

## “The effect of fitness in the emergence of creole”

Makoto Nakamura, Takashi Hashimoto, Satoshi Tojo and Kenny Smith  
Japan Advanced Institute of Science and Technology and University of Edinburgh  
mnakamur@jaist.ac.jp

Language evolution has been dealt with in the framework of population dynamics for recent years in order to establish a mathematical theory of language. The representative models include the language dynamics proposed by Komarova et al.[1], and the results in population dynamics are forthcoming. We applied the language dynamics to the research of the emergence of creole by modifying it to be more adaptable to the environment of the actual creole. Our prime revision is that the transition rate in languages is sensitive to the distribution of population of each generation. In addition, we introduce the exposure probability that is the measure of influence from other languages. In the series of our study from the perspective of the population dynamics, we have already shown the process of the emergence of creole[2] and the condition of the similarities among languages for creole to emerge and to be dominant[3].

In the theme of the present research, we aim to overhaul the term of fitness corresponding to the communicability of language. In our model so far, language speakers bear offspring in proportion to the fitness. However, creole emerges not because creole speakers have more offspring than other pre-existing languages but because the influence of infants' learning biases during the repeated cultural transmission of the creole forces it to take on certain structures. Therefore, we need to find out how the fitness works in the process of the emergence of creole. Because the behavior of the dynamics without fitness can easily be compared to that of with fitness, we start to delete the term of the fitness from the dynamics equations.

A major difference is that the range of the exposure probability in which the creole emerges is remarkably larger in the model without fitness than one with fitness<sup>1</sup>. For the equation without fitness term, the creole exists in the whole range. In contrast, for one with fitness, there is a critical value in the probability only above which creole emerges. While the value depends on the similarities among languages, it is larger than 0.7 for any similarity settings. Below the critical probability, the creole once grows but lose its population eventually. We conclude from these numerical analysis that the fitness works as a suppressor for the creole to emerge when children do not talk with people other than their parents so often.

[1]Komarova, N. L., Niyogi, P., & Nowak, M. A. (2001). The evolutionary dynamics of grammar acquisition, *Journal of Theoretical Biology*, **209** (1), 45–59.

[2]Nakamura, M., Hashimoto, T., & Tojo, S. (2003). The Language Dynamics Equations of Population-Based Transition – a Scenario for Creolization, *Proceedings of the International Conference on Artificial Intelligence (IC-AI'03)*, CSREA Press, 689–695.

[3]Nakamura, M., Hashimoto, T., & Tojo, S. (2003). Creole Viewed from Population Dynamics, *Proceedings of the Workshop/Course on Language Evolution and Computation in ESSLLI*, 95–104.

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<sup>1</sup>Although we have found other differences, there is no space to express here. They will be discussed at the conference.