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RESEARCH PAPER

Let the crowd be my peers? How researchers assess the prospects of social peer review

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Abstract While Internet technologies have provided social networks for researchers as more open means to make their work available to other scholars, the traditionally closed, peer review-based publishing process has remained nearly untouched. We ask researchers about their intention to go one step further and use social peer review (SPR), which enables them to directly publish their work within a web-based social network, where, instead of the traditional pre-publication peer review, it can be evaluated and critiqued by the entire academic community. Based on a sample of 1429 international scholars from various fields and by drawing upon adoption and institutional theory, this study seeks to identify scientists' motivational drivers for engaging in this new forms of scholarly communication. We find that the adoption of SPR is driven more by extrinsic factors than by researchers' intrinsic motivation or normative influences to make science more open. Further challenges for SPR are low scores on the most relevant performance criteria, as well as low acceptance by established scientists. However, rather than a substitute, SPR is well perceived as a possible supplement to the traditional peer-based review system.

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Introduction

The Internet and related technologies have dramatically transformed the entire media industry in recent years and also the field of scholarly communication has not been excluded from this development. With open access (OA), authors of scientific publications can choose to pay the fees for readers to obtain access to their publications (Kingsley and Kennan 2015). In the "Golden Road" model, authors pay a publication fee to make the article freely accessible (Delamothe and Smith 2004). In the "Green Road" model, authors publish in traditional journals but additionally make the article available on personal, institutional repositories or third party websites (Mann et al. 2009).[1] Overall, OA has only affected certain parts of the publication system, namely the distribution and the financing of articles, but in general not the closed peer review process (Hess and Hoerndlein 2015). As part of this peer review process most journals employ editors that seek to ensure the highest quality standards by selecting the best content based on the recommendations of peer reviewers. It is important to note that editors' and peer reviewers' task is not just to make suggestions or take decisions on whether to accept or reject articles, but also to identify the papers with the

[1] Some authors also publish their work in a traditional journal and add preprint versions on a personal web-page. Although not an official form of open access, some publishers do not take any action against these behaviors, because they consider it relevant for their reputation or they have found a stable business model that allows for these specifics.

most potential and to work as "diamond-cutters", helping authors polish their work (Buhl et al. 2012; Straub 2008). Only after the manuscripts have successfully passed this traditional peer-based review, they are published in a journal and can be consumed by the journal's general audience.

More recently, social networks for researchers (such as ResearchGate or Academia.edu) have become more popular as distribution channels. However, in many cases scientists use these social networks merely as complementary channels to publish either work in progress or research that has previously been published elsewhere. Today, the technical capabilities of social networks and other platforms could easily be expanded to cover the entire publishing process, making them the primary source for publications while enabling a more open form of reviewing: social peer review (SPR). By following the principles of social computing (i.e., "the computational facilitation of social studies and human social dynamics as well as the design and use of ICT technologies that consider social context", Wang et al. 2007, p. 79), SPR manuscripts are published instantly within the social network platform as the primary source of publication. Once published on the platform, manuscripts can be evaluated and commented on by the platform's entire academic community in an open manner. SPR could increase the transparency throughout the entire review process and enable a faster time to publication, for instance. It might also offer the potential to distribute the diamond-cutter role of editors and reviewers among a higher number of researchers, who could all contribute to the quality of the article with their individual knowledge and experiences.

Despite these potential advantages, SPR has only caught limited attention in practice and research and it remains unclear, why the development and adoption of SPR lags behind the technological capabilities. While research on OA has focused on the distribution and financing of scholarly communication and its business models, there is still a lack of research on other essential aspects of scholarly communication, namely the production system as well as suitable means of quality control when scientific results are communicated in non-traditional channels (Berger et al. 2015). There are first works on scholars' acceptance of Web 2.0 technologies for research (Ponte and Simon 2011), but the motivational drivers for scientists engaging in more open forms of science are still to be analyzed (Franzoni and Sauermann 2014). Our study therefore sets out to close this research gap by assessing scientists' expectations on SPR and by identifying factors that could foster or impede its adoption and diffusion. We therefore ask the following research questions:

– What are the motivational drivers for scientists to engage in SPR?
– What are the main advantages scientists expect from SPR?
– How do scientists see the prospects of SPR in comparison to traditional peer reviews?

Analyzing SPR as an alternative to traditional peer review is of high interest not only for science, but also beyond. For instance, there are panels on climate change or other legal decisions and regulations that also base their judgements and actions on peer-reviewed literature (Alberts et al. 2008). To find answers to our research questions we conducted a large-scale survey among international scholars from different fields. This allowed us to empirically assess researchers' motivations and expectations, as well as the impediments for a departure from the traditional system of scholarly communication. Our study contributes to research and practice in manifold ways. First, it sheds more light on the technology-driven transformation of scholarly publishing by identifying researchers' motivational drivers to adopt a new innovation in this field. Second, it leads to new insights on the substantial challenges that the media industry faces with the digital transformation (Hess et al. 2016), in scenarios which are governed by both technological and social factors. Third, it adds to extant research on adoption and usage of social computing, which has already found its way in other areas.

The remainder of this paper is structured as follows: We first outline the conceptual foundations of the transformation of academic publishing in the last decades, before describing the research model, its underlying theoretical basis, and the implementation of our study. Lastly, we present the results of our survey and discuss the findings as well as further implications for research and practice.

Conceptual foundations

Traditional (closed) scientific publishing

The traditional system of scholarly communication is based on three basic principles: First, scientists submit their manuscripts to an intermediary, mostly a scientific publisher or a scientific organization (such as AIS or IEEE) that runs a journal in which academic work can be presented and published. Nowadays, for most journals, this step is conducted through an online publishing-system, from which the manuscript is accessible to other stakeholders in the process. Second, prior to publication in reputable journals, research manuscripts usually need to pass scientific peer review. This procedure has basically remained unchanged since its origins in the mid-seventeenth century (Sun 1989) and is performed by a handful of individuals (often two to four). The reviews and the remainder of the publishing process are usually also conducted through an electronic publishing system, which can easily connect authors, editors and peer reviewers from all over the world. Third, scientists compete for limited space in a journal.

