



How to motivate a reviewer with a present bias to work harder

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ABSTRACT

Reviewers with a present bias focus on the here and now, placing more importance on immediate rewards than on future intentions and benefits. In this paper, we are going to address two related research questions: First, can a reviewer's motivation to work hard be increased by using a higher evaluation goal? Second, would a reviewer be more willing to accept a higher evaluation goal if the review process provided a large enough reward? Using a formal model, we predict that a reviewer with a present bias increases their motivation to work hard by setting a higher goal for the manuscript evaluation (relative to having no goal). For example, the reviewer is willing to control the quality of the manuscript, in addition to helping the profession and keeping themselves up to date. However, a reviewer with a severe present bias prefers to exert a low level of effort. In this situation, we find that monetary incentives can play an important role for reviewers. In their absence, a reviewer may not accept the evaluation goal that motivates them to work hard in the peer review process. In this paper, using a series of computational experiments, we discuss the behavior of a reviewer with a present bias and the role of goal intentions and additional instrumental gains.

1. Introduction

Peer review plays a fundamental role in scholarly communication. However, reviewers must provide suggestions for revisions, identify additional work required for consideration, and make comments that would improve the quality of the manuscript. Therefore, most journal editors know how much effort it takes to persuade busy researchers to review a paper.

As discussed in (Seeber, M., & Bacchelli, A., 2017), scholars have begun exploring how different peer review models can affect its quality and outcome. For example, testing the effects of incorporating monetary rewards for reviewers (Squazzoni F, Bravo G, Takács K., 2013) and variations in the number of reviewers (Bianchi, F., & Squazzoni, F., 2015).

Although a few publishers offer rewards for the peer review activity, peer review is typically carried out by academics for free (Copiello S., 2018). Regarding whether or not reviewers should be paid for their work, (Pitsoulis, A., & Schnellenbach, J., 2012) argued that the incentives of both authors and reviewers to fully exploit a manuscript's potential depend on their property rights. Furthermore, (Garcia, J.A., Rodriguez-Sanchez, R.M., Fdez-Valdivia, J., 2022b) presented a comparative study between the cross-subsidy and buy-one-give-one models of compensated peer review. They found that a buy-one-give-one scenario provides a higher total sum of financial and social gain than the cross-subsidy scenario either when the mission-driven journals are highly socially responsible or

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when the social gap between the high-income and the low-income authors is large enough.

Peer review is also in the spotlight because of other issues or alleged shortcomings (Bornmann, L., 2011; Lee, Sugimoto, Zhang, & Cronin, 2013; Nicholas, D. et al., 2015; Squazzoni, F., Brezis, E., & Marušić, A., 2017; Jirschitzka, J., Oeberst, A., Göllner, R., et al., 2017; Sandström U., Hällsten M., 2008). Even worse, (Bohannon, J., 2013; Casnici, N., Grimaldo, F., Gilbert, N., & Squazzoni, F., 2017) exposed doubts about the rigor and quality of the peer review system. As suggested in (Ackerman, D.S., Gross, B.L., 2007; Hall, N.C., Lee, S.Y., Rahimi, S., 2019; Nguyen, B., Steel, P., Ferrari, J.R., 2013), reviewers may procrastinate “because issues such as exhaustion and anxiety outweigh their self-control and motivation”. Fear of failure, lack of motivation, and a challenging work environment seem to be the common causes of procrastination in the workplace. Furthermore, (Ackerman, D.S., Gross, B.L., 2007) found that individual faculty members may choose to purposely delay some tasks (e.g., to complete a reviewer report), especially if they are considered of lesser importance. They suggested that “given that every faculty member is faced with finite time, purposely delaying some tasks can allow the faculty member to elevate more valued projects and prevent the procrastination of those projects of highest personal and professional priority”. In this scenario, reviewer procrastination can lead to reduced scientific quality in scholarly publishing.

This brings us to our research questions: (i) Can a reviewer’s motivation to work hard be increased by using a higher evaluation goal? (ii) Would a reviewer be more willing to accept a higher evaluation goal if the review process provided a large enough reward (monetary and/or non-monetary)? In order to answer these questions, our approach will be to develop a theoretical model of the reviewer with a present bias. Using this mathematical model, we will study the role of goal intentions with respect to manuscript evaluation. Then, also using this formal model, we will analyze the role of financial compensation for a reviewer with a severe present bias. In this article, using a series of computational experiments, we will discuss the behavior of a reviewer with a present bias, and the role of goal intentions and additional instrumental gains (e.g., monetary incentives). Therefore, our analysis is in line with (Thompson, G. D., Aradhyula, S. V., Frisvold, G., Frisvold, R., 2010; Koch, A.K., Nafziger, J., 2011; Chetty, R., Saez, E., Sandor, L., 2014; Zaharie, M. A., Seeber, M., 2018; Garcia, J.A., Rodriguez-Sanchez, R.M., Fdez-Valdivia, J., 2022a; Garcia, J.A., Rodriguez-Sanchez, R.M., Fdez-Valdivia, J., 2022b).

However, what can the formal model tell us and what does type of knowledge can it contribute with? Why not conduct an empirical study instead? Our formal method will allow us to model a complex system of the peer review process as a mathematical entity. By building a mathematically rigorous model of a complex peer review system, we will be able to verify the properties of the system more completely (than we could using empirical testing). Furthermore, our formal model helps disambiguate the system specifications and articulate implicit assumptions. This theoretical model can also uncover errors in the requirements of our complex system in peer review, while its rigorous specification allows for a better understanding of the peer review problem. Additionally, researchers in the field can verify our system specifications independently using formal language.

However, our theoretical methodology cannot completely replace the standard methods of the scientometric field. That is why our formal model is only a complementary technique in system design. Therefore, the purpose of developing such a formal model is: (1) to obtain theoretical predictions about how a reviewer’s goal intentions and monetary incentives can serve as an instrument to increase the reviewer’s motivation to work hard; (2) to create a survey questionnaire (for conducting an empirical study) in which the most relevant questions arise directly from the theoretical predictions of the formal model (e.g., see (Rodriguez-Sanchez, R.M., Montero-Parodi, J.J., Garcia, J.A., Fdez-Valdivia, J., 2023) for further details); (3) to use the mathematical predictions to create different ways of managing the review process; and (4) to develop a multi-agent simulation to create new incentives (monetary and/or non-monetary) for reviewers (for example, following the approach in (Bianchi F, Grimaldo F, Bravo G, Squazzoni F., 2018)).

As shown in the following sections of our article, a formal method takes a three-step approach to modeling a complex system as in our problem: (i) the desired system is specified using mathematical syntax and semantics that eliminate imprecision and ambiguity; (ii) using this specification, a set of formal propositions about the system’s behavior are developed and verified by mathematical proofs, which ensures that the system’s behavior is logically consistent; and (iii) the system specification is finally implemented in code to perform a series of computational experiments.

2. Related works

2.1. Academic procrastination

(Schraw, G., Wadkins, T., Olafson, L., 2007) defined procrastination as the practice of putting off impending tasks to a later time even when it can result in counterproductive and needless delay. The term “academic procrastination” generally refers to the procrastination of people involved in academic life and, in particular, of faculty members. They are affected by several factors such as perceived difficulty of tasks (e.g., a complex peer-review process), clarity about how to proceed, or competing deadlines (Ackerman, D. S., Gross, B.L., 2007). In this situation, faculty may overvalue immediate rewards over future benefits and intentions (Hall, N.C., Lee, S. Y., Rahimi, S., 2019). (O’Donoghue, T., Rabin, M., 1999) called such tendencies “present-biased preferences”.

For example, a faculty member thinks they are going to need to work hard on a review that they intend to do for the following week. But when the time comes to do the review, the costs of the hard work are too immediate and seem to outweigh the potential future gains, so the reviewer decides to delay reviewing the manuscript until a later time. In this situation, procrastination mostly occurs when actions are followed by immediate costs (e.g., writing a reviewer report). However, when actions are instead followed by immediate rewards (e.g., securing peer-reviewed grants), the faculty tend to perform their tasks faster in order to get the reward (Ackerman, D.S., Gross, B.L., 2007). An example of this type of procrastination would be a professor who unnecessarily puts off completing a reviewer’s report with a close deadline.

