

Executing Complex Cognitive Tasks: Prizes vs. Markets

Peter Bossaerts*

Jernej Čopic†

Debrah Meloso‡

March 11, 2006

*California Institute of Technology and CEPR

†California Institute of Technology

‡California Institute of Technology. Corresponding author Debrah Meloso, debrah@caltech.edu. The authors are very grateful to Colin Camerer and John Ledyard for helpful comments, as well as participants of the Social and Information Science Laboratory (SISL) Workshop 2005. The study was sponsored under NSF Grant #SES 0317715.

In an experimental environment, we address the issue of solving complex problems in a social context. How does the institutional setup of social interactions foster the intellectual discovery of a group of agents? Traditional economic theories have addressed this question from two perspectives. Intellectual discovery literature has dealt with individual incentives for discovery when discovery is modeled as a production function. The theoretical prediction is that the optimal institution is one where the first agent to make the discovery receives a large prize. The literature on information aggregation has addressed the question of when will information, which is dispersed among agents, be aggregated. When information acquisition is costly, no agent will have an incentive to acquire information, since in the ensuing market for information, no trade will take place. Thus, no intellectual discovery should ever take place in a market context. We argue that information aggregation or investment of effort in a production function are fundamentally different from problem solving and intellectual discovery. Being made through a cognitive process, the discovery of a solution to a complex problem is affected by how such process is learned and changed in a social interaction.¹

In our experimental setup we consider two institutional scenarios where a group of participants face the same problem and possibly a reward for solving it. They face several instances of the *knapsack problem*, which is an NP-complete problem. In the *Prize* setup, the first participant to solve the problem receives a large prize. In the *Market* setup, there is a market where participants can trade securities with payoffs that depend on the solution to the problem. The reward for finding the solution comes exclusively from trading. We find that, with one exception, the correct solution is always recovered. Generally, *more* participants find the correct solution in the Market setup than in the Prize setup. In the Market setup, trading is heavy, and offer and transaction prices are informative of the correct solution.

Thus, our experimental findings are inconsistent with the theoretical predictions in the Economics literature. Instead, they confirm related results in experimental psychology. Maciejovsky and Budescu [2005] report that groups are better at solving complex

¹Recent work by Aragonés et al. [2005] argues that *learning* can be represented as the problem of finding an optimal regression, given a dependent variable and a set of explanatory variables. This problem is NP-complete (like the knapsack problem used in our work), which allows for “fact-free” learning. In other words, this work makes explicit the difference between information gathering and intellectual discovery or learning. They do not put this in a social context. We show that this difference *is relevant* in interactions.

problems than individuals, regardless of whether the interaction between individuals is cooperative or not. Moreover, groups made up exclusively of individuals that had failed to solve the problems on their own, manage to find the solution when together.

References

- Enriqueta Aragoes, Itzhak Gilboa, Andrew Postlewaite, and David Schmeidler. Fact-free learning. *The American Economic Review*, 95(5):1355–1368, 2005.
- Boris Maciejovsky and David Budescu. Is cooperation necessary? learning and knowledge transfer in cooperative groups and competitive auctions. 2005.