



# Primum simulare deinde philosophari. Insights from simulation models of peer review

Flaminio Squazzoni

GECS-Department of Economics and Management

University of Brescia, Italy

[flaminio.squazzoni@unibs.it](mailto:flaminio.squazzoni@unibs.it)

[www.gecs.unibs.it/squazzoni.html](http://www.gecs.unibs.it/squazzoni.html)

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# A hot issue



## SCIENTIFIC RESEARCH

### End of the peer review show?

Several recent high profile cases have raised questions about the effectiveness of peer review<sup>1,2</sup> ensuring the quality of published research. **Mark Henderson** investigates



Bruce Alberts is the Editor-in-Chief of *Science*.

Brooks Hanson is Deputy Editor for physical sciences at *Science*.

Katrina L. Kelnner is Deputy Editor for life sciences at *Science*.

### Reviewing Peer Review

PEER REVIEW, IN WHICH EXPERTS IN THE FIELD SCRUTINIZE AND CRITIQUE scientific results prior to publication, is fundamental to scientific progress, and the achievements of science in the last century are an endorsement of its value. Peer review influences more than just science. The Intergovernmental Panel on Climate Change and other similar advisory groups base their judgments on peer-reviewed literature, and this is part of their success. Many legal decisions and regulations also depend on peer-reviewed science. Thus, thorough, expert review of research results—without compensation—is an obligation that scientists shoulder for both science and the general public.

## EDITORIAL



### Retraction Watch

Retraction count grows to 35 for scientist who faked emails to do his own peer review

Hyung-in Moon, the South Korean plant compound researcher who made up email addresses so he could do his own peer review, is now up to 35 retractions.

The four new retractions are of the papers in the *Journal of Enzyme Inhibition and Medicinal Chemistry* that initially led to suspicions when all the reviews came back yes. Here's the [gist](#), which includes the same language as Moon's 24 retractions published in *Informa Healthcare* journals.



Hyung-in Moon

corresponding author and publisher hereby retract the following articles in publication in *Journal of Enzyme Inhibition and Medicinal Chemistry*:

Choi of betaine on the hepatic damage from orotic acid-induced fatty liver development in rats

Young-Cha, Hyeon-Soo Kim, Hyung-In Moon, and Young-Su Cho

mal of *Enzyme inhibition and Medicinal Chemistry* [pub ahead of print], 2012, doi: 10.1081/14753566.2011.641014

obesity activity of fermented *Angelica gigantis* by high fat diet-induced obese rats

Young-Cha, Jeon-Jung, Chae-Su Park, Hee-Young Kim, Hyung-In Moon, and Young-Su Cho

mal of *Enzyme inhibition and Medicinal Chemistry* [pub ahead of print], 2012, doi: 10.1081/14753566.2011.615746



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## Research questions



- ☐ Is a “random walk” the worst case scenario of peer review?
- ✓ Is quality of peer review sensitive to scientist behaviour during the process?
- ✓ Can even only “soft” selfish, rational strategies of reviewers have serious implications for the quality of publications?
- ☐ Is there a trade-off between quality and efficiency of peer review?
- ☐ What are the implications of open peer review if scientists are “rational” players?



## The basic model



- ❑ A population of  $N$  agents (authors & referees)
- ❑ Resources, productivity and quality
- ❑ Evaluation process: intrinsic vs. perceived quality
- ❑ Publish or perish

Parameters	Description	Value
$N$	Number of agents	200
$R_a(0)$	Initial agent resources	0
$f$	Fixed amount of resource	1
$p$	Publication rate	[0.25, 0.50, 0.75]
$M$	Publication multiplier	[1, 1.5]
$b$	Evaluation bias by default	0.1
$i$	Author investment	1
$s$	Reviewing expenses for unreliable referees	0.5
$u$	Underrating by unreliable referees	0.1
$o$	Overrating by unreliable referees	1.9
$v$	Velocity of submission quality increase	0.1

