Evolution and Human Behavior 36 (2015) 211–217

Contents lists available at ScienceDirect

Evolution and Human Behavior

journal homepage: www.ehbonline.org

Original Article

The joint emergence of group competition and within-group cooperation

Mikael Puurtinen [a,b,*], Stephen Heap [a,b], Tapio Mappes [b]

[a] Centre of Excellence in Biological Interactions, University of Jyväskylä, Finland
[b] Department of Biological and Environmental Science, University of Jyväskylä, Finland

ARTICLE INFO

Article history:
Initial receipt 15 April 2014
Final revision received 5 November 2014

Keywords:
Between-group competition
Coalitionary aggression
Human cooperation
Parochialism

ABSTRACT

Between-group conflict and within-group cooperation can be seen as two sides of the same coin, coevolving in a group-structured population. There is strong support for between-group competition facilitating the evolution of human cooperative tendencies, yet our understanding of how competition arises is less clear. We show that groups of randomly assembled individuals spontaneously engage in costly group competition, and that decisions promoting between-group conflict are associated with high levels of within-group cooperation. Remarkably, when groups were given the possibility to compete against other groups, net earnings for individuals were higher than when groups were not allowed to interact. The joint emergence of conflict and cooperation along even weakly defined group boundaries, and the apparent benefits of this strategy, suggest the existence of behavioral biases influencing human social behavior and organization.

1. Introduction

Extensive cooperation among unrelated individuals, as displayed by humans, presents an evolutionary puzzle. Beginning with Darwin, scientists have proposed that aggressive between-group competition is a critical component of human social organization that has been instrumental in shaping cooperative tendencies (Alexander, 1979, 1990, 2006; Boyd & Richerson, 2009; Darwin, 1871; Flinn, Geary, & Ward, 2005; Gat, 2006; Hamilton, 1975; Henrich, 2004). Support for this hypothesis comes from studies showing that violent intergroup conflicts have been frequent and severe enough in primitive human societies to have favored the evolution of individually costly traits that increase a group's success in conflict (Bowles, 2009). Furthermore, experimental studies consistently report that interactions between groups tend to be more competitive than interactions between individuals, a phenomenon known as interindividual–intergroup discontinuity (Wildschut & Insko, 2007). This discontinuity has been reported to extend to aggressive behavior (Meier & Hinsz, 2004). However, the reasons why group-against-group aggression is so common in humans, and rare in other animals, are not well understood (Gat, 2009).

Coalitionary aggression, as displayed by humans, is not simply the sum of individual aggression, but a complicated game of coordination and cooperation along group boundaries. Hence, coalitional aggression may place strong adaptive demands on individuals to acquire and process social information that allows them to make effective decisions (Tooby & Cosmides, 1988). In this respect, empirical evidence suggests that humans possess flexible responses to problems of within-group cohesion and between-group aggression. Specifically, individuals typically treat other groups as benign unless they pose sufficient threat to resources or cultural institutions, at which point individuals are willing to promote inter-group hostilities (Halevy, Bornstein, & Sagiv, 2008; Riek, Mania, & Gaertner, 2006; Sherif, Harvey, White, Hood, & Sherif, 1988) Furthermore, individuals cooperate more with group members under conditions of inter-group competition compared to when competition is absent (Bornstein, Erev, & Rosen, 1990; Burton-Chellew, Ross-Gillespie, & West, 2010; Egas, Kats, van der Sar, Reuben, & Sabelis, 2013; Puurtinen & Mappes, 2009).

Importantly, recent theoretical studies suggest that intergroup hostility and within-group cooperation can select for one another, with hostility spawning direct conflict between groups, and within-group cooperation increasing the group's success in conflicts (Choi & Bowles, 2007; Garcia & van den Bergh, 2011; Lehmann, 2011; Lehmann & Feldman, 2008). That is to say, we can expect that the expression of either within-group cooperation or between-group hostility to facilitate the expression of the other. However, research shows that the two are not necessarily expressed together (Brewer, 1999; Cashdan, 2001; Koopmans & Rebers, 2009; Pan & Houser, 2013). Thus, whilst the two behaviors can be fundamentally linked in an evolutionary sense, individuals appear to show a nuanced response to their social situation that does not take the connection for granted. It is thus clear that there is much left to understand about the links and feedbacks between individual decisions and the emergence of hostile between-group interactions.

The complexity involved in social strategies and intergroup interactions imply that individuals may possess an information-processing system capable of motivating beneficial responses to the social environment. One critical aspect of the social environment that could influence decisions about within-group cooperation and between-group aggression is the variability of cooperation within and between groups. In particular, individually costly group-beneficial behaviors are expected to be

* Corresponding author. Department of Biological and Environmental Science, PO Box 35, 40014 University of Jyväskylä, Finland.
E-mail address: mikael.puurtinen@jyu.fi (M. Puurtinen).

http://dx.doi.org/10.1016/j.evolhumbehav.2014.11.005
1090-5138/

selected for when within-group variability in cooperativeness is low and between-group variability is high (Okasha, 2006; Price, 1972). It is thus possible that individually costly cooperation and aggression can be influenced by observed levels of variation in cooperativeness within and between groups.

We designed a decision-making experiment that involves choices of both between-group interaction and within-group cooperation. More specifically, we wanted to test i) if individuals decide to promote between-group competition even when competition is costly, ii) if promotion of between-group competition is associated with high level of within-group cooperation, iii) what the consequences of endogenously determined group interactions are on individual and collective welfare, and iv) whether individual changes in behavior are correlated with levels of within- and between-group variability in cooperation. The experiment was designed to limit any influence of reciprocity, reputation, costly signaling or coercion as an attempt to unravel the behavioral biases that may drive the dynamics of social interactions even in a situation of limited information.