Academic procrastination has been shown to be an issue among university faculty across many studies (Ackerman, D.S., Gross, B.L.,

2007; Hall, N.C., Lee, S.Y., Rahimi, S., 2019; Blix, A.G., Cruise, R.J., Mitchell, B.M., Blix, G.G., 1994; Boice, R., 1989). For example, (Hall, N.C., Lee, S.Y., Rahimi, S., 2019) evaluated “faculty perceptions of self-efficacy, procrastination, and burnout (emotional exhaustion) to provide an in-depth analysis of hypothesized relations between these variables with respect to valence, magnitude, as well as causality”. Many articles on career development found that faculty members procrastinate on assignments without immediate deadlines as they can easily be postponed (Boice, R., 2000; Hall, D.E., 2002; Lang, J.M., 2005; Lucas, C.J., Murry, J.W., Jr., 2002).

Procrastination by academic professionals can also be understood as procrastination in the workplace. (Nguyen, B., Steel, P., Ferrari, J.R., 2013) suggested that workplace procrastination “regularly comprises more than a quarter of many people’s workdays, and evidence of it has been found in a wide range of jobs”. Furthermore, approximately 25% of adults consider that “they procrastinate in a consistent and problematic manner” (Nguyen, B., Steel, P., Ferrari, J.R., 2013). Therefore, workplace procrastination is a common phenomenon, and for reviewers it means that after repeatedly putting off their assessment, in the end, they must rush to submit their reports just before the deadline, leading to low-quality recommendations.

2.2. Incentives motivating the reviewers

Regarding other related works, (Garcia, J.A., Rodriguez-Sanchez, R., Fdez-Valdivia, J., 2015) considered the example of a journal editor (the principal) wondering whether their reviewer (the agent) is “recommending rejection of a manuscript because it does not have enough quality to be published or because the reviewer dislikes effort and they must work to acquire in-depth knowledge of the content of the manuscript.” This inherently leads to an encouragement of moral hazard, where the editor will not know whether the reviewer has done their job in accordance to the editor’s interest. In this situation, some prescriptions need to be given as to how the journal editor should control the reviewers to curb self-interest. (Garcia, J.A., Rodriguez-Sanchez, R., Fdez-Valdivia, J., 2015) suggested that associate editors monitoring the peer-review process as well as incentives can be used to limit moral hazard on the part of the reviewer. Drawing on agency theory, (Garcia, J.A., Rodriguez-Sanchez, R., Fdez-Valdivia, J., 2015) studied the incentives motivating the reviewers to expend effort to generate information about the quality of submissions, and they predicted that “within-job rewards for a referee’s performance should depend on individual differences in ability and promotion opportunities.”

In fact, several works found that scientific reviewers accept more invitations to review, or are able to produce better recommendations when they receive significant financial compensation for their work, e.g., (Chetty, R., Saez, E., Sandor, L., 2014; Collabra: Psychology, 2023; Copiello S., 2018; Davis Phil., 2013; European Open Access Publishing, 2020). For example, (Thompson, G. D., Aradhyula, S. V., Frisvold, G., Frisvold, R., 2010) found a “statistically significant reduction in review duration and an increase in reports’ quality” when reviewers were paid for their reports. Similarly, for seven journals offering payments, (Hamermesh D S., 1994) also found that “offering a monetary reward helps speeding up the peer review process and represents an effective incentive to ensure completion within due date”. In addition, (Chetty, R., Saez, E., Sandor, L., 2014) found further evidence that “a cash payment increases the fraction of referees who agree to review a manuscript and also reduces by some days the median time by which a review is returned”. Furthermore, (Canoy M., Veld D. L., 2014) showed how “a menu of monetary and non-monetary incentives can improve the academic referee process”.

In this paper, we show conditions under which a reviewer will choose to exert a low level of effort and procrastinate, consequently sending a low-quality report to the editor. Due to the fact that if the reviewer faces a severe present bias, high-difficulty reviews may not provide enough motivation, in and of themselves, to circumvent the reviewer’s self-control problem. These manuscript evaluations would be too painful and the reviewer would waiver in their self-regulation. In this situation, monetary incentives are important for those reviewers with a severe present bias. This result (i.e., monetary incentives enhance goal acceptance) is in line with the current psychology and economic literature, e.g., (Koch, A.K., Nafziger, J., 2011; Locke, E.A., 1968; Hollenbeck, J.R., and Klein, H., 1987; Hollenbeck, J.R., Williams, C.R., and Klein, H.J., 1989). On one hand, (Hollenbeck, J.R., Williams, C.R., and Klein, H.J., 1989) found that commitment to difficult goals was higher when goals were self-set as opposed to assigned and made public rather than private. In any case, (Locke, E.A., 1968) concluded that “any adequate theory of task motivation must take account of the individual’s conscious goals and intentions.” On the other hand, (Koch, A.K., Nafziger, J., 2011) showed the power and limits of self-regulation through goals. They found that goals increase an individual’s motivation, but “for a severe present bias goals either lack a motivating force, or are too painful to be accepted”, (Koch, A.K., Nafziger, J., 2011).

In fact, our model predicts that additional instrumental utility gains (e.g., monetary incentives using a pay-for-performance compensation system) will be important as long as reviewers have a severe present bias. This result is consistent with the view in (Garcia, J.A., Rodriguez-Sanchez, R.M., Fdez-Valdivia, J., 2022a; Garcia, J.A., Rodriguez-Sanchez, R.M., Fdez-Valdivia, J., 2022b), according to which “peer-reviewed journals could incentivise the external reviewers to supply the optimal quantity of effort by rewarding them financially for their quality reports”. However, an incentive plan should be a pay-for-performance model. For example, as suggested in (Garcia, J.A., Rodriguez-Sanchez, R.M., Fdez-Valdivia, J., 2022a; Garcia, J.A., Rodriguez-Sanchez, R.M., Fdez-Valdivia, J., 2022b), the editor will use their judgment and discretion to evaluate the reviewer’s performance, and based on the result, they will decide whether or not to award compensation to that reviewer.

However, the effects of extrinsic rewards on intrinsic motivation is a controversial issue in the literature. For example, (Deci, 1999; Deci, E., Ryan, R. M., 1985) argued that while extrinsic rewards can increase performance in some cases, “extrinsic motivation should not be used because it deprives human interest and pleasure in activities”. On the contrary, in a meta-analysis of 96 experimental studies, (Cameron, J., Pierce, W., 1994) found no consistent evidence that reward decreases intrinsic motivation. Furthermore, (Eisenberger, R., Pierce, W. D., Cameron, J., 1999) found that “reward for meeting absolute performance standards did not affect free choice but increased self-reported interest.” Their findings suggested that “reward procedures requiring specific high task performance convey a task’s personal or social significance, increasing intrinsic motivation”. Moreover, (Eisenberger, R., Pierce, W. D., Cameron, J.,

1999) argued that applied studies commonly found positive or null relationships between extrinsic rewards and intrinsic motivation.

3. Methods

In this section, we present a formal model to address the aforementioned research questions. First, we model a reviewer with a present bias who faces a motivation problem. Second, using this theory, we study the role of goal intentions for a reviewer with a present bias. We find that the motivating force of higher goals for the reviewer is limited in the face of a severe present bias. Third, using the formal model, we find that additional instrumental utility gains, such as monetary incentives, can improve the motivation of reviewers to work harder. In this section, we also present the main assumptions of our study.

3.1. A reviewer with a present bias

When receiving an invitation to review a manuscript, a potential reviewer trades off immediate rewards (e.g., writing a report to secure a peer-reviewed grant) for a delayed future benefit (e.g., writing a complex review report for a highly technical manuscript). In a similar situation, (Laibson, D., 1997) found that “individuals often exhibit some degree of present bias, which refers to the tendency for immediate gratification”. Thus, the presence of present bias can prevent reviewers from working hard on a difficult manuscript as they are more likely to opt for what they consider more valuable work of higher professional priority (Ackerman, D.S., Gross, B.L., 2007; Hall, N.C., Lee, S.Y., Rahimi, S., 2019; Nguyen, B., Steel, P., Ferrari, J.R., 2013). Therefore, in our model, the first assumption is that, in a competitive deadline scenario, reviewers may overvalue immediate rewards over future benefits and intentions. Then, they may exhibit tendencies that are present-biased preferences.

The result is that as suggested in (Frederick S, Loewenstein G, O'donoghue T., 2002), a potential reviewer “who discounts the future more heavily is less likely to participate” in a difficult peer review process that requires some effort level ($e \in \{e, \bar{e}\}$). Following (Koch, A.K., Nafziger, J., 2011), we assume that “while high effort causes an immediate utility cost” ($c(\bar{e}) = c$), “low effort causes no disutility” ($c(e) = 0$). A period later, the result of the evaluation of the manuscript ($y \in [y, \bar{y}]$) and any benefits derived therefrom are received by the reviewer. We also assume that a high effort on the part of the reviewer improves the evaluation of the manuscript.