**Tab. 1.** Simulation parameters.



# Play with our NetLogo model!



The screenshot shows the OpenABM website interface. At the top, it says 'open abm' and '... a node in the CoMES Network'. There is a search bar and navigation links for 'home', 'about', 'faq', and 'contact'. On the left, a sidebar lists various categories: Home, Model Library, Education, Resources, Bibliographic Library, Events Calendar, Forums, Jobs & Appointments, and CoMES Membership. The main content area displays the title 'Peer Review with Multiple Reviewers' by Federico Bianchi and Flaminio Squazzoni. It includes submission details: Submitted By: federico\_bianchi, Submitted: Sep 10, 2015, Last Updated: Sep 10, 2015, and 12 Downloads (12 Downloads in the last 3 months). A detailed description of the model follows, explaining its building on the 'Peer Review Model' and its focus on the effect of multiple reviewers. To the right of the text is a small thumbnail image of the NetLogo model interface.

<https://www.openabm.org/model/4718/version/1/view>

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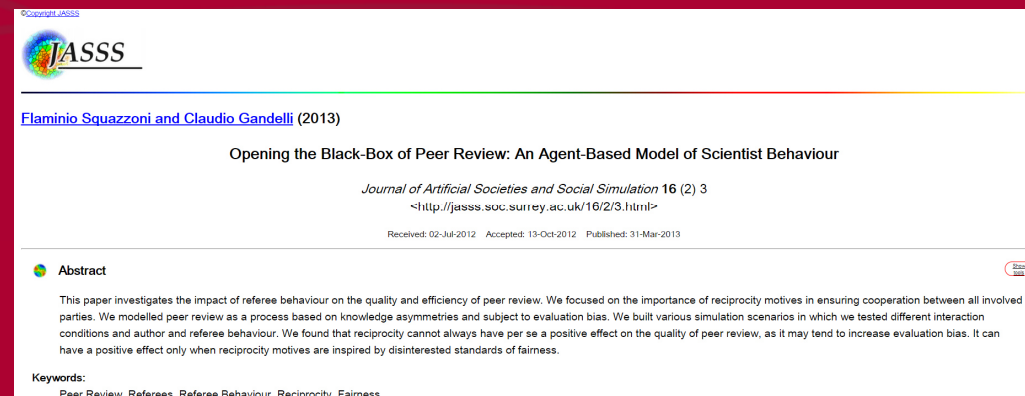




## JASSS 2013



- ❑ Scenarios
- ✓ No reciprocity”: random probability of behaving unreliably when selected as referees
- ✓ “Indirect reciprocity”: past publication success as authors determines higher reliability next turn as referee
- ✓ “Fairness”: past pertinent judgement by referees on previous author submission determines higher reliability next turn as referee



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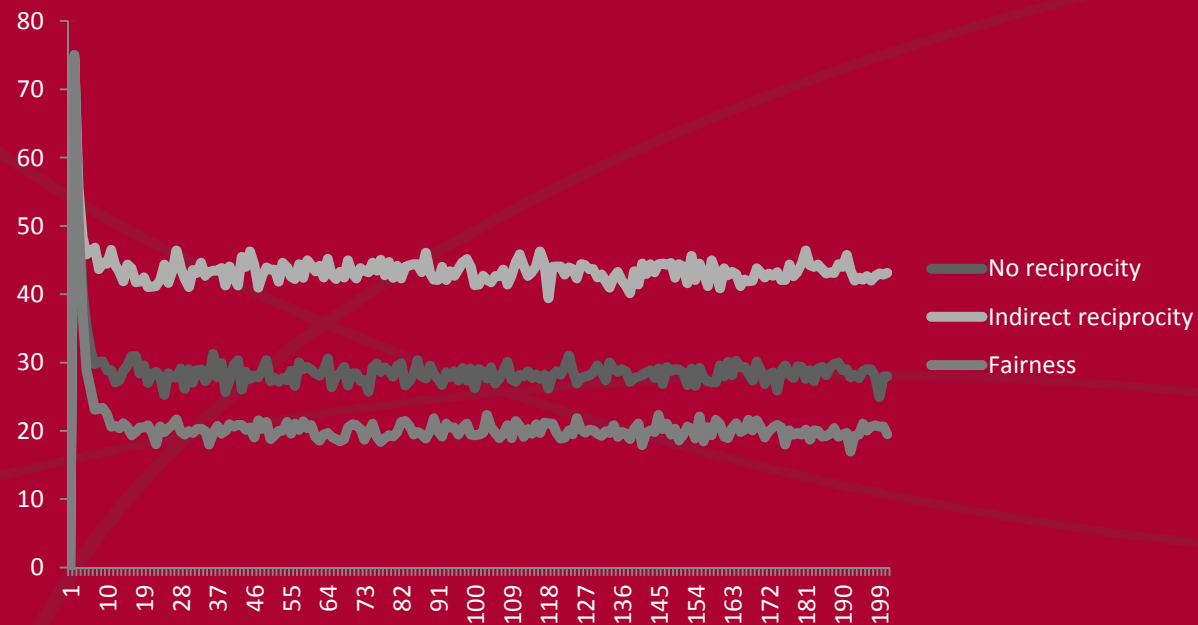


