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GENERATION AND IMPACT OF NOVEL ARTICLES IN PHYSICS

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ABSTRACT

The aim of this paper is twofold. First, it investigates how the characteristics of a research team relate to the probability of generating a novel article. Second, once a novel article has been generated, it investigates the moderating effects of the team's characteristics on the impact of the article. We consider 42,493 teams of researchers publishing a corresponding number of articles in 273 reputed journals in physics from 2005 to 2009. We find that team experience and team specialization are negatively associated with the probability of generating a novel article. On the contrary, having already written novel articles in the past is positively associated with the probability of generating a novel article. When analyzing the impact of novel articles, we find that a novel article published by an experienced team receives fewer citations than a novel article published by a team with less experience and is published in a lower impact factor journal. We also find that a novel article published by a large established team of researchers receives more citations than a novel article published by a small newly formed team. The team size is also positively related to the impact factor of the journal in which the novel article is published.

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1. Introduction

Scientific research is increasingly conducted by teams (Price, 1963; Wuchty et al., 2007). Several factors explain the emergence of teamwork, such as the increasing cost of scientific equipment, the reduction in the costs of travel and communication, the increase of researchers' specialization due to the growing complexity of scientific research, and the increase of interdisciplinary projects (Katz and Martin, 1997). Existing Research on teams has focused on how team characteristics affect the publication productivity of team members and the impact of their research outcomes (Adams, 2013; Börner et al., 2010; Bozeman and Lee, 2003; Defazio et al., 2009; Guimerà et al., 2005; Jones et al., 2008).

Different from the previous literature, this paper investigates how team characteristics are associated with the probability of generating a novel scientific idea and with the impact of that novel idea. To do so, we use publication data and focus on multi-authored articles resulting from collaborative teamwork between authors. As relevant team characteristics, we consider team experience, team specialization, team size, previous collaborations between team members, and team reputation in producing novel ideas.

Following Wang et al. (2017), we identify novel scientific ideas, or novelty, as the result of recombining existing pieces of knowledge. We consider the journals referenced in scientific articles as pieces of knowledge and novelty as an unprecedented combination of the referenced journals (Ayoubi et al., 2017; Uzzi et al., 2013). However, not all novelty is successful. Some novel ideas might be abandoned after their generation or might lead to non-promising research outcomes (Amabile, 1983; Fleming et al., 2007; Stein, 1963). This paper focuses on successful novelty, namely the novelty that is reused after its first appearance. Following Mairesse and Pezzoni (2021), to be defined as novelty, we require the unprecedented combination of referenced journals to be reused a minimum number of times in other scientific articles after its first appearance.

We find that having already written novel articles in the past is associated with a higher probability of generating a novel article. On the contrary, team experience and specialization are associated with a lower probability of generating a novel article. When analyzing the impact of novel articles, we find that novel articles published by teams with more experience tend to receive fewer citations and are published in lower impact factor journals than articles published by teams with less experience. Novel articles published by larger teams end up in higher impact factor journals and receive more citations than novel articles published by smaller teams. Similarly, citations received by novel articles benefit from the previous collaborations of the team that wrote the article. Novel articles published by teams that have already published novel work are associated with a higher number of citations received one year after publication, while novel articles published by specialized teams are associated with a lower number of citations received three and four years after publication.

2. Effect of team characteristics on the generation of a novel article and its impact

Team characteristics and generation of a novel article

Team experience is an important factor affecting the generation of novel ideas. Extant literature has shown that team members' previous collaborations positively affect the probability of generating creative work (Delmar and Shane, 2006; Huckman et al., 2008; Taylor and Greve, 2006). However, experienced teams might develop routines that constrain their creative processes, preventing them from exploiting novel and unconventional research avenues. Routine work might generate a lock-in on familiar ideas and solutions to scientific problems, leading to a negative effect on the probability of generating creative work (Cohendet and Simon, 2016; Gersick and Hackman, 1990). Therefore, we expect either a positive or negative effect of team experience on the probability of generating novel ideas. In addition to the team experience, the individual experience of each team member might affect the team's probability of generating a novel outcome (ElBardissi et al., 2013). Similar to team experience, the individual experience might either be beneficial or hamper the probability of generating a novel article. On the one hand, an individual with a long experience might have a larger stock of knowledge with which she contributes to the team's creative process. On the other hand, experienced team members might replicate past successful ideas, decreasing the team's probability of exploring creative and unconventional solutions. Team size also plays a role. The presence of a large number of individuals in a team increases the probability of exposing team members to a "broader set of perspectives and cross-fertilization of ideas" (Lee et al., 2015; Taylor and Greve, 2006). Thus, larger teams are expected to increase the probability of generating a novel idea increasing the variety of scientific knowledge available. On the contrary, high levels of team specialization are expected to decrease the probability of generating a novel article: the higher the team specialization, the lower the "cognitive diversity" characterizing the team that can be used to generate novel ideas (Taylor and Greve, 2006). Finally, teams might have different innate propensity to introduce novel ideas, all other things equal. We expect that teams that have already published novel articles have a higher propensity to generate an additional novel article.

Team characteristics and impact of a novel article

Once a novel article is generated, team characteristics might affect its impact. Previous literature has shown that novel articles have a lower impact in the short run but a higher impact in the long run if compared to non-novel articles and that there is a negative publication bias regarding the impact factor of the journals in which novel articles are published (Wang et al., 2017). We complement this literature by assessing how the team characteristics moderate the novel articles' impact. Team experience, as represented by the stock of team members' publications, might enhance the number of citations received by a novel article published by the team, acting as a guarantee of the quality of the novel article and increasing its visibility (Merton, 1968). Similarly, a novel article might receive more citations when published by an existing team rather than by a newly created team. An existing team provides a better guarantee of the quality of the novel article, enhancing the citations received. Concerning team size, large teams might diffuse the novel scientific idea included in a novel article more easily than small teams (e.g., participating in a conference or using personal scientific networks), attracting citations to the novel article and increasing its impact (Lee et al., 2015; Valderas, 2007). A highly specialized team is expected to attract more citations to a novel article from colleagues specialized in the same sub-discipline (Chavarro et al., 2014; Rafols and Leydesdorff, 2009). However, a novel article published by a specialized team might be perceived as less reliable since the team does not have the multidisciplinary competencies often needed to combine different pieces of knowledge. Finally, we expect a positive effect of the team novelty reputation on the impact of a novel article published because the novelty produced by teams that already published novel work in the past is expected to be perceived as more reliable.

Table 1 summarizes the expected relationships between the team characteristics and the probability of generating a novel article (Column 1) and the expected moderating effects of the team characteristics on the impact of a novel article (Column 2).

Table 1: Expected relationships between team characteristics and the probability of generating a novel article (Column 1) and expected moderating effects of the team characteristics on the novel article impact (Column 2)

	(1)	(2)
Team characteristics	Probability of generating a novel article	Moderating effects of the team characteristics on the impact of novel articles
Team experience	+ / -	+
Team previous collaborations	+ / -	+
Team size	+	+
Team specialization	-	+ / -
Team novelty reputation	+	+

3. Data and variables

Definition of the study sample

We conduct our empirical analysis within the domain of physics. We define the universe of physics articles as all the articles published in 273 physics journals with an impact factor higher than 0.5 from 2005 to 2009 (Lissoni et al., 2011). We end up with 473,314 articles, including 5,226 distinct (physics and non-physics) journals in their references.

We define a research team as the authors listed in each of the 428,395 multi-authored scientific articles in our sample (90.5% of all the articles published in the 273 journals considered). Reconstructing the team characteristics implies reconstructing the scientific careers of the authors of each article following the paper trail left by their scientific publication history. Therefore, correctly attributing publications to authors is a central issue in our analysis. Unfortunately, the attribution process using bibliometric data might be affected by severe homonymy problems (Azoulay et al., 2017). To address this issue, we apply a name disambiguation algorithm relying on the idea that if articles published in different disciplines report the same author's name, they are likely to be published by different homonym individuals. For instance, if "John Smith" appears as an author in publications in physics, biology, and economics, the publications attributed to "John Smith" are likely to belong to three different scientists with the same name. In our disambiguation algorithm, we consider that if less than 40% of the scientific production attributed to an author's name is in the field of physics, the author is likely to have homonyms working in disciplines other than physics. We include in our analysis only those articles for which all the authors are unlikely to have homonyms, i.e., only those author teams having all members with more than 40% of their publications in physics. Although this constraint significantly reduces the size of our study sample to 43,237 multi-authored articles and a corresponding number of teams (10% of the initial sample of articles published in the 273 journals considered), it also significantly decreases the homonymy problem in our data. In Appendix A, we report a detailed description of the conservative method used to identify those authors who are not likely to have homonyms. Appendix C reports a robustness check of our econometric exercises applying a less stringent version of the disambiguation algorithm leading us to obtain a study sample of 257,530 articles. We obtain similar results to the ones reported in Section 4 of the main text.