Together with the peer reviewers, it is the editor's task to identify those articles that have the most potential. Even if the manuscript has not yet reached publication readiness when initially submitted to the journal, editors and reviewers should act as diamond-cutters and help the authors shape their work (Straub 2008). For those articles that do not succeed in this process, editors and reviewers function as gatekeepers (Hess and Matt 2013); they thereby reduce the information overload on readers, who are only able to absorb a certain number of articles (Suls and Martin 2009).

The outcome of the publication processes is important for scientists, since a journal publication serves as a way of communicating their research to others, which can help strengthening their reputation in return. Scientists' careers depend on "reputational credits", which they can leverage to gain raises, promotions, and funding (Squazzoni et al. 2013; Stephan 1996). Since reputation is related to citation counts, scientists are likely to submit their manuscripts to journals (or conferences) with a good trade-off between the expected effort for the publication of an article and the number of citations that is likely to result from it. Journals also strive for reputation. This is important not only for the level of impact the journal can have within a scientific discipline, but also in terms of higher revenues that can be generated for granting access to its content. The quality of the published articles is one main driver of the reputation of a journal. In some fields of research it might not even be the number of citations that counts most, but for instance the perceived reputation of the journal that decides upon the appraisal of a publication in the community. Altogether, these reputational reward mechanisms encourage scientists to make their findings publicly available and they help solving the appropriability problem associated with the production of a public good (Partha and David 1994; Stephan 1996).

It has been argued that science and its standing in society could not have been achieved without the role of the peer review process (Alberts et al. 2008). However, the peer review process has been criticized for being slow, expensive and subjective (Smith 2006; Ware 2011). It has also been criticized that peer review would favor the publishing of positive findings at the expense of non-confirming findings, and that submissions from prestigious universities and researchers would unfairly profit (Suls and Martin 2009). Last, despite usually employing several peer reviewers per article, it has been found that published articles can still contain errors and scientific fraud might slip through the editorial net (Ioannidis 2005). Taking the current technological developments into consideration, one can also hold that the concepts of limited journal space and editorial filtering do not correspond with the virtually unrestricted amount of information that is available on the Internet, and that peer review does not exploit new search technologies that enable individuals to handle and select from larger collections of information themselves.

Social computing and the scientific publication process

Social computing has already been influential in the creation, organization, and sharing of information outside of science, as can be seen in the popularity of online encyclopedia (especially Wikipedia), or social bookmarking sites (e.g. Digg, Reddit). In addition, it has had an impact on the creation and evaluation of ideas and (open) innovation (Chesbrough 2006). Applications of social computing can already be found in the realm of science (Friesike et al. 2015). In the process of scientific discovery, crowd science uses web technologies to combine open project participation and the open disclosure of intermediate research outputs (Franzoni and Sauermann 2014). Services such as Mendeley allow for the sharing of references among scientists, while services such as Naboj allow scientists to comment on each other's research deposited on arXiv.org. Altmetric and other websites aggregate and visualize the impact that publications have in non-traditional publication channels such as social bookmarking. ImpactStory lets researchers display the impact of research artifacts other than traditional articles (e.g. datasets, presentations, or software code).

Social networks for scientists, such as ResearchGate and Academia.edu, which help facilitate collaboration among scientists, have become immensely popular in recent years. As of August 2014, ResearchGate, for instance, had more than five million members, with a focus on biomedical sciences and technology, and it had 67 million publications indexed, of which 14 million were full texts.[2] With "RG Score" ResearchGate provides a measure of scientific reputation for each scientist that is also influenced by a researcher's effort on the platform. RG Score has been found to moderately correlate with traditional measures for the reputation of academic institutions (Thelwall and Kousha 2015).

The aforementioned efforts contain elements of SPR, namely the open sharing of research on a common platform, the possibility for researchers to provide feedback on other research, and a reputation measure within the platform. However, SPR goes one step further and allows new research to be published instantly on the platform where it is directly subject to a feedback process in which the platform's entire academic community can participate. Similar to traditional peer review, authors are expected to react to this feedback and integrate it into their work. The overall goal is to improve research with the help of the entire audience, rather than a small number of editors and peer reviewers who conduct a

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closed peer review process that is usually not apparent to the academic or the general public. SPR is not double-blind, both authors and reviewers know the identity of each other, promoting an open and transparent environment for academic discussion. As part of this process, both authors and reviewers profit from publishing and commenting on the platform as they can gain more reputation within the community. Altogether these characteristics address several shortcomings of the traditional peer review process: First, they increase transparency concerning who is responsible for the review and they enable the direct interaction between authors and reviewers. Second, given the higher number of potential reviewers for an article, this could speed up peer review processes. Third, this might also enable higher diversity and better chances for non-confirmative thoughts owing to SPR's flat hierarchies.

However, to date there are only few approaches in practice that have fully established SPR. In March 2014, ResearchGate has introduced "Open Review". This feature allows every scientist to provide feedback on other scientists' research in an open and more transparent way. Although the focus of Open Review is on verifying the reproducibility of research, the review can include feedback on facets such as methodology, analyses, references, and conclusions. Academia.edu, now accounting for more than 25 million users, has started its first attempts to promote SPR with a feature called "Sessions" (TechCrunch 2015). Despite these first efforts to provide open mechanisms to replace traditional pre-publication peer review, the integration of the entire publication process on social networks for scientists and the shift away from traditional peer review has not yet happened. With a full implementation of SPR, these procedures could change fundamentally, making social networks for researchers a primary source for publications. Our work seeks to discover whether scholars could imagine adopting SPR and it seeks to identify the intentions and expectations that they would expect from this change.

