

Children's academic performance and reciprocity in an experimentally elicited collaboration network

Keywords: Experimental game theory - Peer interaction - Collaboration networks – Reciprocity - Non-anonymous social dilemma

Extended Abstract

Does reciprocity foster academic performance in elementary school? If so, to which extent? A large corpus of literature has reported significant associations between social relationships and academic performance (Kassarnig et al., 2018; Berthelon, 2019). Yet, we still lack a complete understanding of the types and conditions of social relationships that facilitate learning outcomes among children. In our work, we run a game-theoretic experiment implemented through a friendly video game in 14 primary schools in Chile. Thereby, we mapped the cooperation patterns of 855 students with all their peers. In a non-anonymous social dilemma. Students simultaneously choose how many tokens to send to their counterparts in each peer interaction (see Figure 1).

Individual-level reciprocity is operationalized as the average peer-reciprocity for each student (Squartini et al., 2013). Then, we show that reciprocity helps to improve academic performance using fixed effects regression models and a difference-in-difference identification strategy. Indeed, the size effect of average reciprocity is 117% of the average academic performance change between the first and the second semester analyzed. We note that this result considers the impact of confounder variables such as students' attendance, social ranking, individual average sent cooperation, guardian's education, sex, and previous academic performance.

Our findings can inform the design of collaborative learning interventions for primary school students and help adjust the expectations of reciprocity interventions beyond individual features. We believe that these results are relevant to the journal's scope and will interest its readership. From a methodological standpoint, our findings provide new opportunities for the application of game-theoretical and network-based methods to harness relational information in primary education while avoiding conventional survey instrument biases. We propose a measure of the individual's social capital, which is directly represented in the connections between students and indirectly by the configuration of the network as a whole.

References

- Berthelon, M., Bettinger, E., Kruger, D. I., & Montecinos-Pearce, A. (2019). The structure of peers: The impact of peer networks on academic achievement. *Research in Higher Education*, 60, 931-959.
- Kassarnig, V., Mones, E., Bjerre-Nielsen, A., Sapiezynski, P., Dreyer Lassen, D., & Lehmann, S. (2018). Academic performance and behavioral patterns. *EPJ Data Science*, 7, 1-16.

Squartini, T., Picciolo, F., Ruzzenenti, F., & Garlaschelli, D. (2013). Reciprocity of weighted networks. Scientific reports, 3(1), 2729.

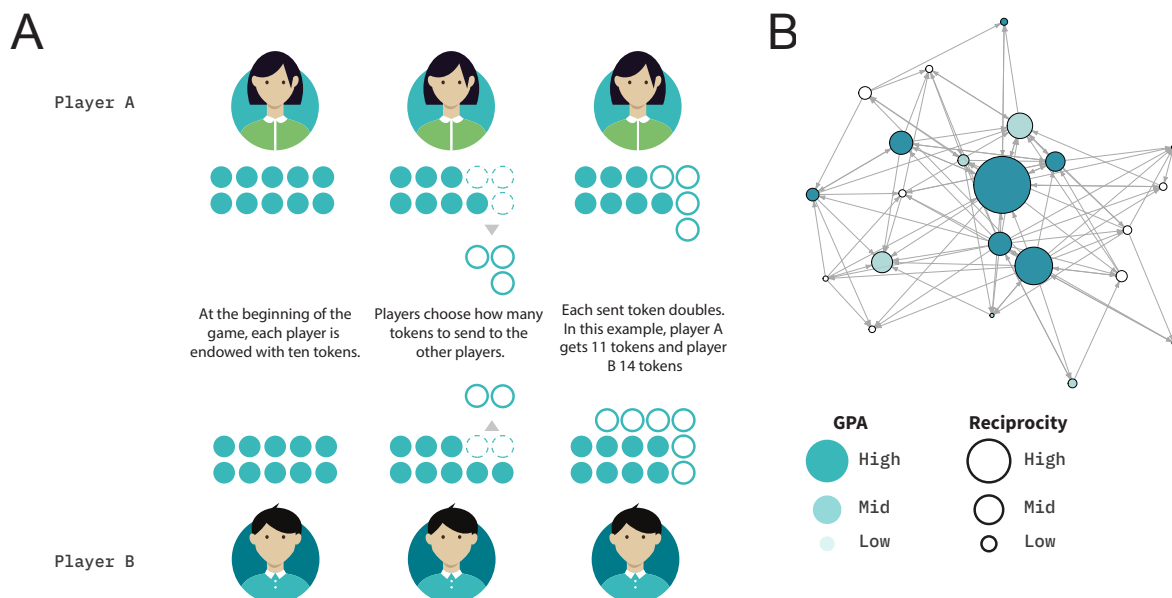


Figure 1. A) Experimental game. Students play a social dilemma; an example of a dyadic interaction: (i) both players are endowed with ten tokens. (ii) Simultaneously, player A sends three tokens, and player B sends two tokens. (iii) After sent tokens are doubled, Player A receives four tokens, and player B receives six tokens. (B) Visual correlation pattern between GPA and Reciprocity. The figure shows a student interaction network for a single class group using observed behaviors in the game. Each node represents one student, and the directed edges connecting them represent fully cooperative interactions in which at least one individual sent ten tokens. The node size is proportional to the average reciprocity and colors represent GPA. We observe that the darker the color, the greater the node size suggesting a positive correlation between GPA and reciprocity.