According to our definition of teams, we observe only successful collaborations that result in a publication (Börner et al., 2010). All the team members listed in an article, are expected to have contributed to the research project. However, the authorship practices at play in physics might lead to papers with long lists of authors, including also researchers who did not contribute actively to the scientific achievement described in the article (Gonzalez-Brambila et al., 2008). In order to ensure a minimum contribution from each author, we limit our study to articles including less than 20 authors. Moreover, we also drop articles reporting a large number of references in the bibliography, i.e., more than 50, being these articles likely to be a review of the extant literature rather than new scientific contributions. These two additional restrictions led us to obtain a final study sample of 42,493 articles published by a corresponding number of teams.

Definition of novelty and novel articles

For each of the 42,493 articles in our sample, we calculate all the combinations of the journals included in the references. According to our definition of novelty, we selected the combinations that do not appear in any other article published in the 273 selected physics journals before the focal article[1]. Among these combinations, we select the successful ones, namely those combinations that are used at least in 10 articles in the five years after their appearance (Mairesse and Pezzoni, 2021). We define the dummy variable *Novel article* as a variable that equals one if an article includes at least one successful novel combination of referenced journals and zero otherwise. In our study sample, we identified 724 novel articles. The 724 novel articles correspond to 1.7% of the 42,493 articles included in our study sample.

[1] WOS publication data are available only from 2000. For a journal combination referenced in an article published in year *t*, we observe the preceding publication history from 2000 to *t-1*. To identify novel combinations, we define a buffer period of an arbitrary length of 5 years, from 2000 to 2004, that represents the minimum period needed to claim that the journal combination is novel. For instance, in evaluating the novelty of the journal combination *J1-J2* included in an article published in *t=2005*, we screen all the articles published in the period 2000-2004 to verify if the same combination *J1-J2* has previously appeared. If not, we consider the combination *J1-J2* appearing for the first time in the history of physics in the article published in *t=2005*.

The previous literature has criticized the definition of novelty based on journal recombination (Fontana et al., 2020). Specifically, unprecedented journal recombinations embedded in articles have been considered as indicators of interdisciplinarity rather than novel ideas. We investigate this possibility by calculating the correlation between the variable *Novel article* and the *Stirling* index in our sample of 42,493 articles. The *Stirling* index is a widely used measure of articles' interdisciplinarity (Cassi et al., 2014). We find that the correlation between *Novel article* and the *Stirling* index is positive but limited to 0.086. Conditional on considering the *Stirling* index as a good indicator of interdisciplinarity, the low correlation provides empirical evidence against the hypothesis that *Novel article* and the *Stirling* index are both measuring interdisciplinarity.

Table 2 shows the ranking of the ten physics journals publishing the highest number of articles included in our sample. These ten journals include 46.70% of the articles in our sample.

Table 2: 10 journals publishing the largest number of articles.

Journal	Number of articles	Share of articles	Number of novel articles
Physical Review B	4,990	11.74%	62
Physical Review L	3,072	7.23%	30
Physical Review A	2,446	5.76%	20
Physical Review D	2,234	5.26%	8
Physical Review E	1,823	4.29%	80
Journal of Applied Physics	1,257	2.96%	30
Journal of Chemical Physics	1,176	2.77%	32
Applied Physics L	1,106	2.60%	8
Journal of Physics: Condensed Matter	888	2.09%	13
Physical Review C	852	2.01%	3
Other journals	22,649	53.30%	438
Total	*42,493*	*100%*	*724*

Dependent variables

The first part of the empirical analysis assesses the effect of team characteristics on the probability of generating a novel article. The dependent variable is the dummy *Novel article*.

The second part of the analysis assesses the moderating effect of the team characteristics on the impact of a novel article. We evaluate the impact of an article by calculating the number of citations received by the article in year t (*Citations in t*). Similarly, we define the other four dependent variables by calculating the *Citations in t+1, t+2, t+3,* and *t+4.* We also consider the 5-year impact factor of the journal in which an article is published (*IF5*) as a complementary impact indicator. The value of the impact factor is time-invariant, and it is calculated in the year

2005. In Appendix E, we consider an alternative measure of journal impact factor (*IF5*), namely a measure of journal impact factor normalized according to the citations received by the articles published in the same scientific field and year (*Normalized Journal Impact*). Results obtained using the *Normalized Journal Impact* are in line with those obtained in the main analysis using *IF5*.

Team characteristics

We consider the five team characteristics described in Section 2 as the characteristics affecting both the probability of generating a novel article and moderating the novel article's impact. The first characteristic, *Team experience*, is measured as the number of distinct articles authored by the team members in the period from *t-1* to *t-5*, where *t* is the publication year of the focal article. Only 0.27% of the teams in our sample have no previous experience. The second characteristic, *Team specialization*, is measured as the Herfindahl-Hirschman index of the disciplines of the journals referenced in the team members' work. *Team specialization* is calculated in three steps. First, we consider all the articles published by the team members in the period from *t-1* to *t-5*. Second, we look at the references of the articles, and we classify each reference according to the *Web of Science* (WOS) sub-disciplines[2] . Finally, we calculate the Herfindahl-Hirschman concentration as the squared sum of the shares of references in each WOS sub-discipline. The third team characteristic considered is a dummy variable that equals one if at least two team members have co-authored a publication from *t-1* to *t-5* (*Team previous collaborations*). The fourth characteristic is the novelty reputation of the team, calculated as a dummy that equals one if at least one team member has published a novel article in the five preceding years, from *t-1* to *t-5* (*Team novelty reputation*). Finally, we calculate the *Team size* as the number of authors of the focal article.

To obtain unbiased estimates of the coefficients associated with the team's characteristics, we include in our regression exercise a set of controls for the team members' biographical characteristics and for the characteristics of the focal article published by the team. We consider the average seniority of the team members (*Average seniority*). The seniority of each team member is calculated by looking at the documents referenced by the scientists in her published work. Specifically, we calculate for each scientist the years that have passed since the publication year of the oldest self-cited document. In the absence of self-citations reported on the scientist's work, we calculate seniority according to the first publication observed in our

[2] A detailed description of the WOS sub-disciplines can be found at the following link http://webofscience.help.clarivate.com/en-us/Content/research-areas.html

sample authored by the scientist. We control for the presence of at least one author with a US affiliation in the team (*United States*). Similarly, we define dummies for the other countries (the *United States* dummy is used as the reference category in the regression exercises). We also control for the number of distinct countries listed in the authors' affiliations reported in the focal article (*N. countries*). We include 69 dummy variables[3] in our regression exercise investigating the determinants of generating novel articles, one for each *Team sub-discipline* in which the team members have published in the period form t-*1* to *t-5.* Specifically, each of the 69 dummy variables *Team sub-discipline* equals one, if there is at least one article published by a team member in that sub-discipline in the period from *t-1* to *t-5*. The *Team sub-discipline* variables are non-exclusive dummy variables. To control for the article characteristics, we count the number of references in the article (*References*), we calculate a dummy variable for each publication year (*Dummy publication year*), and, finally, we add 69 dummy variables *(Article sub-discipline),* one for each scientific subfield in which the focal article is classified. Specifically, each of the 69 dummy variables *Article sub-discipline* equals one if the journal where the article is published is classified in that WOS category. The *Article sub-discipline* dummy variables are used only in the regression investigating the moderating effect of team characteristics on the novelty impact. *Team sub-discipline* and *Article sub-discipline* dummy variables identify disciplines other than physics. Indeed, team members might have published in disciplines other than physics, and the journal in which the focal article is published might also be classified in disciplines other than physics[4].

Table 3 reports the descriptive statistics for the 42,493 articles included in our study sample. We observe that novelty is rare. Only 1.7% of the articles in our sample are novel articles. The articles' impact measured with the number of citations shows an inverted-u shape: the number of citations received by an article (novel or non-novel) increases in the first three years *t, t+1, t+2,* while it decreases in *t+3* and *t+4* (Columns 1, 3, and 4)[5]. Novel articles receive significantly more citations than non-novel articles in *t+2*, *t+3,* and *t+4.* Teams publishing novel articles have significantly less experience, are less specialized, less likely to have previous collaborations, and are smaller than teams publishing non-novel articles. Moreover,

[3] The articles included in our study sample are the ones published in the 273 physics journals selected. These articles are classified according to 69 WOS sub-disciplines out of the 250 WOS sub-disciplines available.
[4] In Appendix F, we conduct a robustness check of our analysis considering the subset of articles published in journals classified only in Physics categories, as defined by the WOS database. We find similar results as the ones reported in Tables 4 and 5 of the main text.
[5] We count the citations received by the focal article in year *t* without distinguishing in which period of the year the article is published. In other words, we count in the same way the citations if the article is published in January or December.

we observe a persistence of the novelty generation activity: teams generating a novel article are significantly more likely to have written other novel articles in the past.

