Scientometrics (2020) 122:397–408
https://doi.org/10.1007/s11192-019-03297-4

What is the best article publishing strategy for early career scientists?

Yajie Zhang[1] · **Qiang Yu**[1]

Received: 27 March 2019 / Published online: 22 November 2019

Abstract
To date, it remains unclear how different approaches to early career publishing behaviors (e.g., publishing papers in the same journal or in different journals) may benefit a young scholar's career success. In this paper, we develop a quantitative understanding of this question, analyzing 2982 qualified authorships who have academic ages ≥ 5 years and publications ≥ 3 during the first five years of their careers from 37,542 publications in three fields of science. We defined author categories by three particular publishing behaviors, and determined how authors performed in their subsequent academic careers by using six bibliometric proxies. From the results of Welch's ANOVA and Games–Howell multiple comparisons test, we found that the best publishing choice included publishing some of the author's papers in the same journal. This early career publishing choice may produce a dramatic increase in career success as seen in higher numbers of publications and collaborators, and a higher *h*-index, with different magnitudes for different scientific fields and authorships. Our findings illustrate the role that early career publishing behavior plays in relation to future career success and indicate that in order to maximize career outcomes, an advantageous publishing strategy for early career scholars is to publish some of their papers in the same journal.

Keywords Publishing behavior/strategy · Career success · Early stage · Bibliometric analysis

Introduction

In recent decades, scientific workforce bubbles have appeared due to substantial growth in the number of awarded Ph.D. degrees in contrast to only a modest increase in the number of academic positions available (Milojevic et al. 2018). This is not an optimistic situation for young researchers who have only limited scientific research capacity and resources. What paper publishing behaviors or strategies might they adopt during their early career years that would lead to successful academic careers? Currently, some "science of science"

✉ Yajie Zhang
zhangyajie1990@yeah.net

[1] Institute of Soil and Water Conservation, Northwest A&F University, No. 3 Taicheng Road, Yangling 712100, Shaanxi, China

research has applied a transdisciplinary approach that uses large data sets to study the mechanisms underlying the practice of science and to provide enlightenment for this question (Fortunato et al. 2018). In a recent study, Milojevic et al. (2018) reviewed prior studies that identified important factors correlated with career success. Those factors were productivity, impact, number of collaborators, gender, and prestige of Ph.D.-granting and -hiring institutions, prestige of the advisors, advisor gender, and level of specialization. Another study (Larivière and Costas 2016) analyzed publishing strategy and found that, in some domains for younger scholars, higher scientific output was associated with decreasing shares of highly cited publications.

Another factor that has a potential impact on future career success of early career researchers is the diversity of target journals for publication. On one hand, publishing many articles in the same journal may attract the attention of other researchers who are in the same field and may result in greater reading and citation of a young researcher's work. On the other hand, publishing articles in different journals may let readers in different fields know about a young scientist's research and apply it in different disciplines, thereby extending the citation network (Abramo et al. 2019). Therefore, it is still unclear what early career article publishing approach leads to more career success for young scientists.

In order to resolve this problem, we present here a cross-disciplinary bibliometric analysis to investigate relationships between different article publishing behaviors for authors belonging to three scientific disciplines and who have academic ages greater than five years with more than three early career publications. The publishing behaviors under consideration involved publishing papers in the same journal or in different journals during the early years of a scholar's career. We evaluated and compared the related career characteristics of authors (productivity, citations, academic age, *h*-index, collaboration, and number of articles in top journals) as measures of the quantity and quality of scientific output resulting from these different publishing behaviors (Sugimoto et al. 2016). Our goal was to be able to provide suggestions regarding paper publishing approaches or strategies that would result in future career success for young researchers.

