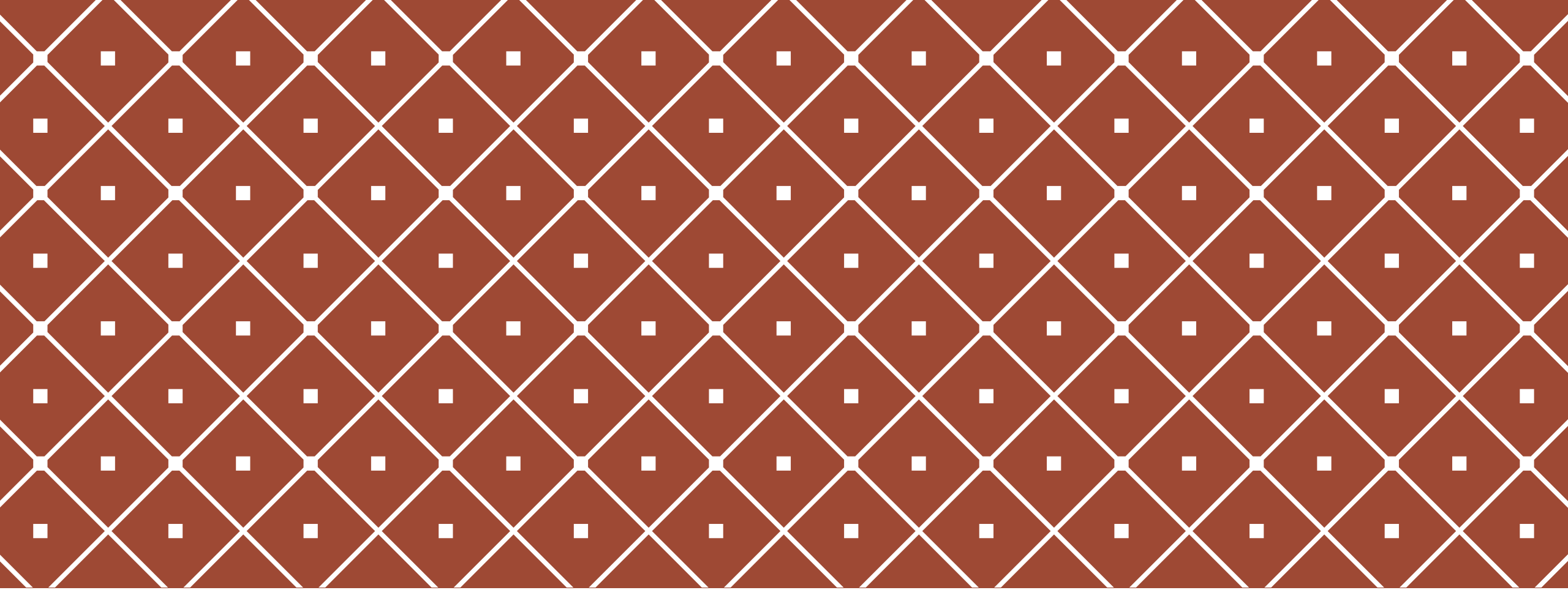

THE DYNAMICS OF LANGUAGE MINORITIES: EVIDENCE FROM AN AGENT-BASED MODEL OF LANGUAGE CONTACT

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A DEFINITION OF COMPLEXITY

The world is a **much more complex** and **interconnected** place than it used to be.

Understanding complexity is central for policy making.

To avoid collapsing under an unsustainable level of complexity, effective policy interventions have to be **as complex as** the issue they are addressing.

Complexity theory could be described as a **method of study**, rather than a theory *strictu sensu*.

Complexity theory gives up the mechanistic view of the world in favour of a non-linear, holistic approach, whereby the object of study is often characterized by a level of **uncertainty**.

A DEFINITION OF COMPLEXITY (CONT.)

"Complex" does not equal "complicated"

- A complicated system is made up of several different parts that work together in order to bring about one or more results in a **patterned** and **predictable way**. It is nothing else but the **sum of its components**.
- A complex system is characterized by a level of **unpredictability**. The same starting conditions can lead to different outcomes, depending on existing interactions.

