Evolutionary games between authors and their editors

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A B S T R A C T

Here we examine the evolution of manuscript quality control between authors and their editors, using evolutionary games. Within these games, with a certain probability, authors prefer to submit manuscripts of low- or high-quality, and editors prefer to accept low- or high-quality manuscripts. The frequency with which authors (editors) choose to submit (accept) high-quality or low-quality manuscripts change over time in response to the decisions made by all authors and editors in the respective populations. Using this dynamical structure, we study which strategies become extinct and which survive, as well as whether the system approaches some stable end-point. We also explore a number of case studies for editors' and authors' beliefs about that the submitted manuscripts must be of quality. When these beliefs are too weak, the stable end-point of the evolution is a situation in which the scientific communication system will be so broken that it should be abandoned. By contrary, when editors' beliefs are strong enough, scholarly communication will be reliable and will give the highest status to scientific research that is likely to be right and useful. In a third case study, when editors' beliefs are not strong enough, the growing gap between the need for quality manuscripts and the quality of the material submitted threatens scientific communication. Computer simulations are used to mimic a real world system of authors and their editors.

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1. Introduction

In scholarly communication, the peer review provides a "system of institutionalized vigilance in the self-regulation of knowledge communities" [8], in which "peer expertise is coordinated to vet the quality and feasibility of submitted work", [7]. In the peer review process, it first checked whether the submitted manuscript is suitable for review. After this initial stage, the editor selects a minimum number of reviewers. The role of referees can vary from journal to journal, but in general, the reviewer will give a recommendation on the quality of the manuscript to the editor. With the reviewers' comments, the editor will make a decision about the manuscript that should be communicated to the author. Probably, in a second stage of the review process, the author will have to implement and answer all the issues raised by the editor in order to improve the original manuscript, [1,2].

In this work, using evolutionary games, we shall study the evolution of quality profiles for authors and their editors at the peer review stage. The author's quality profile can be defined operationally as the probability s_A that the author prefers to submit high-quality manuscripts [5]. This profile represents their preferences to submit articles of high or low quality. Similarly, the editor's quality profile can be defined as the probability s_E that the editor prefers to accept articles of high quality [4]. Here, the Nash equilibrium within evolutionary game theory is used as a metaphor for the problems surrounding the evolution of quality

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Fig. 1. Expected payoffs for the author-editor game, prior to the final disposition by the editor.

profiles at the peer review stage [6,13]. Using a set of experiments, we shall study the asymptotic behavior of this system for various values of the model's parameter.

In an evolutionary game, players are interpreted as populations, in our case we have two different populations: manuscript authors and their editors. Following [5], the actions of the populations are determined by the probabilities of a mixed strategy in a game like the "Author–Editor" game: i.e., the author prefers to submit high or low quality manuscripts; whereas his or her editor prefers to accept high or low quality manuscripts (see Fig. 1). The author–editor game, which was presented in [5], is a formal model of peer review in which the players of the game are a manuscript author and his or her editor, while the model is intended to capture the interaction between them.

Individuals on the same side of the population, authors (editors), play the same strategy, in our case, submit (accept) high- or low-quality manuscripts. A solution to this game is to find an evolutionarily stable strategy [3,9]. There, a state of equilibrium will be that which gets the same payment for all pure strategies.

In evolutionary games, the payment given to a strategy coincides with the growth rate of individuals who play such a strategy [13]. So the higher the payment of a strategy, the higher the growth rate of individuals who play that strategy, and consequently, a greater number of individuals will be playing this same strategy in the next generation [6]. We say that an undisturbed equilibrium state must persist because all strategies are equally perpetuated in future generations. However, in real situations, equilibrium states are almost always disturbed by variations. In this sense we are interested in such equilibrium states that even though the system is disturbed, it returns to equilibrium. In this case, the equilibrium state is said to be stable [6,10,11].

Section 2 presents an evolutionary game in which successful strategies for authors and editors are rewarded by high reproductive rates, and therefore, they will be more likely to participate in subsequent playings of the author–editor game. This section also shows the dynamics of the author–editor game over time. Using this dynamical structure, we can ask which strategies become extinct and which survive, as well as whether the system approaches some stable equilibrium.

Next, Section 3 studies the evolution of the author–editor game (as given in [5]) over time toward some stable state such as the evolutionarily stable strategy. There, authors and their editors are decision makers. The frequency with which they choose one strategy can change over time in response to the decisions made by all authors and editors in the respective populations. The interpretation of this evolution is that the populations change because authors and editors play the author–editor game many times and consciously switch their strategies, [12]. The interesting point is to know what are the endpoints of this evolution. Section 3 studies one type of evolutionary end-point which is called the evolutionarily stable strategy [3]. This section explores a number of case studies for editors' and authors' beliefs about that submitted manuscripts must be of high-quality.

In Section 4, computer simulations are used to mimic a real world system of authors and their editors. There, we conduct a number of computer experiments using the same scenario for the author–editor game, with the actions of authors (editors) being to submit (accept) manuscripts of high or low quality. Section 5 concludes by suggesting some implications of our analysis.

2. The dynamics of the author–editor game

Garcia et al. [5] presented a formal study on manuscript quality control in peer review. Within this analysis, a biased editor was defined operationally as an editor that exerts a higher (or lower) level of quality control. If the editor is more biased than the manuscript's author, the author undertakes the type of revision that the editor prefers instead of following his or her own opinion. Garcia et al. [5] showed that the effects of editors' bias on authors' satisfaction and motivation cause sorting in the authors who submit manuscripts to scholarly journals, and therefore, match authors and journals with similar quality standards.

2.1. The author–editor game

Drawing in Game Theory, Garcia et al. [5] introduced the "author–editor" game. This game is a formal model intended to capture the interaction between authors and their editors at the peer review stage.

In the author–editor game, the author chooses the manuscript type (HQ-type or LQ-type) which he or she will submit for consideration to be published in a scholarly journal. The HQ-type denotes a high-quality manuscript, whereas the LQ-type denotes a low-quality manuscript. Thus, the author prefers to submit high or low quality manuscripts. When the author submits