2. Material and methods

2.1. General experimental procedures

Subjects to the study were recruited from all faculties in the University of Jyväskylä with emails sent to student mailing lists, announcing a study involving playing a game on a computer and a chance to earn money. The game sessions were held in two computer classrooms with 12 computers. Each computer was in a separate cubicle with a cloth covering the entrance. The subjects received instructions to the game on a sheet of paper (English translations of the original instructions in Supplementary Material, available on the journal's website at www.ehbonline.org).

After everyone had read the instructions, the subjects were asked to put on earmuffs to exclude any auditory disturbance, and the experimenter started the computer software. The software first presented a series of questions to make sure that everyone understood the structure of the game. After all the subjects in the session had correctly answered all questions, the game started and ran automatically until the last round. After the last round, the experimenter handed out a questionnaire asking some background information about the subjects (age, sex, etc.), and about motivations for their decisions in the game. After subjects had filled in the questionnaire, they were individually excused and paid in cash the amount of Euros corresponding to their earnings in the whole game session.

2.2. Experimental treatments

We conducted public goods experiments with two treatment conditions. In the Public Goods (PG) treatment, subjects played the basic public goods game with changing group composition between rounds. In the Public Goods with Choice (PGwC) treatment, subjects played a similar public goods game, but also decided how groups divide their earnings. We executed four sessions of the PG treatment and six session of PGwC treatment. Each session had 24 subjects, so altogether 240 subjects participated in the study. Sessions consisted of 30 game rounds. In each round, subjects interacted in groups of four. Between each round, the subjects were randomly reallocated to new groups.

In the PG treatment, each subject received an endowment of 20 money units (MUs) in the beginning of the round. The subjects then decided how to allocate the endowment between a private account and a group project. Each subject made the allocation decision independently, without knowing the decisions of other subjects. After all subjects had made their decision, the total amount of MUs allocated to the group project was doubled by the experimenter and divided equally among the four group members. Subjects were then informed about the allocations and resulting pay-offs of all group members. Following this, the subjects were presented with a comparison of the total amount of MUs allocated to the group project between their own group and another, randomly chosen group. The comparison had no monetary consequences, but previous research has shown that mere comparison between groups elicits higher levels of cooperation (Böhm & Rockenbach, 2013; Burton-Chellew & West, 2012). By incorporating between-group comparisons to both treatments, we control for the group comparison effect. The comparison between groups ended the game round in the PG treatment. The pay-off structure of the PG treatment is a social dilemma where allocating 1 MU to the group project returns 0.5 MUs; thus it is in the material self-interest of any subject to keep all MUs privately, irrespective of how much the other three subjects contributed. Yet, individuals will only earn 20 MUs if all group members keep their MUs privately, whereas individuals can earn $(20 \times 4 \times 2)/4 = 40$ MUs if each group member allocates their 20 MUs to the group project.

The PGwC treatment was similar to the PG treatment, except that subjects made a choice between three options for desired interaction with a randomly chosen out-group: 'separate', 'competition', or 'equal division'. In 'separate', like in the PG treatment, groups would be compared with no monetary consequences. In 'competition', the more cooperative group would win money from the less cooperative group. In 'equal division', earnings would be divided equally between groups, with the more cooperative group giving money to the less cooperative group. 'Equal division' can be seen as a benign complementary option to 'competition'. The exact pay-off of consequences of group interaction types are described in more detail below. The decision about the group interaction type was made simultaneously with the decision on allocating the endowment, and without knowing the decisions of other subjects.

The group decision of the interaction type was determined by simple majority voting, or in case of a tie, by random draw between the tied choices. After all subjects in a group had made their choices, the total allocations to the group project were doubled by the experimenter and divided equally among the four group members. The subjects were then informed about the choices and pay-offs of their group members, and about the interaction type decided by the group. Following this, the groups were paired randomly for interaction, and the type of interaction was determined by the decisions of the paired groups. If both groups had chosen the same interaction type, that interaction was implemented. If the groups had chosen different interaction types, 'competition' dominated over 'separate' and 'equal division', and 'separate' dominated over 'equal division'. This dominance hierarchy was chosen as it mirrors a natural hierarchy of interactions; aggressive interaction requires only one aggressive party, but generosity between parties requires that both parties agree to be generous.

The pay-off consequences of the group interaction types were as follows: In 'separate', the groups were compared with no consequences to the pay-offs. In 'equal division', the total earnings between the two groups were leveled. Each member of the group that had earned more lost an equivalent of one-eighth of the difference in the total investments of the groups, and each member of the group that that had earned less gained an equal amount of MUs. After 'equal division', the average earnings between groups were thus equal, but pay-off differences within groups were not altered. In 'competition', each member of the group that had earned more gained an equivalent of one-half of the difference in the total investments of the groups, and each member of the group that that had earned less lost an equal amount of MUs. Negative earnings were not allowed. In case some group member did not have enough tokens to cover the losses, other members of the group covered the losses the player was not able to pay. If total losses exceeded total earnings of the group, the group lost all tokens earned during the game round. The winning group could win only as many tokens as the losing group held. Additionally, when competition was implemented, 1 MU was deducted from all subjects in both groups as a cost of group competition (no deduction was made for subjects holding zero tokens). The cost of group competition signifies the costs involved with