Over the years, many scholars have provided a definition of complexity, stressing different aspects.

- A **large number** of **interacting components**, able to evolve along multiple pathways
- High **sensitivity to initial conditions** or to small perturbations
- **Unintended** consequences
- **Difficulty making sense** of the situation

COMPLEXITY THEORY AND LANGUAGE SYSTEMS

Language systems display many of the recurring **traits of complex systems** as described the relevant literature, such as:

- Non-linearity
  - A threshold level in the process of language shift where “it is too late” to go back, a point where language B will now inevitably give way to language A
- Non-Gaussian distributions
  - Because of extreme events (terrorism and war in the Middle East), migration flows towards Europe have dramatically increased during the last few years, boosting the presence of non-indigenous people on European soil, from all sorts of different cultural and linguistic backgrounds.
- Power laws
  - The distribution of languages by number of speakers tend to follow a power law
- Feedback loops
  - A decreasing level of language vitality induces a decline in the level of intergenerational transmission, as well as in the level of acquisition, which eventually cannot make up for the loss of speakers over time, reducing language vitality.

AGENT-BASED MODELLING

1. ABMs are explicit models (as opposed to implicit models) – assumptions are transparent, it is tested for consistency, logical relations and consequences are known. Other people can change the assumptions and produce different results.
2. It allows for sensitivity analysis.
3. ABMs are particularly useful for exploration.
4. ABMs, being based on iterated functions, account for chaos and stochasticity, as opposed to other methods such as ordinary differential equations.

LANGUAGE CONTACT

A simple definition:

"Language contact is the use of more than one language in the same place at the same time."

We distinguish three types of **societal bilingualism**:

1. two languages are spoken by two different groups and each group is monolingual;
2. two languages are spoken and everybody is bilingual;
3. *two languages are spoken, but one group is monolingual and the other is bilingual.*

AN AGENT-BASED MODEL OF LANGUAGE CONTACT - CHARACTERISTICS

The environment is a **multilingual community** in which two languages are spoken, majority language A and minority language B. Besides, the environment is assumed to be closed, i.e. there are no migratory flows.

Every individual is assumed to be fully fluent in the **majority language** and *some individuals* are also able to speak the **minority language** with varying degrees of fluency.

Speakers of the minority language can either be willing to **reveal** their linguistic background or to **hide** it.

People **reproduce:**

- Babies born to a majority couple speak the majority language only
- Babies born to a minority couple speak both the majority and the minority language
- Babies born to mixed couple speak the majority language only