(Gollwitzer, P.M., 1999) suggested that “by forming goal intentions, people turn their noncommittal desires into binding goals”. Following (Gollwitzer, P.M., 1999), in our model, the second assumption is that reviewers may have evaluation goals that, after accepting the review invitation, motivate them to exert a high level of effort in the peer review process. Therefore, to regulate their behavior, the potential reviewer can choose a goal $a \geq y$ when receiving an invitation to review a manuscript (at date 0): “quality control”, “helping the profession”, “staying up-to-date”, “networking opportunities”, “just enjoying it”, or “I have no goal intention”.

For simplicity, in our model we will assume that these goals are represented by a numerical value $a \geq y$, which indicates when they are more or less high. However, how do we determine which goals are higher than others? These goals represent what reviewers want to achieve in their performance. For example, “quality control” and “helping the profession” represent higher, rather non-selfish goals that aim to maintain the standards of the peer review process and ensure quality scientific communication; while “staying up to date,”

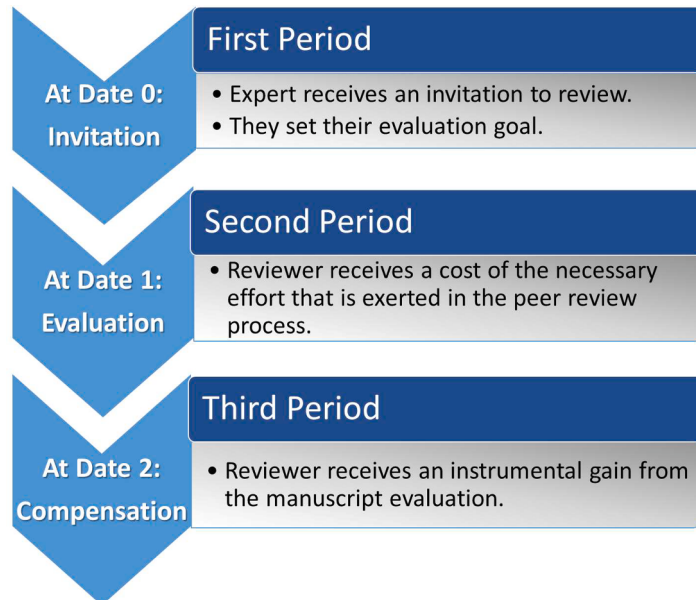


Figure 1. Timing of the manuscript evaluation: At date 0, review invitation; at date 1, manuscript evaluation; at date 2, reviewer compensation.

“networking opportunities,” and “just enjoying it” represent lower, selfish goals of reviewers who wish to gain some immediate personal benefit through the peer review process. Otherwise, “I have no goal intention” represents the situation of a reviewer who has no intention of achieving any goal by accepting an invitation to review.

At date 0, when the reviewer chooses their goal, they do not experience any cost of effort. This goal a will be used as a reference for the evaluation of the manuscript. This is illustrated in Fig. 1. In the absence of a reviewer’s goal, we simply set $a = \underline{y}$.

One period later (at date 1), the reviewer sustains a certain cost from the necessary effort e that is exerted in the peer review process (see Fig. 1). Finally, in the next period (date 2), the reviewer receives an instrumental gain related to the manuscript evaluation y corresponding to a reviewer’s goal a (see Fig. 1).

In our model, the third hypothesis is that the reviewers have a psychological utility derived from the gain for meeting the evaluation goal and the loss for not meeting that goal. Therefore, the utility gain at date 2 is given by the outcome-based utility $v(y)$ and the psychological utility obtained from the difference between the manuscript assessment y and the reviewer’s goal a . This is illustrated in Appendix A. To study the reviewer’s gain in instrumental utility when the reviewer provides different levels of effort, we reformulated the expected value of reviewer utility at date 2, given an effort level e and an evaluation goal a , as a value function $g(e, a)$ (see Appendix A for further details).

However a reviewer with a present bias has time-inconsistent preferences, where $\beta \in [0, 1)$ represents the extent to which a reviewer’s present bias causes these time-inconsistent preferences (i.e., a lower value of β represents a higher present bias). In our model, the reviewer knows that their preferences are present-biased. At the date of receiving a review invitation (date 0), they weigh equally the costs of effort $c(e)$ and the expected gain from the manuscript evaluation $g(e, a)$ (i.e., $U_0(e) = \beta[-c(e) + g(e, a)]$). However, a period later (at date 1), the same reviewer assigns a higher relative weight to the cost of the effort $c(e)$ (i.e., $U_1(e) = -c(e) + \beta g(e, a)$, with $\beta < 1$).

For instance, in the absence of a goal regarding the manuscript evaluation ($a = \underline{y}$), a reviewer with a present bias ($0 \leq \beta < 1$) faces a motivation problem if the following occurs (recall that while a high level of effort has a cost of $c(\bar{e}) = c$, a low level of effort has no cost to the reviewer $c(\underline{e}) = 0$):

- 1 When they receive the review invitation (at date 0), the reviewer prefers to exert a high level of effort $\bar{e}$ because the utility from the high effort exceeds that of low effort (i.e., $U_0(\bar{e}) = \beta[-c + g(\bar{e}, \underline{y})] > \beta g(\underline{e}, \underline{y}) = U_0(\underline{e})$).
- 2 However, a period later (at date 1), the reviewer will exert a low level of effort $\underline{e}$ instead as immediate costs hurt more (i.e., $U_1(\bar{e}) = -c + \beta g(\bar{e}, \underline{y}) < \beta g(\underline{e}, \underline{y}) = U_1(\underline{e})$).

3.2. The role of goal intentions for a reviewer with a present bias

We now consider that at date 0, when receiving a review invitation, a reviewer with a present bias chooses a certain goal a for the manuscript evaluation (e.g., keeping up-to-date). At date 1, after accepting the review invitation, they prefer to exert a high level of effort $\bar{e}$ in their assessment if the utility gain that the reviewer would obtain from a high-effort evaluation exceeds that from a low-effort one:

$$U_1(\bar{e}) = -c + \beta g(\bar{e}, a) \geq \beta g(\underline{e}, a) = U_1(\underline{e})$$

or equivalently,

$$\beta [g(\bar{e}, a) - g(\underline{e}, a)] \geq c$$

where, at date 1, a high-effort evaluation $\bar{e}$ causes the reviewer a utility cost of c while that of a low level of effort $\underline{e}$ is 0; with $\beta \in [0, 1)$ being the extent of a reviewer’s present bias.

Therefore, it is possible that in the absence of a goal regarding the manuscript evaluation ($a = \underline{y}$), a reviewer with a present bias faces a motivation problem (i.e., $\beta [g(\bar{e}, a) - g(\underline{e}, a)] < c$). However, if the difference $g(\bar{e}, a) - g(\underline{e}, a)$ increases in the goal level a , then a higher goal such as helping the profession and keeping up-to-date could prevent the reviewer’s self-control problem. In this situation, a higher goal a can increase the value of $\beta [g(\bar{e}, a) - g(\underline{e}, a)]$ above the value of c . The reviewer’s motivation to work hard increases with a higher goal for the manuscript evaluation because the reviewer is much more likely to fail this goal of helping the profession and keeping up-to-date if they exert a low level of effort in the peer review process. Thus, the result of a reviewer’s goal is to discipline themselves into exerting more effort than the reviewer would without a goal regarding the manuscript evaluation. This is formalized in the following mathematical result:

Proposition 1. *A reviewer with a present bias increases their motivation to work hard by setting a higher goal for the manuscript evaluation*

(relative to having no goal).

Proof: See [Appendix A](#).

However, can a reviewer always set a goal for a manuscript evaluation that helps them to avoid their self-control problem (i.e., their preference to exert low effort because $U_1(\bar{e}) - U_1(\underline{e}) = \beta \left[g(\bar{e}, a) - g(\underline{e}, a) \right] - c < 0$)? Recall that $\beta \in [0, 1)$ represents the extent to which a reviewer's present bias causes time-inconsistent preferences. The following mathematical result finds that the motivating force of higher goals for the reviewer is limited in peer review. That is, an increase in reviewer goal a above the maximum level $\bar{y}$ does not produce any additional motivating forces. The result is that a reviewer with a severe present bias cannot push their motivation for the manuscript evaluation to infinity by only using higher goals.

