‘They all look the same to me.’ An agent based simulation of out-group homogeneity.

Ansgar E. Depping
Nathaniel Osgood
Kurt Kreuger
University of Saskatchewan, Department of Computer Science
176 Thorvaldson Bldg, 110 Science Place, Saskatoon, CA

ansgar.depping@usask.ca

Abstract

Group memberships can dramatically affect the way people perceive each other. One of the effects group membership elicits is called out-group homogeneity. It is the tendency to judge members of out-groups as more similar to one another than in-group members. Research on out-group homogeneity faces some challenges that are difficult to overcome in experimental or field settings. We propose that simulation models can help us further understand these principles and test hypotheses that are difficult to test in classical research settings. Our model simulates trust developments using a classic social dilemma based on the prisoner’s dilemma. The patterns that emerge in our model are coherent with what literature would suggest. We also shed some light onto so far unexplored territory such as the longitudinal analysis of trust development in the context of group perceptions. We further discuss limitations and possible future directions.

Keywords: out-group homogeneity, prisoner’s dilemma

1 Background

A large area of social psychology deals with the effects of group membership, with decades of research showing that dividing people into groups dramatically affects social perception and behavior. A commonly researched effect associated with group membership is out-group homogeneity (OGH) [5]. Tajfel & Turner conceptualize it as the asymmetrical accentuation of intragroup similarities in favor of OGH [7]. This means that people judge members of outgroups as more similar to one another than they do members of their in-group. To understand how animosities between groups commence, evolve and persist, out-group biases have been heavily researched [5,7]. However, the research on out-group homogeneity, being mostly limited to experimental and field studies, is facing major difficulties.

First, research on OGH has mostly investigated the relationship between individuals and their attitudes toward out-groups [5]. It is assumed that these biases will affect group interactions on a population level. However, with current research methods the effect OGH has on a societal level remain unclear. Second, while OGH can be observed, it is difficult if not impossible to meaningfully manipulate group perception for research purposes. Presently, researchers cannot experimentally look at group dynamics with OGH 'on' or 'off'. Third, lab experiments or field questionnaires can only ever get a temporary snapshot of how OGH relates to other constructs. What is missing is a longitudinal view at how group perceptions shape inter-group relationships over time. In the present study we propose simulation models as a viable research tool to overcome these challenges.

2 Model Description

2.1 Model scope & architecture

We simulated a population of agents who repeatedly interact. We utilized a classic investment dilemma in which two agents of a population repeatedly 'trade' with each other. In these interactions, the agents can cooperate or compete [2]. We draw from previous literature on trust formation and assume that cooperation is determined by the perceived trustworthiness of the trade partner; agents will only cooperate if they anticipate cooperation from their partner [3,6]. Inter-agent trust is tracked over time.

To introduce the idea of OGH we implemented three features. First, agents are given a group membership, and were randomly assigned to group A or B. Second, each agent has a generalized idea of how trustworthy the out-group is, implementing the belief that out-group members behave similarly. Third, this belief is used to affect future behavior with out-group agents.

Using the simulation program Anylogic, [1] we adopted a simulation model on group interactions [4]. The simulation creates an environment with a population of 100 agents. The agents engage in randomly assigned 'trades' with other agents. Each agent waits on average one unit of time before starting the next trade. The more agent A trusts agent B, the higher the chance that agent A cooperates and vice versa. The perceived trustworthiness of the partner is a value between -100 for complete distrust and 100 for complete trust. The model assumes an inherent tendency towards initial trust; when perceived trustworthiness is at its neutral position of 0, the chance of cooperation is 60%. The agent-to-agent trust matrix, *S*, contains all trust perceptions; agent A's trust value of agent B is S_{ab}, being updated after each trade. If agent B cooperates, A increases S_{ab} by the value of 10 (*trust build*). If B competes, A adjusts S_{ab} by the value of -15 (*trust break*). Trust break is greater than trust build to simulate the assumption that trust builds slowly and breaks easily. In the beginning of each simulation the initial trust values are drawn from a uniform distribution between -50 and 50 ($\mu = 0$), simulating the findings that people make *naïve* assumptions about someone's trustworthiness even without and personal history[6].

