# CONVENTIONAL STRUCTURE FROM TRANSFORMATIVE ACTIONS ON PRIOR GESTURES IN AN EMERGENT SYSTEM

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Face-to-face interaction is the most common locus for human communication. Interlocutor adhere, in most cooperative conversation, to features of interaction, including turn-taking, requesting repair and correcting misunderstandings, using gestures to facilitate meaning, and coordinating eye gaze and body position. Here we propose how emergent silent gesture communication may rely on features of interaction, namely repair and using priors, during the process of conventionalization as the negotiation of form-meaning pairs is carried out over multiple turns.

## 1. Introduction: The Study of Interaction and Language Evolution

Co-operative action refers to the joint construction of action by interacting individuals performing operations on diverse materials (Goodwin, 2013). The organization and co-operation of human action allows people to coordinate activity in ways that might not be present in other animals. People engage in joint action by bringing together meaningful materials (e.g. language, cultural artifacts), and performing operations on a prior, public substrate (e.g. action, talk). The affordance of prior talk, gesture, and other semiotic materials in human interaction provides interlocutors a context from which to build, reconstruct, and negotiate meanings across multiple turns.

One interactional tool of import to negotiation is repair, or the process of marking trouble-sources and performing actions to correct the misunderstanding. Repair sequences adhere to turn-taking practices in natural conversation (Sacks, Schegloff, & Jefferson, 1974) and can be initiated by either the producer of the trouble-source or the hearer. The repair itself can also be given by the original speaker or the hearer. Though there is a preference for self-initiated-self-repair in natural conversation (Jefferson, 1974), in the context of language emergence and evolution, repair may serve a different function: facilitating conventionalization. As such, repair might be more frequently other-initiated in evolving communication as interactional partners attempt to negotiate meanings. This difference suggests that the transformations repair actions make on prior output could be influential to the process of conventionalization.

Studies on emergent communication systems have acknowledged the benefits of repair as an index for conventionalization and as a resource for

building alignment to more abstract communicative forms (Fay *et al*, 2010; Healey *et al*, 2007). Here we extend previous studies to increase the opportunity for repair in an experimental setting to examine how repair shapes conventionalized forms. Furthermore, given the nature of repair to operate on prior structures (whether oral or gestural output), we are interested in how transformative actions reuse and modify initial attempts at communication in order to evolve a systematic structure.

## 2. Methodology

Participants played an iterated communication game requiring the disambiguation of similarly gestured noun-verb pairs using only silent gesture (Goldin-Meadow *et al,* 2008; Schouwstra, 2012). The game was played over four gradual turn-over generations. Dyads switched roles as Director (gesturer) and Matcher (guesser), while an Observer watched the interaction so as to be a more informed participant in the subsequent generation in which they would become part of a dyad. A pressure for time was also included. Participants were placed in one of two interactive conditions, in which the manipulation for one condition was the immediate opportunity for a repair turn after an incorrect guess. See Micklos (2016) for detailed description of experimental procedures.

## 3. Building from Priors: Repair, Alignment, and Conventionalization

Participants in both conditions made use of repair to facilitate accurate guessing and, in turn, a more efficient communication system. The non-immediate repair participants produced repair sequences *before* guessing, highlighting participant resourcefulness and the apparent usefulness repair has, even in an emergent context, given participant desire to perform potentially time-consuming repairs.

The changes that occur to the silent gesture system in these experiments can be attributed to the interaction that takes place between the participants, the gestures they produce that are selected for modification, and the negotiation and repair that improves upon the system-in-progress. The face-to-face, contingent interaction of the experiment allows participants to build from one another's prior gestures as a means of developing systematicity over generations. Once a gesture has been performed, it is available for future use and manipulation. Immediate modification on a gesture can involve a reference to the gesture space or a particular element of the gesture. These references can be seen in examples of other-initiated-other-repair, as when a Matcher points to the gesture space of the Director. More removed reference to a prior gesture was also demonstrated by some participants (as the Director) who would gesture to the Matcher's previous gesture space (during their prior turn as Director), as a

means to indicate they would be communicating a similar item. However, even when a gesture is far removed temporally from the current gesture sequence, there is evidence that participants recall, reuse, and build upon priors to communicate similar or the same meaning (as in gestures from one generation to the next).

Instances of other-initiated-other-repair (OIOR) sequences demonstrate the ability of learners, or innovators, of a new communicative system to use prior outputs in an effort to conventionalize features (here, verb and noun meanings). Other-initiated repair is an attempt to get the Director to align with the Matcher's conceptions of the silent gesture system. When a Matcher initiates repair with facial gestures (e.g. furrowed brow) or a look back to the Director, they are communicating a misunderstanding of the prior, and attempting to make the Director repair to a more communicable gesture. If, on the other hand, the Matcher performs a repair (i.e. gives the repair options), they may be presenting a more effective strategy which can be taken up in subsequent gestures. Instances of OIOR in this experiment demonstrate how Matchers perform operations on the Director's prior gesture and gesture space to clarify the intended meaning. One strategy is to point to the specific parts of the gesture space that should undergo repair, as in the handled object "A Nail" in which the gesture most closely resembles the verb "Nailing." Pointing to the space in which the imagined noun was located provides a candidate repair to clarify the noun-ness of the target word. The Director nods in acceptance of this repair and the chain continued to highlight the noun-ness through an "Object Emphasis" noun marker to distinguish between noun-verb pairs. In another chain, a Matcher's candidate repair for "Whipping" provided the option of pointing to the noun ("A Whip"). The Matcher reused the Director's initial gesture, and also modified it when giving the potential solution to disambiguating the noun from the verb. Furthermore, the Director could in turn operate on the gesture space of the Matcher to indicate the intended meaning. This instance of OIOR promoted the chain's continued use of the "Object Point" noun marker. The immediacy of repair turns allows for transformative operations that promote the innovation of and fixation on disambiguation strategies that make communication more effective.

Over generations, participants modify and systematize prior gestures to conform to emergent conventions in the silent gesture system. This process involves reusing elements of prior gestures, even if temporally distant, to communicate a meaning, and it is complementary to speech produced over multiple turns (Goodwin, 2013). For example, the transformation of "A Guard" over four generations builds from one gesture to the next, incorporates similar-semantic gestures, and adds a marking system, resulting in a concise,

communicative, and compositional gestural structure. Generation 1 performs "A Guard" by enacting the duty of a guard, standing in a rigid pose and looking from side to side. While the "Index Finger" noun marker has been used prior to this target word, it did not have patterned use early in the generation. Generation 2's "A Guard" built from the previous generation, re-incorporating the rigid body posture, but adding a salute. The Index Finger marker had not been transferred to all nouns yet, as it was applied to instruments initially. In Generation 3, the gesture for "A Shield," which included the initial Index finger marker, produced a new structure wherein the shield was represented by crossed arms in front of the Director. In the final generation, these elements were brought together in a systematic way to communicate "A Guard" by providing the Index Finger marker, then crossing the arms to indicate an action, and saluting to indicate the person-hood of the noun. Building upon and transforming prior generations' gestures results in a systematic structure that is both expressive- it can distinguish between different meanings- and efficient- it can be easily transmitted and interpreted.

The unique ability to perform transformative operations on priors to create conventionalized communicative structures might be one influential factor in the emergence and evolution of language. Basic tenants of interaction give new language innovators a platform from which to build up an effective communication system. The interactional toolkit afforded to humans is a resource to be co-opted for negotiating the structure and features of emerging languages.

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