Proposition 2. *When a reviewer's present bias is not overly strong (i.e., β is higher), there is a manuscript evaluation goal that, after accepting the review invitation, motivates the reviewer to exert a high level of effort in the evaluation of the manuscript. However, when a reviewer's present bias is severe, i.e., β is lower than $\underline{\beta} = \frac{c}{g(\bar{e}, \bar{y}) - g(\underline{e}, \bar{y})}$, the reviewer prefers to exert a low level of effort.*

Proof: See [Appendix B](#).

In [Appendix B](#), we find that the minimum value of β for which the motivation through higher evaluation goals is possible is such that

$$\underline{\beta} = \frac{c}{g(\bar{e}, \bar{y}) - g(\underline{e}, \bar{y})}$$

and therefore, when a reviewer's present bias is overly strong (i.e., β is lower than $\underline{\beta}$), their self-control and motivation using a goal is not feasible. In this situation, the reviewer prefers to exert a low level of effort in the peer review process.

3.3. The role of financial compensation for a reviewer with a severe present bias

In the previous section we found that the motivating force of higher goals for the reviewer is limited in the face of a severe present bias. In a more general scenario, (Koch, A.K., Nafziger, J., 2011) showed that "goals are painful self-disciplining devices". Therefore, higher evaluation goals may negatively impact a reviewer's future benefits when invited to review a manuscript. As suggested in (Hall, N.C., Lee, S.Y., Rahimi, S., 2019), this will be particularly true for exhausted faculty members who are invited to review a high-difficult manuscript. This is so because if, for example, the reviewer wants to control the quality of the manuscript, in addition to helping the profession and keeping themselves up-to-date, such a high goal means working hard in the future. In this situation, the potential reviewer may decline the review invitation due to the high cost of effort that would be required. For a complex peer review process, achieving quality control, helping the profession, and staying up to date at the same time is a difficult goal for an exhausted member of faculty to accept (see, for example, (Hall, N.C., Lee, S.Y., Rahimi, S., 2019)).

However, additional instrumental utility gains, such as monetary incentives, can improve the invitation-to-review acceptance rates for potential reviewers with a severe present bias (Koch, A.K., Nafziger, J., 2011; Hollenbeck, J.R., Williams, C.R., and Klein, H.J., 1989; Hollenbeck, J.R., and Klein, H., 1987). Note that a reviewer's present bias is such that a lower value of β represents a higher present bias. Therefore, the fourth hypothesis of our model is that reviewers may be more likely to accept higher evaluation goals if they receive some monetary compensation for their efforts in the peer review process.

In the absence of an additional financial compensation, experts may not accept the high level goal that is needed to work hard on a difficult manuscript and thus may decline the invitation to review. This is formalized in the following mathematical result:

Proposition 3. *Suppose that a potential reviewer is ready to accept an evaluation goal when they receive a review invitation if this goal motivates a high level of effort and yields a higher benefit (relative to no goal and low effort).*

In this scenario, if the review process provides the reviewer with an additional utility gain that is sufficiently large, they will accept a manuscript evaluation goal $\hat{a}$ that motivates them to exert a high level of effort, whenever the reviewer's self-regulation by using a goal is feasible, i.e., $\beta \geq \underline{\beta}$.

On the contrary, if the review process provides a small instrumental utility gain to the reviewer, an evaluation goal that motivates them will only be accepted by the reviewer if a reviewer's present bias is not too severe, i.e., $\beta > \beta_0$, with $\beta_0 > \underline{\beta}$.

Proof: See [Appendix C](#).

In this situation, given that $\underline{\beta} < \beta_0$, we find that additional gains are important for reviewers with a severe present bias β such as $\beta \in [\underline{\beta}, \beta_0]$. In their absence, the reviewer would prefer not to accept the goal $\hat{a}$ that would motivate them to exert a high level of effort.

Therefore, potential reviewers with a severe present bias are more likely to accept higher goal levels for the manuscript evaluation if the review process provides them with an additional utility gain that is sufficiently large. However, what do we mean by "sufficiently large"? how to determine it or predict it before sending an invitation to review?

Using an online survey, (Rodríguez-Sánchez, R.M., Montero-Parodi, J.J., García, J.A., Fdez-Valdivia, J., 2023) analyzed the features that characterize a reviewer's behavior regarding the manuscript evaluation. The most relevant questions in the online survey

have arisen directly from the propositions that have been stated and proved in this paper using our formal model. (Rodríguez-Sánchez, R.M., Montero-Parodi, J.J., García, J.A., Fdez-Valdivia, J., 2023) found some tendencies that are present-biased preferences. For instance, in a competitive deadline scenario, at least a quarter of respondents would rather write a report to secure a peer-reviewed grant than write a review report for a difficult manuscript. Furthermore, they also found the existence of a psychological utility derived from the difference between the actual assessment of the manuscript and the reviewer's goal intentions. Regarding the associations between these characteristics of the reviewer's profile, (Rodríguez-Sánchez, R.M., Montero-Parodi, J.J., García, J.A., Fdez-Valdivia, J., 2023) found that in a competitive deadline scenario, a reviewer with "Quality control" as their evaluation goal as well as an overly strong present bias will need a monetary incentive of \$200 to write a review report for a difficult manuscript. Furthermore, (Rodríguez-Sánchez, R.M., Montero-Parodi, J.J., García, J.A., Fdez-Valdivia, J., 2023) found that if a reviewer's present bias is not overly strong, there is an evaluation goal that, after accepting the review invitation, motivates the reviewer to exert a high level of effort. Moreover, those reviewers surveyed with a severe present bias are more likely to exert a high level of effort if the effort cost is lower. All of these results (for a sample of 193 reviewers) agree with the theoretical predictions of our formal model.

4. Discussion and conclusion

In this section, we discuss the behavior of a reviewer with a present bias given by the value of β (i.e., a lower value of β represents a higher present bias) and the role of goal intentions a and additional instrumental gains such as monetary incentives.

To this aim, we performed several computational experiments varying the value of β , the goal intentions a , the reviewer's effort cost c , and the additional instrumental gains (e.g., monetary incentives). The results of these experiments are shown from Fig. 2 to Fig. 6.

The software used to perform the experiments is available at https://github.com/rosadecsai/theorymodel_how_to_motivate_reviewer.git

After accepting the review invitation, a reviewer chooses to exert a high level of effort $\bar{e}$ in the peer review process if the utility gain that they would obtain from a high-effort evaluation exceeds that from a low-effort one, or equivalently, if it follows the incentive constraint:

$$\beta \left(g(\bar{e}, a) - g(\underline{e}, a) \right) - c \geq 0$$

where a high effort $\bar{e}$ causes the reviewer a utility cost of c while that of low effort $\underline{e}$ is 0; with $\beta \in [0, 1]$ being the extent of the re-

