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Quantifying the Emergence of Symbolic Communication

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Abstract

We quantitatively study the emergence of symbolic communication in humans with a communication game that attempts to recapitulate an essential step in the development of human language: the emergence of shared signs. In our experiment, a teacher must communicate a first order logic formula to a student through a narrow channel deprived of common shared signs: subjects cannot communicate with each other with the sole exception of car motions in a computer game. Subjects spontaneously develop a shared vocabulary of car motions including indices, icons, and symbols, spanning both task-specific and task-agnostic concepts such as "square" and "understand". We characterize the conditions under which indices, icons, and symbols arise, finding that symbols are harder to establish than icons and indices. We observe the dominant sign category being developed transitions from indices to icons to symbols, and identify communicating in ambiguous game environments as a pressure for icon and symbol development.