Methods

We collected bibliographic data extracted from the Scopus database (https://www.scopus.com/search/form.uri?display=basic; last accessed: January 14, 2019) to analyze the changing careers of researchers who have published English-language articles in journals focused on three nearly unrelated research topics: climate change in agriculture (CC; adopting two keywords "climat* W/3 chang*" and "agricultur*" to search and collect publications), natural earthquake (NE; adopting "natural earthquake*"), and autism spectrum disorder treatments (AT; adopting "therap*/treatment*" and "autistic/autism"). We focused on researcher cohorts in these three particular fields that covered widely different areas of science (i.e., environmental sciences, geophysics, and medicine). The term of "climat* W/3 chang*" encompasses the expressions of climate change, climate changes, climatic change, climatic changes, changing of climate, etc. These selected research areas are fields of science in which we observed similar publication patterns over time (e.g., similar annual productivity growth trajectories, proportions of different publication types with respect to total productivity, etc.). The use of alphabetical authorship order in publications may not have had much impact on the publication and citation cultures in these fields (Waltman 2012). We searched for publications beginning in 1917, 1940, and 1947, respectively, as Scopus indexing for these three topics did not begin before these years.

We acquired data only from authors who had academic ages ≥ 5 years and publications ≥ 3 during the first five years of their careers. The academic age was defined as the interval from the first year of publication to the most recent publication year of an author. We defined the first five years as the early stage of a researcher's academic career in the selected field (Milojevic et al. 2018). We used a cut-off number of publications of three to limit the possibility that publication outcomes were highly accidental and probabilistic. We then classified all of the authors into three categories based on their publication outlets during the first five years: authors who had published each of their early career publications in different journals (AUD), authors who had published all of their early career publications in one single journal (AUO), and authors who had published some of their publications in the same journals (AUS). We also classified all of the authors into three types: corresponding authors (CA), first authors (FA), and supporting authors (SA). Each author was placed in one of the three author types in terms of his or her ultimate career authorship role. Corresponding authors were all authors who had ever served as the authors for correspondence (we took only the first listed corresponding author as a corresponding author in cases where co-corresponding authors were provided). First authors were authors who were listed as lead authors but had never served as corresponding authors (we took only the first listed author as a first author in cases where co-first authors were listed). Supporting authors were authors who had never had the role of corresponding author or first author in their careers.

We then established an author list to investigate the trends in careers of researchers. This list contained the information and indicators of name [with Scopus Author Identifiers (SAI)], number of articles, average citations per article, start year of career (year of first publishing), end year of career (year of last publishing), academic age (span in years between the first and the most recent article), *h*-index (*h* papers with at least *h* citations each) (Hirsch 2005), number of collaborators (the number of authors on articles on which he/she was a co-author), number of articles published in top-ranked journals, and the author category (AUD, AUO, and AUS) and type (CA, FA, and SA). We selected the first quartile (Q1) journals classified in all subjects based on their SCImago Journal Rank indicator as of 2018 as the top-ranked journals (https://www.scimagojr.com/journalrank.php). Best journal quartile for all subject categories was considered for journals. The number of publications and total citations are the most elementary metrics for assessing research impact (Carpenter et al. 2014). The *h*-index is derived from a formula using publications and citations, which provides an estimate of the importance, significance, and broad impact of the scientific contributions of a researcher (Hirsch 2005), and it is also able to predict future scientific success (Acuna et al. 2012; van Dijk et al. 2014). Furthermore, science has become increasingly collaborative (Sugimoto et al. 2016). Engaging in collaboration is beneficial to scientific work, supporting the premise that collaboration can bring together different specialties, effectively combining knowledge and the collective resource base to promote scientific breakthroughs (Petersen 2015; Fortunato et al. 2018). A team-authored paper generally receives more citations than a solo-authored paper, and this difference cannot be explained by self-citations (Wuchty et al. 2007). In addition, publishing papers in the top-ranked journals remains one of the principal factors in career and funding decisions; researchers rationally react to it by incorporating it into their own decision-making. These variables (e.g., productivity, impact, and collaboration) have been identified as correlated with career trajectories and directly related to career success (Milojevic et al. 2018).