Simulating out-group homogeneity. The first step to conceptualizing OGH in trust-requiring interactions is to assign groups. The population was split into two equal groups. The second step was to make agents aware of group membership and have them consider group membership into their decision process. Specifically we want to implement the heuristic of out-group homogeneity in the decision process. Given that agents A and B are in different groups and they engage in a trade, in addition to the inter-individual trust between agent A for B (S_{ab}), agent A also includes the average experience they had with every member of agent B's group (*Group perception,* G_{ab}). Including the average trust towards a group when deciding how to interact with a specific group member represents the assumption that agent B will behave like other agents from their group. How heavily the group perception weighs into the decision process is determined by the value *groupSalience* (ranging between 0 and 1). The overall perceived trustworthiness (T) can be represented as:

$$T = (1 - groupSalience) * S_{ab} + groupSalience * G_{ab}$$

3 Experimental Runs

The simulation ran multiple times with different values for *groupSalience*. For each parameterization, 20 replications were run. Each realization ran for 500,000 time steps.

As an indicator for intergroup trust, we measured the ratio of trusting relationships (trust > 0) between groups over all relationships between groups. The positive relationship score (*PR*) is this ratio, where a value of 1 means every between-group-relationship is positive and 0 meaning every between-group-relationship is negative.

We also present a visual representation of *S*, with the columns representing the trusters, and the rows the trustees. The possible range of values from -100 to 100 is represented by the scale form black (distrust) to white (trust).

3.1 A world without out-group homogeneity

Figure 1a shows the S matrix when groupSalience is 0. All agents make trust decisions purely on their individual trade history with their partner. The example shows that roughly half of squares are full white and the other half are full black. There are no grey cells. This is coherent with the self-reinforcing nature of trust observed in literature [6]. Positive experiences increase the chance for cooperative behavior in the future and vice versa. Over the course of these prolonged relationships, trust develops into either full trust or full distrust.

a) b)

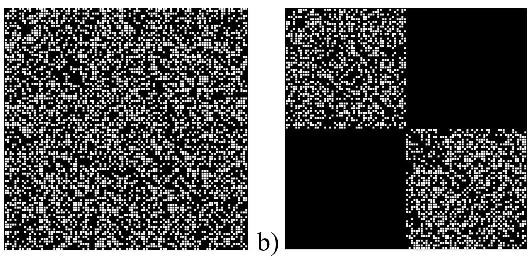

Fig. 1. a) S-matrix with groupSalience = 0 (Group A: agents 1-50, Group B: agents 51-100). b) S-matrix with groupSalience = 0.5. (Group A: agents 1-50, Group B: agents 51-100)

3.2 Introducing out-group homogeneity.

Figure 1b shows a matrix for a realization with groupSalience at 0.5 (50%). All agents perceive every outgroup-agent as completely untrustworthy. The perception of in-group members remains the same. To get a closer look at the effect of OGH on trust formation we present the PR values over time given different groupSalience values (see Figure 2). We ran our model, varying the groupSalience in 5% iterations from 50% down to 10%. Each scenario was run 20 times. The scores were averaged. The chart shows how quickly the PR ratio drops depending on the groupSalience. The decline towards complete distrust between the groups strongly depends on group salience.

Due to the longitudinal view on intergroup relations we can also observe how the decline towards group animosity is not linear but rather exponential with a strong decline in the beginning of our simulations. The tilt towards distrust is especially strong in the beginning of the simulation in the absence of any personal history where decisions are only informed by a generalized group perception. The stronger this group perception weighs in, the stronger the initial burst of distrust. Intergroup relations appear to be especially vulnerable to OGH effects in early interactions.

