CALIFORNIA STATE SCIENCE FAIR
2010 PROJECT SUMMARY

Name(s)
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Project Number
S1619

Project Title
Computer Modeling of Altruistic Punishment and the Fitness of Cooperative Behavior

Abstract

Objectives/Goals
The purpose of this project was to develop a program in Java to investigate altruistic punishment and its effect on the fitness of cooperative behavior, where altruistic punishment refers to the punishment of non-cooperators, or defectors, at the expense of the punisher. It was believed that the use of altruistic punishment by the cooperators on defectors would significantly increase the relative fitness of the cooperators and encourage greater cooperation overall.

Methods/Materials
The Java program was developed on a computer using the Eclipse integrated development environment, an open source development platform. In the computer model, the simulated individuals played a series of games, the word "games" being in the mathematical, game-theoretic sense. The decisions of the individuals were dictated by pre-programmed logic. In the simulation, players were each given the same amount of "points" (standing for fitness), of which they could "contribute" some to their group or keep some for themselves. Next, only in the version of the game with punishment, players had the opportunity to individually "punish" other members of the group, based on how much they contributed. Fitness was determined by the number of points an individual had at the end of the simulation, and these values were compared between the cooperators and defectors. Besides the ability to punish, a secondary factor tested was the ratio of the number of cooperators to the number of defectors in the population.

Results
In all cases without punishment, the cooperators earned 20 to 25% less than the defectors. With punishment and equal numbers of cooperators and defectors, the cooperators averaged with 2.3% more than the defectors; with punishment and a population of 75% defectors, the cooperators averaged 21.62% less; and finally, with punishment and a population of 75% cooperators, the cooperators averaged 28.2% more.

Conclusions/Discussion
The original hypothesis was supported; in this computer simulation, the use of altruistic punishment greatly increased the relative fitness of the cooperators. With altruistic punishment present, cooperation may be a stable strategy.

Summary Statement
This project used a computer simulation to investigate altruistic punishment and its effect on the fitness of cooperative behavior.

Help Received
My parents helped me get started in learning Java and producing a program like this.