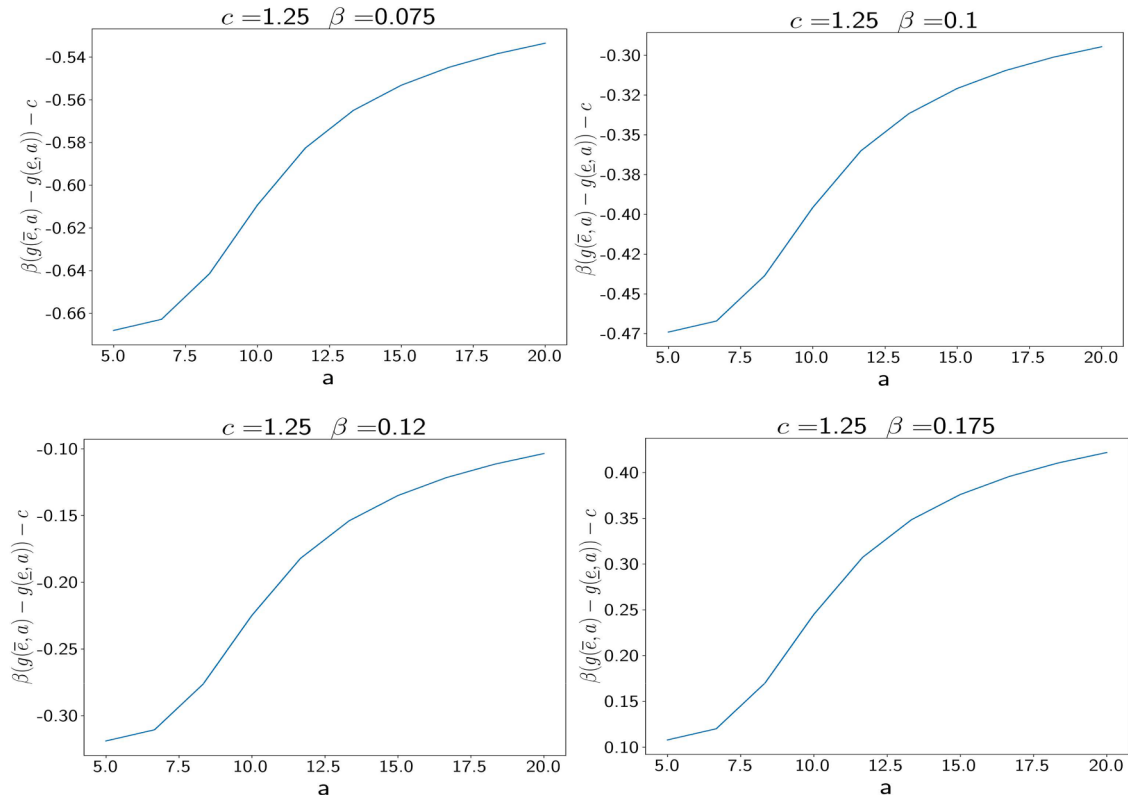


Figure 2. The value of $\beta(g(\bar{e}, a) - g(\underline{e}, a)) - c$ increases as goal intentions a increase. In this figure, the cost of high effort is $c = 1.25$.

viewer's present bias.

Figs. 2 through 4 illustrate that $\beta(g(\bar{e}, a) - g(\underline{e}, a)) - c$ increases as evaluation goal a increases. Therefore, reviewers with a present bias β are more likely to exert a high level of effort $\bar{e}$ (i.e., the incentive constraint is true) if the goal intentions for the manuscript evaluation a are higher. In this computational simulation, we set $\beta \in \{0.075, 0.1, 0.12, 0.175\}$, and $c \in \{0.75, 1, 1.25\}$.

Furthermore, Figs. 2 through 4 show that if a reviewer's present bias is not overly strong (i.e., β is higher), there is a manuscript evaluation goal a that, after accepting the review invitation, motivates the reviewer to exert a high level of effort in the evaluation of the manuscript. This is so because the incentive constraint is true: $\beta(g(\bar{e}, a) - g(\underline{e}, a)) - c \geq 0$. For example, this constraint is true for $\beta = 0.175$ in Fig. 2; while it is true for $\beta \geq 0.12$ in Fig. 3 and for $\beta \geq 0.1$ in Fig. 4.

However, when a reviewer's present bias is severe (i.e., β is lower), the reviewer prefers to exert a low level of effort, due to the fact that the incentive constraint is false. Therefore, these figures also show that the minimum value of β for which the motivation through higher evaluation goals is feasible decreases from 0.175 to 0.1 as effort cost c decreases from 1.25 in Fig. 2 to 0.75 in Fig. 4.

In this situation, reviewers with a severe present bias β are more likely to exert a high level of effort $\bar{e}$ (i.e., the incentive constraint is true) if the effort cost c is lower. It should be noted that the effort cost c is higher the more complex the peer review process is, the more difficult the manuscript is to evaluate, and the less expertize the reviewer who performs the evaluation has.

In the same line, Fig. 5 shows that reviewers with a present bias are more likely to work hard (i.e., the incentive constraint is satisfied) if a reviewer's present bias is not overly strong (i.e., β is higher) and the effort cost c is lower. In this computational simulation, we set $c \in [0, 2.5]$, and $\beta \in [0, 1]$.

Moreover, Fig. 6 shows that reviewers with a severe present bias are more likely to accept higher manuscript evaluation goals if the review process provides a large instrumental utility gain to the reviewer (as Proposition 3 predicted). To do this, we again suppose that a potential reviewer is willing to accept a manuscript evaluation goal a when they receive a review invitation if it motivates a high level of effort in the assessment and a higher expected gain (relative to no evaluation goal and a low level of effort), or equivalently, $\beta(g(\bar{e}, a) - g(\underline{e}, a)) - c \geq 0$.

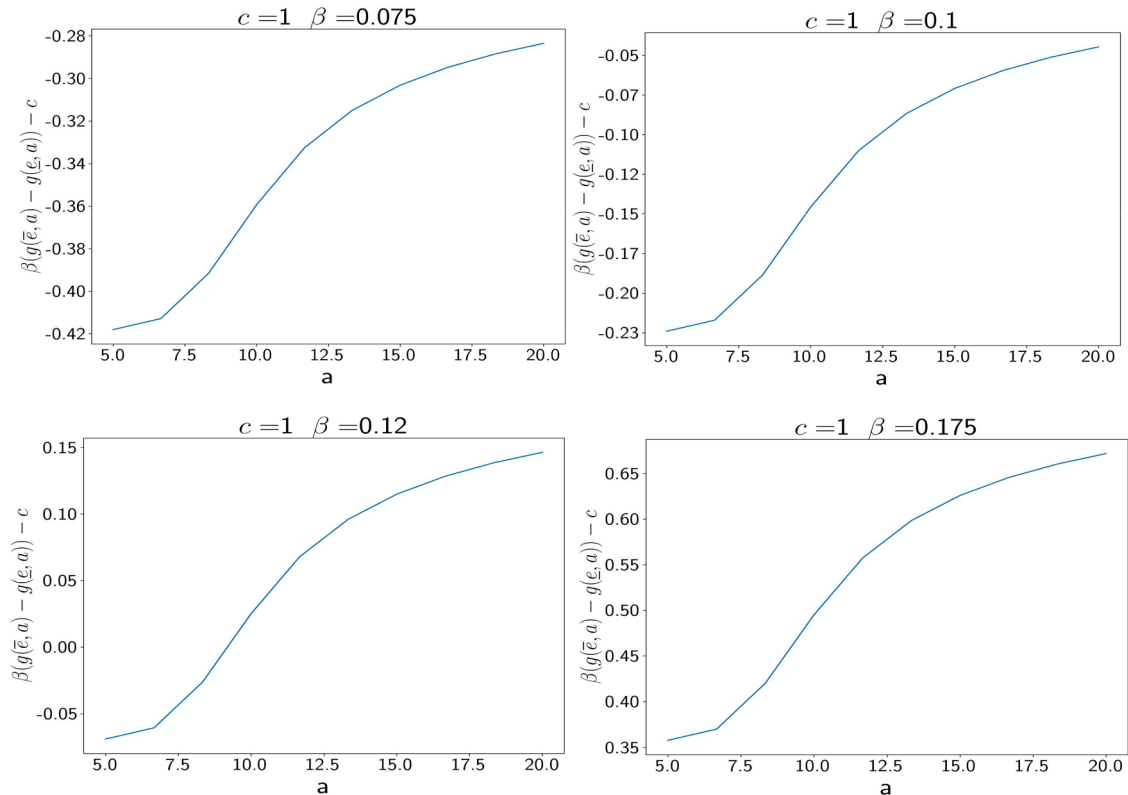


Figure 3. The incentive constraint $\beta(g(\bar{e}, a) - g(\underline{e}, a)) - c \geq 0$ is more likely as goal intentions a increase. If a reviewer's present bias is not overly strong (i.e., $\beta \geq 0.12$), there is a manuscript evaluation goal a that, after accepting the review invitation, motivates the reviewer to exert a high level of effort in the evaluation of the manuscript, i.e., the incentive constraint is true. In this figure, the cost of high effort is $c = 1$.