Table 3: Descriptive statistics of the dependent and independent variables considered in the regression analysis.

	All: 42,493 articles		Non-novel: 41,769 articles	Novel: 724 articles	Novel versus non-Novel
	(1)	(2)	(3)	(4)	(5)
	mean	sd	mean	mean	P-value
Novelty generation: Dep. Var.					
Novel article	0.017	0.129	0.000	1.000	
Novelty impact: Dep. Var.					
Citations t	0.651	1.574	0.652	0.579	0.213
Citations t+1	2.31	3.612	2.306	2.519	0.115
Citations t+2	2.583	4.122	2.575	3.037	0.003
Citations t+3	2.413	4.234	2.399	3.186	0.000
Citations t+4	2.23	4.308	2.215	3.043	0.000
IF5	7.402	5.166	7.418	6.474	0.000
Team characteristics					
Team experience	38.028	30.771	38.122	32.576	0.000
Team specialization	0.195	0.104	0.196	0.159	0.000
Team Previous collaborations	0.82	0.384	0.821	0.791	0.042
Team novelty reputation	0.2	0.4	0.199	0.286	0.000
Team size	2.991	1.382	2.995	2.786	0.000
Controls					
Average seniority	7.937	2.723	7.944	7.505	0.000
N. countries	1.449	0.679	1.45	1.384	0.010
References	13.294	8.948	13.208	18.246	0.000
United States	0.244	0.43	0.244	0.271	0.096
China	0.005	0.072	0.005	0.007	0.527
Germany	0.152	0.359	0.152	0.112	0.003
France	0.11	0.313	0.11	0.119	0.445
Japan	0.017	0.131	0.018	0.007	0.028
Russia	0.146	0.353	0.146	0.094	0.000
Other countries	0.42	0.494	0.419	0.467	0.010

Note: Column 5 reports the P-value of the t-test of comparison between the averages reported in Column 3, i.e., non-novel articles, and in Column 4, i.e., novel articles.

4. Results

Probability of generating a novel article

Table 4 reports the estimates of the model assessing the probability of generating a novel article. Column 1 shows the OLS estimates, while Column 2 reports the marginal effects of the *Probit* estimates. Team experience is associated with a lower probability of generating a novel article (Column 2). Specifically, increasing experience by 30 articles, i.e., one standard deviation of the variable *Team experience*, is associated with a probability of 0.297 percentage points lower of generating a novel article (30*-0.000099*100). Although this value might seem small, it corresponds to 17.5% of the unconditional probability of observing a novel article[6]. Increasing the team specialization by 0.10, i.e., one standard deviation of the *Team specialization* index, is associated with a 0.41 percentage points lower probability of generating a novel article, which corresponds to 24% of the unconditional probability of observing a novel article. Having already published a novel article in the past increases the probability of generating a novel article by 0.63 percentage points, 37% of the unconditional probability of observing a novel article. Finally, we find that the presence of previous collaborations between team members is not associated with the probability of generating a novel article as well as the number of team members.

As for the controls, not surprisingly, we find that the higher the number of references reported in an article, the higher the probability of the article being novel. Indeed, the variable *References* is included in our regression to correct for the possible mechanic effect due to the presence of a long reference list in an article that might enhance the probability of observing a novel combination of journals. Also, we find a u-shaped effect of the average seniority of the team members. The lowest chance of generating a novel article is for teams having 13.8 years of seniority, which is about twice the average seniority in our sample (7.937 years as reported in Table 3). Therefore, a large part of our study sample is located in the decreasing branch of the U-shaped curve, meaning that we observe a decrease in the probability of generating a novel article with seniority.

[6] The value of 17.5% is obtained applying the following calculation: ((30*-0.000099)/0.017)*100.

Table 4: Probability of generating a novel article

	(1) Linear Probability Model Dependent variable: Novel article	(2) Probit, marginal effects Dependent variable: Novel article
Team characteristics		
Team experience	-0.00014***	-0.000099***
Team specialization	-0.060***	-0.041***
Team previous collaborations	-0.00098	-0.00048
Team novelty reputation	0.0083***	0.0063***
Team size	-0.00084	-0.00060
Controls		
Average seniority	-0.0015*	-0.00083*
Average seniority^2	0.000062**	0.000030*
N. countries	0.00089	0.00050
References	0.0014***	0.00075***
China	0.0077	0.0087
Germany	-0.0035*	-0.0020
France	0.00058	-0.000047
Japan	-0.0083*	-0.0054**
Russia	0.00055	-0.00030
Other countries	0.0016	0.0013
Dummy publication year	Yes	Yes
Dummy team sub-discipline	Yes	Yes
Constant	0.043***	-
Observations	42,493	42,493
R-squared	0.024	0.13

Note: *** p<0.01, ** p<0.05, * p<0.1

Moderating effects of the team characteristics on the impact of a novel article

Table 5 reports the estimates of the model assessing the moderating effect of the team characteristics on the marginal effect of publishing a novel article. Columns 1 to 5 report the *Poisson* estimations that explain the number of citations received by the focal article for each of the first five years after publication. The coefficients of the interactions between the dummy *Novel article* with *Team experience*, *Team specialization*, *Team previous collaborations*, *Team novelty reputation*, and *Team size* represent the moderating effects of the team characteristics on the effect of publishing a novel article. Column 6 reports the OLS estimation explaining the logarithmic transformation of the impact factor of the journal in which the focal article is published. Coefficients reported in Column 6 should be interpreted as semi-elasticities.

Table 5: Team characteristics moderating the marginal effect of publishing a novel article.

	(1) Poisson Dependent variable: Cit. t	(2) Poisson Dependent variable: Cit. t+1	(3) Poisson Dependent variable: Cit. t+2	(4) Poisson Dependent variable: Cit. t+3	(5) Poisson Dependent variable: Cit. t+4	(6) OLS Dependent variable: log(IF5)
Novel article	-0.42**	-0.19**	-0.23***	-0.045	-0.087	-0.10
*Novelty*Team characteristics*						
Novel article*Team experience	-0.0019	-0.0044***	-0.0049***	-0.0051***	-0.0046***	-0.0041***
Novel article*Team specialization	0.21	-0.17	-0.35	-0.62**	-0.49*	-0.23
Novel article*Team previous collab.	0.17	0.23***	0.15***	0.13**	0.15***	0.028
Novel article*Team novelty reputation	0.18*	0.16***	0.067	-0.054	0.064	-0.00077
Novel article*Team size	0.060	0.050*	0.11***	0.12***	0.10***	0.048*
Team characteristics						
Team experience	0.0042***	0.0038***	0.0035***	0.0035***	0.0033***	0.0026***
Team specialization	0.49***	0.18***	-0.050	-0.18***	-0.25***	-0.19***
Team Previous collaborations	0.033*	-0.11***	-0.12***	-0.12***	-0.13***	-0.058***
Team novelty reputation	0.020	0.014	0.025***	0.055***	0.035***	-0.016*
Team size	-0.014**	0.0039	0.011***	0.0075***	0.0064**	-0.039***
Controls						
Average age	0.020**	-0.013***	-0.028***	-0.041***	-0.044***	0.0094**
Average age^2	-0.00041	0.00052***	0.00093***	0.0013***	0.0015***	-0.00021
N. countries	0.058***	0.029***	0.040***	0.035***	0.046***	0.091***
References	0.030***	0.033***	0.034***	0.034***	0.035***	0.013***
China	-0.53***	-0.34***	-0.55***	-0.55***	-0.56***	-0.41***
Germany	-0.082***	-0.066***	-0.065***	-0.066***	-0.083***	-0.014
France	-0.20***	-0.12***	-0.10***	-0.12***	-0.15***	-0.027**
Japan	-0.17***	-0.16***	-0.18***	-0.24***	-0.24***	-0.11***
Russia	-0.63***	-0.50***	-0.48***	-0.49***	-0.52***	-0.67***
Other countries	-0.36***	-0.30***	-0.29***	-0.31***	-0.33***	-0.18***
Dummy publication year	Yes	Yes	Yes	Yes	Yes	Yes
Dummy article sub-discipline	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-1.04***	0.63***	0.86***	0.97***	0.96***	1.84***
Observations	42,493	42,493	42,493	42,493	42,493	42,493
R-squared						0.292

Note: *** p<0.01, ** p<0.05, * p<0.1

We find that novel articles published by teams with greater experience tend to receive fewer citations than those published by teams with less experience. The team subject specialization is not associated with the impact of novel articles in the short run, but three and four years after the publication, it is associated with a lower impact. Team previous collaborations and larger teams are associated with a higher impact of novel articles[7]. In the short run, the team's reputation of publishing novel articles is associated with a higher impact of novel articles.

