Cooperation between Referees and Authors Increases Peer Review Accuracy

(Plos One, 2011)

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Scientific assessment & peer review

Peer Review:

Cooperative process between scientists in a community who agree to review each other's work in an unbiased fashion

- publications in journals
- grants awarding
- academic promotion

Objective of the paper

Laboratory study of closed and open peer review

- **Closed peer review:** anonymous referees
- **Open peer review:** non-anonymous referees

The peer review model

- K players
- T units of time
- 2 activities:
  - solve N_k^s problems
  - review N_k^r solutions of peers

$$T_k^s + T_k^r \leq T$$

s_{ikj}: i^{th} solution of player k reviewed by player j

t_{ikj}^s: time of submission of s_{ikj}

t_{ikj}^r: time of completed review of s_{ikj}

Probability of acceptance for a solution ikj

$$A_k(t) = \sum_{i|t^r_{ikj}<t} \mathbb{1}_{s_{ikj} \text{ accepted}}$$

$$\mathbb{E}\left[A_k(t)\right] = \mathbb{E}\left[\sum_{i|t^r_{ikj}<t} \mathbb{1}_{s_{ikj} \text{ accepted}}\right] = \sum_{i|t^r_{ikj}<t} p_{ikj}$$

$$p_{ikj} = f\left(s_{ikj}, t^s_{ikj}, j, k\right)$$

Closed peer review (CPR)

$$f^{-1} = \alpha(s_{ikj}) + \beta(k) + \gamma(j) + \kappa\left(A(t^r_{ikj})\right)$$

- $\alpha(\cdot)$ large effect of the solution itself
- $\beta(\cdot)$ solver effect
- $\beta(\cdot)$ reviewer effect
- Under CPR, the public information is the number of accepted solution a time t^r_{ikj}: $A(t^r_{ikj})$

Open peer review (OPR)

$$f^{-1} = \alpha(s_{ikj}) + \beta(k) + \gamma(j) + \kappa\left(A(t^r_{ikj})\right) + \eta\left(R^a(t^r_{ikj})\right) + \xi\left(R_{kj}(t^r_{ikj}), R^a(t^r_{ikj})\right)$$

- same terms as CPR
- more public information:
  - $\eta(\cdot)$ effect of the number of reviewed & accepted solutions
  - $\xi(\cdot)$ effect of the number of times player j reviewed player's k solutions and his rate of acceptance

Optimal strategies & Nash equilibrium

3 possible strategies at a given time point:

1. solve problem and submit the solution
2. review a solution and reject it
3. review a solution and accept it

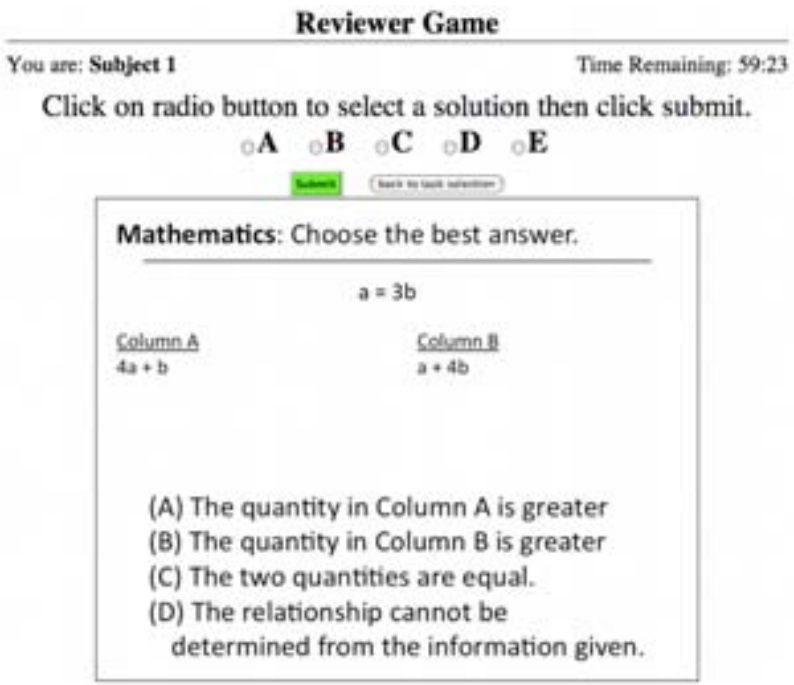
- **CPR:** always choosing (1) is optimal
- **OPR:** choosing (2) or (3) can also be beneficial