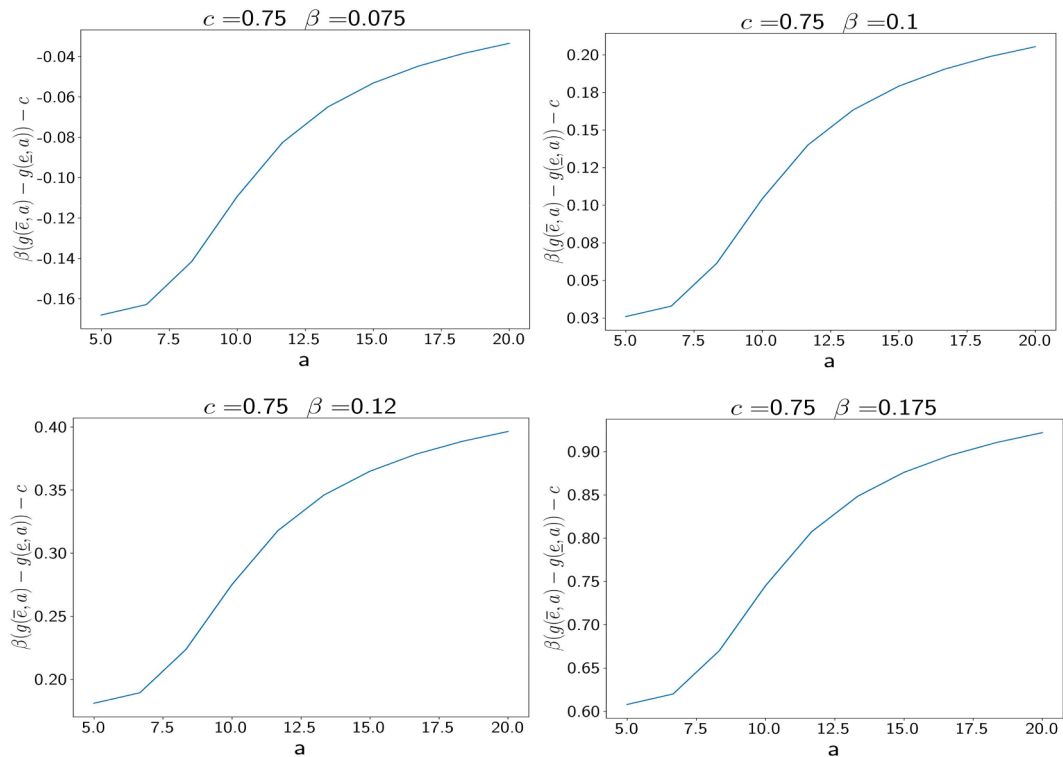


Figure 4. The incentive constraint $\beta(g(\bar{e}, a) - g(e, a)) - c \geq 0$ is more likely as goal intentions a increase. If a reviewer's present bias is not overly strong (i.e., $\beta \geq 0.1$), there is a manuscript evaluation goal a that, after accepting the review invitation, motivates the reviewer to exert a high level of effort in the evaluation of the manuscript, i.e., the incentive constraint is true. In this figure, the cost of high effort is $c = 0.75$.

Fig. 6 shows that this condition is more likely to be satisfied if the review process provides a (monetary and non-monetary) compensation to the reviewer (i.e., $E(y|\bar{e}) - E(y|e)$) that is sufficiently large. This figure illustrates that additional compensations such as monetary incentives (represented as $E(y|\bar{e}) - E(y|e)$) are relevant for reviewers with a strong present bias. In their absence, the reviewer might not accept the evaluation goal that is needed to motivate them to work hard in the review process.

A wide variety of factors can affect reviewer procrastination in completing manuscript evaluations, as well as starting them, such as the existence of competitive deadlines, the perceived complexity of the peer review process, and the lack of clarity on how to assess the manuscript. In this situation, reviewers may exhibit present-biased preferences according to which they tend to focus on the here and now and overvalue immediate rewards at the expense of long-term intentions and benefits. The result is a reviewer who decides to postpone the evaluation of the manuscript and unnecessarily continues to put off writing a report with an approaching deadline. However, in this paper, we have found that a reviewer's motivation to work hard may increase with a higher goal for the manuscript evaluation. This is so because the reviewer is much more likely to fail their goal of helping the profession and keeping themselves up-to-date if they exert a low level of effort. The result of a reviewer's goal would be to discipline themselves to exert more effort than the reviewer would in the absence of a goal regarding the manuscript evaluation.

Therefore, using a formal model, we have found that a reviewer with a present bias increases their motivation to work hard by setting a higher goal for the manuscript evaluation (relative to having no goal). Nevertheless, when a reviewer has a severe present bias, the reviewer's self-regulation in terms of a goal for the manuscript evaluation is not feasible. In this situation, the reviewer prefers to exert a low level of effort. For a complex peer review process, achieving quality control, helping the profession, and staying up to date at the same time is a difficult goal for an exhausted faculty member to accept.

However, monetary incentives can improve the invitation-to-review acceptance rates for potential reviewers with a severe present bias. On the contrary, in the absence of such a financial compensation, experts may not accept the high goal that is needed to work hard on a difficult manuscript and thus decline the invitation to review. In our model, we have found that if the review process provides a sufficiently large reward (monetary and non-monetary) to the reviewer, they will choose a goal regarding the manuscript evaluation that motivates them to work harder, as long as the reviewer's self-regulation using a goal is feasible.

In conclusion, what are the reviewer behavior patterns that we have identified with the parameterization and results of the formal model? How can these reviewer behavior patterns be used? Here we found that in a competitive deadline scenario, a reviewer with a high evaluation goal (e.g., "quality control" and/or "helping the profession") and with an overly strong present bias will need a large

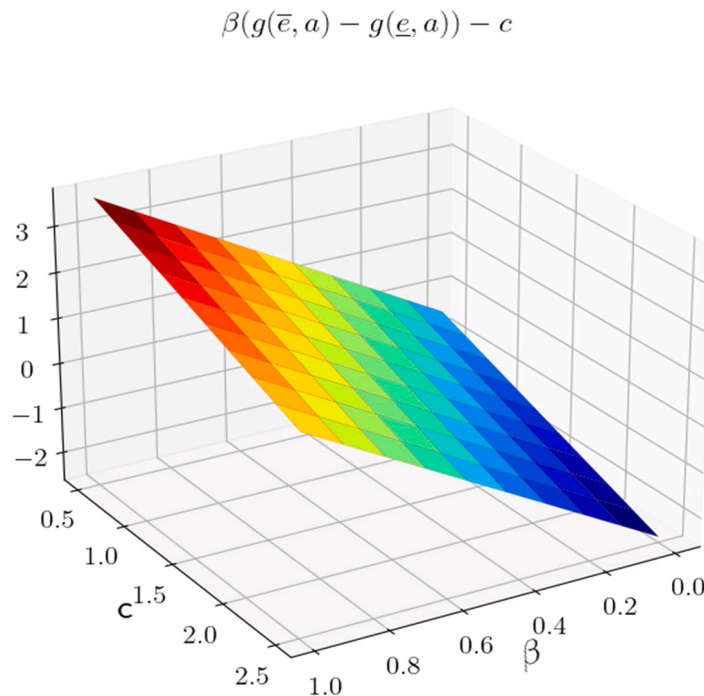


Figure 5. The incentive constraint $\beta(g(\bar{e}, a) - g(\underline{e}, a)) - c \geq 0$ is satisfied if a reviewer's present bias is not too strong (i.e., β is higher) and the effort cost c is lower.

enough monetary incentive to write a review report in a complex peer review process. However, if a reviewer's present bias is not overly strong, there is an evaluation goal that, after accepting the review invitation, motivates the reviewer to exert a high level of effort. Therefore, our answer to these questions would be as follows. Complex review processes carried out by reviewers who show severe present bias would have to be financially rewarded in a sufficiently high amount. However, reviewers whose present bias is not severe should be encouraged to choose high evaluation goals. In conclusion, high evaluation goals are important for all reviewers, while financial incentives are important to incentivize reviewers who exhibited an overly strong present bias.

Our model assumed that evaluation goals could be ranked from highest to lowest. However, what if different reviewers have different preferences? In our problem, the evaluation goals are ranked from highest to lowest according to their social importance, not from the point of view of the reviewers' preferences. Although different reviewers may have different preferences, they tend to be similar within different disciplines. However, when using the incentive system that was proposed, different reviewers should be treated differently based on their individual characteristics and preferences. In that sense, our model suggested that the key point will be to encourage reviewers to choose those evaluation goals that are higher from a social point of view. And in the case of identifying that they have a very strong present bias (for example, through a questionnaire that was sent to them along with the invitation to review) is when, in addition to stimulating higher goals, the possibility arises of incentivizing them financially. In summary, is the model for individual reviewers? Since the incentive system is based on individual goals and the reviewer's present bias, it cannot be generalized to the group of reviewers. Our model suggested that the incentive system should be individual for each reviewer and conditional on their sociodemographic characteristics and behavioral patterns.

However, what are the limitations of our formal model? There are five specific weaknesses associated with our formal model: (1) It may be unrealistic to characterize reviewers as goal-oriented individuals. It is often difficult to determine the goals of reviewers in different areas of knowledge. Formal goals may have little operational relevance because they are often vague and general, or because they differ from one field of research to another; (2) describing a reviewer's decision-making as a rational process may be unrealistic. Much of a reviewer's behavior is irrational and this inevitably influences the nature of decision making in scientific evaluation; (3) formal models, because of their necessary simplicity, assume that reviewers' behaviors reflect their organizational positions rather than their individual qualities and experience; (4) our model assumes that reviewers, selected based on their expertise and scientific knowledge, have the competence to send appropriate recommendations to the editor and authors. However, this does not always have to be true; and (5) our formal approach is based on the implicit assumption that peer-reviewed journals and the scientific environment of reviewers are relatively stable. Therefore, we assume that reviewers may come and go, but are located in a static organizational structure and within a simple, stable environment. However, reviewers often find themselves in a much more complex scientific environment, where authority, rules and policies can change significantly and, consequently, stability assumptions may be unrealistic.