An additional estimate reported in Appendix B includes only the variable *Novel article* not interacted. The coefficients estimated for the variable *Novel article* without interactions are coherent with the findings of Wang et al. (2017). Indeed, we find a negative relationship between the dummy variable *Novel article* and the citations received by the article in the year of its publication (*t*), while we find a positive relationship in years *t+3* and *t+4* (Table B1).

[7] In an additional econometric exercise, reported in Appendix G, we consider the geographical spread of the team members as another potential moderating factor of the novelty impact. Specifically, we add to the econometric specification the interaction between the variables *Novel article* and *N. countries*. We find that a larger number of countries is associated with lower citations in t+2, t+3 and t+4.

To visualize the moderating effects of the team characteristics for novel and non-novel articles, Figure 1 and Figure 2 plot the marginal effects obtained using the *Poisson* estimates reported in Table 5, Columns from 1 to 5.

Figure 1 plots the values of the coefficients of the interactions between the variable *Novel article* and each of the five team characteristics considered. Doing so, we obtain the percentage variation of citations received by a novel article (*Novel article* = 1) when the team increases its experience level (*ΔTeam experience* = 30), its specialization level (*ΔTeam specialization* = 0.1), it shows a previous collaboration between team members (*ΔTeam previous collab.* = 1), it shows a novel reputation (*ΔTeam novelty reputation* = 1), and it increases its size by one additional team member (*ΔTeam size* = 1).

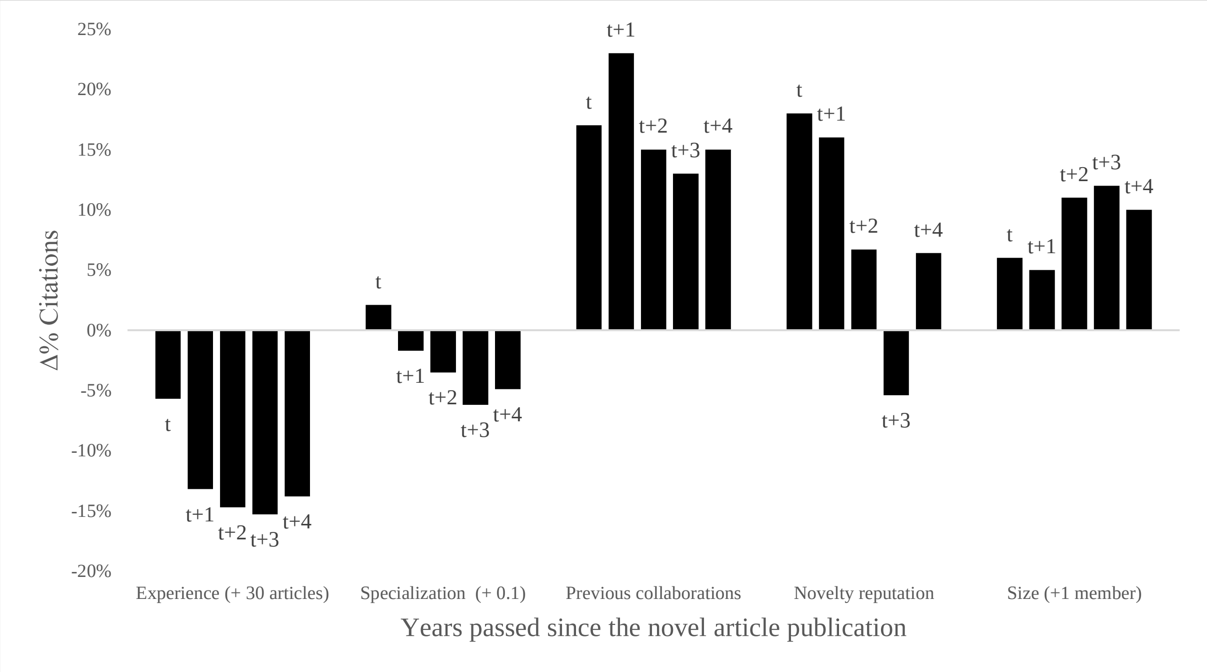
Figure 2 shows the effects of the team characteristics on the impact of non-novel articles. Specifically, it reports the percentage variations of the impact of a non-novel article (*Novel article* = 0) when the team increases its experience level, specialization, collaboration between members, novelty reputation, and size as described in the above paragraph (i.e., Δ*Team experience* = 30, *ΔTeam specialization* = 0.1, *ΔTeam previous collab.* = 1, *ΔTeam novelty reputation* = 1, *ΔTeam size* = 1).

Comparing Figures 1 and 2, we show that *Team experience* has an opposite moderating effect on the impact of novel and non-novel articles. Indeed, *Team experience* is associated with a lower impact of novel articles, while it is associated with a higher impact of non-novel articles. On the contrary, the variable *Previous team collaborations* is associated with a higher impact of novel articles and a lower impact of non-novel articles. Moreover, the variable *Team specialization* has a similar effect on the impact of novel and non-novel articles. Both *Team novelty reputation* and *Team size* vary similarly in the impact of novel and non-novel articles, although they are associated with a higher percentage variation of the impact of novel articles.

By comparing the moderating effects of the team characteristics for novel and non-novel articles reported in the two figures, we can conclude that team characteristics affect novel and non-novel articles' impact differently.

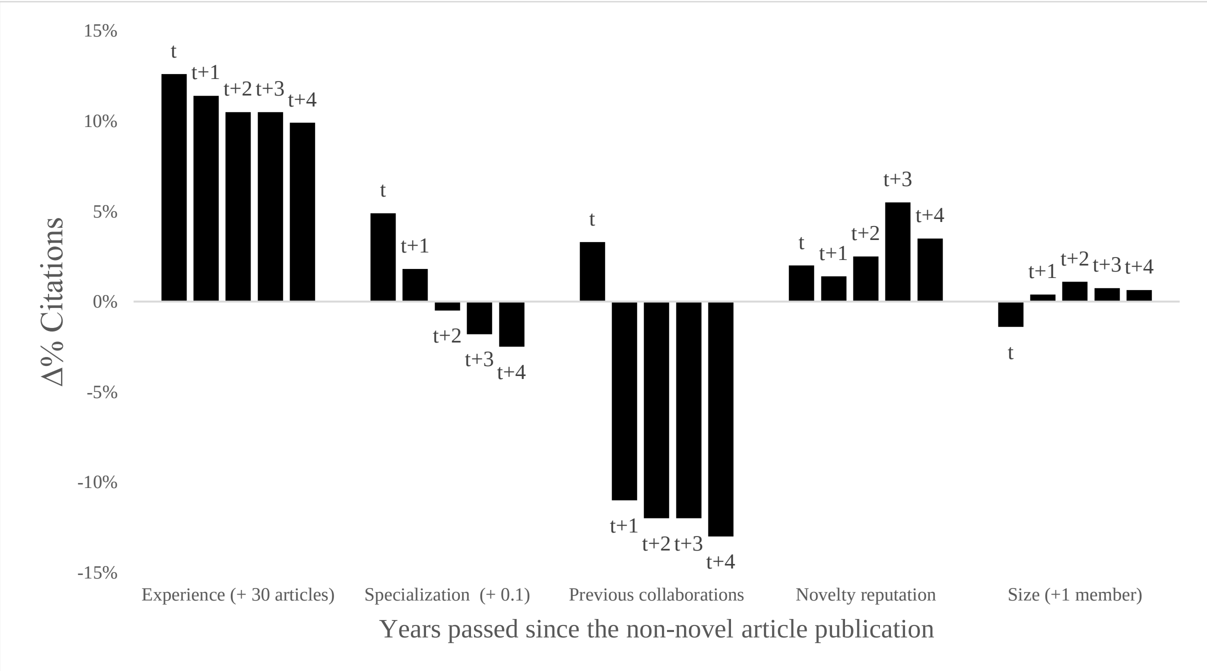
Looking at the regression exercise explaining the impact factor of the journal where the article is published (Column 6 of Table 4), we find that only two team characteristics moderate the impact of novel articles: team experience and team size. Specifically, novel articles published by experienced teams end up in lower impact factor journals than novel articles published by inexperienced teams, while novel articles published by larger teams end up in higher impact factor journals than those published by smaller teams.

Figure 1: Team characteristics moderating the marginal effect of publishing a *novel article*.



Note: This figure plots the estimated coefficients for the interaction terms between the *Novel article* dummy and the team characteristic variables.