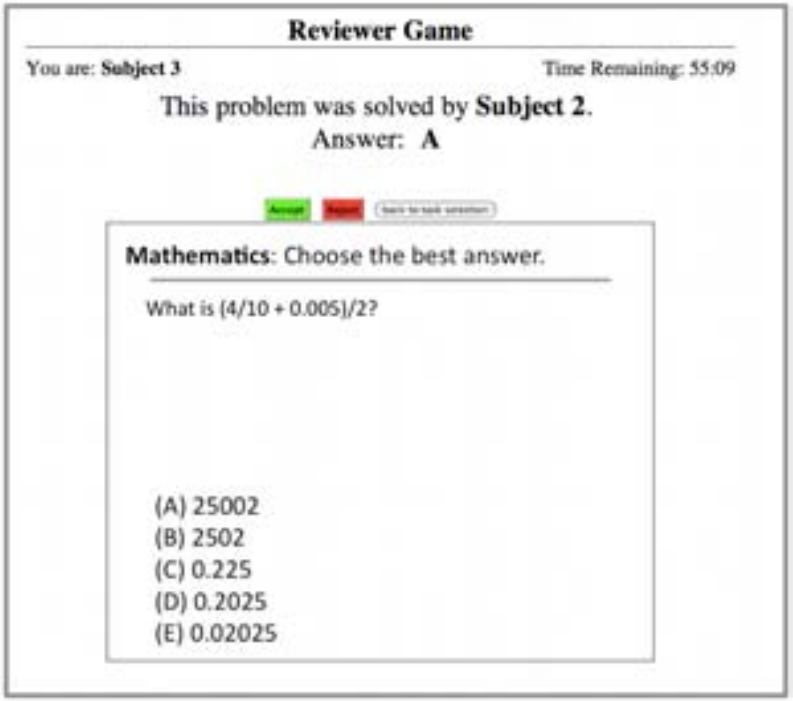
Set up

- most reviewers know the authors of the papers they referee
- peer review is usually performed within relatively small communities of individuals
- peer review involves repeated interactions between referees and authors

2 players with the largest number of accepted submissions at the end received \$\$ $\Rightarrow$ "*publish or perish*"

