# A Framework for the Emergence of Intra-Species Mutual Recognition Patterns

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## ABSTRACT

This one-page abstract presents a framework for the emergence of recognition patterns that are used by individuals to find each other and mate. A genetic component determines the brain of the individuals, a machine learner architecture, which is then used to transmit knowledge. The a priori information is kept down to a minimum. All species are initially indistinguishable and agents can only find each other by chance at the beginning. Differentiation occurs as a result of the interactions between the genetic and the knowledge parts. Restricted availability of different symbolic values forces the emergence of more elaborated recognition patterns. The sequences that form as the result of this simulation cannot be related to either the genetic or the environmental initial conditions. A Baldwin effect is observed where parts of the machine learning architecture adapts to accommodate for each species dominant sequence, which further stabilizes it. Mutually infertile species, limited learning capacities, and a restricted imperfect communication are thus all that is needed for the emergence of stable recognition patterns.

## Categories and Subject Descriptors

I.2.6 [**Computing Methodologies**]: Artificial Intelligence–*learning*

## General Terms

Experimentation, Languages.

## Keywords

Mutual recognition, Mating parade, Knowledge transmission, Genetic algorithm, Baldwin effect.

## 1. DESCRIPTION OF THE WORK

Computer simulations are a powerful tool to analyze the emergence of language [1], but despite the progress they entail [2] the field remains controversial [3, 4, 5, 1]. The work introduced by this short abstract is about interactions between communication and reproduction. Previous related work have studied for example the knowledge transmission of the categorization of object attributes [6], or have introduced specific mappings between meaning and symbols [7]. The present work does not rely on any a priori concepts. It is a nonsituated, unstructured model [7] that is stripped down to the bare minimum: genetic reproduction, and basic learning capabilities. The model also omit social interactions [8, 9] and ecology [10]. Yet patterns emerge for the mutual recognition of individuals belonging to the same species. An hypothesis is that these patterns can then serve as basis for a protolanguage [11,5], which may then be extended into a full-featured language thanks to social interactions [9]. This work is about how some of the precursor patterns may form in the first place, not about the later two transitions to a full-featured language.

Communication is imperfect and takes the form of strings of symbolic values. Each individual emits a string and is presented the other strings. The task is then to find a suitable mate. Initially all strings are random and all species indistinguishable. The individuals who could find a mate may teach the others (from the same generation or the next).

Genetics act on the brain structure. A brain is an assembly of maximum likelihood machine learners. Genetics alone cannot determine the recognition patterns, but merely shape the space of non-conflicting ones. Knowledge transmission alone cannot solve the problem: there are few and noisy learning instances, and less available symbols than the number of species. Hence the combination of both is necessary for the agents to agree on more complex recognition patterns, that are formed by sequences of symbols. As time passes the agents get to recognize each other better, using these more elaborated strings.

An extensive analysis of the relations between the genetic and the knowledge transmission components is performed, demonstrating a Baldwin effect and an adaptation of the agents learning capacity in term of the number of patterns they can recognize.

This work shows that mild conditions are sufficient for the emergence of mutual recognition patterns: limited cognitive capacities, mutually infertile species, and an imperfect communication operating in a limited space of possible transmissible symbolic values.


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