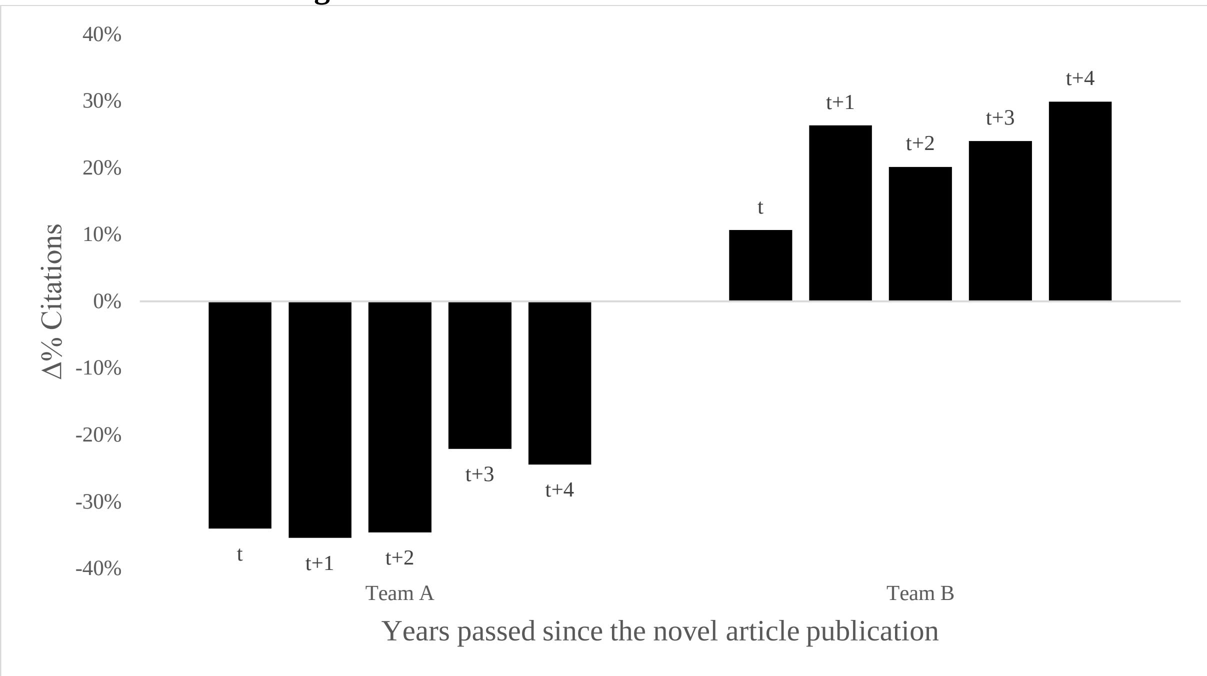
Figure 2: Team characteristics moderating the marginal effect of publishing a *non-novel article*.



Note: This figure plots the estimated coefficients for the team characteristic variables.

To further investigate the moderating effect of team characteristics on novel articles' impact, in Figure 3 we simulate the overall marginal effect of publishing a novel article for two teams, A and B, with different characteristics. The values of the team characteristics are chosen by looking at the coefficients reported in Table 5 to maximize the difference between the marginal effects of publishing a novel article by each team. Team A is formed by two scientists who never collaborated before, and it is specialized (75^{th} percentile of the team specialization index = 0.26). Its members have an excellent publication score, having published 50 articles, none of which was a novel article. Team B is formed by three scientists who have collaborated before and is not specialized (25^{th} percentile of the team specialization index = 0.12). In addition, its members have a low publication score, having published only 15 articles, some of which were novel.

Figure 3: Novel article marginal effect simulated for two teams.



Note: *Team A* is made by two scientists who never collaborated before and is specialized (75th percentile of the team specialization index = 0.26). Its members have an excellent publication score, having published 50 articles, none of which included a novel idea. *Team B* is made by three scientists who have collaborated before, and are not specialized (25th percentile of the team specialization index = 0.12). Its members have a low publication score, having published only 15 articles, which included novel ideas.

Team A, smaller, newly formed, specialized, and made of scientists with an excellent publication score who have never published novel articles before, shows a negative effect of publishing a novel article. On the contrary, Team B, which is bigger, established, not specialized, and made of scientists with a low publication score who published novel articles before, shows a positive effect of publishing a novel article. Concerning the impact factor of the journal in which Team A publishes a novel article, it is 26.7% lower than the impact factor of the journal where the same team could have published a non-novel article. For Team B, the impact factor is only 1.8% lower than the impact factor of a journal where the same team could have published a non-novel article. This simulation shows that the team characteristics strongly affect the impact of publishing a novel article. Indeed, the impact of publishing a novel article might change its sign according to the team characteristics, as shown in the simulation.

Robustness checks

As explained in Section 3 (and Appendix A), we have adopted a conservative strategy to minimize the risk of incorrect attribution of publications to authors due to homonymy problems by applying restrictive criteria for the attribution of publications. Although this conservative approach ensures that we correctly calculate team characteristics, it excludes from our dataset those teams in which at least one author is likely to have homonyms. To check for the robustness of our results, in Appendix C, we replicate the regressions reported in Tables 3 and 4, including all the articles for which we observe at least one author likely not to have homonyms, i.e., an author to whom we can attribute publications correctly. For those articles, we calculate the team characteristics only using the subset of authors without homonyms. We end up with a large sample of 257,530 articles representing a corresponding number of teams. Tables C1 and C2 show that our results using this large sample are similar to the ones reported in Tables 3 and 4. The only difference regards the impact of *Team size* on the probability of generating a novel article that is positive and significant in Table C1, while it is non-significant in Table 3. Table C2 shows similar effects to Table 4 for the team characteristics affecting the impact of publishing a novel article. The differences found in Table C2, regard the moderating effect of *Team specialization* that decreases the impact of the novel articles in the long run. In contrast, the effect was positive in Table 4. The other difference regards the moderating effect of *Team previous collaborations* that is positive in Table C2, while it was not significant in Table 4. Concerning the impact factor regression, we observe results that are qualitatively similar comparing Table 4, Column 6 with Table C2, Column 6.

In Appendix D, we conduct an additional robustness check adopting a loose definition of novelty. Specifically, we consider novel articles as those articles embedding a novel combination of journal references that are reused more than one time in the next five years (instead of 10 times as in the definition adopted in our main analysis). According to the loose definition of novelty, we increase the number of novel articles to 6.3 percent of our sample (instead of 1.7% of novel articles found in our main analysis). We find substantial coherence between the results reported in Tables 3 and 4 in the main text and Tables D1 and D2.

5. Conclusion

This paper investigates the relationship between team characteristics, the probability of generating a novel article, and the subsequent impact of that novel article. In our analysis, we include all the teams of physicists publishing an article in 273 reputed journals between 2005 and 2009, for which we can reasonably exclude homonymy problems in the attribution of publications to team members. We end up with 42,493 articles and a corresponding number of teams. We define scientific novelty as the first time appearance of a combination of journals in the references of an article that is reused at least ten times in follow-on articles. We define a novel article as an article using the novel combination in the year when the novel combination appears.

We find that team experience and team specialization are negatively associated with the probability of generating a novel article. On the contrary, having already written novel articles in the past is positively associated with the probability of generating an additional novel article. A possible interpretation of these findings is that experienced teams might replicate past successful ideas, decreasing the team's probability of exploring creative and unconventional scientific paths. Concerning the negative effect of specialization, highly specialized teams might be characterized by a lower "cognitive diversity," making them less likely to generate novel ideas. Finally, teams that already generated novel ideas in the past might have an intrinsic propensity to introduce novel ideas.

When analyzing the impact of novel articles, we confirm the existing literature results showing that, on average, novel articles tend to receive fewer citations immediately after publication, but they catch up on the non-novel articles' impact a few years later.

We contribute to the existing literature by showing how the team characteristics moderate the effect of publishing a novel article. We find that the team specialization on specific subjects is not associated with the impact of novel articles in the years immediately after publication. However, it is negatively associated with the impact of the novel articles three and four years after publication. We interpret this finding as evidence that the scientific community perceives the novel articles written by specialized teams as less reliable since these teams might not have the multidisciplinary competencies to combine different pieces of knowledge. On the contrary, the presence of previous team collaborations is positively associated with the impact of a novel article. An existing team might better guarantee the quality of the novel article, enhancing the citations received. Also, team size is positively associated with the impact of novel articles both in terms of citations received and the impact factor of the journal where the article is published. Larger teams might diffuse the novel idea included in a novel article more easily than smaller teams, attracting citations to the novel article. The reputation of teams having published novel articles in the past is positively associated with the impact of the focal novel article in the two years after the article's publication. One explanation for this finding is that the scientific community easily recognizes the value of novel papers when published by teams with a reputation for producing successful novel ideas. Contrary to our expectations, we find that novel articles published by teams with greater experience tend to receive fewer citations and end up in lower impact factor journals than novel articles published by teams with less experience. Indeed, the scientific community might better perceive the novelty associated with young, inexperienced teams.

Table 6 summarizes the relationships identified by our empirical analyses.

Table 6: Estimated associations between team characteristics and the probability of generating a novel article (Column 1) and moderating effects of team characteristics on the novel article impact (Column 2).