Open versus closed peer review systems for the peer review game





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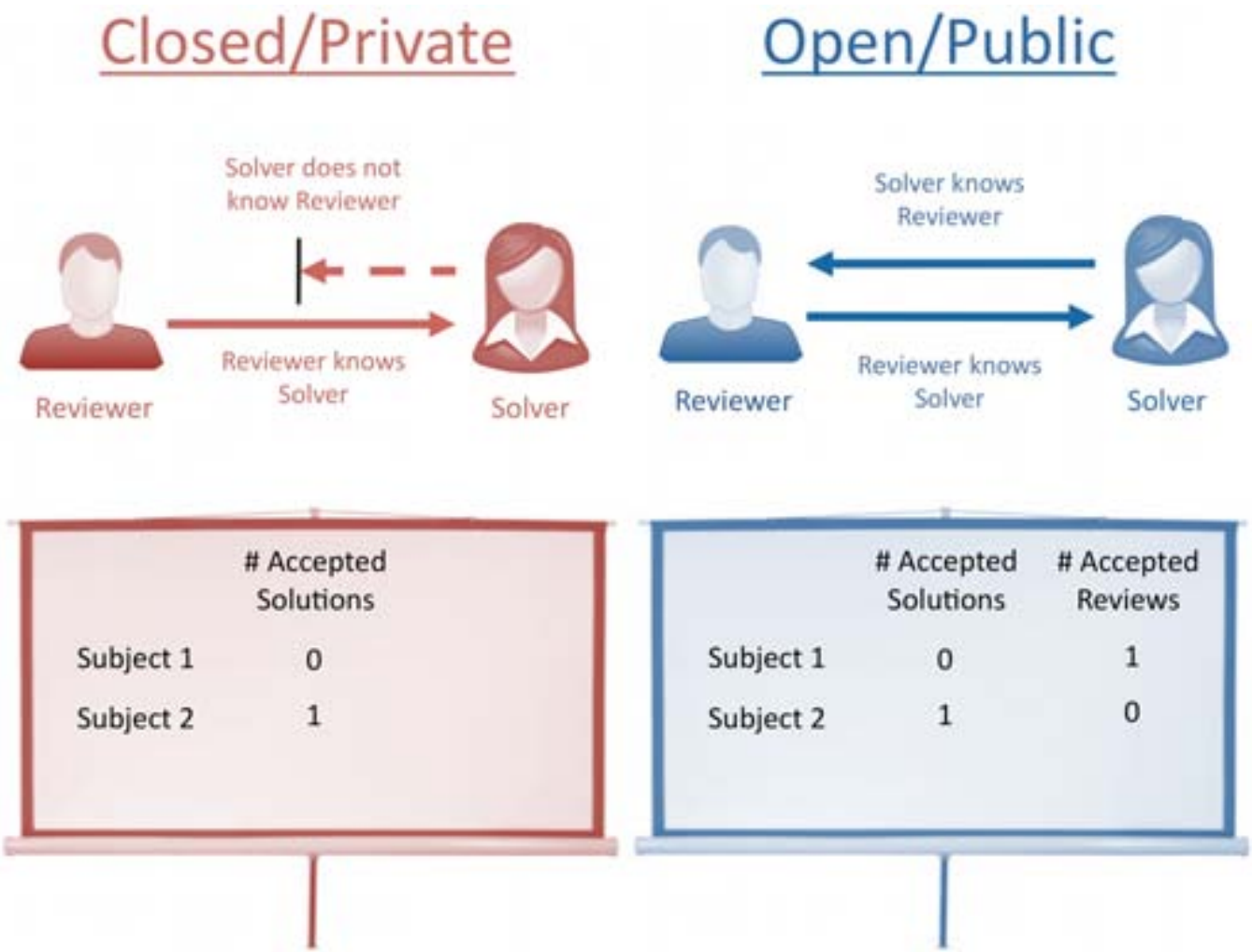


Recruitment and descriptive results

- T = 40 minutes
- CPR: 3 labs, n = 8, 8, and 9 players
- OPR: 3 labs, n = 7, 10, and 8 players

⇒ 6 experiments: 1,143 solutions and 666 reviews

Descriptive results:

