The natural stability of 'unnatural' morphology

Models can serve as powerful tools for uncovering how a simple change process may lead to striking emergent outcomes [1,2], and likewise, how small revisions in assumptions can lead to dramatic shifts in how a system is predicted to behave [3]. Here we use simple modelling to demonstrate that analogical changes in inflectional systems can be expected to have a particularly counterintuitive, yet empirically well-supported, long-term effect: namely, inflectional classes' and stem alternation patterns' resilience against levelling, even as they undergo constant analogical change [4]. We first underscore why this resilience is so surprising. Next, we explain why analogical reasoning in inflectional systems is expected to trigger changes based not only on similarity but also on dissimilarity. Finally, we implement the predicted change processes in a simple iterated evolutionary model and show that their long-term consequence is to support not only the ongoing coalescence and coherence of morphological classes but also their resistance to complete collapse and levelling.

In inflectional systems, idiosyncratic morphological class systems such as inflectional classes and stem alternation patterns are empirically ubiquitous [5, 6] yet they present a stark theoretical challenge. Relative to their absence, these systems (i) incur a learning cost [7], yet (ii) offer no clear functional benefit [8]. Given that they are constantly undergoing analogical changes [4], standard evolutionary logic predicts that they *ought to disappear*—and indeed, early modelling work has implied this conclusion [9,10]. Yet in real languages and families, stem alternations and inflection class systems routinely persist across millennia, even as other, more functionally motivated inflectional phenomena collapse and fade. So, what makes these systems so resilient?

Recent work in experimental and computational psychology [11] has emphasised that inferential reasoning occurs within an *inductive context*, which is appropriate to the situation at hand, and which shapes the inferences that are more or less likely. For instance, people reason differently when items are related by physical distances, versus via a taxonomic tree. Carefully applying the notion of inductive context to inflectional systems reveals a significant implication: analogy is expected to licence both similarity-enhancing and dissimilarity-enhancing inferences. When these two types of inference are implemented in an iterative model, they give rise to two dynamic forces: one of attraction and one of repulsion. As in many attraction-repulsion systems in nature [12,13], this dynamic leads the system to self-organise into areas of internal coherence (i.e., morphological classes) while maintaining difference across them (i.e., avoidance of total levelling).

In conclusion, inflectional classes and other 'morphomic' categories [14, 15] have long been held in suspicion within certain theoretical circles [16], and have even earned the label 'unnatural' [17]. On the contrary, however, here we demonstrate that they are natural phenomena *par excellence*: they are natural (emergent) outcomes of natural (rational) inference, and they just so happen to be naturally tenacious survivors of aeons of unceasing analogical change.

References

1. Boyd, R. & P. J. Richerson . 1988. *Culture and the evolutionary process*. Chicago: University of Chicago Press.
2. Smaldino, P. E. 2017. Models are stupid, and we need more of them. In R. R. Vallacher, S. J. Read & A. Nowak (eds), *Computational social psychology,* 311-331. New York: Routledge.
3. Guest, O. & A. E. Martin. 2021. How computational modeling can force theory building in psychological science. *Perspectives on Psychological Science*, *16*(4), 789-802.
4. Maiden, M. 2018. *The Romance verb: Morphomic structure and diachrony*. Oxford: Oxford University Press.
5. Bach, X. 2018. *The origins of inflectional classes*. D.Phil dissertation, University of Oxford.
6. Herce, B. 2020. *A typological approach to the morphome*. Doctoral dissertation, University of Surrey.
7. Clark, E. V. 1998. Morphology in language acquisition. In A. Spencer & A. Zwicky (eds), *The handbook of morphology*, 374-389. Oxford: Blackwell.
8. Anderson, S. R. 2015. Dimensions of morphological complexity. In M. Baerman, D. Brown & G. G. Corbett (eds), *Understanding and measuring morphological complexity*, 11-26. Oxford: Oxford University Press.
9. Ackerman, F. & R. Malouf. 2015. The No Blur Principle effects as an emergent property of language systems. In *Proceedings of the 41st Annual Meeting of the Berkeley Linguistics Society*. Berkeley, CA.
10. Esher, L. 2015. Approaches to the function and emergence of metamorphomic structure. Presentation given at Décembrettes 9. Toulouse, December 2015.
11. Kemp, C. & J. B. Tenenbaum. 2009. Structured statistical models of inductive reasoning. *Psychological review*, *116*(1), 20.
12. Lennard-Jones, J. E. 1931. Cohesion. *Proceedings of the Physical Society*, 43(5), 461–81.
13. D'Orsogna, M. R., Chuang, Y. L., Bertozzi, A. L., & Chayes, L. S. 2006. Self-propelled particles with soft-core interactions: patterns, stability, and collapse. *Physical review letters*, *96*(10), 104302.
14. Aronoff, M. 1994. *Morphology by itself*. Cambridge: MIT Press.
15. Round, E. R. 2015. Rhizomorphomes, meromophomes and metamorphomes. In M. Baerman, D. Brown & G. G. Corbett (eds), *Understanding and measuring morphological complexity*, 29-52. Oxford: Oxford University Press.
16. Bermúdez-Otero, R. & A. R. Luís. 2016. A view of the morphome debate. In A. R. Luís & R. Bermúdez-Otero (eds), *The morphome debate*, 309–340. Oxford: Oxford University Press.
17. Aronoff, M. 2016. Unnatural kinds. In A. R. Luís & R. Bermúdez-Otero (eds), *The morphome debate*, 11-32. Oxford: Oxford University Press.