	(1)	(2)
Team characteristics	Probability of generating a novel article	Moderating effects of the team characteristics on the impact of novel articles
Team experience	-	-
Team previous collaborations	***Not statistically significant***	+
Team size	***Not statistically significant***	+
Team specialization	-	- **(in *t+3* and *t+4*)**
Team novelty reputation	+	+ **(in *t* and *t+1*)**

Note: Column 2 reports the signs of the moderating effects estimated in the regressions using the yearly citations as dependent variables.

Finally, in a simulation exercise, we show two extreme combinations of team characteristics that enhance and reduce the impact of publishing a novel article. A small team, newly formed, specialized, and made of scientists with an excellent publication record who never published novel ideas before, shows a negative effect of publishing a novel article. On the contrary, a large team, established, not specialized, and made of scientists with a low publication score who published novel ideas before, shows a positive effect of publishing a novel article.

Overall, our results show that the emerging literature attempting to identify novel scientific ideas and to measure their impact should account for the characteristics of the scientists who are proposing those novel ideas.

Our study has three main limitations. First, it focuses only on Physics, while the relationship between team characteristics, the probability of generating a novel article and its impact might differ across disciplines. In particular, the concept of teamwork and the notion of team considerably varies across disciplines. Second, we selected a limited number of team characteristics that have been investigated in the literature on scientific teams. However, other team characteristics such as gender composition and prestige of authors' affiliations might play a role in determining the probability of generating a novel article and on its impact. Finally, our estimation strategy allows for identifying associations between variables. Although introducing several controls in our regression exercises reduces the potential estimation bias, we cannot claim a causal interpretation of our results.

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Appendix A

The identity of the authors listed in the publications considered might be affected by severe homonymy problems. In order to mitigate this problem, we proceed in four steps. First, we collect all the articles reporting a given author name in the whole Web of Science (WOS), e.g. “John Smith.” Second, we attribute each article to physics or other fields, e.g., biology, according to the fact that the article is published in our selection of (273) physics journals or other journals. Third, we calculate the share of publications attributed to “John Smith” in physics. When this share is high, one at the limit (100%), it means that all the publications existing in the WOS associated with “John Smith” are in the field of physics. When the share of publications in physics is low, it means that a large share of publications existing in the WOS associated with “John Smith” is in other fields than physics. Therefore, when the share of articles in physics is high, the name is likely to be associated with a unique individual active in the domain of physics. In contrast, when the share is low, the attribution process is likely to attribute to the name “John Smith” the publications of several homonym researchers active in different fields. We drop from our study sample all the individuals who have less than 40% of the publications in physics. Then we also drop the (few) individuals with productivity too high to be credible (i.e., more than 300 articles between 2005 and 2009) (Lissoni et al., 2011). We ended up with 107,000 physicists who published 258,336 articles[8] on the 273 journals considered over a period ranging from 2005 to 2009.

After having ensured a correct attribution of the publications to the authors, we excluded from our regression analysis the articles for which we have incomplete information on the team members, i.e., where the publications have been correctly attributed only to a subset of the team members. In 16.45% of the cases (42,493 articles), the publications are correctly attributed to all the team members. In 62.10% of the cases, publications are correctly attributed to more than 50% of the team members.

[8] We dropped also articles with more than 25 authors, one author, and more than 50 refences

Appendix B

In Columns 1 to 5 of Table 4 in the main text, we consider the citations received in years *t*, *t+1*, *t+2*, *t+3*, and *t+4* by the focal article as dependent variables. In Table B1, we present the same regressions but excluding the interaction terms between the dummy variable *Novel article* and the team characteristics. Coherently with the previous literature, we find that in the publication year *t*, novelty has a negative impact on the citations received. As years pass, i.e., in *t+3* and *t+4*, the impact of novelty becomes positive, showing a citation premium for novel articles. We also find that novel articles are published in journals with a 12% lower impact factor with respect to non-novel articles.

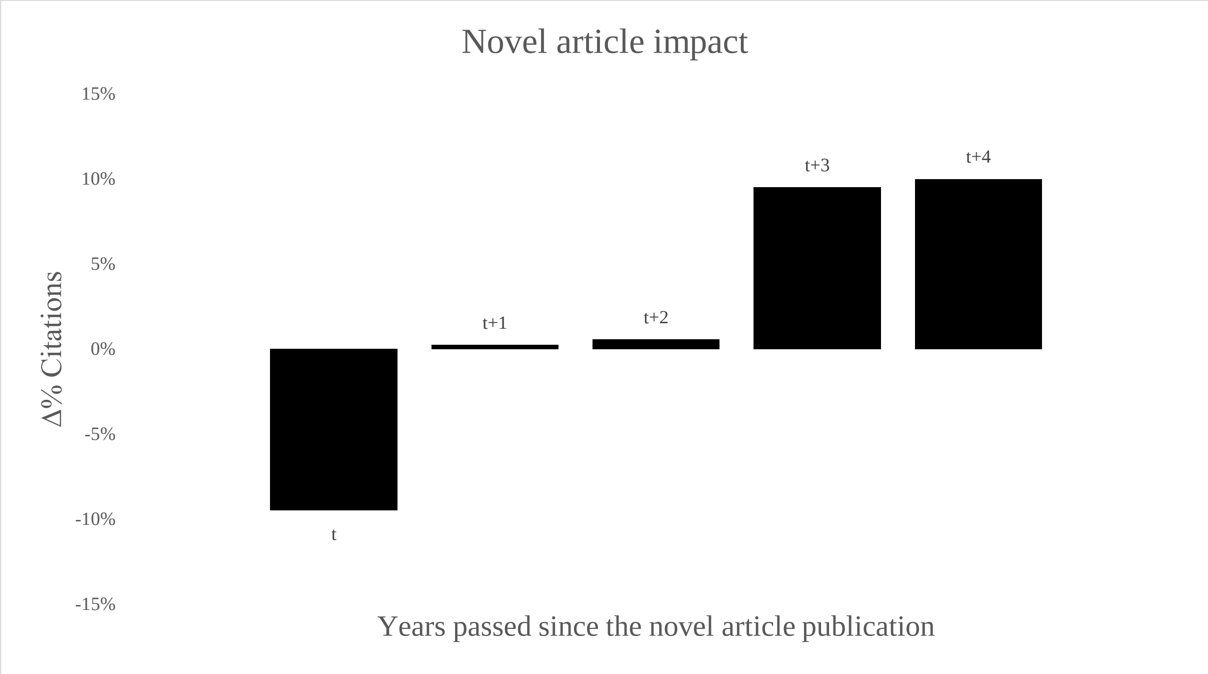
Table B1: Novel article marginal effect on the article impact.

	(1) Poisson Cit. t	(2) Poisson Cit. t+1	(3) Poisson Cit. t+2	(4) Poisson Cit. t+3	(5) Poisson Cit. t+4	(6) OLS Log (IF5)
Novel article	-0.095*	0.0024	0.0057	0.095***	0.10***	-0.12***
Team experience	0.0042***	0.0037***	0.0034***	0.0034***	0.0032***	0.0026***
Team specialization	0.49***	0.17***	-0.055	-0.19***	-0.26***	-0.20***
Team Previous collaborations	0.036**	-0.11***	-0.11***	-0.11***	-0.13***	-0.057***
Team novelty reputation	0.024	0.018**	0.027***	0.053***	0.037***	-0.016*
Team size	-0.013**	0.0046	0.013***	0.0092***	0.0079***	-0.038***
Average age	0.020**	-0.013***	-0.028***	-0.041***	-0.044***	0.0093**
Average age^2	-0.00041	0.00051***	0.00092***	0.0013***	0.0015***	-0.00021
N. countries	0.058***	0.029***	0.040***	0.035***	0.046***	0.091***
References	0.030***	0.033***	0.034***	0.034***	0.035***	0.013***
China	-0.53***	-0.34***	-0.55***	-0.54***	-0.56***	-0.41***
Germany	-0.082***	-0.067***	-0.066***	-0.066***	-0.083***	-0.014
France	-0.20***	-0.12***	-0.10***	-0.12***	-0.15***	-0.027**
Japan	-0.17***	-0.16***	-0.18***	-0.23***	-0.24***	-0.11***
Russia	-0.63***	-0.50***	-0.49***	-0.49***	-0.52***	-0.67***
Other countries	-0.36***	-0.30***	-0.29***	-0.31***	-0.33***	-0.18***
Dummy publication year	Yes	Yes	Yes	Yes	Yes	Yes
Dummy sub-discipline article	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-1.05***	0.62***	0.86***	0.97***	0.96***	1.84***
Observations	42,493	42,493	42,493	42,493	42,493	42,493
R-squared						0.292

Note: *** p<0.01, ** p<0.05, * p<0.1

Figure B1 shows the impact of publishing a novel article, as estimated in Table B1. Similarly, it shows that the impact of publishing a novel article is negative in the short run and positive in the long run.