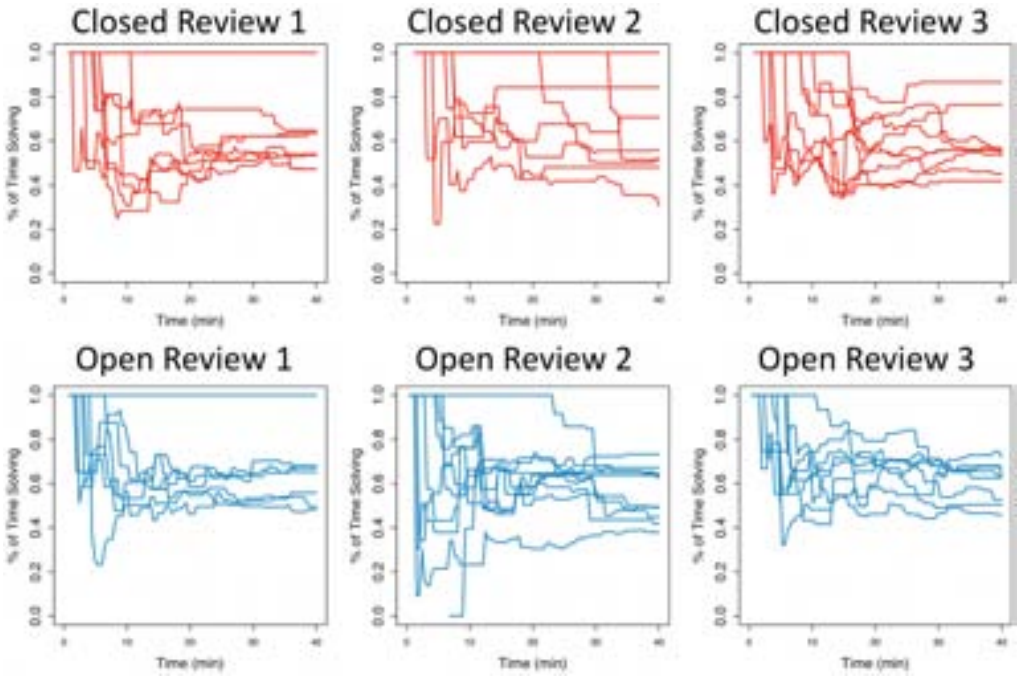
- 62% of the submitted solutions were correct
- Peer review did lead to an increase in accuracy: 39% of rejected solutions were correct VS 78% of accepted solutions were correct

General results

- OPR:
  - each solution a player accepted led to an increased probability their own next submission would be accepted:
    2% increase per accepted solution (pval = 0.047)
  - 1 of the top 2 reviewers was always one of the winners of the game
- CPR:
  players not rewarded for reviewing additional submissions: 0.8% decrease per accepted solution (pval = 0.30)
- reviewing accuracy was statistically indistinguishable between OPR and CPR: 1% more accuracy under CPR (pval = 0.762)

In agreement with theoretical model fitted via mixed models framework

Open peer reviewers spend a greater proportion of their time reviewing



- review times were not significantly different between CPR and OPR (2 seconds longer on average for closed games, pval = 0.31)
- in the CPR players spent a higher proportion of their time solving problems instead of reviewing, while in the OPR there was a greater balance between reviewing and submission