Before bibliometric indicators were calculated, we quality checked the data for typographical errors in the source papers, and for duplicates and missing data. Moreover, in order to minimize ambiguity regarding author names, SAI (unique numbers automatically assigned to each author in Scopus) were used in this study to obtain accurate information for authors. The matching procedure of Scopus, which groups author names under a common SAI, is based on an algorithm that matches affiliation, address, subject area, source title, dates of publication citations, and co-author information. This author name disambiguation method was applied in this study to avoid errors induced by homonyms, i.e., distinct individuals sharing the same formatted name. However, some systematic errors can be produced, sometimes merging multiple Scopus profiles under the same SAI or attributing the same author publications to different SAIs (Kolesnikov et al. 2018). To account for these issues, we then conducted manual disambiguation of Scopus author profiles based on information of researchers in the bibliographic collection used in this study. Bibliometric metrics were then aggregated and recalculated for each individual. The numbers of publications covered by this database were 17,132, 9110, and 11,324 for climate change in agriculture, natural earthquake, and autism treatments, respectively. Ten articles focused on both climate change in agriculture and natural earthquake, and those articles were removed from this analysis. After excluding data errors and authors who had academic ages <5 years and had published fewer than three papers during the first five career years, the final number of authorships included in the analysis was 2982.

Bibliometric data were numerical data with highly skewed distributions (Bornmann and Leydesdorff 2014). Therefore, we applied Welch's ANOVA test in conjunction with the Yeo–Johnson transformation to obtain normally distributed data (normality and homogeneity of variance were tested using the Lilliefors normality test and Levene's test, respectively) and to compare differences among the article publishing choices during early years of researchers' academic careers, and Games–Howell test for post hoc comparisons (Yeo and Johnson 2000; De Battisti and Salini 2013). Welch's ANOVA test could obtain higher statistical power and much more accurate results for heteroscedastic data from an unbalanced design, even with small sample sizes (except for extremely small sample size, i.e. $N \leq 5$) (de Winter 2013; McDonald 2014). We tested only the main effects by collapsing the factors. Interaction effects cannot be derived from Welch's ANOVA. Significance was accepted when H_0 was rejected at a probability level of $p < 0.05$.

We used R (version 3.5.1; Statistics Department of the University of Auckland, https://www.r-project.org/) to process the data described above. The R packages used in these calculations and visualizations mainly contained "bibliometrix" (Aria and Cuccurullo 2017), "stringr", "car", and "ggpubr".

Results

Linear regression analysis was used in constructing data trends, and considered publication productivity in the first five years of a career as the independent variable, while dependent variables for six career success metrics were taken for the full length of the career. Strong linear relationships (adjusted $R^2 > 0.4$, $p < 0.05$) were observed between the number of publications in the first five years of an academic career and the number of articles (and articles in top journals) and *h*-index (Fig. 1). There was, however, no clear trend in the relationship between the number of publications in the first five years and either the average number of citations per article or academic age. The number of articles published by about 90% of