Research model and implementation

Theoretical concept and operationalization

Instead of purely focusing on technological aspects, research has begun to start paying more attention to the integration of social artifacts, considering IT within its socio-economic and political context (Currie 2009; Orlikowski and Barley 2001). Hence, we incorporated two theoretical decision perspectives when asking whether scientists would be willing to engage in SPR: the adoption of an IT-driven innovation and the decision to engage in behavior that deviates from an "institutionalized" mode. It is essential that both perspectives are considered simultaneously, since the adoption of technology-driven innovations does not occur in a "social vacuum" (Orlikowski and Barley 2001), especially when strong cultural values are likely to shape the perception and adoption of innovations, as is the case in the scientific community (Merton 1973; Polanyi 1962).

However, there has only been sparse usage of institutional theory on an individual level at the adoption stage of the innovation process (Mignerat and Rivard 2009). Our research model draws on the work of Hoerndlein et al. (2012), who rigorously developed and combined constructs from institutional theories with aspects of individual technology adoption and who called for further research at this cutting point. Hence, we adopted constructs from the Unified Theory of Acceptance and Use of Technology (UTAUT 2) and the institutional literature and incorporated them in our research model. As the main dependent variable of our study we measured the intention to use SPR. In addition, we included the following five sociodemographic control variables in the model: age, gender, field of research, geographic location, and scientists' position in the academic hierarchy. We measured all constructs with at least three reflective items on a 5-point Likert scale (Appendix 1). Figure 1 presents a conceptual visualization of our research model.

UTAUT 2 (Venkatesh et al. 2012) is a recent theory on technology adoption in information systems research and has been applied to a variety of research settings, such as the participation of academics in virtual academic communities of practice (Nistor et al. 2014) and the adoption and use of social media services (Chong and Ngai 2013) – both represent contexts that are very similar to the focus of our study. We profit from these previous works and take UTAUT 2 as a theoretical basis that allows us to consider for individual-level factors of

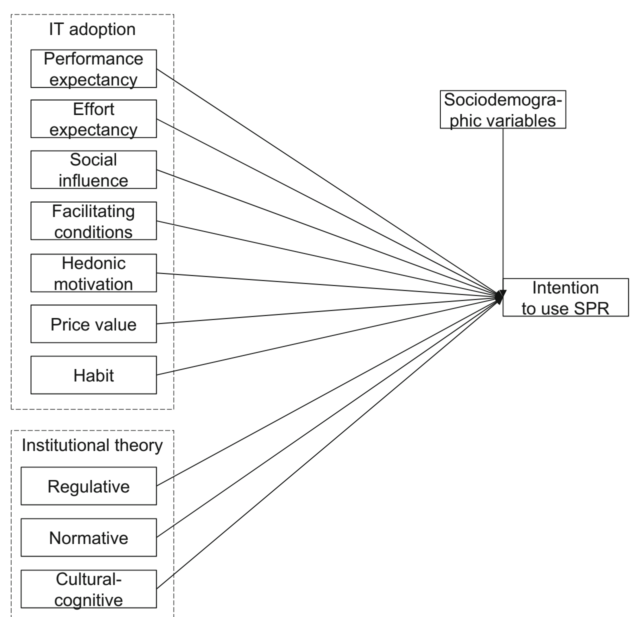

Fig. 1 Conceptual research model

technology acceptance, while also taking into account user-specific environmental factors. We integrated the following seven factors:

- Performance expectancy: "*the degree to which an individual believes that using the system will help him or her to attain gains in job performance*" (Venkatesh et al. 2003, p. 447)
- Effort expectancy: "*the degree of ease associated with the use of the system*" (ibid., p. 450)
- Social influence: "*the degree to which an individual perceives that important others believe he or she should use the new system*" (ibid., p. 451)
- Facilitating conditions: "*the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system*" (ibid., p. 453)
- Hedonic motivation: "*the fun or pleasure derived from using a technology*" (Venkatesh et al. 2012, p. 161)
- Price value: "*[the] cognitive tradeoff between the perceived benefits of the [technology] applications and the monetary cost for using them*" (ibid., p. 161)
- Habit: "*the extent to which an individual believes the behavior to be automatic*" (ibid., p. 161)

Institutional theory as the second pillar of our research model addresses how actors are shaped by powerful influences that are not covered by neoclassical rational-actor models (Friedland and Alford 1991). The origins of institutional theory can be traced back to the works from Meyer and Rowan (1977), Zucker (1977), and Dimaggio and Powell (1983). Institutional theory's core concept relates to the "tendency for social structures and processes to acquire meaning and stability in their own right rather than as instrumental tools for the achievement of specialized ends" (Lincoln 1995, p. 1147). Scott (2008) takes stock of the different meanings of institutions and integrates them into the following definition: "Institutions are comprised of regulative, normative and cultural-cognitive elements that, together with associated activities and resources, provide stability and meaning to social life" (p. 48). The regulative pillar operates through rule-setting, monitoring, and sanctioning through either informal pressures of customers or suppliers (Teo et al. 2003) or through highly formalized mechanisms, such as courts or the police (Scott 2008). Following Scott (2008), the normative pillar is connected to social obligations and how they form binding expectations for one's behavior. The cultural-cognitive pillar and its mimetic mechanisms result from taken-for-granted conceptions and a shared understanding of one's environment.

Scenario and data collection

To derive expectations regarding new forms of scholarly communication, identify its strengths and weaknesses, and determine the factors that would foster or impede its adoption, we conducted a web-based survey among an international and interdisciplinary sample of scientists. We presented participants with a scenario of a fictional SPR platform for researchers and described its functionality along the process flow of a research article, starting with its submission to the platform. Hence, the scenario mainly depicted an author's submission perspective, but participants were asked to incorporate their overall experience as a scientist (which may include experiences from editor or reviewer roles) to determine their appraisal of SPR.

We explained participants that once they have uploaded their research on the fictional platform it is published immediately without prior peer review and it enters a community based social peer review process thereafter. As part of this, the research can be rated and critiqued by the entire academic community. Any comments can also be rated and discussed to enable an interactive way of communication, and the authors are asked to respond and incorporate this feedback. A "reputation index" is automatically calculated by aggregating positive/negative votes to assess the quality and impact of the work attributable to individual authors, research groups, and institutions. It was assumed that both the submission of and the access to the research on the platform are free.

