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An evolutionary approach to sign language emergence

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An evolutionary approach to sign language emergence: from *state* to *process*

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How does language emerge from a prior state in which no language exists? This is the central question for the field of Language Evolution. Although early attempts to address this question focussed on biological evolution, the current consensus is that cultural evolution plays a fundamental explanatory role (Tamariz & Kirby, 2015). To understand language evolution, we need to understand how individual humans improvise solutions to communicative challenges, how groups of individuals create conventions through interaction, and how these conventions are transmitted over time through learning.

The manual modality provides the best hope we have of understanding how these processes work and answering the central question of language evolution. It offers a broad range of phenomena, from fully conventionalised sign languages to cases where a conventionalised system has not yet been established. In particular, research into homesign systems and emerging sign languages such as Nicaraguan Sign Language, but also the silent gesture paradigm in the laboratory, allow observation of human communication systems from their point of origin, and directly allow us to investigate how linguistic structures evolve.

We recognise that it is essential to have clear terminology, and to be aware of the differences between sign and gesture. However, the rigid dichotomy between gesture as pictorial and sign as categorical is problematic when it comes to determining the characteristics of the cases mentioned above: silent gesture, homesign and possibly also emerging sign languages. Because on which side of the dividing line do these

fall? Like the authors note (sections 7.1 and 7.2), homesign and silent gesture are language-like in some respects, but not in others.

An evolutionary perspective shifts emphasis away from problematic questions about the *status* of silent gesture, homesign, and the early stages of emerging sign languages as being either pictorial and gesture-like or categorical and sign-like. Instead, we argue that the emphasis should be on the continuity of cultural-evolutionary *processes* involved in shaping these various systems.

These phenomena are ultimately rooted in situations of communicative stress; they emerge because no existing conventional language system is available. Where they differ is in which cultural forces have the upper hand in the situations in which they emerge. For example, silent gestures elicited in laboratory experiments are not subject to the routinisation that occurs from using a system repeatedly, whereas homesign systems are. This may be the explanation behind differences found between the two phenomena, such as that for motion events mentioned by the authors (section 7.2): silent gesturers do not break their gestures for motion events into path and manner components, whereas homesigners do.

This shift of emphasis that is at the heart of an evolutionary approach to language - a shift from considerations of *state* to considerations of *process* - can be extended to the silent gesture laboratory paradigm. We propose augmenting this paradigm by implementing different cultural processes, such as communicative interaction and cultural transmission. To do this, we can borrow from the experimental techniques developed in the field of language evolution more broadly.

The iterated learning paradigm (Kirby et al., 2014), where a participant learns a language from the output of a previous participant, has been used to probe the role that learning plays in shaping linguistic structure, specifically through modelling the transmission of language to new learners. More recently, this experimental framework has been expanded to investigate the effects of interaction in conjunction and in comparison with transmission to new learners. Kirby et al. (2015) studied pairs of participants organised into transmission chains (a condition with both interaction and transmission) compared with isolated pairs of participants (an interaction-only condition). Their results showed that when both transmission and interaction processes were at play, the compositional structures found in natural languages emerged. Isolating these processes however, had different effects: the participants in the interaction-only condition produced "holistic" systems, useful for expressive communication, but not compositionally structured. Similarly, studies looking only at transmission to new learners, but without interaction between pairs (Kirby, Cornish and Smith, 2008; Cornish, Smith and Kirby, 2013) found that easily learnable but non-expressive, unstructured languages were the result.

We have now begun to apply this framework to the manual modality, assessing the effects of cultural processes in the laboratory alongside data from homesign and emerging sign languages. Following research into motion events in Nicaraguan Sign Language, Smith et al. (in prep) examined the effect of cultural transmission on motion events in silent gesturers. Supporting previous results, the gestures produced by participants became more regular and structured as they were transmitted to new learners, showing increasingly language-like properties.

Expanding this paradigm, Motamedi et al. (in prep) studied the emergence of systematic category structures in silent gesturers, looking at the effects of iteration alone, interaction alone and the effects of both processes working together. Corroborating Kirby et al. (2015), the systems produced by participants in the iteration and interaction condition produced fully systematic systems, which did not emerge in the conditions where these processes were isolated.

These findings make it clear that silent gesture elicited from single participants is a very temporary phenomenon: they are the structures that participants produce in the lab when they are asked to do this *for the first time*. The patterns that are observed can be seen as representative of an individual's cognitive preferences for structuring information (Schouwstra & de Swart, 2014). When these utterances are subject to cultural processes such as communicative interaction and cultural transmission, they will be transformed to become more systematic and increasingly regular. Being able to witness these processes at play in the lab is extremely exciting and informative. At the same time, we are convinced that we should not restrict our view to laboratory data alone (Schouwstra, 2012). Combining the precision of laboratory experiments with the naturalness of field data is a promising next step in uncovering the cultural processes that shape emerging language.

Cornish, H., Smith, K., & Kirby, S. (2013). Systems from Sequences: an Iterated Learning Account of the Emergence of Systematic Structure in a Non-Linguistic Task. In *Proceedings of the 35th annual meeting of the cognitive science society* (pp. 340–345). Retrieved from http://mindmodeling.org/cogsci2013/papers/0087/paper0087.pdf

Goldin-Meadow, S., So, W. C., Ozyürek, A., & Mylander, C. (2008). The natural order of events: how speakers of different languages represent events nonverbally. *Proceedings of the National Academy of Sciences of the United States of America*, *105*(27), 9163–8. doi:10.1073/pnas.0710060105

Kirby, S., Cornish, H., & Smith, K. (2008). Cumulative cultural evolution in the laboratory: an experimental approach to the origins of structure in human language. *Proceedings of the National Academy of Sciences of the United States of America*, *105*(31), 10681–6. doi:10.1073/pnas.0707835105

Kirby, S., Griffiths, T., & Smith, K. (2014). Iterated learning and the evolution of language. *Current Opinion in Neurobiology*, *28C*, 108–114. doi:10.1016/j.conb.2014.07.014

Kirby, S., Tamariz, M., Cornish, H., & Smith, K. (2015). Compression and Communication in the Cultural Evolution of Linguistic Structure linguistic structure. *Cognition*, *141*, 87–102.

Motamedi, Y., Schouwstra, M., Smith, K., & Kirby, S. (2015). *From improvised gesture to systematic sign: a laboratory study*. Manuscript in preparation.

Schouwstra, M. (2012). *Semantic structures, communicative principles and the emergence of language*. Netherlands Graduate School of Linguistics.

Schouwstra, M., & de Swart, H. (2014). The semantic origins of word order. *Cognition*, *131*(3), 431–6. doi:10.1016/j.cognition.2014.03.004

Smith, K., Abramova, K., Cartmill, E., & Kirby, S. (2015). *The experimental study of sign language emergence*. Manuscript in preparation.