Scenario	Evaluation bias	Resource loss	Reviewing expenses
<i>75% of published submissions</i>			
No reciprocity	14.10	5.69	23.47
Indirect reciprocity	12.58	6.51	44.16
Fairness	13.14	7.48	40.61
<i>50% of published submissions</i>			
No reciprocity	26.32	15.65	30.32
Indirect reciprocity	25.32	12.64	39.88
Fairness	15.68	8.60	38.68
<i>25% of published submissions</i>			
No reciprocity	28.00	15.01	29.47
Indirect reciprocity	43.12	16.92	33.39
Fairness	19.52	8.32	38.29

**Tab. 2.** The impact of referee behaviour on the quality and efficiency of peer review in various selective environments (values expressed as percentage).



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## WSC (2016)



### Scenarios

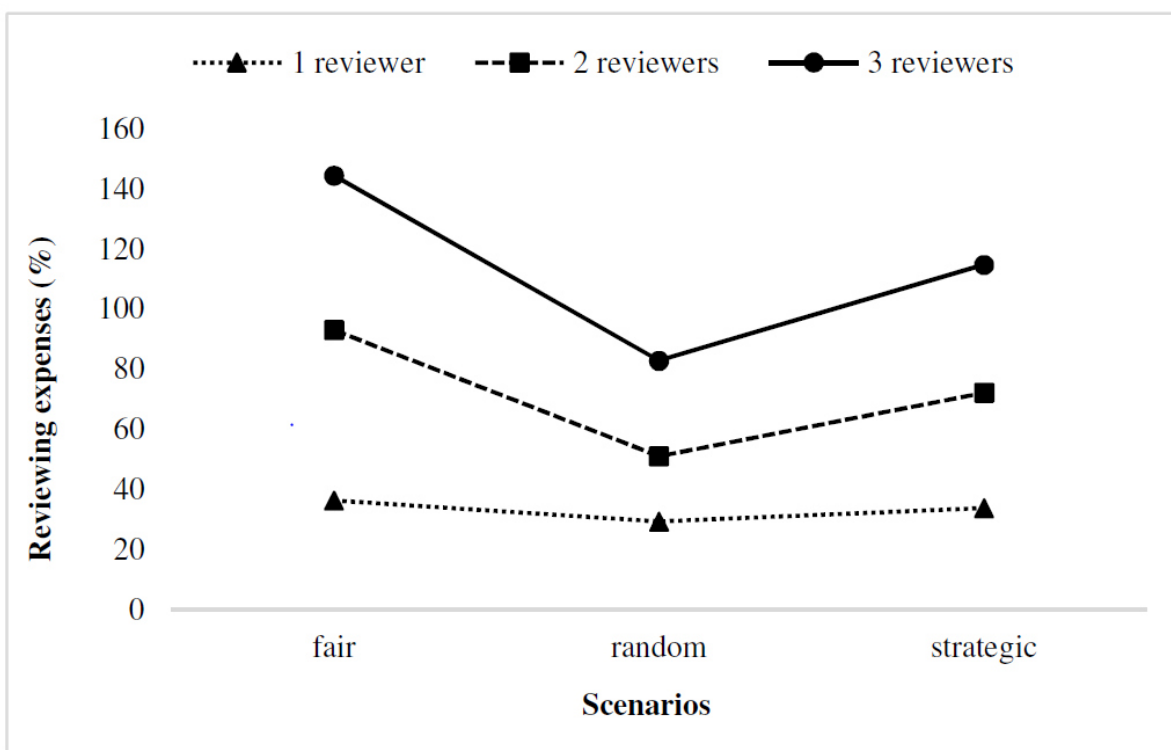
- ✓ Fair reviewers (altruistic)
- ✓ Random (selfish)
- ✓ Strategic reviewers (indirect reciprocity)

