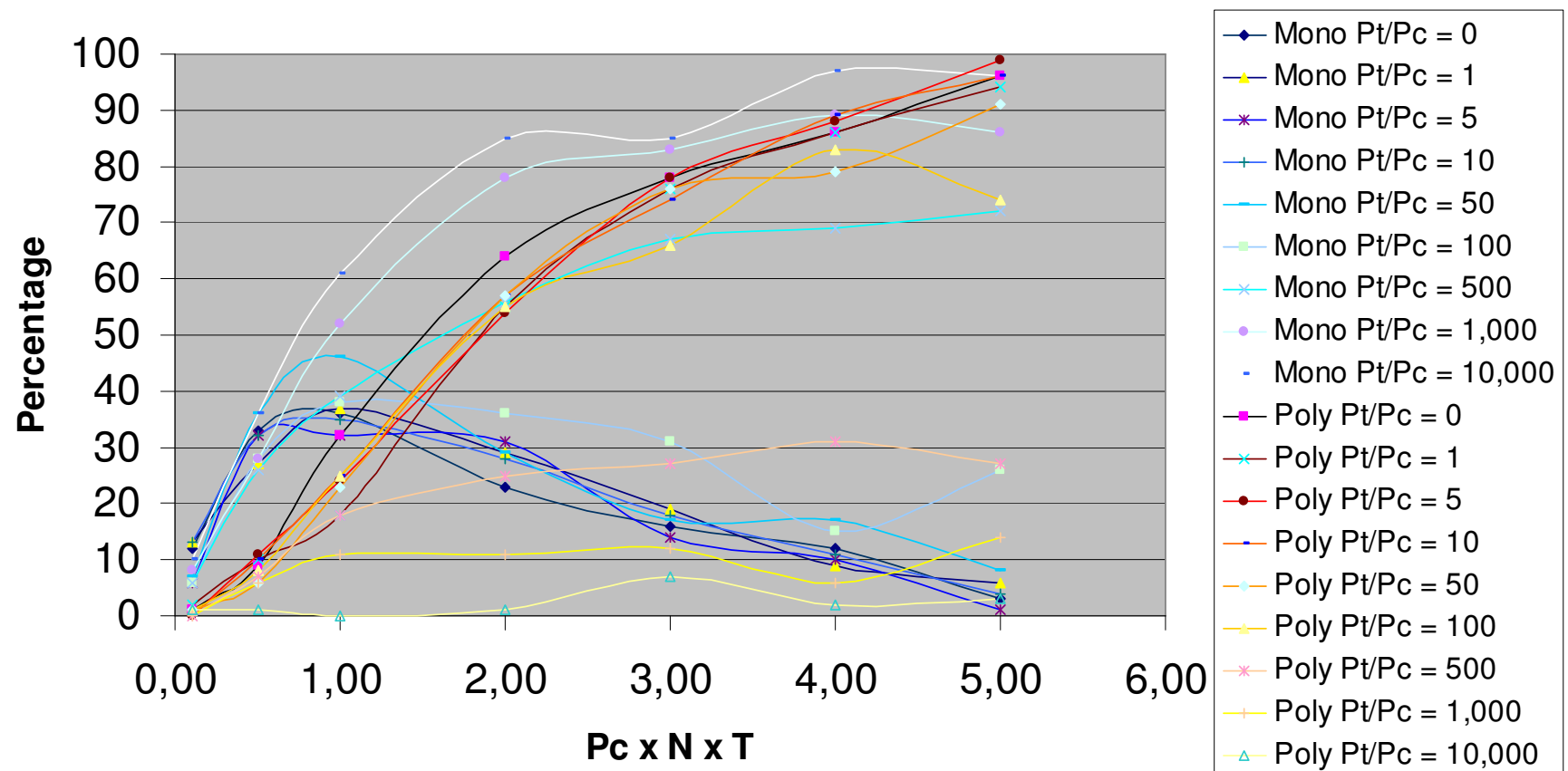# Pt = 0, ∀ d

Theoretical probabilities
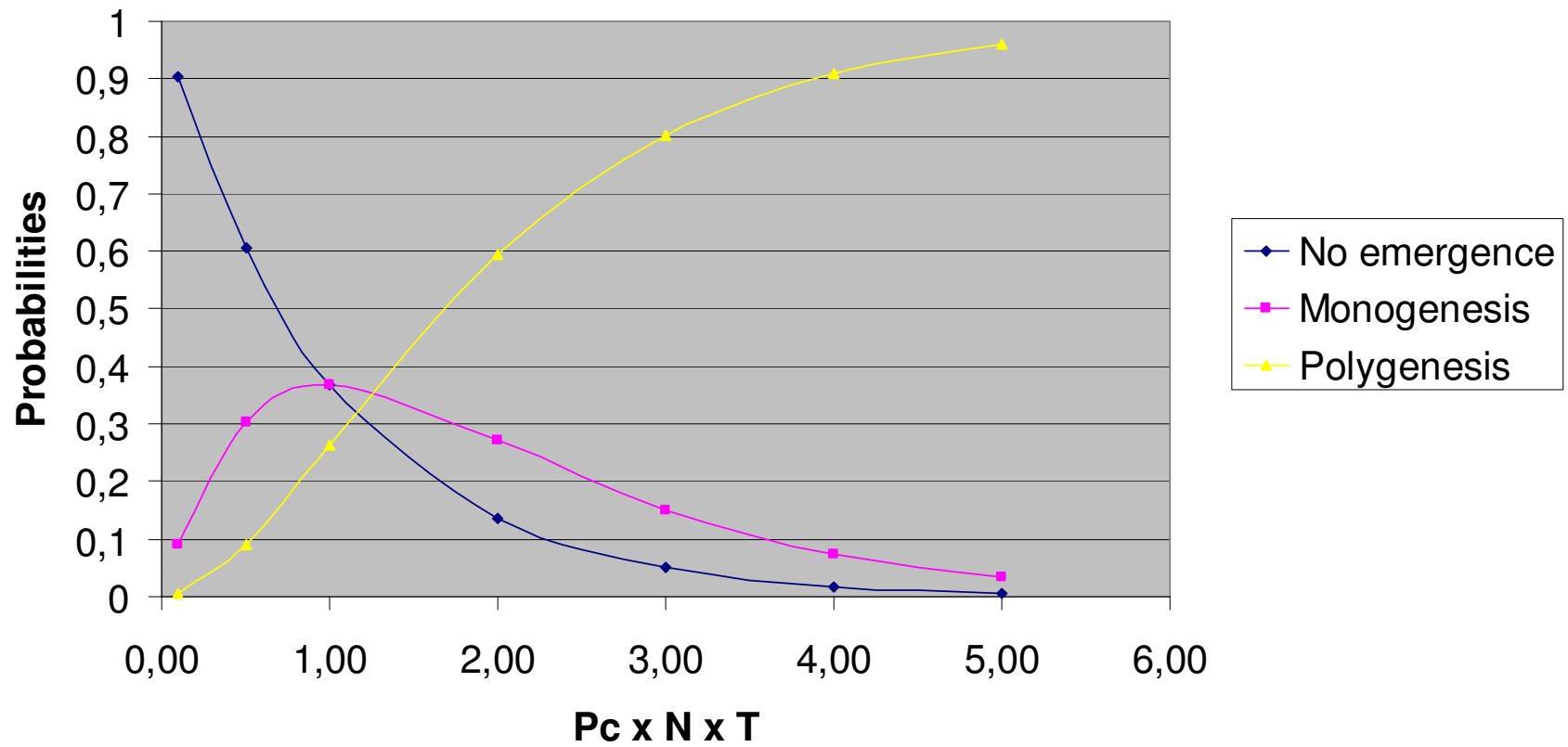
Results (1): small densities

Monogenesis vs Polygenesis, d = 1e-4

Results (2): increasing density

Monogenesis vs Polygenesis, d = 10e-2

Analysis and discussion

❑ Higher densities or easy transmissions favor monogenesis against polygenesis

❑ Even if the polygenesis is favored in terms of probability of invention, the first emergence is followed by a rapid expansion by contact that prevents other independent emergences

❑ Critics: can this model tell us anything about possible past situations?

Rooting the values of the parameters (1)

❑ T: 80,000 years

❑ Moves of the agents: 2 kms / year (first farmers in Europe ≈ 1 km / year)

❑ Distance of contact between agents : 10 kms; corresponds to a territory of around 100 sq. kms for each human group

❑ Relying on the notion of cognitive potential, we hypothesize that the ratio P_t/P_c might have been quite important

❑ Human groups did have non agressive contacts: exchanges of lithic material

Rooting the values of the parameters (2)
Surfaces and number of agents

Area in Square Kms

	Area in Square Kms
Entire World	510,072,200
Total Land	148,939,800
Total Water	361,132,400
Asia	44,547,800
Africa	30,043,900
North America	24,255,200
South America	17,819,100
Europe	10,404,000
Australia	7,687,100

Humans groups of 50 individuals:
