SQUIGGLE: LARGE-SCALE SOCIAL EMERGENCE OF SIMPLE SYMBOLS

RICK DALE
Department of Psychology
The University of Memphis
Memphis, TN, USA

GARY LUPYAN
Department of Psychology
University of Pennsylvania
Philadelphia, PA, USA

Recently, several prominent studies have developed human experimental methods to explore the emergence and evolution of simple linguistic systems. In one line of research, often termed *iterated learning* (Kalish, Griffiths, & Lewandowsky, 2007; Kirby, Cornish, and Smith, 2008), human participants see word-picture pairings in an invented mini-language. The learner then reproduces these pairings, which become the training material for the next learner. Because learning is imperfect, subsequent generations produce gradually stable, systematic versions of the "language." Another line of work has explored how social coordination between participants produces simplified linguistic systems. Simon Garrod and Nicholas Fay and colleagues (Garrod, Fay, Oberlander, Lee, & MacLeod, 2007; Fay, Garrod, & Roberts, 2008) had participants function in pairs, creating line drawings to identify a referent picture among a list of candidates. After multiple rounds of interaction, participants create a simplified set of symbolic representations for images (see also Galantucci, 2005).

In the present work, we have loosely integrated both empirical approaches, and taken them in a new direction in a multiplayer communication game we call *Squiggle*. Players connect to the game engine via Internet, and create and interpret visual signs for real-world objects. Successful communication occurs when other players are able to match a previously created sign to its referent. As gameplay proceeds, we track the evolution of individual signs and study in real-time the transition from iconic to symbolic communication.

The Squiggle game consists of *speaking* trials in which a player is presented with a picture (common objects, faces, and place pictures) and has 4 seconds to draw a squiggle—a black and white line drawing created on a computer interface—such that another person would be able to match the squiggle with the picture. On a *listening* trial, a player is shown a previously created squiggle along with two pictures and has to select the picture they think the

squiggle refers to. They are then provided with accuracy feedback. On speaking trials, a picture is randomly chosen to be "squiggled." On listening trials, an evolutionary algorithm, factoring in the novelty and previous comprehensibility of a squiggle in the database, determined whether a squiggle had an opportunity to be presented to the community of users for a randomly selected picture. The most successful squiggles remain in game play while less successful squiggles (those which are not reliably understood) gradually disappear. Initial data were collected from 60 players who produced about 1,400 squiggles and participated in 4,100 listening trials. Many players report the game to be very entertaining (even addictive) and several played for almost an hour or more.

Basic findings suggest that the same patterns observed in previous work occur in this large-scale online game. First, squiggles get simplified. The average size of a squiggle shrinks over gameplay. Second, the evolutionary algorithm produced stability for most images, despite opportunities for novel squiggles to replace them during listen trials. Third, while squiggles are drawn highly iconically at first, participants gradually use simplified squiggles that distinguish pictures from others in the same domain. Finally, we describe a referent set in which compositionality may be emerging (akin to Kirby et al., 2008).

Currently, we are extending this game-based approach to a massively multiplayer environment for the iPhone in the hope of getting thousands to play. This will permit explorations of language evolution hitherto inaccessible to human experimentation, including questions regarding social network connectivity, small-world network structure, and the emergence and interaction between human dialects. The approach therefore holds promise by allowing us to study the emergence of linguistic communities in real-time at a very large scale.

References

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