We invited 24,012 scientists from different fields and countries to participate in our survey, out of which 1634 completed the survey, corresponding to a response rate of 6.8%. No incentives were offered for the participation in the survey. The mean completion time was just over 15 min and the median time was slightly below 15 min. We excluded participants from Asian countries other than China and India, participants from Australia/Oceania, and participants from Latin America other than Brazil, since these groups had very few cases that did not allow for a further evaluation with the bootstrapping procedure. For the same reason, architecture was excluded as a field of research. We also excluded industry researchers, since they show motivational structures different from purely academic researchers (Haeussler 2011; Sauermann and Roach 2014). This resulted in a dataset with 1429 cases. Table 1 shows the composition of the survey participants along the dimensions location, field of research, position, age, and gender.

For any question that participants were asked, we gave them the choice to not respond in case they did not feel comfortable with or did not have an opinion/knowledge to answer the question. Hence, the sample size of each analysis varies dependent on how many participants responded to all of the construct's underlying questions. We have chosen the more conservative approach of removing all responses of participants that have not answered all underlying relevant items to avoid potential bias related to mean-value replacements in case of large numbers of non-responses.

Table 1 Sociodemographic information of respondents (n = 1429)

	%	N
Geographic region		
Asia – China	16.3%	233
Asia – India	16.1%	230
Europe	39.9%	570
Latin America - Brazil	5.9%	84
North America	21.3%	305
not answered	0.5%	7
Academic position		
Full Professor / Reader	39.0%	557
Associate Professor / Senior Lecturer	23.6%	337
Assistant Professor / Lecturer	16.5%	236
Post-doctoral Researcher	13.1%	187
PhD Student / Junior Researcher	7.1%	102
Graduate Research Student	0.6%	8
not answered	0.1%	2
Field of research		
Behavioral Science / Psychology	5.3%	76
Biomedical and Life Sciences	23.0%	329
Business and Economics	9.6%	137
Chemistry and Materials Science	5.2%	74
Computer Science	3.8%	54
Earth and Environmental Science	4.8%	69
Engineering	16.0%	228
Humanities, Social Sciences and Law	7.0%	100
Mathematics and Statistics	9.2%	132
Medicine	3.0%	43
Physics and Astronomy	8.0%	115
Other	4.8%	68
not answered	0.3%	4
Gender		
male	77.8%	1112
female	21.6%	308
not answered	0.6%	9
Age		
< 30	6.4%	92
30–39	29.4%	420
40–49	27.9%	398
50–59	19.2%	275
60 and higher	14.6%	209
not answered	2.4%	35

Evaluation of the measurement instrument

Data was analyzed using partial least squares structural equation modeling with SmartPLS (Ringle et al. 2012). The reflective constructs were assessed in terms of their internal consistency reliability as well as their convergent and discriminant validity. Composite reliability values were greater than the recommended threshold of 0.7 (Hair et al. 2011). Values for the constructs' average variance extracted were above 0.5 and higher than the squared inter-construct correlations, indicating convergent and discriminant validity respectively (Fornell and Larcker 1981). Table 2 shows the inter-construct correlations along with the measures for reliability and validity.

Results

Overall model

To analyze the explanatory power of the theoretical concepts, we calculated two different models: One with only the control variables and one aggregated model with both theoretical concepts and control variables (Table 3). The control variables only explained 14.0% of the variance of scientists' intention to adopt SPR, while our aggregated model explained 78.7% of the variance. The substantial difference of more than 64% percentage points indicated that the theoretical constructs possess substantial explanatory power Using a blindfolding procedure, we obtained a Q^2 value of 0.719 for the cross-validated redundancy for the endogenous construct to measure the intention to adopt SPR, indicating that the model exhibits predictive relevance.

Next, we analyzed the influence of the theoretical constructs' effects. Performance expectancy emerged as the strongest predictor of scientists' intention to use SPR, followed by social influence, and effort expectancy. The positive impact of hedonic motivation underlines the requirements to design SPR as a process and the underlying platform in a way that stimulates researchers in an affective manner. Habit was assessed with reference to the use of traditional publishing options. Consequently, habit showed a negative influence on the intention to use SPR, indicating higher resistance the more a researcher is used to rely on traditional options. Interestingly, monetary aspects that are often put forward by the proponents of OA publishing (here measured by price value, which includes potential savings to individual scientists as well as savings to their home institutions), did not have a significant impact. Likewise, facilitating conditions did also not have a significant impact on intention to use. Normative influences, such as open participation (Franzoni and Sauermann 2014) and a broader dissemination of research results (Sauermann and Roach 2014), which are often considered to be the driving force behind open science, had only a fairly small impact on scientists' intention to use SPR. Concerning the other two institutional factors, cultural-cognitive aspects exhibited a very small influence, while regulative factors did not influence scientists' intention to adopt SPR. Controlling for sociodemographic factors, neither scientists' age, gender, nor their position in the academic hierarchy had a direct impact on intention to use. Regarding the influence of a scientists'

Table 2 Inter-construct correlations and reliability/validity of measurement instrument

	Mean	SD	Composite Reliability	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) Performance Expectancy	3.10	1.21	0.964	0.898										
(2) Effort Expectancy	3.54	1.08	0.955	0.585	0.875									
(3) Hedonic Motivation	2.96	1.15	0,934	0.663	0.525	0.824								
(4) Facilitating Conditions	3.08	1.03	0.935	0.822	0.604	0.668	0.705							
(5) Price Value	3.22	1.17	0.924	0.586	0.480	0.511	0.645	0.801						
(6) Social Influence	2.64	1.14	0.971	0.729	0.486	0.555	0.723	0.564	0.919					
(7) Habit	4.03	0.90	0.923	-0.230	-0.073	-0.176	-0.166	-0.127	-0.171	0.811				
(8) Cultural-Cognitive	3.32	0.99	0.864	-0.192	-0.118	-0.120	-0.106	-0.128	-0.101	0.443	0.680			
(9) Normative	3.35	1.07	0.935	0.796	0.593	0.715	0.810	0.611	0.670	-0.169	-0.184	0.742		
(10) Regulative	3.89	1.02	0.920	-0.047	0.026	-0.014	-0.056	0.003	-0.076	0.515	0.351	-0.033	0.793	
(11) Intention	3.05	1.25	0.975	0.822	0.629	0.685	0.787	0.575	0.743	-0.241	-0.139	0.775	-0.093	0.929

Average variance extracted (AVE) on diagonal

geographical region and academic discipline, only Brazil and the field of engineering had a positive, but very small impact.

