

Successful love stories as differential games

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Abstract

Understanding long-term romantic relationships poses a substantial problem in the social sciences with enormous implications for the well-being of individuals in modern Western societies; see e.g. [2]. In particular, the keys to the proper functioning of stable and happy couples are not well known [1]. The difficulty of the problem depends in part on the fact that large longitudinal data sets of marital quality are scarce and noisy. In [3], a computational differential game model was introduced to synthesize long-term trajectories of stable and happy couples. How the long-term success of real love stories depends on environmental or psychological factors remains essentially unexplained. In this paper, we analyze how successful trajectories depend on the cognitive processing of emotional rewards and costs for both partners in the relationship. Our analysis draws on the differential love game modeling to carefully explore the sensitivity of successful outcomes (optimal control policies, feeling equilibria, and well-being) to the combinations of inputs that represent the cost and rewards of partners. In particular, we show how the degree of heterogamy -i.e. the size of the gap between partner contributions - affects the optimal solution to the problem of the couple.

As a previous step, the statistical analysis allows us to determine a centralized reference trajectory of marital quality, using a longitudinal sample of more than 7000 subjects from 33 countries obtained from survey data [4]. The data sample is used to determine a suitable parameter space so that the reference trajectory can be replicated by calibrating our model. This provides further evidence of the potential of the differential love game model to accurately describe real trajectories.

Furthermore, we show how the feedback policies provided by the model allow us to estimate realistic response times to recover a successful trajectory after external shocks of different sizes and durations.

References

- [1] Paul R. Amato and Spencer L. James. Changes in spousal relationships over the marital life course. *Alwin, Duane F.; Felmler, Diane H.; and Kreager, Derek A. Editors (2018) Social Networks and the Life Course. Integrating the Development of Human Lives and Social Relational Networks*, pages 139–158, 2018.
- [2] Stephanie Coontz. *Marriage, a history*. New York, Viking, 2005.
- [3] Jorge Herrera and José-Manuel Rey. Controlling forever love. *PloS one*, 16(12):e0260529, 2021.

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- [4] Piotr Sorokowski et al. Marital satisfaction, sex, age, marriage duration, religion, number of children, economic status, education, and collectivistic values: Data from 33 countries. *Frontiers in Psychology*, 8, 2017.