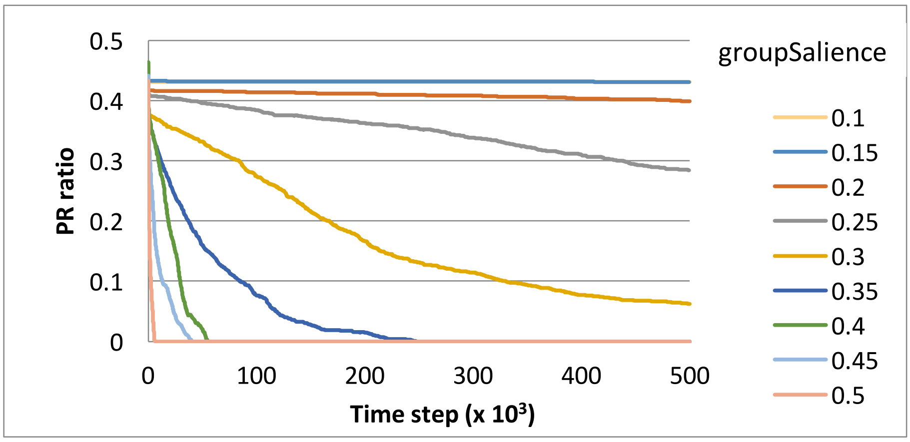

Fig. 2. PR scores over time for different groupSalience values.

4 Discussion and conclusion

We demonstrated a simple individual behavioral feature that leads to the emergence of a population-wide phenomenon widely seen in human populations. We were able to address some of the challenges face by traditional research methods on OGH. By giving agents only the expectation that out-group members will behave similarly, we have drastically changed population-wide dynamics with mostly devastating effects on group segregation and intergroup trust. We experimentally varied the salience of OGH resulting in expected differences in outcomes. Our approach also revealed a nonlinear development of intergroup relations indicating a sensitivity towards OGH in the absence of personal history.

Our work has some obvious limitations, the most obvious of which are the simplifying assumptions made. Notably our model does not include other well documented stereotyping mechanisms such as in-group favoritism. Similarly, we assume group perception to be based solely on personal experience, avoiding descriptions of human cultural values. Both points can be further investigated in variations of the present model. Secondly, while the model behavior matches qualitatively the behavior of human populations, it is too stylized to be able to validate against real human data. Nonetheless, the insights gleaned from this work could direct future human studies. We do not argue simulation models to be a superior method, but rather a complementary, even synergistic, strategy to understand complex social phenomena. Effects predicted in simulation models need to be corroborated by data, generated perhaps from field studies.

4 References

1. AnyLogic Software, version 7.0.1, Available at http://www.anylogic.com.
2. Axelrod, R. (1987). The evolution of strategies in the iterated prisoner's dilemma. *The dynamics of norms*, 1-16.
3. Dirks, K. T., & Ferrin, D. L. (2001). The role of trust in organizational settings. *Organization science*, *12*(4), 450-467.
4. Esfahbod, B., Kreuger, K., & Osgood, N. (2015, March). Gaming the Social System: A Game Theoretic Examination of Social Influence in Risk Behaviour. In *International Conference on Social Computing, Behavioral-Cultural Modeling, and Prediction* (pp. 296-301). Springer International Publishing.
5. Ostrom, T. M., & Sedikides, C. (1992). Out-group homogeneity effects in natural and minimal groups. *Psychological Bulletin*, *112*(3), 536.
6. Rusman, E., Van Bruggen, J., Sloep, P., & Koper, R. (2010). Fostering trust in virtual project teams: Towards a design framework grounded in a Trust-Worthiness Antecedents (TWAN) schema. *International Journal of Human-Computer Studies*, *68*(11), 834-850.
7. Tajfel, H., & Turner, J. C. (2004). The Social Identity Theory of Intergroup Behavior.