Results on performance expectancy

Since performance expectancy emerged as the strongest predictor of the intention to use SPR, we sought to gain a more detailed understanding of the specific aspects that drive scientists' perceptions of SPR's usefulness, thus identifying the motivational drivers for engaging in this alternative form of publishing. To analyze the main drivers for performance expectancy, we performed a redundancy analysis (Cenfetelli and Bassellier 2009; Chin 1998) by regressing the reflectively measured construct on a formatively measured construct with 14 items (Table 4). This approach allowed us to identify the drivers of performance expectancy indirectly, i.e. without asking the respondents directly about the importance they would place on the different indicators, which could have distorted the findings through social desirability bias (Fisher 1993).

Table 4 shows the ranking of the most influential factors along with their mean values, measured on a scale from 1 (lowest) to 5 (highest), and their statistical significance. Variance inflation factors were below the recommended threshold of 5 (Hair et al. 2011), indicating that multicollinearity is unlikely to have affected the validity of the redundancy analysis. The three most influential factors were "be perceived as innovative", considering SPR as an "alternative to publishing in a high-quality journal", and being "helpful to decide which papers to read". In contrast, factors such as "network with other researchers", "improve own research through feedback", and "publish research quickly", turned out to be non-significant. Moreover, consistent with our previous finding that normative influences only had a limited impact on adopting SPR, intrinsic aspects such as disseminating results to the broader scientific community were not found to be among the most important drivers of the performance expectancy (cf. values for the indicators "have an impact on society" and "reach many readers"). Besides, indicators with higher mean values (italics in Table 4) were found to be less important to researchers (i.e. exhibiting lower β values) than most indicators with lower mean values. This indicates that SPR was perceived to lack performance on the criteria most relevant to scientists when they judged SPR's usefulness.

To account for potential differences subject to researchers' experience with social networks for scientists, we analyzed whether the motivational drivers differed between researchers who used existing social networks (such as ResearchGate or Mendeley) at least occasionally and those who have never used them. As shown in Table 4, the three factors with the highest β coefficients had lower mean values (indicating their current satisfaction) than the median of 3.245.

Various other noticeable findings emerged: while we found gaining reputation through giving high-quality feedback to be an important factor for scientists not using scientific collaborative platforms, it played no role for scientists who already used these services. The former group did also not consider SPR to be an important venue for having their research scientifically validated, but they would appreciate improving their research through the feedback they obtain through SPR.

Since the main function of traditional peer review is to assure the quality of publications, we asked scientists whether they could imagine that SPR is able to fulfill equivalent functionalities. The results suggested that scientists had medium confidence (mean = 2.96 out of 5) in SPR as a new way of conducting quality assurance in science. However, as indicated in Table 5, this perception varied subject to scientists' position (one-factorial ANOVA: $F(4, 903) = 6.113$, $p < 0.01$).

Table 3 Regression results (Independent variable: intention to adopt SPR)

	Step 1		Step 2	
	β (t values)		β (t values)	
Age	-0.076$^{n.s.}$	(1.897)	0.059$^{n.s.}$	(1.854)
Gender	-0.001$^{n.s.}$	(0.039)	-0.013$^{n.s.}$	(0.809)
Position	0.141***	(3.384)	0.052$^{n.s.}$	(1.788)
dummy "region" (baseline: Europe)				
Brazil	0.072*	(2.293)	0.055*	(2.545)
China	0.171***	(5.525)	-0.026$^{n.s.}$	(1.275)
India	0.219***	(6.346)	0.016$^{n.s.}$	(0.810)
North America	-0.068*	(2.158)	0.023$^{n.s.}$	(1.230)
dummy "area of research" (baseline: Biomedical & Life Sciences)				
Behavioral Science & Psychology	-0.003$^{n.s.}$	(0.175)	0.012$^{n.s.}$	(0.718)
Business & Economics	0.049$^{n.s.}$	(1.591)	0.009$^{n.s.}$	(0.505)
Chemistry & Materials Science	-0.001$^{n.s.}$	(0.079)	0.003$^{n.s.}$	(0.228)
Computer Science	0.034$^{n.s.}$	(1.398)	-0.005$^{n.s.}$	(0.340)
Earth & Environmental Science	-0.095**	(2.938)	0.012$^{n.s.}$	(0.987)
Engineering	0.016$^{n.s.}$	(0.666)	0.066*	(2.423)
Humanities, Social Sciences and Law	0.036$^{n.s.}$	(1.256)	0.004$^{n.s.}$	(0.228)
Mathematics & Statistics	-0.029$^{n.s.}$	(1.200)	-0.009$^{n.s.}$	(0.566)
Medicine	0.034$^{n.s.}$	(1.454)	0.001$^{n.s.}$	(0.059)
Other	-0.037$^{n.s.}$	(1.407)	-0.001$^{n.s.}$	(0.034)
Physics & Astronomy	0.049$^{n.s.}$	(1.541)	0.014$^{n.s.}$	(0.923)
Performance Expectancy			0.333***	(6.477)
Effort Expectancy			0.152***	(4.478)
Hedonic Motivation			0.125**	(3.143)
Facilitating Conditions			0.086$^{n.s.}$	(1.815)
Price Value			-0.002$^{n.s.}$	(0.128)
Social Influence			0.217***	(5.047)
Habit			-0.067*	(2.358)
Cultural-Cognitive			0.051*	(2.005)
Normative			0.119*	(2.435)
Regulative			-0.047$^{n.s.}$	(1.639)
R^2	14.0% (N = 1073)		78.7% (N = 512)	

Regression weights based on casewise deletion, t values based on bootstrapping with 1000 replications

***, ** and * indicate significance at the 0.1%, 1% and 5% levels

The more senior researchers were, the more skeptical they were towards SPR's role as a means of quality assurance. This aspect might prove to be essential for the adoption of SPR, since it is often the more senior authors that tend to have a stronger impact in the traditional publishing system.