### Manipulations

- ✓ 1, 2 and 3 reviewers
- ✓ Different probability of unreliability

Table 2: The impact of unreliability by reviewers and multiple reviewers on the evaluation bias of peer review with multiple reviewers (values in percentage, averaged over 3,000 simulation runs,  $t = 200$ ).

Degree of unreliability of reviewers	Number of reviewers		
	1	2	3
0.00 ( <i>fair scenario</i> )	5.59	9.87	13.41
0.25 ( <i>random scenario</i> )	15.26	12.97	14.86
0.33 ( <i>random scenario</i> )	20.95	12.78	13.80
0.50 ( <i>random scenario</i> )	28.97	15.92	12.92
<i>Strategic scenario</i>	43.32	35.20	25.74



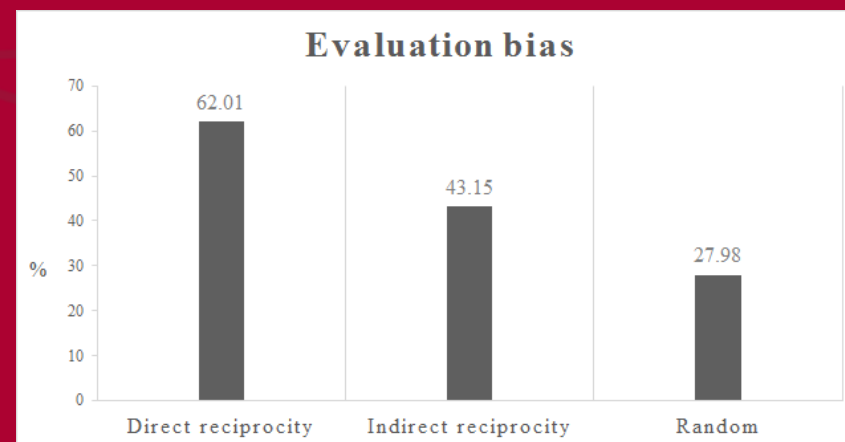


# Transparency implications



Evaluation bias				
Scenario	Number of reviewers			
	1	2	3	
random	27,98	14,98	12,43	18,46
reliable	5,05	9,39	13,19	9,21
strategic	62,01	49,05	33,15	48,07
unreliable	50,37	29,76	27,26	35,80
	36,35	25,80	21,51	27,89
Reviewing expenses				
Scenario	Number of reviewers			
	1	2	3	
random	29,49	50,30	81,30	53,70
reliable	35,26	92,77	144,12	90,72
strategic	23,10	46,85	70,55	46,83
unreliable	23,08	45,21	69,93	46,07
	27,73	58,78	91,48	59,33

Parameter	Value
Number of agents	240
Number of reviewers per author	[1, 2, 3]
Initial scientist resources	0
Fixed productivity gain	1
Number of accepted publications	30
Publication productivity multiplier	1,5
Evaluation bias by default	0,1
Author investment for publication	1
Reviewing expenses of unreliable reviewers	0,5
Underrating by unreliable reviewers	0,1
Overrating by unreliable reviewers	1,9
Velocity of best quality approximation	0,1



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## Key findings



- ❑ Peer review outcomes are strongly sensitive to scientist behavior
- ❑ The “luck of the reviewer draw” is not the worst case scenario
- ❑ Even minimal strategic behavior by reviewers might have significant implications on the quality of publications
- ❑ Open, transparent peer review might nurture excessive animal spirits
- ❑ The quality of peer review may be generally improved but at a serious cost, i.e., a resource drain from researching to reviewing, which could even achieve abnormal, unsustainable levels



What is missed here to increase cooperation?