50,000 ind. $\rightarrow$ 1,000 groups
1,000,000 ind. $\rightarrow$ 20,000 groups
10,000,000 ind. $\rightarrow$ 200,000 groups

S / Pop	1 000	5 000	10 000	50 000	100 000	200 000	500 000	1 000 000
1,000,000	1 E-3	5 E-3	0.01	0.05	0.1	0.2	0.5	1
5,000,000	2 E-4	1 E-3	2 E-3	1 E-2	0.02	0.04	0.1	0.2
10,000,000	1 E-4	5 E-4	1 E-3	5 E-3	0.01	0.02	0.05	0.1
25,000,000	4 E-5	2 E-4	4 E-4	2 E-3	4 E-3	8 E-3	0.02	0.04
50,000,000	2 E-5	1 E-4	2 E-4	1 E-3	2 E-3	4 E-3	0.01	0.02
100,000,000	1 E-5	5 E-5	1 E-4	5 E-4	1 E-3	2 E-3	5 E-3	0.01

Conclusions of the experiment

❑ Two possible scenarios:

- if language emerged when humans were occupying large areas, due to the size of ancient populations, polygenesis is more plausible (to compare with other cultural innovations)

- if language emerged when modern humans were still in East Africa, the possibility of monogenesis was higher (but depends on the number of individuals; need of genetic data)

Summary

❑ Probabilistic studies favor polygenesis

- (but « large » densities or easy transmissions might have biased this scenario; these large values were probably not reached in the past)

❑ Notion of cognitive potential; no necessary correlation between the emergence of species and the emergence of modern languages

❑ Emergence of modern languages by polygenesis of various linguistic strategies that were then combined by contacts

❑ Significance of demographic factors and structures

Thank you for your attention ☺