SPR's positioning compared to traditional peer review and importance of peer use

Since traditional peer review is still the dominating model and SPR has yet to be established on a large scale, we sought to obtain an overall assessment of the chances that scientists see for SPR's success in comparison to traditional peer review. In particular, we asked participants about how they saw the chances that SPR could replace respectively complement traditional publishing. As Figure 2 shows, scientists mostly agreed that SPR would not replace traditional publishing: only 12.9% considered this likely or very likely, while 65.1% considered it very unlikely or unlikely. However, scientists' assessment was the opposite regarding whether SPR would complement traditional publishing: more than half of the scientists (56.9%) considered this likely or very likely.

It is important to note that SPR is a specific form of social computing, trying to make traditional peer review processes more transparent by using the strength of the academic crowd in virtual social spaces. Scientists strive to gain reputational

Table 4 Redundancy analysis performance expectancy

	full sample (n = 914)		already using social networks for researchers (n = 259)		not yet using social networks for researchers (n = 655)	
Indicator	β	mean (out of 5)	β	mean (out of 5)	β	mean (out of 5)
Be perceived as innovative	0.225*	2.96	0.210*	3.58	0.241*	2.94
Alternative to publishing in a high-quality journal	0.160*	2.98	0.190*	3.50	0.149*	2.77
Helpful to decide which papers to read	0.157*	3.06	0.266*	3.66	0.137*	3.02
Gain a reputation through giving high-quality feedback	0.124*	3.12	0.117	*3.71*	0.116*	3.06
Have own research cited frequently	0.109*	3.19	0.017	3.65	0.155*	*3.09*
Reach right target group	0.085*	*3.25*	0.155*	*3.78*	0.062	*3.23*
Have an impact on practitioners	0.081*	*3.39*	0.129	3.62	0.070*	3.02
Improve own research through feedback	0.066	*3.50*	0.235*	*3.82*	0.003	*3.37*
Have an impact on society	0.061*	*3.60*	0.070	3.53	0.041	2.88
Make own research more easily found	0.061*	*3.61*	0.107	*3.92*	0.047	*3.48*
Have own research scientifically validated	0.055	*3.70*	-0.119	3.40	0.116*	2.79
Network with other researchers	0.033	*3.75*	-0.098	*4.08*	0.073*	*3.62*
Reach many readers	-0.001	3.20	-0.041	*3.89*	0.003	*3.51*
Publish research quickly	-0.005	3.24	0.015	*3.89*	-0.004	*3.62*

Note: *indicates significance at the 5% level, italic items with mean values higher than the median of 3.245

credits within their academic community, which can also be seen as a complex social structure in which the interaction between researchers also determines the acceptance of research works. Therefore, we assumed scientists' expectation of whether their peers would use SPR to be an important factor for their own adoption. Our analysis showed that social influence was strongly driven by whether scientists anticipated that other scientists in their field would use SPR (correlation coefficient $r = 0.60$, $p < 0.01$). We analyzed the direct influence of anticipated peer use on intention to use SPR by dividing the sample into four groups with increasing levels of anticipated peer use. For each of the four groups we report how many percent of the scientists thought that SPR would replace or complement traditional peer review (Table 6). The results indicate that scientists who expected their peers to use SPR were also much more likely to adopt SPR themselves.

Discussion and implications

With this study, we sought to identify scientists' perceptions and their expectations of SPR as an alternative to the traditional system of peer review based scholarly communication. Our findings lead to interesting implications and contribute to research and practice.

First, our empirical results shed more light on researchers' motivational drivers to leave well-established structures in academia behind and adopt a new technology-driven innovation that is strongly based on social interaction between researchers. We find that scientists' intention to use SPR is strongly influenced by extrinsic motivational factors related to individual perceptions of its usefulness. However, SPR currently still lacks the necessary performance on the most important drivers of usefulness, namely SPR's ability to make them appear as innovative, SPR's status as a well-respected alternative to publishing in a high-quality journal, and its helpfulness in deciding which publications to read. Neither SPR's potential to make scientific communication cheaper nor normative influences associated with open science have a major impact on its adoption. Therefore, it is unlikely that these external factors will lead scientists to adopt SPR if no system is provided that comes closer to what traditional outlets deliver in terms of the aforementioned performance indicators. This is an important aspect, not only since the reputation of researchers is still mostly based on traditional criteria (e.g. the quality of the journals and the number of citations), but also since structural incentives for researchers are governed by these factors. While for young researchers this could decide

Table 5 Perception of SPR as a means of quality assurance in science

	Ø	n
Full Professor / Reader	2.76	360
Associate Professor / Senior Lecturer	2.91	208
Assistant Professor / Lecturer	3.09	164
Post-doctoral Researcher	3.27	109
PhD Student / Junior Researcher	3.39	67
Overall mean / total n	2.96	908

Ø: mean value (out of 5) of the indicator "SPR would allow me to have my research scientifically validated", excluding graduate research students