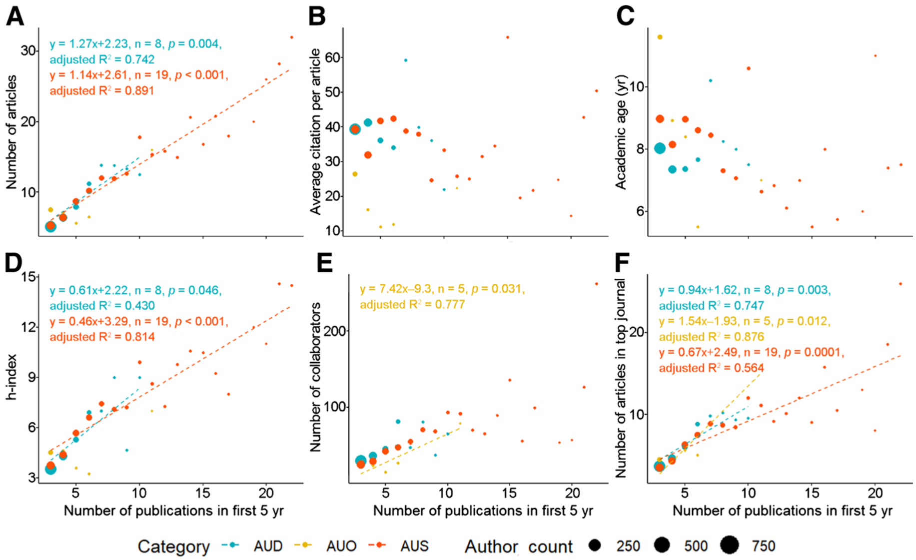

Fig. 1 Scatterplot of mean values of **a** number of articles, **b** average citations per article, **c** academic age, **d** *h*-index, **e** number of collaborators, and **f** number of articles in top journals between author categories [authors who had published all of their early career publications in one single journal (AUO), authors who had published each of their early career publications in different journals (AUD), and authors who had published some of their publications in the same journals (AUS)] for different numbers of articles published in the first five years of their academic careers. Author counts are displayed as different size bubbles. Trend lines are also presented when significant (adjusted $R^2 > 0.4$, $p < 0.05$)

authors fell within the range of three to eight. But the data range extended much further for AUS than for AUO or AUD. For AUS, the more articles published in the first five years of academic careers, the higher the *h*-index, numbers of articles, and number of articles in top journals during the entire academic career. For example, the *h*-index increased from about 3.5 after three publications to nearly 15 after twenty-two publications for AUS. However, the other three career success indicators (average citations per article, academic age, and number of collaborators) showed no clear linear relationship for AUS, and fluctuated slightly as number of articles published in the first five years increased from three to twenty-two. For AUD, the variation trends of these six career success indicators were similar to the trends seen with AUS. The upward trend for AUD was somewhat greater than observed for AUS. For AUO, as the number of articles published in the first five years of academic careers increased, positively linear relationships were observed for the bibliometric indicators of the numbers of collaborators and articles in top journals. Meanwhile, the other bibliometric indicators mostly declined, with some fluctuation. Therefore, based on Fig. 1, we observe that with the AUS and AUD publishing behaviors, each publication during the first five years of an academic career had substantially more impact on career success, at least for the total number of publications and *h*-index, while AUO publishing behavior had more impact on the number of articles in top-tier journals, although this effect was limited by the short range of initial publishing productivity observed for AUO publishing behavior. To explore these differences further, Welch's ANOVA and Games–Howell multiple comparisons tests were used to provide the following direct comparisons between different publishing behaviors.

