A three-state language competition model including language learning and attrition

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Starting with the seminal work by Abrams and Strogatz on language competition, a common assumption in most subsequent models has been that the key driving force for the prevalence of one language vs. another is its perceived status or "prestige". This makes sense and the impact of language prestige has been well established also thanks to a few comparisons of model predictions with historical census data. However, there are other factors that can influence language competition. Because language shift is related to learning and forgetting, memory is with no doubt one of the most direct and important ones, yet to our knowledge none of the existing language competition models accounts for memory effects.

For the above reasons, we have developed a three-state agent-based language competition model that takes into account the fact that language learning and attrition are not instantaneous but occur over a finite time interval, i.e., we have introduced memory in the system. The model contemplates the possibility both to learn a new language in addition to the mother tongue, and to forget either the acquired language or the mother tongue after becoming bilingual. Also, the two competing languages may have equal or different degrees of difficulty, resulting in a potentially different number of interactions and/or length of time period required to learn or forget either language.

We show that upon including memory in a Minnet-Wang type model with a population of speakers having homogeneous linguistic skills, the final outcome of the language competition can be: (1) the extinction of one of the competing languages; (2) the coexistence in two isolated language communities; (3) a state where the minority language survives due to the bilingual speakers. Which of the three possible scenarios is realized, depends on the initial population composition, the parameters that determine learning/attrition (among which the asymmetry between the language learning difficulties), and the interaction frequency between individuals.

The results of our study suggest that while language prestige is certainly crucial for language shift and in determining the outcome of language competition, memory effects may play a critical role too and their relative importance versus prestige may depend on the specific features of the system under consideration.

In addition, since linguistic skills can have a significant variability among individuals, another relevant issue addressed in the present work concerns the impact of heterogeneity in language dynamics models. We demonstrate that the outcome of language competition depends besides other parameters also on the level of population diversity in terms of language learning and retention skills. In fact, adding heterogeneity to the model changes significantly the time evolution of population fractions and the final population composition. Diversity also allows to observe, differently from the corresponding homogeneous system, a final equilibrium state where all three linguistic groups – the two monolingual and the bilingual groups – are present. Therefore, we conclude that, besides the learning and retention processes, the impact of heterogeneity in language dynamics deserves a broader investigation.

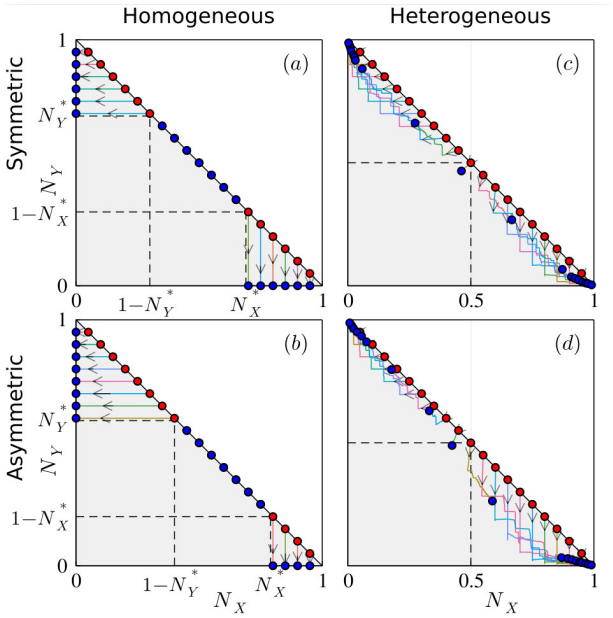

Fig. 1. Phase portraits of homogeneous and heterogeneous systems with symmetrical and asymmetrical language learning difficulties. The grey triangle represents the area accessible to the system. The initial conditions are represented by the red dots and the final positions by the blue dots (overlapping the red ones on the diagonal).