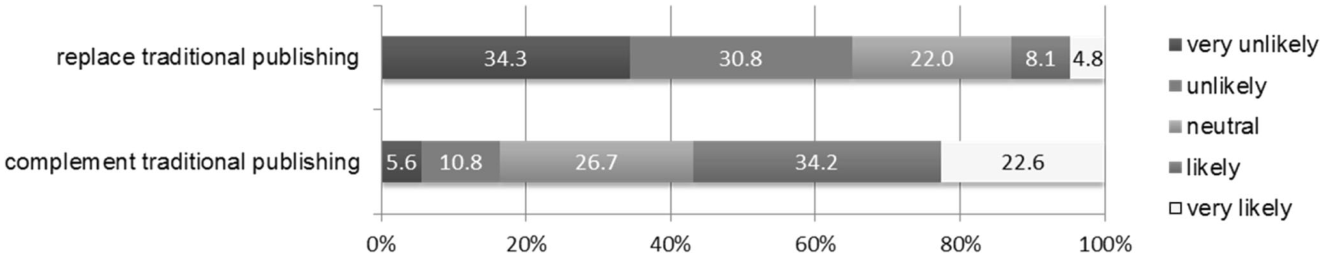

Fig. 2 Social peer review as a substitute or complement for traditional publishing

upon tenure decisions, for more established researchers this could primarily impact fundraising opportunities and industry recognition. Furthermore, the more senior scientists are, the more critical is their attitude towards SPR's potential for providing new means of scientific quality verification. This could be related to senior scholars' existing power in the traditional publishing outlets and their experience and faith in the current system with reviewers and editors working as diamond-cutters, identifying and helping the authors polish their work. However, it is also plausible that senior researchers are just less experienced with social networks and as a consequence less open towards SPR.

For a successful diffusion, it will be important to clearly communicate the advantages of SPR to users, and to build up trust in the SPR system (Ajjan and Hartshorne 2008). Compared to traditional peer review, with SPR, a greater number of scholars could engage in these processes and bring in their expertise. However, missing structures and hierarchies in SPR communities might at the same time become an obstacle for a clear and structured polishing process. Adequate reviewer assignment is critical in all publication processes, and authors need to trust journals to appoint adequate reviewers, but even the traditional system of peer reviewer assignments does not always meet these expectations (Li et al. 2015). However, without transparent and firm procedures this might become even more difficult to ensure for SPR and in the end, it might be up to the authors to assess the reviewers' qualifications when receiving feedback on SPR platforms.

Our results have important implications for research on adoption and usage of social computing, which has already found its way in other areas (Parameswaran and Whinston 2007). We found a strong indication that the intention to adopt SPR depends on the extent of anticipated peer use. Regardless of rational-efficient choices, the adoption of new social forms of publishing by a minimum number of early adopters could trigger the adoption through other scientists who are not yet convinced of the innovation's merits, but who do not wish to be left out and use the innovation simply because "everybody is using it". This is similar to the "bandwagon effect" (Abrahamson and Bartner 1990), which is expected to be even stronger for those IT-based innovations that are likely to be affected by strong network effects (Katz and Shapiro 1985). However, what differs here compared to most other forms of social computing (e.g. social media or online wikis) is the complexity of the content and the different processes it takes to improve the content. While social media often almost accepts any form of content, online wikis already require a quality control system to ensure that the content is accurate. For academic publishing, content is usually even more specialized and only a handful of people is sometimes able to evaluate it. One open question is whether the entire academic community should be able to evaluate other's manuscripts independent of their own skills or proximity to the content. On the other hand, to keep voluntary participation high, it also needs to be ensured that not only authors, but also SPR reviewers have an incentive to continuously contribute on SPR platforms. Stimulating and preserving user engagement is not just important for the attractiveness and survival of any Web 2.0 community (Yan et al. 2013), given the complexity of the content and the potential effort of voluntary contributions, it seems particularly crucial for SPR. While our work has provided better insights into scientists' motivational drivers, it remains to be answered how these can translate directly into incentives on SPR platform.

This aspect also relates to the importance of adequate governance of systems for academic publishing. This is by far not only limited to technological questions, since it closely relates

Table 6 The influence of anticipated peer use

	mean intention (out of 5)	% consider it a replacement	% consider it a complement	mean anticipated peer use [%]
Group 1: Lowest anticipated peer use	1.90	5.1	23.3	8.5
Group 2	2.83	7.2	62.3	28.1
Group 3	3.55	17.1	66.5	53.7
Group 4: Highest anticipated peer use	4.16	30.6	69.8	78.9

to the more recent discussions of how "second generation media companies" can govern these platforms (Hess 2014). These companies focus on the management of content platforms and still often face challenges to transform their traditional "first generation" business (involving content production, aggregation and dissemination) to the novel content platform management. Adequate content platform management is essential for the success of a platform, but likewise complex and several companies have struggled to establish new content platforms or new social functions on existing platforms. ResearchGate, for instance, enjoys substantial popularity for secondary tasks in publishing, but they have not yet succeeded in integrating SPR throughout the entirety of the publishing process – and this does not appear to be a question of technological capabilities. Critical factors are, for instance, establishing and preserving user engagement as well as procedures to ensure the quality and determine the success of research on the platform and how this translates into the reputation of the researchers themselves (Ponte and Simon 2011). Developing adequate governance procedures is essential not only to gain researchers' trust and support their SPR adoption, but also since their reputational capital and that of academic publishing as a whole are at stake.

Concerning a potential transformation of the media industry specializing on academic publishing, our empirical results do not indicate that social forms of reviewing and scholarly communication will become the new standard of how scientists communicate their research findings. Our findings show that SPR is perceived as having its merits as a potential complement to the traditional system. Can for-profit publishers therefore be unconcerned that their business model will remain stable for the time to come, because the "three C's" – culture, credit, and critical mass (Priem and Hemminger 2010) – work in favor of maintaining the traditional system of scholarly communication? Not necessarily. Disruptive innovations (Christensen 2013) serve the needs of customers in non-mainstream markets where performance criteria prevail that differ from the mainstream market. When disruptive innovations incrementally improve concerning these performance criteria, they are eventually more important to the mainstream market, and they might be able to subsequently gain widespread adoption. OA has, for example, initially been adopted in fields where quick dissemination of results is paramount and where scientific communities considered scientific reliability as the main criterion to decide on publication, while other fields followed track. Our findings indicate that SPR is considered more useful among less established scientists. If SPR is widely accepted among younger scientists who are likely to move up in the academic hierarchy soon, and if SPR at the same time increasingly improves on the performance criteria, SPR might well be able to replace the traditional system of scholarly communication, at least in certain niches.