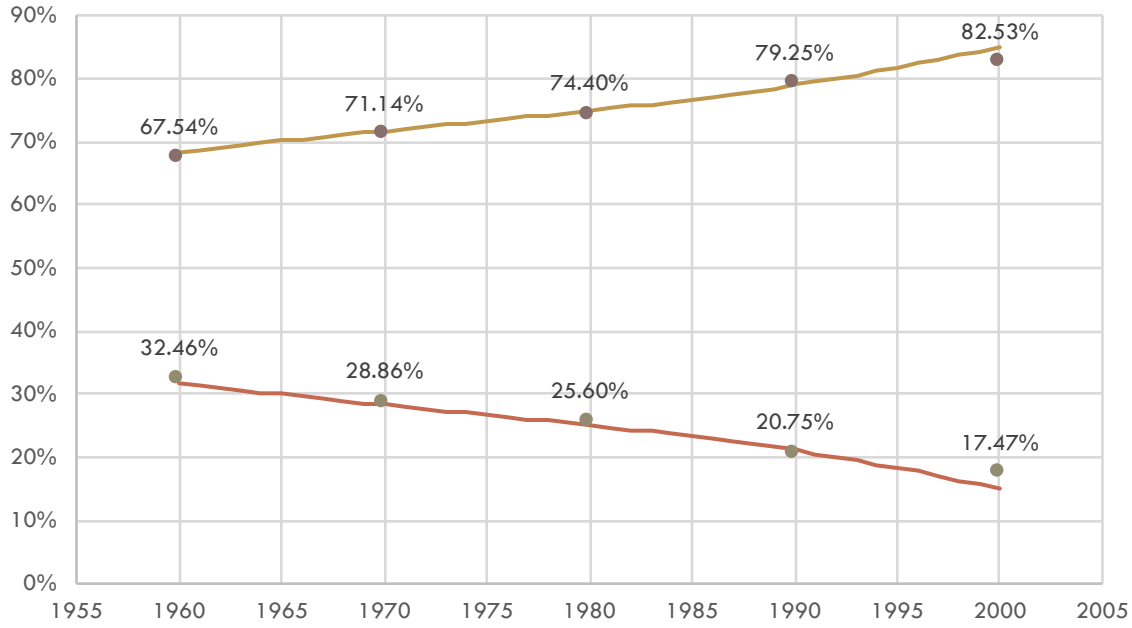
AN AGENT-BASED MODEL OF LANGUAGE CONTACT - INTERACTIONS

Interactions happen based on the following rules:

- if a language B speaker meets a language A speaker, they will converse in language A and the proficiency in language B of the former will be slightly reduced;
- if two language B speakers meet, the way they interact depends on their personality:
  - if two hide-personality individuals meet, they will not know that they are both able to speak the minority language and they will converse in the majority language, causing their level of fluency in the minority language to be reduced;
  - if at least one reveal-personality person is involved, the conversation will be held in the minority language and the level of fluency increases for both.

AN AGENT-BASED MODEL OF LANGUAGE CONTACT - VALIDATION

The model is validated by comparing its projections with actually observed data from the case of Romansh in Switzerland's canton of Grisons.



DATA GENERATION AND ANALYSIS

The following variables are allowed to vary and were combined to create different scenarios to simulate:

- the rate of **exogamy** of minority-language speakers (exogamy-rate), i.e. the likelihood with which a female minority individual gives birth to a baby with a majority individual
- the proportion of **reveal-strategy** minority individuals (reveal-strategy), i.e. the proportion of minority language speakers that are willing to reveal that they speak the minority language
- the proportion of minority language speakers in school age that receive **education** in the minority language, if a language education plan is in place (education)
- the **threshold** under which the proportion of minority has to fall before a **language education plan** is put into place (minority-threshold)

Other variables were fixed at some arbitrary values

DATA GENERATION AND ANALYSIS (CONT.)

The vast amount of data generated by the simulations was analysed by means of Cox proportional hazards analysis.

Cox regression is a semi-parametric method belonging to the greater family of survival analysis methods and is used to investigate the effect of non-categorical variables upon the time until a given event takes place, which, in our case, is the moment when the proportion of minority-language speakers reaches zero.

DATA GENERATION AND ANALYSIS (CONT.)

The hazard function is defined as

- $h(t) = \lim_{\Delta_t \to 0_+} \frac{P(t \leq T \leq t+\Delta_t | T \geq t)}{\Delta_t}$

which is the e *instantaneous extinction rate*, i.e the probability that a certain event happens to subject i at time T if it has not happened at a moment immediately before T.

The Cox model specifies the hazard of a specific event happening for subject i as

- $\lambda_i(t) = \lambda_0(t) e^{\boldsymbol{X}_i \boldsymbol{\beta}}$

where λ_0 is a baseline hazard shared by all subjects (corresponding to the value of the hazard if all the $\mathbf{X}_i$ are equal to zero, left unspecified), $\mathbf{X}_i$ is the vector of (time-fixed) independent variables for subject i, and $\boldsymbol{\beta}$ is the vector of estimated coefficients.

DATA GENERATION AND ANALYSIS (CONT.)

