The role of cross-modal biases in cultural evolution of artificial languages

For a long time, linguists assumed that form-meaning mappings in language were arbitrary. This property was listed as one of the basic design features of language (Hockett, 1960). However, the notion that there is no motivated connection between referents and the form of the signals being used is no longer considered valid. Especially in signed languages, but also in spoken languages, many types of motivated, or iconic words exist (Perniss, Thompson, & Vigliocco, 2010). It is still unclear how exactly iconic forms emerge and persist in the evolution of language. The experiment presented here was designed to study this.

Certain types of iconic mappings may be linked to (universal) biases in human cross-modal perception and neural mappings in the brain. The existence of such biases is hinted at by phenomena such as the bouba-kiki effect (Ramachandran & Hubbard, 2001), in which a consistent non-arbitrary preference is observed for mapping speech sounds to objects of different shapes. Here, we focus on another auditory-visual bias, linking pitch with lightness. A near-universal preference has been identified for pairing high pitch sounds with light colors (e.g. Marks, 1974; Melara, 1989; Ward et al., 2006). This preference has been demonstrated not only among humans but also chimpanzees (Ludwig et al., 2011) and is therefore most likely pre-linguistic. Hubbard (1996) additionally found that humans associate lighter colors with rising intonation and darker colors with a falling intonation, and that the size of the melodic interval influences lightness preferences, so that larger intervals are associated with more extreme luminosity.

From studies in language evolution we know that with repeated transmission of artificial languages, structures emerge that are shaped by human cognitive biases (e.g. Kirby, Cornish and Smith, 2008). Here, the influence of the pitch-lightness bias on the emergence of structure in artificial whistled languages is studied, by simulating cultural transmission with human participants, following Verhoef et al. (2011). Participants learned and reproduced seven whistled ‘words’, produced with a slide whistle (see figure 1), for seven different shades of gray. The reproductions of one participant were used as the form-meaning mappings the next person was trained on. Four transmission chains of ten learners were created in this fashion.

The evolution of the systems of whistle-shade mappings was analyzed, focusing on the potential emergence of systematic patterns that follow known pitch-lightness biases. Evidence for such patterns was found in the final generations of the chains, but the magnitude of it differed from one chain to the other. For two out of the four chains, a correlation was found between pitch and luminosity in the expected direction. The other chains did not exhibit any significant correlation relating pitch to luminosity, so whenever there was a pattern, it reflected the bias. A significant correlation between interval size and luminosity extremeness was also found for two out of the four chains, but the opposite pattern was found in one other chain as well.

Overall, all chains showed changes over the course of transmission and the form-meaning mappings appeared to become more systematic. The emerging systems seem to be more likely to systematize in the direction that fits with known cross-modal biases, but other patterns emerge as well. If it happens to be the case (through for instance founder effects) that the system organizes with another or even the opposite pattern, then a drive to adopt this pattern may as well override the effect of cross-modal biases. This study demonstrates how methods for studying cultural evolution of artificial languages can be used to investigate the emergence of perceptually motivated form-meaning mappings in language.
References