Concerning this matter, the powerful role of certain publishing companies, which still enjoy great margins with certain journals, should not be forgotten. These publishing houses clearly have an interest in preserving their currently profitable business, while an open SPR community could easily erode their margins. However, especially for smaller publishing houses, developing a sustainable business model behind SPR might be a good opportunity to enter new markets with a relatively small investment. If policy-makers seek to restrict the currently strong power of certain publishing houses by fostering more social forms of scholarly communication, they could contribute to establishing adequate guidelines and frameworks for a new "currency" of scientific reputation. For instance, instead of the number of citations or the h-index, this currency could be based on social forms of measuring scientists' impact. Establishing alternative metrics would have to be complemented by institutional arrangements that also grant promotions and provide funding based on this new scientific currency. In this respect, it is also necessary to analyze the criteria responsible for scientists to choose their publication outlets and to explore to what extent traditional and social forms of scholarly communication could possibly coexist and complement each other.

Certain limitations could have impacted our results. First, we asked respondents to indicate their willingness to engage in SPR as a new form of scholarly communication from an author's perspective in a fictitious setting. Instead of measuring actual behavior, we could only measure intentions. However, we were interested in the motivational drivers at an early, still emergent stage of more open forms of scholarly communication, and intention is a well-established predictor of actual behavior in information systems research (Venkatesh et al. 2003). Besides, our comparison between scientists who already use scientific social networks for researchers and those who do not showed very similar results. Asking scientists about their perceptions of SPR coming from a different perspective (e.g. reviewers or editors) could lead to additional insights.

Second, our study relies on self-reported measures from the same survey instrument, which could have resulted in common method bias (Podsakoff et al. 2003). However, indicator-level analysis revealed several non-significant inter-indicator correlations. We therefore do not see a substantial threat through correlations that are the mere result of the same measurement instrument.

Third, due to sample size restrictions, we did not conduct a detailed analysis of potential differences between research disciplines, which might share similar or different publishing traditions and that might have similar or different incentive and reputation metrics. For instance, in computer science, conferences have a traditionally high importance compared to most social sciences. Likewise, citation counts might also have a higher importance for computer scientists than for other researchers, for whom the perceived journal reputation might matter more. Hence, researchers' motivation to join SPR might be dependent on how actual SPR platforms score in these aspects. Given the importance of this matter, we see this as a fruitful opportunity for future research.

Fourth, we did not touch upon the subject of whether SPR produces "better" science than the traditional system of scholarly communication. Prior research has already found that ResearchGate scores correlate with established ranking of academic institutions (Thelwall and Kousha 2015). More research is clearly needed in this area, also related to whether and how well diamond-cutting in SPR works compared to its traditional execution by reviewers and editors in traditional journals.

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Appendix 1

Table 7 Reflective items used in the survey

	Mean	SD	α
Performance Expectancy			
SPR would have many benefits for me.	3.07	1.27	0.94
SPR would allow me to gain a reputation.	3.00	1.27	
SPR would be be useful to me.	3.22	1.29	
Effort Expectancy			
SPR would be easy for me to use.	3.58	1.14	0.93
It would be easy for me to become skillful at using SPR.	3.53	1.17	
Using SPR would be clear and understandable to me.	3.52	1.17	
Hedonic motivation			
Using SPR would be fun.	2.88	1.28	0.89
Using SPR would be exciting.	3.05	1.28	
Using SPR would be entertaining	2.94	1.24	
Facilitation Conditions			
SPR would allow me to ensure the long-time availability of my research	3.09	1.26	0.92
SPR would allow me to protect my intellectual property.	2.67	1.30	
SPR would allow me to get support when I have difficulties.	3.03	1.21	
SPR would make it easier to provide supporting materials (e.g. datasets, videos).	3.45	1.16	
SPR would provide a good infrastructure for publishing.	3.18	1.18	
SPR would provide all the necessary functionality for publishing.	3.08	1.24	
Price Value			
SPR would allow me to reduce my publication costs.	3.12	1.32	0.88
SPR would allow me to decrease my costs for accessing research.	3.21	1.30	
SPR would enable my institution to save money.	3.34	1.28	
Social Influence			
People who are important to me would think that I should use SPR.	2.65	1.20	0.96
People who influence my behavior would think that I should use SPR.	2.61	1.17	
People whose opinion I value would think that I should use SPR.	2.67	1.19	
Habit			
The use of traditional publishing has become a habit for me.	3.97	1.02	0.88
Using traditional publishing has become natural to me.	3.95	1.04	
I usually use traditional publishing.	4.16	0.93	
Cultural-cognitive			
There are no real alternatives to traditional publishing.	3.15	1.23	0.77
Traditional publishing is here to stay.	3.54	1.10	
Science would not work without traditional publishing.	3.28	1.27	
Regulative			
People who fund my research want me to use traditional publishing.	3.75	1.20	0.87

Table 7 (continued)

	Mean	SD	α
My home institution wants me to use traditional publishing.	3.99	1.12	
People whom my career is dependent on want me to use traditional publishing.	3.94	1.11	
Normative			
SPR would make science fairer.	2.94	1.29	0.91
SPR would make science more democratic.	3.24	1.25	
SPR would make science more transparent.	3.45	1.25	
SPR would make science more accesible.	3.75	1.16	
SPR would make science more collaborative.	3.39	1.25	
Intention			
I intend to use SPR once it is available.	3.14	1.30	0.96
I plan to use SPR once it is available.	3.06	1.28	
I would use SPR frequently once it is available.	2.95	1.31	

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