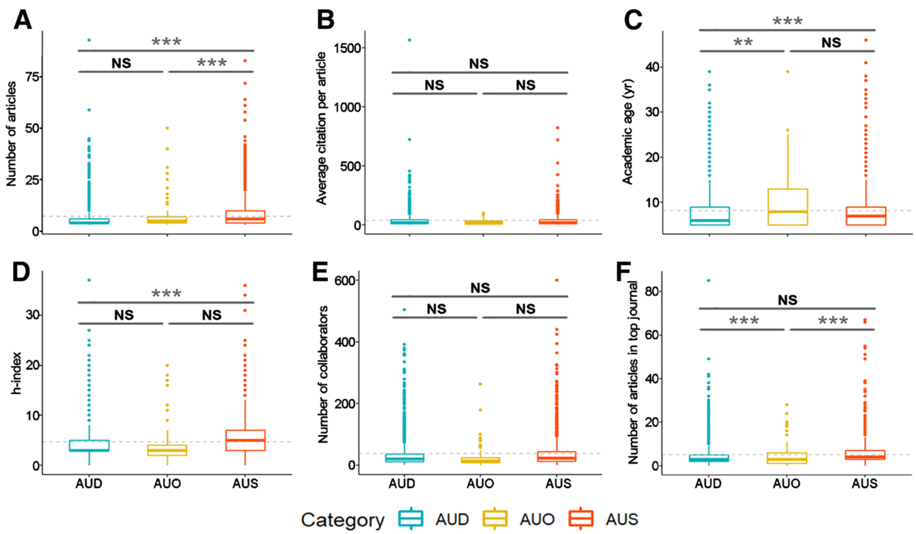

Fig. 2 Comparisons of **a** number of articles, **b** average citations per article, **c** academic age, **d** *h*-index, **e** number of collaborators, and **f** number of articles in top journals between author categories {$n = 85$, 1566, and 1331 for the three author categories [authors who had published all of their early career publications in one single journal (AUO), authors who had published each of their early career publications in different journals (AUD), and authors who had published some of their publications in the same journals (AUS)], respectively}. Welch's ANOVA followed by Games–Howell multiple comparisons test were used; shown are boxplots, overall average lines, and significant changes (*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$; NS indicates no significant difference at $p = 0.05$)

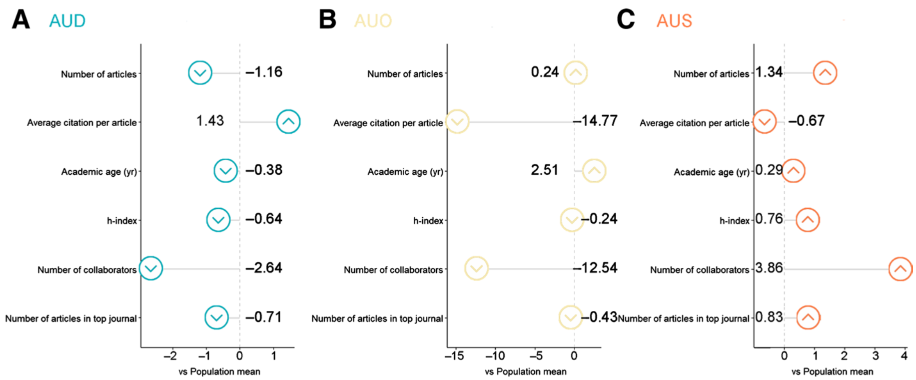

Fig. 3 Means of the three author categories [**a** authors who had published each of their early career publications in different journals (AUD), **b** authors who had published all of their early career publications in one single journal (AUO), and **c** authors who had published some of their publications in the same journals (AUS)], respectively, versus mean of population for number of articles, average citation per article, academic age, *h*-index, number of collaborators, and number of articles in top journals

Figures 2 and 3 show the six indicators of academic success for the three author categories. AUS had significantly more published articles than AUO and AUD ($p < 0.001$). AUS also had significantly higher academic age and greater *h*-index than AUD ($p < 0.001$). For AUO, the indicator of academic age was significantly higher ($p < 0.01$) than for AUD, but AUO had significantly fewer articles in top journals than AUS and AUD ($p < 0.001$). Moreover, there was no significant difference between AUO, AUD, and AUS in average number of citations per article and number of collaborators. The six indicators of academic success shown in Fig. 3 were interpreted by estimating how far they were from the population mean. For example, for AUS, only the average citation per article was lower than the mean (− 0.67). An author categorized as following the AUS publishing behavior would publish more articles (+ 1.34) and articles in top journals (+ 0.83), participate in more collaboration (+ 3.86 in number of collaborators), and achieve a higher *h*-index (+ 0.76) during his/her entire academic career than authors having the AUO and AUD publishing behaviors. In contrast, AUO and AUD authors would not surpass AUS in most career success indicators, especially in number of collaborators (− 12.54 and − 2.64 for AUO and AUD, respectively). However, AUO authors might have a longer academic age (+ 2.51), and AUD authors may have more citations of their articles (+ 1.43).