The hazard ratio for subject i with respect to subject j, having respectively covariates $\mathbf{X}_i$ and $\mathbf{X}_j$, is equal to

- $\frac{\lambda_i(t)}{\lambda_j(t)} = \frac{\lambda_0(t)e^{\boldsymbol{X}_i\boldsymbol{\beta}}}{\lambda_0(t)e^{\boldsymbol{X}_j\boldsymbol{\beta}}} = \frac{e^{\boldsymbol{X}_i\boldsymbol{\beta}}}{e^{\boldsymbol{X}_j\boldsymbol{\beta}}} = e^{(\boldsymbol{X}_i - \boldsymbol{X}_j)\boldsymbol{\beta}}$

The Cox model orders events (in our case, the moments when the language minority disappears across the various simulations) chronologically and then computes the partial likelihood of event i by comparing the hazard of individual i to the hazard of all individuals to which the event has not happened before time t_i:

- $L_i(\beta) = \frac{e^{\boldsymbol{X}_i\boldsymbol{\beta}}}{\sum_{j \geq i} e^{\boldsymbol{X}_j\boldsymbol{\beta}}}$

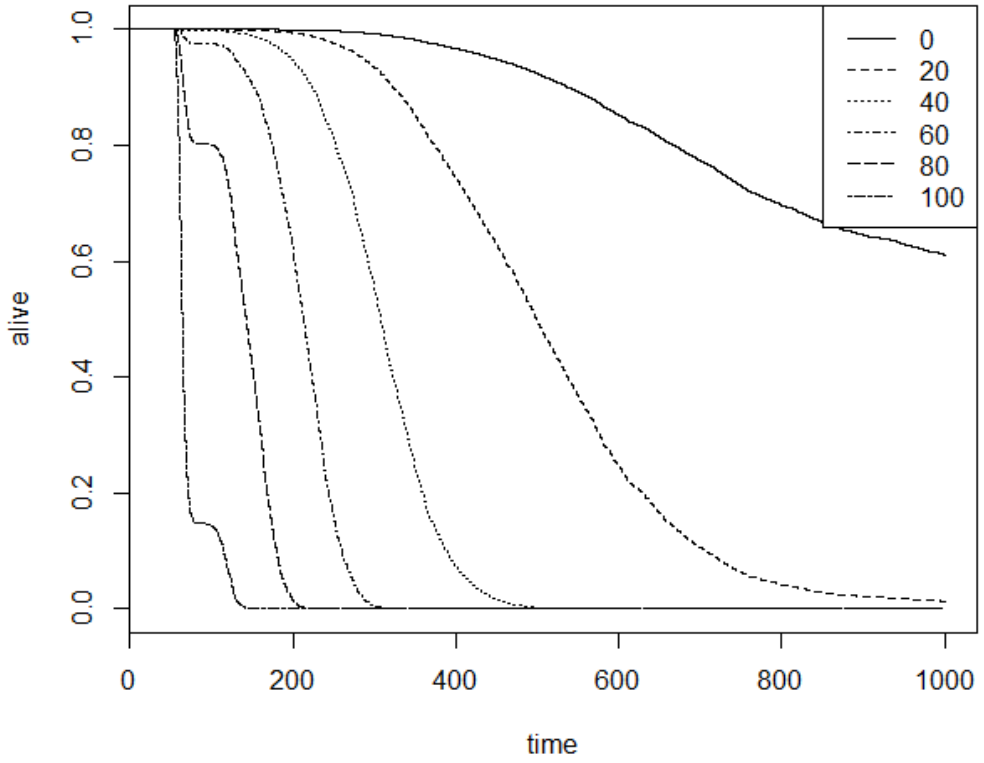
Considering each time that the event happened as a separate event, the joint probability of all events is:

