

02. November 2007  
Zentrum für interdisziplinäre Forschung  
Tagungsraum „Round Table“ (Raum 213)  
10:00h – 11:00h

Christina Pawlowitsch  
*Harvard, Program of Evolutionary Dynamics*

### **Finite populations choose an optimal language**

This paper studies the evolution of a proto-language in a finite population under the frequency-dependent Moran process. A proto-language can be seen as a collection of concept-to-sign mappings. An efficient proto-language is a bijective mapping from objects of communication to used signs and vice versa. Based on the comparison of fixation probabilities, a method for deriving conditions of evolutionary stability in a finite population (Nowak et al. 2004, Nature), it is shown that efficient proto-languages are the only strategies that are protected by selection, which means that no mutant strategy can have a fixation probability that is greater than the inverse population size. In passing, the paper provides interesting results about the comparison of fixation probabilities as well as Maynard Smith's notion of evolutionary stability for finite populations (Maynard Smith, 1988, J. theor. Biol.) that are generally true for games with a symmetric payoff function.

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Tagungsraum „Round Table“ (Raum 213)

11:15h – 12:15h

Immanuel Bomze

*Wien, Institut für Statistik und Decision Support Systems*

### **Fixation conditions in finite population games**

In a recent article "Finite population always choose optimal languages" (Theor.Pop.Biol., to appear 2007), Pawlowitsch employed a first-order condition (as selection intensity becomes small) for fixation of a strategy in finite populations. The theory draws upon earlier results by Nowak et al. (Nature, 2004) who modeled contests with 2 x 2 base games in a finite (large) population by means of a frequency-dependent Moran process. In essence, this condition was claimed by Nowak et al. (2004) to be equivalent to fixation with a probability exceeding that of equidistribution for large population numbers.

While being correct for a large class of games (i.e. generically), this condition is not necessary for an important subclass of doubly symmetric base games. We investigate first- and second-order conditions and arrive at interesting local interpretations, as well as a nice characterization of degeneracy in terms of the base game for the case where the first-order condition fails. Exactly in this situation, we show that fixation never holds if the strict inequality specified by Nowak et al. (2004) is weakened. These results become relevant in highly structured games like sender-receiver games treated in Pawlowitsch (2007) which may exhibit inherent degeneracy in the above sense. Fortunately, the results in Pawlowitsch (2007) are unaffected since her argument only uses sufficiency, not necessity of the conditions specified by Nowak et al. (2004).

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Tagungsraum „Round Table“ (Raum 213)

14:15h – 15:15h (Gerhard Jäger)

15:30h – 16:30h (Frank Riedel)

Gerhard Jäger

*Bielefeld, Fakultät für Linguistik und Literaturwissenschaft*

Frank Riedel

*Bielefeld, Institut für Mathematische Wirtschaftsforschung*

### **Evolution of communication about conceptual spaces**

In his book "Conceptual Spaces", Peter Gärdenfors argues that (a) meanings are arranged in spaces with a geometrical structure, and that (b) natural meanings of simple natural language expressions denote convex regions of such a conceptual space. In the first part of our talk (Gerhard Jäger) we will argue that this convexity postulate can be derived as a self-reinforcing equilibrium in communication if meanings are drawn from a finite set of points in an Euclidean space. This result is derived by means of analytical techniques from evolutionary game theory.

In the second part of the talk (Frank Riedel), we will present two applications of this general setup relating to the typology of color terms and to the pragmatics of measure terms.

In the final part, we will consider the case when the meaning space is continuous, i.e. if each point within some compact  $n$ -dimensional Euclidean space is a possible meaning. Since the standard insights about the relation between static and dynamic stability in evolutionary game theory only apply to games with finite strategy spaces, we will address some foundational issues about evolution of games with infinitely many strategies.