# SOE 18: Social Systems, Opinion and Group Dynamics I

Time: Thursday 15:30–16:30             Location: ZEU 260

SOE 18.1   Thu 15:30   ZEU 260

**Homophily-based social group formation in a spin-glass self-assembly framework** — •Jan Korbel[1,2], Simon Lindner[1,2], Tuan Pham[1,2,3], Rudolf Hanel[1,2], and Stefan Thurner[1,2,4] — [1]Section for the Science of Complex Systems, CeMSIIS, Medical University of Vienna, Spitalgasse 23, A-1090, Vienna, Austria — [2]Complexity Science Hub Vienna, Josefstädterstrasse 39, A-1080, Vienna, Austria — [3]Niels Bohr Institute, Blegdamsvej 17, 2100 Copenhagen, Denmark — [4]4Santa Fe Institute, 1399 Hyde Park Road, Santa Fe, NM, 87501, USA

Homophily, the tendency of humans to attract each other when sharing similar features, traits, or opinions, has been identified as one of the main driving forces behind the formation of structured societies. Here we ask to what extent homophily can explain the formation of social groups, particularly their size distribution. We propose a spin glass-inspired framework of self-assembly, where opinions are represented as multidimensional spins that dynamically self-assemble into groups; individuals within a group tend to share similar opinions (intra-group homophily), and opinions between individuals belonging to different groups tend to be different (inter-group heterophily). We compute the associated non-trivial phase diagram by solving a self-consistency equation for magnetization (combined average opinion). Below a critical temperature are two stable phases: one ordered with non-zero magnetization and large clusters, the other disordered with zero magnetization and no clusters. The system exhibits a first-order transition to the disordered phase.

SOE 18.2   Thu 15:45   ZEU 260

**Heider balance observed for multidimensional attributes** — Joanna Linczuk[1], Piotr J Górski[1], Boleslaw K Szymanski[2,3], and •Janusz A Hołyst[1] — [1]Faculty of Physics, Warsaw University of Technology, Warsaw, Poland — [2]Social Cognitive Networks Academic Research Center, Rensselaer Polytechnic Institute, Troy, USA — [3]Społeczna Akademia Nauk, Łódź, Poland

The majority of measured and studied social interactions arise from dyadic relations. An exception is the Heider Balance Theory (HBT) that postulates the existence of a social triad dynamics. Most of the past literature on HBT focuses on opinions about a single topic in such triads. In contrast, we study opinions of university students on a multidimensional set of topics. We discover limits of HBT observability by considering a novel agent-based model that accounts for: (i) multiple topics on opinions of individual students, (ii) influence of such opinions on dyadic relations (social link polarization), and (iii) influence of triadic relations on individual's sets of opinions on all topics. Using longitudinal records of university student behavior, we create a coevolving social network on which we introduce models of student interactions. We validate the model by showing that the triadic influence is empirically measurable for static and dynamic observables in this network. However, when we consider opinions on each topic separately from the others, the influence of triadic interactions is indistinguishable from the noise.

SOE 18.3   Thu 16:00   ZEU 260

**Evolution of signed relations due to principles of structural balance and status theories** — •Adam Sulik[1], Piotr J. Górski[1], Georges Andres[2], Giacomo Vaccario[2], and Janusz Hołyst[1] — [1]Faculty of Physics, Warsaw University of Technology — [2]Chair of System Design, ETH Zürich

One of the issues of social science is the analysis of why and how human relationships are formed. The causes of these phenomena are explained by structural balance theory and status theory, among others. Although the structural balance model by Antal et al. is a breakthrough in modeling the formation of social relationship structures, but by the diverse nature of positive and negative relationships in real-world social networks, it is unable to capture a complete picture of the relationships between users of different online communities. In addition to stability as understood by Heider's hypothesis, which is contained in structural balance theory, dynamics based on social status should also be taken into account.

We present two new models: an extended model of structural balance on directed networks and a model combining dynamics of structural balance and status theories. Presented numerical simulation results are consistent with analytical expectations. The theoretical observations have been verified on real networks, where the effect of status on the relationship between users of the studied websites has been noticed.

SOE 18.4   Thu 16:15   ZEU 260

**Analysing the structure of opinion spaces** — •Eckehard Olbrich[1] and Sven Bansich[2] — [1]Max Planck Institute for Mathematics in the Sciences — [2]Karlsruhe Institute for Technology

Data for understanding opinion dynamics arise in a variety of contexts: from voting patterns and multi-item surveys to hashtags use and users participation in different online groups. Despite their different origins they have a similar mathematical structure: a matrix with rows representing members of a population and columns representing e.g. items of a survey or political issues. Recently various novel methods have been proposed to make sense of correlational patterns in such data in order to identify them with cultural schemata [3] or dimensions of an underlying political space [1]. In this contribution we will compare different such methods including (1) issue bundles [1], (2) latent space models [2] and (3) correlational class analysis [3]. We will discuss their advantages and disadvantages using data sets from a survey on attitudes towards Corona measures and from Swiss public votes.

[1] E. Olbrich, and S. Banisch, The rise of populism and the reconfiguration of the German political space, Frontiers in Big Data 4, 731349 (2021).

[2] F. Gaisbauer, A. Pournaki, S. Banisch, and E. Olbrich, Grounding force-directed network layouts with latent space models. arXiv:2110.11772 (2021).

[3] A. Boutyline, Improving the measurement of shared cultural schemas with correlational class analysis: Theory and method. Sociological Science 4.15 (2017): 353-393.