

Arbitrariness and path dependence in a noisy-channel communication model

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Abstract

Keywords: Add your choice of indexing terms or keywords; kindly use a semi-colon; between each term.

Introduction

Successful communication depends on a set of shared linguistic conventions (de Saussure, XX; Lewis, XX). These conventions allow communities of speakers to coordinate group behavior (cite collective behavior lit??), initiate speech acts (Strawson, 1964), and align beliefs or memories (Coman, Momennejad, Drach, & Geana, 2016; Stolk, Verhagen, & Toni, 2016). While *global* conventions adopted and sustained throughout a large population of speakers may form over much longer time scales (cite historical ling?), we also effortlessly coordinate on *ad hoc* or *local* conventions – or conceptual pacts – within the span of a single dialogue.

For instance, in a seminal study by Clark & Wilkes-Gibbs (1986), pairs of participants played an interactive reference game in which they were separately presented with arrays of abstract tangram shapes in randomized orders. One player – the *speaker* – was instructed to describe the tangrams such that the other player – the *listener* – could rearrange their tangrams to accurately match the speaker’s board. Over six rounds, descriptions were dramatically shortened: an early description like “All right, the next one looks like a person who’s ice skating, except they’re sticking two arms out in front” became “The ice skater” by the final round.

In this paper, we present a probabilistic model of language conventionalization in a communication game. We show that this model, based on recent successes capturing language understanding as social inference (Goodman & Frank, 2016; Goodman & Stuhlmiller, 2013), can account for key empirical signatures of conventions, including limited arbitrariness, path-dependence, and systematic shortening over time. These computational results are compared with qualitative empirical results from a new large-scale replication of Clark & Wilkes-Gibbs (1986).

While simple evolutionary or agent-based models (Barr, 2004; Centola & Baronchelli, 2015; Shoham & Tennenholtz, 1997; Young, 2015) have previously been used to understand the dynamics of *global* conventions, relatively little modeling work has focused on the cognitive mechanisms supporting emergence of conventions during shorter dyadic interactions.

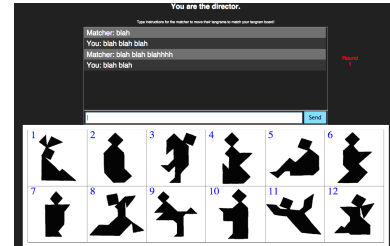


Figure 1: Example trial

Reference game experiment

Participants

200 participants were recruited from Amazon’s Mechanical Turk and paired into dyads to play a reference game. We excluded X games because participants reported confusion at the instructions, Y games because one or both of the participants reported being a native language different from English, and Z games for terminating early.

Stimuli

On every trial of the game, both participants were shown grid of twelve tangram shapes, reproduced from (cite Herb; see Fig. ??).

Procedure

After passing a short quiz about task instructions, participants were randomly assigned the role of either ‘director’ or ‘matcher’ and automatically paired into virtual rooms containing a chat box and grid of stimuli. Both participants could freely use the chat box to communicate, but only the matcher could click and drag stimuli to reorder them. The director’s goal was to tell the matcher. . .

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