- $\prod_{i=1}^{n} L_i$

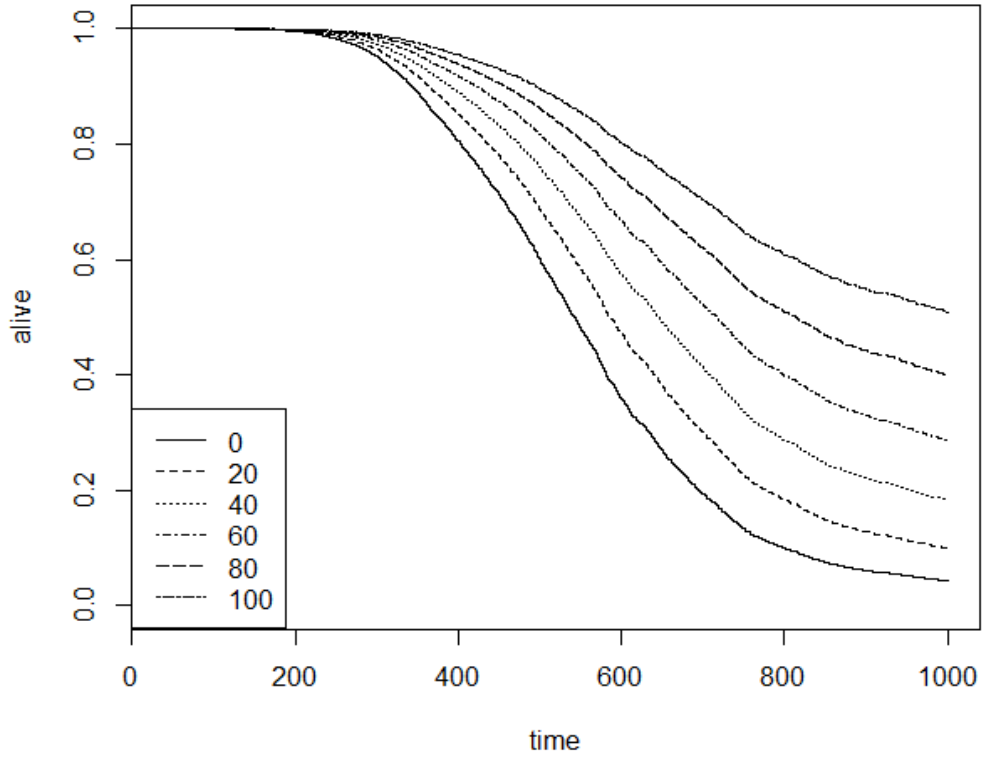
DATA GENERATION AND ANALYSIS (CONT.)

	Coef	Exp(coef)	SE(coef)	p-value	Sig.
Exogamy rate	0.0853674	1.0891172	0.0002714	<2.00E-16	***
Reveal strategy	-0.0043116	0.9956976	0.0001217	<2.00E-16	***
Education	-0.0112835	0.9887799	0.000128	<2.00E-16	***
Minority threshold	-0.017524	0.9826286	0.0002395	<2.00E-16	***

DATA GENERATION AND ANALYSIS (CONT.)



Survival function for different levels of exogamy rate (%) (other variables at mean values)



Survival function for different levels of students involved in minority language programs (%) (exogamy rate at 10%, other variables at mean values)

DISCUSSION AND CONCLUSIONS

Exogamous pairing seems to have a major negative impact on the long-term chances of survival of the minority language.

Numerous authors have observed a substantial negative correlation between the rate of exogamy and the level of minority language intergenerational transmission.

For example, Harrison (1999), discussing the case of German immigrants to Canada, observes that a considerable amount of exogamy contributes to a lower level of language maintenance across generations. He compares this case with the case of Punjabi-, Chinese- and Spanish-speaking immigrants to Canada, who were characterized by substantially lower rates of exogamy and had a higher tendency to pass their language on to the next generation.

Besides, the **implications** of exogamous pairing in terms of language transmission could be change.

DISCUSSION AND CONCLUSIONS (CONT.)

The analyses show that both variables concerning **education** programs ("education" and "minority threshold") have a positive impact on the chances of long-term survival of the minority language.

However, the impact is rather weak. Indeed, they only seem to slow down the decline of the minority language, rather than stop it, let alone revert it. Sadly, examples of unsuccessful language education programs are quite frequent in the relevant literature, the case of Irish being one of the most famous.

DISCUSSION AND CONCLUSIONS (CONT.)

Needless to say, promoting endogenous marrying is not an advisable solution, nor is forcing people to speak the minority language.

A more **positive social attitude** towards minority languages, which may result from measures such as granting the status official language or supporting cultural activities, could improve the chances of long-term survival. Indeed, it could:

- influence communication dynamics in mixed families, pushing parents to raise their children bilingually and make sure that they become fluent in the minority language;
- increase the likelihood that a minority-language speaker reveals that she speaks the minority language.

These two effects combined could have a significant impact on the long-term survival of minority languages.

THANK YOU!

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Mobility and Inclusion
in Multilingual Europe

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