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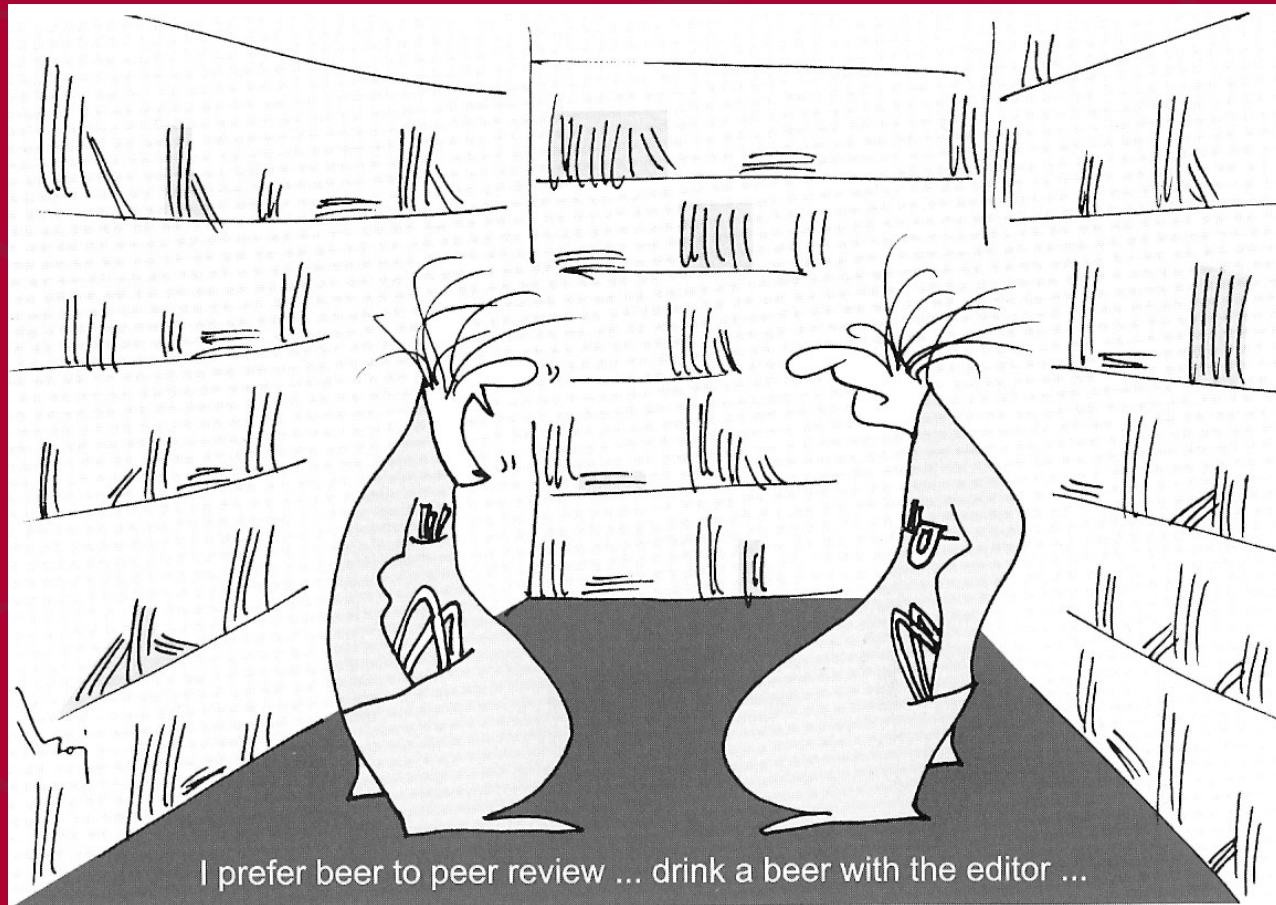
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