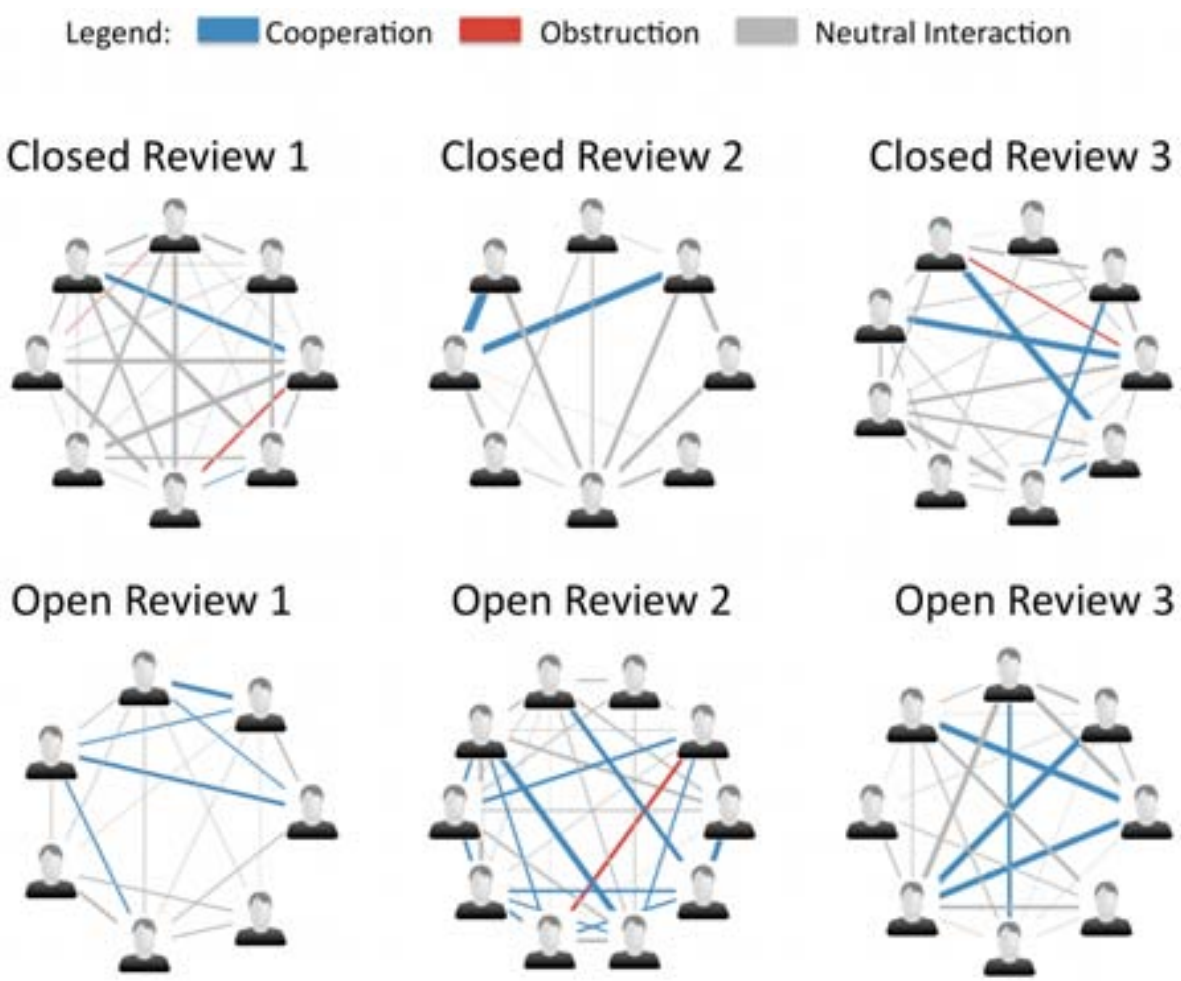
pair-wise measure of cooperation between players

- $P_i = A_i/N_i$: the acceptance probability of subject i
- $P_{ij} = A_{ij}/N_{ij}$: the probability of a solution from subject j is accepted by subject i
- $d_{ij} = P_{ij} - P_i$

  - $d_{ij} > 0$ and $d_{ji} > 0 \Rightarrow$ cooperation
  - $d_{ij} < 0$ and $d_{ji} < 0 \Rightarrow$ obstruction

Two-sample test of proportion for cooperation: 22% (OPR) vs 9% (CPR) $\Rightarrow$ pval = 0.018

Open review leads to increased cooperation which leads to increased review accuracy



Open review leads to increased cooperation which leads to increased review accuracy

Does cooperation between referees and authors increase reviewing accuracy?