Figure 4 shows comparisons of the six indicators of academic success for AUO, AUD, and AUS for the three research fields. Results varied from discipline to discipline. Authors in the fields of AT and CC had significantly higher production ($p < 0.001$), higher numbers of articles in top journals ($p < 0.001$), and more opportunities to cooperate with others ($p < 0.001$), than authors in the field of NE, while AT authors had

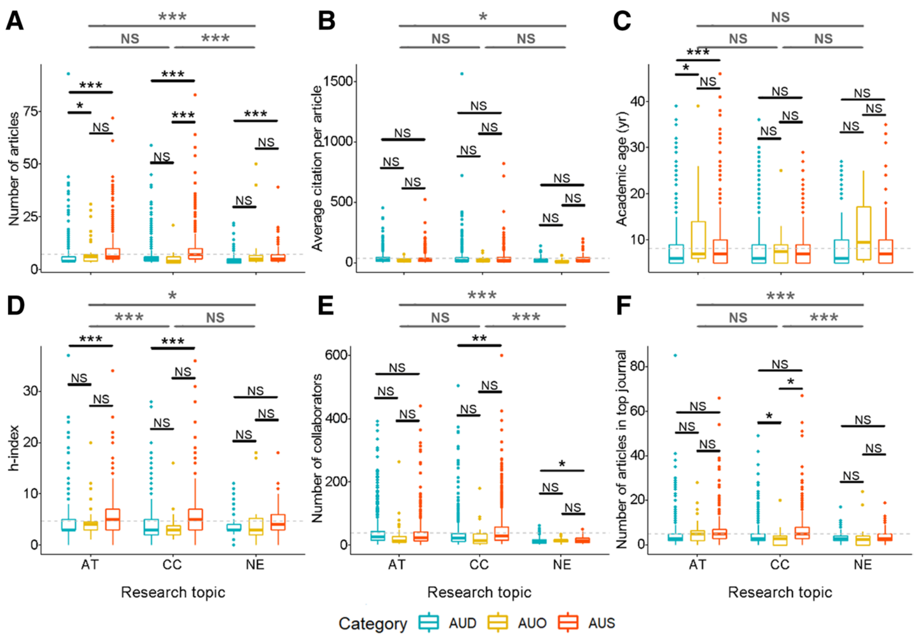

Fig. 4 Comparisons of **a** number of articles, **b** average citations per article, **c** academic age, **d** *h*-index, **e** number of collaborators, and **f** number of articles in top journals between author categories in different research topics {$n = 43$, 22, and 20 for the three research topics [autism treatments (AT), climate change in agriculture (CC), and natural earthquake (NE)] of AUO (authors who had published all of their early career publications in one single journal); 551, 850 and 165 for AUD (authors who had published each of their early career publications in different journals); and 498, 662 and 171 for AUS (authors who had published some of their publications in the same journals), respectively}. Welch's ANOVA followed by Games–Howell multiple comparisons test were used; shown are boxplots, overall average lines, and significant changes (*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$; NS indicates no significant difference at $p = 0.05$)

significantly higher *h*-index. For these three author categories, in general, AUS produced more articles and achieved higher *h*-index than AUO and AUD, with differences reaching significant levels ($p < 0.001$). AUS also resulted in more chances for collaboration and publication in top journals, with some interdisciplinary differences. Compared with AUD and AUS, AUO had the highest academic age and lower values for the other indicators. There was no significant difference between AUO, AUD, and AUS in average number of citations per article.

Figure 5 shows the means comparisons of the six indicators of academic success for AUO, AUD, and AUS characterized by three author types. Of these three author types, CA had significantly more published articles, higher academic age, and *h*-index ($p < 0.001$, respectively). CA also had significantly more published articles in top journals ($p < 0.01$) than FA and SA. There was no significant difference for CA, FA, and SA in average number of citations per article. Moreover, significant differences for FA and SA were observed for most of the indicators, except for number of articles in top journals. For these three author categories, AUS had significantly higher production of publications and *h*-index level than AUO and AUD ($p < 0.001$). Compared with AUD and AUS, AUO had the lowest level of collaboration and publication in top journals but almost the highest level of academic age. There was no significant difference