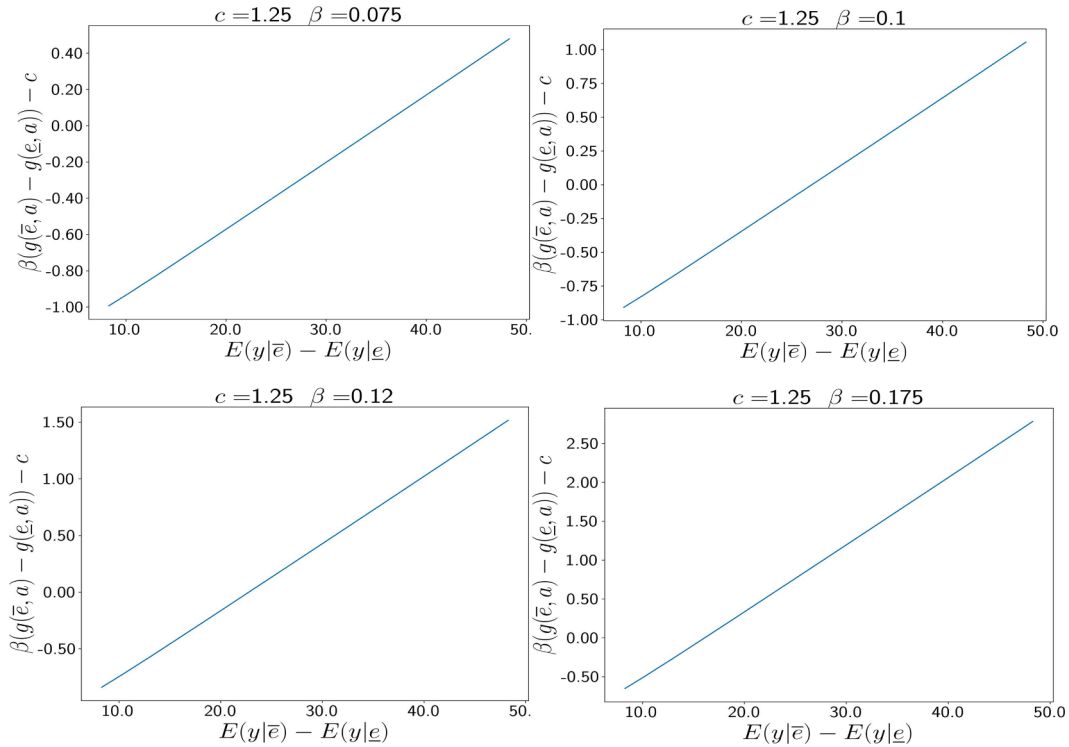


Figure 6. The incentive constraint $\beta(g(\bar{e}, a) - g(e, a)) - c \geq 0$ is satisfied when the review process provides a gain in instrumental utility to the reviewer $E(y|\bar{e}) - E(y|e)$ that is sufficiently large. In this figure, the cost of high effort is $c = 1.25$.

Author contribution

The authors contributed equally to this work.

Declaration of conflicting interests

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Appendix

A. Proof of Proposition 1

From the timing of the manuscript evaluation as described in Fig. 1, it follows that at date 2, the reviewer obtains an instrumental utility related to the manuscript evaluation y relative to the reviewer's goal a . The utility at date 2 is given by the outcome-based utility and the psychological utility from the difference between the manuscript evaluation y and the reviewer's goal a as follows (to simplify our notation, we assume that the reviewer exhibits linear loss aversion and linear outcome-based utility):

$$U_2(y, a) = y + \eta[\max\{y - a, 0\} - \mu\max\{a - y, 0\}]$$

with $\mu > 1$ representing the reviewer's loss-aversion coefficient and $\eta > 0$ being the weight attached to the gain from satisfying the goal and the loss from falling short of the evaluation goal. The expected value of reviewer's utility at date 2 given effort level e is represented

as a value function of goal setting $g(e, a)$ as follows (using integration by parts):

$$\begin{aligned} g(e, a) &= \int_{\underline{y}}^{\bar{y}} y f(y|e) dy + \eta \left(\mu \int_{\underline{y}}^a (y-a) f(y|e) dy + \int_a^{\bar{y}} (y-a) f(y|e) dy \right) \\ &= (1+\eta) E(y|e) - \eta a - \eta(\mu-1) \int_{\underline{y}}^a F(y|e) dy \end{aligned}$$

where the manuscript evaluation depends stochastically on the reviewer's effort according to the distribution $F(y|e)$, with density $f(y|e) > 0$ for all $y \in [\underline{y}, \bar{y}]$ and mean $0 < E(y|e) < \infty$.

At date 1, after accepting the review invitation, they prefer to exert high effort $\bar{e}$ if the utility that the reviewer obtains from a high-effort evaluation exceeds that from low effort, or equivalently, it follows the incentive constraint:

$$\beta \left[g(\bar{e}, a) - g(\underline{e}, a) \right] \geq c$$

where, at date 1, a high-effort evaluation $\bar{e}$ causes the reviewer a utility cost of c while that of low effort $\underline{e}$ is 0; with $\beta \in [0, 1)$ being the extent of the reviewer's present bias.

We have to prove that the difference between the utility that a reviewer with a present bias obtains from a high-effort evaluation and that from a low-effort evaluation, i.e., $U_1(\bar{e}) - U_1(\underline{e}) = \beta \left[g(\bar{e}, a) - g(\underline{e}, a) \right] - c$, increases its value in the reviewer's goal a , for all $a \in (\underline{y}, \bar{y})$. That is, a reviewer with a present bias increases their motivation to work hard by setting a higher goal for the manuscript evaluation (relative to having no goal for the review).

To do this, using the value of $g(e, a)$ to rewrite this incentive constraint, we obtain as follows:

$$\beta \eta (\mu - 1) \int_{\underline{y}}^a \left(F(y|\underline{e}) - F(y|\bar{e}) \right) dy \geq c - \beta \left[g(\bar{e}, \underline{y}) - g(\underline{e}, \underline{y}) \right]$$

where the left hand side of the above equation represents the loss from falling short of the review goal a if the reviewer exerts low effort at date 1; while the right side measures the utility gain that, at date 1, a reviewer obtains by exerting low effort in the absence of a goal ($a = \underline{y}$). Therefore, the left side is the part of the incentive constraint that depends on a , and thus, we have that

$$\frac{\partial}{\partial a} \left[\beta \left(g(\bar{e}, a) - g(\underline{e}, a) \right) - c \right] = \beta \eta (\mu - 1) \left(F(a|\underline{e}) - F(a|\bar{e}) \right),$$

which is strictly positive for a review goal a in the range $(\underline{y}, \bar{y})$, and zero, otherwise. This is so because we assume that high effort $\bar{e}$ raises the quality of the manuscript evaluation as follows:

$$F(y|\underline{e}) > F(y|\bar{e})$$

for all y in $(\underline{y}, \bar{y})$. Furthermore, given that $F(a|\underline{e}) = 1 = F(a|\bar{e})$ for $a \geq \bar{y}$, with $\bar{y}$ bounded, we find that increasing the manuscript evaluation goal a beyond the limit $\bar{y}$ does not increase the reviewer's motivation to exert high effort.

B. Proof of Proposition 2

First, we have to prove that if the present bias of the reviewer is not severe, there is an evaluation goal $\hat{a}$ such that, after accepting the review invitation, motivates the reviewer to exert a high level of effort in the peer review process.

We assume that in the absence of a goal regarding the manuscript evaluation outcome ($a = \underline{y}$), a reviewer with a present bias ($0 \leq \beta < 1$) faces a self-control problem, and thus, at date 1, $U_1(\bar{e}) = -c + \beta g(\bar{e}, \underline{y}) < \beta g(\underline{e}, \underline{y}) = U_1(\underline{e})$, or equivalently, $\beta \left(g(\bar{e}, a) - g(\underline{e}, a) \right) - c < 0$. Therefore, it follows that a goal $\hat{a}$ such that motivates the reviewer to work hard at date 1, it must satisfy that $\hat{a} > \underline{y}$.