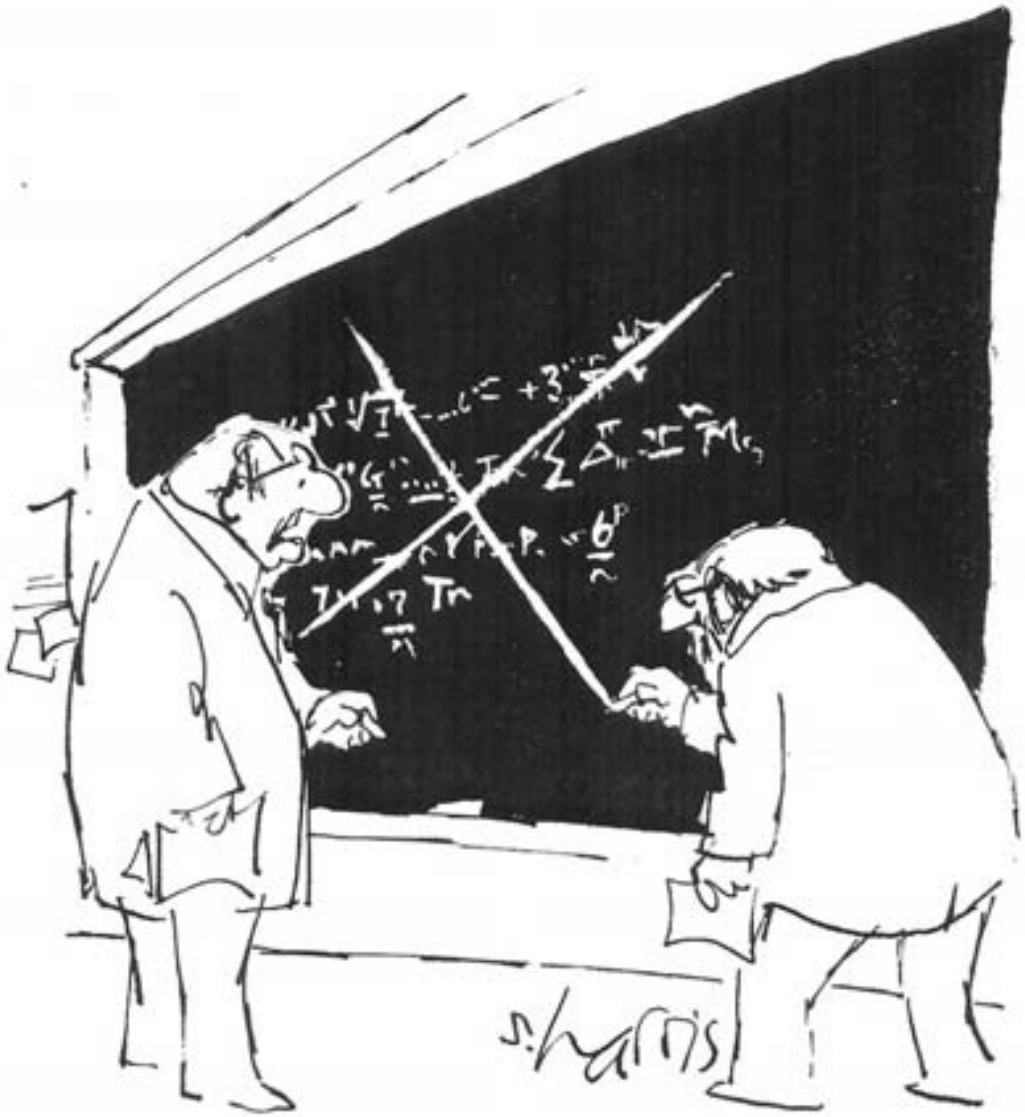
Intuition: players who cooperate would always accept each others solutions (regardless of whether they were correct)

- when a submitter and reviewer acted cooperatively, reviewing accuracy actually increased by 11% (pval = 0.016)
- adjusting for the fact that some solvers had higher accuracy than others: still 11% increase in accuracy (pval = 0.039).

Remark: increase in reviewing accuracy was mediated by cooperative interactions between players: overall accuracy was comparable under OPR and CPR (1% more accuracy under closed, pval= 0.762).

Leek JT, Taub MA, Pineda FJ (2011). Cooperation between Referees and Authors Increases Peer Review Accuracy. *PLoS ONE* 6(11):e26895. doi:10.1371/journal.pone.0026895

⇒ `http://www.plosone.org/article/info:doi/10.1371/journal.pone.0026895`



"THAT'S IT? THAT'S PEER REVIEW?"