Figure B1: Novel article marginal effect on the article impact.



Appendix C

In this appendix, we define the study sample as all the articles, including at least one team member to whom we can correctly attribute the publication history. We use only the authors to which we can correctly attribute publications to calculate team characteristics. We end up with a study sample of 257,530 articles.

Table C1: Novel article generation.

	(1) Linear Probability Model Novel article	(2) Probit, marginal effects Novel article
Team experience	-0.00021***	-0.00019***
Team specialization	-0.064***	-0.040***
Team previous collaborations	-0.011***	-0.0073***
Team novelty reputation	0.0094***	0.0083***
Team size	0.0018***	0.0012***
Average seniority	-0.00014	0.000026
Average seniority^2	0.000012	2.6e-06
N. countries	-0.00037	-0.000067
References	0.0026***	0.0014***
China	-0.0084***	-0.0045***
Germany	-0.00061	0.000034
France	0.0016	0.0013
Japan	-0.010***	-0.0079***
Russia	0.0051***	0.0034***
Other countries	0.0042***	0.0035***
Dummy publication year	Yes	Yes
Dummy team sub-discipline	Yes	Yes
Constant	0.052***	
Observations	257,530	257,530
R-squared	0.035	0.130

Note: *** p<0.01, ** p<0.05, * p<0.1

Table C2: Team characteristics moderating the marginal effect of publishing a novel article.

	(1) Poisson Cit. t	(2) Poisson Cit. t+1	(3) Poisson Cit. t+2	(4) Poisson Cit. t+3	(5) Poisson Cit. t+4	(6) OLS log(IF5)
Novel article	-0.25***	-0.087***	-0.043**	-0.0058	0.00088	-0.14***
Novel article*Team experience	0.00020	-0.0012***	-0.00081***	-0.00092***	-0.00051*	-0.00053*
Novel article*Team specialization	0.089	-0.051	0.052	0.23***	0.15**	0.033
Novel article*Team previous collab.	-0.097**	-0.00024	-0.0090	0.018	-0.0077	0.00066
Novel article*Team novelty reputation	0.11***	0.023	-0.064***	-0.088***	-0.064***	-0.034*
Novel article*Team size	0.0082	0.0057*	0.010***	0.0073***	0.011***	0.0057*
Team experience	0.0018***	0.0017***	0.0013***	0.0010***	0.00084***	0.0015***
Team specialization	0.33***	0.068***	-0.10***	-0.19***	-0.32***	-0.11***
Team Previous collaborations	0.11***	0.00015	-0.026***	-0.042***	-0.052***	-0.0014
Team novelty reputation	-0.0097	0.026***	0.050***	0.052***	0.063***	-0.026***
Team size	0.013***	0.027***	0.030***	0.029***	0.027***	-0.0087***
Average age	0.0040**	-0.013***	-0.015***	-0.016***	-0.017***	0.0082***
Average age^2	-0.00013**	0.00023***	0.00021***	0.00019***	0.00025***	-0.00019***
N. countries	0.055***	0.032***	0.030***	0.034***	0.043***	0.058***
References	0.033***	0.036***	0.036***	0.036***	0.036***	0.014***
China	-0.43***	-0.35***	-0.35***	-0.36***	-0.39***	-0.36***
Germany	-0.087***	-0.042***	-0.043***	-0.057***	-0.066***	-0.035***
France	-0.19***	-0.14***	-0.13***	-0.14***	-0.16***	-0.078***
Japan	-0.22***	-0.19***	-0.21***	-0.27***	-0.30***	-0.098***
Russia	-0.58***	-0.46***	-0.44***	-0.47***	-0.48***	-0.61***
Other countries	-0.39***	-0.31***	-0.30***	-0.32***	-0.33***	-0.21***
Dummy publication year	Yes	Yes	Yes	Yes	Yes	Yes
Dummy sub-discipline article	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-1.09***	0.51***	0.73***	0.76***	0.75***	1.83***
Observations	257,530	257,530	257,530	257,530	257,530	257,530
R-squared						0.282

Note: *** p<0.01, ** p<0.05, * p<0.1

Appendix D

In this appendix, we adopt a loose definition of novelty. We consider as novel articles those articles embedding a novel combination of journal references that are reused more than one time in the next five years after publication. Adopting this definition increases the number of novel articles to 6.3 percent of our sample.

Table D1: Novel article generation. A loose definition of novel article.

	(1) Linear Probability Model Novel article	(2) Probit, marginal effects Novel article
Team experience	-0.00056***	-0.00054***
Team specialization	-0.19***	-0.16***
Team previous collaborations	-0.012***	-0.010***
Team novelty reputation	0.037***	0.032***
Team size	-0.00023	-0.000018
Average seniority	-0.0012	-0.00073
Average seniority^2	0.000047	0.000027
N. countries	0.0025	0.0019
References	0.0037***	0.0027***
China	0.014	0.021
Germany	-0.0015	-0.00033
France	0.0078*	0.0064*
Japan	-0.0021	-0.0032
Russia	0.0066*	0.0051
Other countries	0.0095***	0.0095***
Dummy publication year	Yes	Yes
Dummy team sub-discipline	Yes	Yes
Constant	0.13***	
Observations	42,493	42,493
R-squared	0.057	0.111

Note: *** p<0.01, ** p<0.05, * p<0.1

Table D2: Team characteristics moderating the marginal effect of publishing a novel article. A loose definition of novel article.

	(1)	(2)	(3)	(4)	(5)	(6)
	Poisson	Poisson	Poisson	Poisson	Poisson	OLS
	Cit. t	Cit. t+1	Cit. t+2	Cit. t+3	Cit. t+4	log(IF5)
Novel article	-0.011	-0.22***	-0.15***	-0.17***	-0.22***	-0.24***
Novel article*Team experience	-0.00097	-0.0014***	-0.0015***	-0.0012**	-0.0014***	-0.0019***
Novel article*Team specialization	-0.61**	0.043	0.057	0.017	0.40***	0.100
Novel article*Team previous collab.	0.17**	0.13***	0.089***	0.041	0.0095	0.057*
Novel article*Team novelty reputation	0.030	0.026	-0.00040	-0.091***	-0.045	0.039
Novel article*Team size	-0.045	0.017	0.016	0.060***	0.065***	0.036***
Team experience	0.0042***	0.0038***	0.0035***	0.0034***	0.0033***	0.0026***
Team specialization	0.50***	0.15***	-0.078**	-0.21***	-0.30***	-0.22***
Team Previous collaborations	0.026	-0.12***	-0.12***	-0.12***	-0.13***	-0.064***
Team novelty reputation	0.026	0.021**	0.031***	0.064***	0.045***	-0.014
Team size	-0.012**	0.0034	0.012***	0.0057*	0.0041	-0.040***
Average age	0.020**	-0.013***	-0.028***	-0.041***	-0.044***	0.0094**
Average age^2	-0.00041	0.00052***	0.00093***	0.0013***	0.0015***	-0.00021
N. countries	0.058***	0.030***	0.040***	0.036***	0.046***	0.091***
References	0.030***	0.033***	0.035***	0.034***	0.035***	0.013***
China	-0.53***	-0.34***	-0.55***	-0.54***	-0.56***	-0.41***
Germany	-0.081***	-0.067***	-0.066***	-0.068***	-0.085***	-0.015
France	-0.19***	-0.12***	-0.10***	-0.12***	-0.14***	-0.026**
Japan	-0.17***	-0.16***	-0.18***	-0.24***	-0.24***	-0.11***
Russia	-0.63***	-0.50***	-0.48***	-0.49***	-0.52***	-0.67***
Other countries	-0.36***	-0.30***	-0.29***	-0.31***	-0.33***	-0.18***
Dummy publication year	Yes	Yes	Yes	Yes	Yes	Yes
Dummy sub-discipline article	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-1.04***	0.64***	0.87***	0.98***	0.98***	1.86***
Observations	42,493	42,493	42,493	42,493	42,493	42,493
R-squared						0.294

Note: *** p<0.01, ** p<0.05, * p<0.1

Appendix E

In this appendix, we use as dependent variable for our regression exercises, a measure of journal impact that is normalized according to the citations received by the articles published in the same scientific field and year of the journal in which the focal article is published. Table E1 compares the results of using *IF5* as dependent variable in the model specification (Column 1 is the same regression reported in Table 5, Column 6) with the results of using as dependent variable the *Normalized journal impact* (Table E1, Column 2). Columns 1 and 2 in Table E.1 show similar results.