From Appendix A, we know that $\beta \left(g(\bar{e}, a) - g(\underline{e}, a) \right) - c$ increases with a , for $a \in (\underline{y}, \bar{y})$. Furthermore, from Lemma 1 in (Koch, A. K., Nafziger, J., 2011), it follows that

$$\lim_{a \rightarrow \infty} \left(g(\bar{e}, a) - g\left(\underline{e}, a\right) \right) = g(\bar{e}, \bar{y}) - g\left(\underline{e}, \bar{y}\right).$$

Therefore, if $\beta \left(g(\bar{e}, \bar{y}) - g\left(\underline{e}, \bar{y}\right) \right) - c > 0$ for a given β , it follows that there exists a goal for the manuscript evaluation $\hat{a}$, with $\underline{y} < \hat{a} < \bar{y}$, which verifies as follows:

$$\beta \left(g(\bar{e}, \hat{a}) - g\left(\underline{e}, \hat{a}\right) \right) - c = 0.$$

Now, we have to prove that if the reviewer's present bias is severe, there is no goal for the evaluation of the manuscript that can solve the problem of a lack of self-control (i.e., $U_1(\bar{e}) - U_1(\underline{e}) < 0$) and, therefore, the reviewer with a severe present bias prefers to put little effort into their manuscript assessment.

To see this, by using the implicit function theorem, we find (for $\bar{y} > \hat{a} > \underline{y}$):

$$\frac{\partial \hat{a}}{\partial \beta} = \frac{\eta(\mu - 1) \int_{\underline{y}}^{\hat{a}} \left(F(y|\underline{e}) - F(y|\bar{e}) \right) dy + \left[g(\bar{e}, \underline{y}) - g(\underline{e}, \underline{y}) \right]}{\eta(\mu - 1) \left(F(\hat{a}|\underline{e}) - F(\hat{a}|\bar{e}) \right)} < 0.$$

Therefore, from $\frac{\partial \hat{a}}{\partial \beta} < 0$, we find that the minimum β for which $\beta \left[g(\bar{e}, \bar{y}) - g(\underline{e}, \bar{y}) \right] - c = 0$ is such that

$$\underline{\beta} = \frac{c}{g(\bar{e}, \bar{y}) - g(\underline{e}, \bar{y})}.$$

Hence, when β is lower than $\frac{c}{g(\bar{e}, \bar{y}) - g(\underline{e}, \bar{y})}$, the self-regulation using a goal for the manuscript evaluation is not feasible, and thus, the reviewer would exert a low level of effort.

C. Proof of Proposition 3

Now, we have to prove that potential reviewers with a severe present bias are more likely to accept evaluation goals that motivate them to exert a high level of effort if the reviewer compensation is sufficiently large.

To this aim, we suppose that a potential reviewer is ready to accept a manuscript evaluation goal a when $\phi(a) = g(\bar{e}, a) - c - g(\underline{e}, \underline{y}) \geq 0$ which is a strictly decreasing and continuous function because we have

$$\frac{\partial}{\partial a} \beta [g(e, a) - c(e)] = -\eta[1 + (\mu - 1)F(a|e)] < 0.$$

Hence, using the results from Appendix A, it follows that at date 0, the reviewer will never choose a manuscript evaluation goal a such that $a > \bar{y}$. This is so because $\bar{y}$ represents the manuscript evaluation goal for which the reviewer achieves the maximum motivation force to work hard. Therefore, given that $\phi(a)$ is a strictly decreasing function, if $\phi(\bar{y}) \geq 0$, then it will be that $\phi(a) \geq 0$ for any manuscript evaluation goal a in the interval $[\underline{y}, \bar{y}]$. The condition

$$\phi(\bar{y}) = g(\bar{e}, \bar{y}) - c - g(\underline{e}, \underline{y}) = (1 + \eta\mu)E(y|\bar{e}) - (1 + \eta)E(y|\underline{e}) - \eta(\mu\bar{y} - \underline{y}) - c \geq 0$$

will be satisfied if the review process provides a (monetary and non-monetary) compensation to the reviewer (i.e., $E(y|\bar{e}) - E(y|\underline{e})$) that is large enough.

In this scenario, whenever the reviewer's self-regulation is feasible, i.e., $\beta \geq \underline{\beta} = \frac{c}{g(\bar{e}, \bar{y}) - g(\underline{e}, \bar{y})}$, if the review process provides a large enough compensation to the reviewer (and, therefore, the condition $\phi(\bar{y}) \geq 0$ is satisfied) then, from the results in Appendix A and B, it follows that potential reviewers will choose a manuscript evaluation goal $\hat{a}$ that motivates the reviewer to exert high effort in the peer review process because $\beta \left(g(\bar{e}, \hat{a}) - g(\underline{e}, \hat{a}) \right) - c = 0$.

On the contrary, if the review process provides a small instrumental utility gain to the reviewer (and, therefore, $\phi(\bar{y}) = g(\bar{e}, \bar{y}) - c - g(\underline{e}, \underline{y}) < 0$), then a manuscript evaluation goal will only be accepted by the reviewer at date 1 if the present bias is not too severe, i.e., β

$> \beta_0$, with $\beta_0 > \underline{\beta} = \frac{c}{g(\bar{e}, \bar{y}) - g(\underline{e}, \bar{y})}$. This will be proved further below. In this situation, given that $\underline{\beta} < \beta_0$, we find that additional instrumental gains such as monetary incentives are important for reviewers with a severe present bias β such as $\beta \in [\underline{\beta}, \beta_0]$. In their absence, the reviewer would prefer not to accept the goal $\hat{a}$ that would motivate them to exert a high level of effort.

To prove that goals are only accepted if the present bias is not overly severe, i.e., $\beta > \beta_0$, with $\underline{\beta} < \beta_0 < \hat{\beta}$, we proceed as follows. Given that $\phi(a)$ is a strictly decreasing and continuous function, and, assuming that $\phi(\underline{y}) > 0$, we have that a_0 in $[\underline{y}, \bar{y}]$, for which $\phi(a_0) = 0$, represents the maximum level for an evaluation goal to get the reviewer to work hard at date 1.

Now, we will find a β_0 , with $\underline{\beta} < \beta_0 < \hat{\beta}$, such that the incentive constraint holds at the maximum goal level a_0 , i.e.,

$$\beta_0 \left[g(\bar{e}, a_0) - g(\underline{e}, a_0) \right] - c = 0.$$

In our model, we assume that at date 1, a reviewer chooses to exert low effort in the absence of a manuscript evaluation goal (i.e., $a = \underline{y}$) whenever $\beta < \hat{\beta} = \frac{c}{g(\bar{e}, \underline{y}) - g(\underline{e}, \underline{y})}$. Therefore,

$$\hat{\beta} \left(g(\bar{e}, \underline{y}) - g(\underline{e}, \underline{y}) \right) - c = 0.$$

From Appendix A, we have that $\frac{\partial}{\partial a} \left[\beta \left(g(\bar{e}, a) - g(\underline{e}, a) \right) - c \right]$ is strictly positive for a review goal a in the range $(\underline{y}, \bar{y})$. Therefore, it follows that

$$\hat{\beta} \left[g(\bar{e}, a_0) - g(\underline{e}, a_0) \right] - c > 0.$$

Similarly, from Appendix B, it follows that

$$\underline{\beta} \left[g(\bar{e}, \bar{y}) - g(\underline{e}, \bar{y}) \right] - c = 0,$$

and therefore,

$$\underline{\beta} \left[g(\bar{e}, a_0) - g(\underline{e}, a_0) \right] - c < 0.$$

Now, from Appendix A and given that $g(\bar{e}, \underline{y}) - g(\underline{e}, \underline{y}) > 0$, we obtain that

$$\frac{\partial}{\partial \beta} \left[\beta \left(g(\bar{e}, a_0) - g(\underline{e}, a_0) \right) - c \right] = g(\bar{e}, a_0) - g(\underline{e}, a_0) > 0.$$

It then follows that there exists a unique $\beta_0 \in (\underline{\beta}, \hat{\beta})$ that satisfies

$$\beta_0 \left(g(\bar{e}, a_0) - g(\underline{e}, a_0) \right) - c = 0.$$

From this result, we obtain that β_0 , with $\underline{\beta} < \beta_0 < \hat{\beta}$, is the minimum value of β for which the potential reviewer sets a manuscript evaluation goal at date 0 to motivate themselves to exert a high level of effort at date 1, after accepting the invitation to review.

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