Table E1: Normalized journal impact

	(1) OLS log(IF5)	(2) OLS Normalized journal impact
Novel article	-0.10	-0.11
Novel article*Team experience	-0.0041***	-0.0036***
Novel article*Team specialization	-0.23	0.0023
Novel article*Team previous collab.	0.028	0.012
Novel article*Team novelty reputation	-0.00077	0.0059
Novel article*Team size	0.048*	0.039
Team experience	0.0026***	0.0020***
Team specialization	-0.19***	-0.14***
Team Previous collaborations	-0.058***	-0.060***
Team novelty reputation	-0.016*	-0.016*
Team size	-0.039***	-0.018***
Average age	0.0094**	0.0068*
Average age^2	-0.00021	-0.00019
N. countries	0.091***	0.055***
References	0.013***	0.010***
China	-0.41***	-0.38***
Germany	-0.014	-0.031***
France	-0.027**	-0.051***
Japan	-0.11***	-0.19***
Russia	-0.67***	-0.45***
Other countries	-0.18***	-0.20***
Dummy publication year	Yes	Yes
Dummy article sub-discipline	Yes	Yes
Constant	1.84***	1.39***
Observations	42,493	42,493
R-squared	0.292	0.304

Note: *** p<0.01, ** p<0.05, * p<0.1

Appendix F

In this appendix, we consider the subset of articles published in journals classified only in Physics categories, as defined by the *Web Of Science* database. In other words, we drop all the articles in our sample published in journals classified in additional categories other than physics, such as chemistry or mathematics. We end up with a study sample of 21,214 articles (about 50% of the original sample). Tables F1 and F2, report the results of our regression exercises conducted on the sample of 21,214 articles published in journals classified only in Physics. We find that the regressions explaining the probability of observing a novel article reported in Table F1 show similar results as the ones in Table 4. When comparing Table F2 and Table 5 explaining the article's impact, we lose the significance of team experience and team size as moderating factors of novelty. The other moderating factors show similar effects to the ones estimated in Table 5.

Table F1: Probability of generating a novel article

	(1) Linear Probability Model Dependent variable: Novel article	(2) Probit, marginal effects Dependent variable: Novel article
Team experience	-0.00016***	-0.00011***
Team specialization	-0.053***	-0.035***
Team previous collaborations	-0.0011	-0.00040
Team novelty reputation	0.0052**	0.0035**
Team size	-0.000048	-0.000024
Average seniority	-0.0018*	-0.00087
Average seniority^2	0.000097**	0.000039*
N. countries	0.00050	0.00031
References	0.0011***	0.00057***
China	0.013	0.010
Germany	-0.0026	-0.0015
France	0.0021	0.00012
Japan	-0.0030	-0.0018
Russia	-0.00050	-0.0010
Other countries	-0.00018	0.000021
Dummy publication year	Yes	Yes
Dummy team sub-discipline	Yes	Yes
Constant	0.037***	
Observations	21,297	21,297
R-squared	0.022	0.13

Note: *** p<0.01, ** p<0.05, * p<0.1

Table F2: Team characteristics moderating the marginal effect of publishing a novel article.

	(1) Poisson Dependent variable: Cit. t	(2) Poisson Dependent variable: Cit. t+1	(3) Poisson Dependent variable: Cit. t+2	(4) Poisson Dependent variable: Cit. t+3	(5) Poisson Dependent variable: Cit. t+4	(6) OLS Dependent variable: log(IF5)
Novel article	0.030	0.28**	0.22*	0.27**	0.064	0.015
Novel article*Team experience	0.0025	-0.00064	-0.000032	-0.00098	0.0012	-0.00084
Novel article*Team specialization	-0.98	-1.86***	-1.60***	-1.71***	-0.57	-0.11
Novel article*Team previous collab.	0.14	0.26***	0.31***	0.37***	0.41***	0.14
Novel article*Team novelty reputation	0.15	0.10	-0.18**	-0.31***	-0.096	-0.11
Novel article*Team size	-0.082	-0.024	-0.015	0.0047	-0.024	-0.041
Team experience	0.0048***	0.0039***	0.0036***	0.0030***	0.0029***	0.0025***
Team specialization	0.71***	0.25***	-0.16***	-0.25***	-0.38***	-0.25***
Team Previous collaborations	0.056**	-0.11***	-0.13***	-0.15***	-0.18***	-0.051***
Team novelty reputation	-0.020	0.0047	0.0061	0.039***	0.021	-0.019
Team size	-0.039***	-0.016***	-0.0020	0.0021	0.0064	-0.059***
Average age	0.034**	-0.0025	-0.012*	-0.016**	-0.014**	-0.0020
Average age^2	-0.0016***	-0.00040	-0.000020	0.00024	0.00019	0.00027
N. countries	0.073***	0.024***	0.031***	0.019***	0.031***	0.10***
References	0.029***	0.032***	0.033***	0.032***	0.033***	0.012***
China	-0.18*	-0.17***	-0.37***	-0.36***	-0.27***	-0.12**
Germany	-0.056**	-0.031**	-0.031**	-0.021*	-0.053***	0.027**
France	-0.15***	-0.079***	-0.045***	-0.063***	-0.090***	0.034**
Japan	-0.26***	-0.17***	-0.16***	-0.18***	-0.17***	-0.069**
Russia	-0.58***	-0.47***	-0.47***	-0.46***	-0.48***	-0.69***
Other countries	-0.31***	-0.27***	-0.25***	-0.27***	-0.27***	-0.072***
Dummy publication year	Yes	Yes	Yes	Yes	Yes	Yes
Dummy article sub-discipline	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-1.23***	0.55***	0.80***	0.88***	0.84***	1.91***
Observations	21,297	21,297	21,297	21,297	21,297	21,297
R-squared						0.284

Note: *** p<0.01, ** p<0.05, * p<0.1

Appendix G

In this appendix, we consider the number of countries (*N. Countries*) listed in the authors' affiliations as moderating factors of the impact of publishing a novel article. In Table G1 we find that a larger number of countries is associated with lower citations in t+2, t+3 and t+4. The estimated coefficients associated with the other moderating factors show signs and significance similar to those in Table 5.

Table G1: Team characteristics moderating the marginal effect of publishing a novel article, including the number of countries.

	(1) Poisson Dependent variable: Cit. t	(2) Poisson Dependent variable: Cit. t+1	(3) Poisson Dependent variable: Cit. t+2	(4) Poisson Dependent variable: Cit. t+3	(5) Poisson Dependent variable: Cit. t+4	(6) OLS Dependent variable: log(IF5)
Novel article	-0.55***	-0.22**	-0.16*	0.046	0.078	-0.064
Novel article*Team experience	-0.0026	-0.0046***	-0.0045***	-0.0045***	-0.0037***	-0.0039***
Novel article*Team specialization	0.27	-0.16	-0.37	-0.66***	-0.56**	-0.25
Novel article*Team previous collab.	0.17	0.23***	0.15***	0.13**	0.15***	0.028
Novel article*Team novelty reputation	0.18*	0.16***	0.066	-0.055	0.062	-0.00089
Novel article*Team size	0.051	0.048*	0.12***	0.12***	0.11***	0.050*
Novel article*N. countries	0.11	0.028	-0.064*	-0.081**	-0.15***	-0.034
Team experience	0.0042***	0.0038***	0.0035***	0.0034***	0.0033***	0.0026***
Team specialization	0.49***	0.18***	-0.050	-0.18***	-0.25***	-0.19***
Team Previous collaborations	0.033*	-0.11***	-0.12***	-0.12***	-0.13***	-0.058***
Team novelty reputation	0.020	0.014	0.025***	0.055***	0.035***	-0.016*
Team size	-0.014**	0.0039	0.011***	0.0073***	0.0062**	-0.039***
Average age	0.020**	-0.013***	-0.028***	-0.041***	-0.044***	0.0094**
Average age^2	-0.00040	0.00052***	0.00093***	0.0013***	0.0015***	-0.00021
N. countries	0.056***	0.029***	0.041***	0.037***	0.048***	0.091***
References	0.030***	0.033***	0.034***	0.034***	0.035***	0.013***
China	-0.53***	-0.34***	-0.55***	-0.54***	-0.56***	-0.41***
Germany	-0.081***	-0.066***	-0.065***	-0.066***	-0.083***	-0.014
France	-0.20***	-0.12***	-0.10***	-0.12***	-0.15***	-0.027**
Japan	-0.17***	-0.16***	-0.18***	-0.24***	-0.24***	-0.11***
Russia	-0.63***	-0.50***	-0.48***	-0.49***	-0.52***	-0.67***
Other countries	-0.36***	-0.30***	-0.29***	-0.31***	-0.33***	-0.18***
Dummy publication year	Yes	Yes	Yes	Yes	Yes	Yes
Dummy article sub-discipline	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-1.04***	0.63***	0.86***	0.97***	0.96***	1.84***
Observations	42,493	42,493	42,493	42,493	42,493	42,493
R-squared						0.292

Note: *** p<0.01, ** p<0.05, * p<0.1