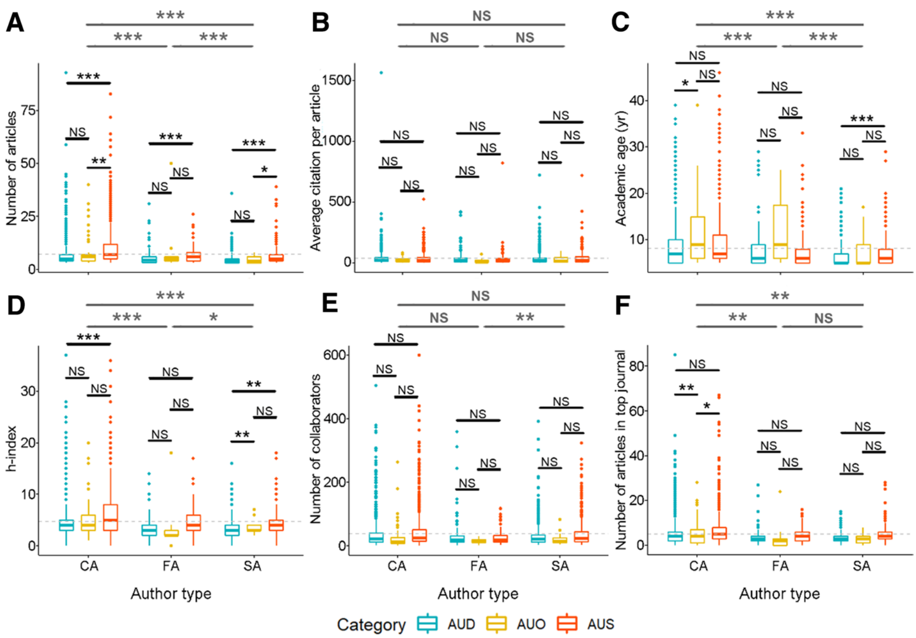

Fig. 5 Comparisons of **a** number of articles, **b** average citations per article, **c** academic age, **d** *h*-index, **e** number of collaborators, and **f** number of articles in top journals between author categories for different author types {$n = 53$, 11, and 21 for the three author types [corresponding authors (CA), first authors (FA), and supporting authors (SA)] of AUO (authors who had published all of their early career publications in one single journal); 804, 178, and 584 for AUD (authors who had published each of their early career publications in different journals); and 790, 142, and 399 for AUS (authors who had published some of their publications in the same journals), respectively}. Welch's ANOVA followed by Games–Howell multiple comparisons test were used; shown are boxplots, overall average lines, and significant changes (*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$; NS indicates no significant difference at $p = 0.05$)

between AUO, AUD, and AUS in average number of citations per article and number of collaborators.

Discussion

In this study, we looked at the effects of total publication productivity during the first five years of a scientific career on six indicators of career success in relation to different authorship roles. We also examined the six bibliometric indicators for differences caused by three author categories of publishing behaviors. Our results appear to show that.

Higher total publication productivity during the first five years of authors' careers often leads to future career success

van Dijk et al. (2014) indicated that career success for a scientist is largely predictable by only the first few years of the publication record. Success in academia also depends on the impact and status of the journals in which those papers are published (van Dijk et al. 2014). These findings were also confirmed by our study. Scholars who had AUS or AUD behaviors would benefit from the increasing number of publications in the first five years of their careers. Furthermore, early-career productivity extended much further for AUS (from 3 to 22), resulting in higher levels of subsequent career success. Experience also likely plays a critical role in crafting scientific work. A scientist is unlikely to appear as a senior author if he or she has not previously published in the same journal (Sekara et al. 2018). At the same time, it should be noted that we also found potentially negative impacts of higher productivity on some career success metrics. Specifically, for the average number of citations and academic age, negative (albeit non-significant) relationships with productivity during the first five years were observed (see Fig. 1). The possible explanations are discussed in Kolesnikov et al. (2018), who reported negative effects of excessive productivity in certain disciplines on long-term publication impact, while Larivière and Costas (2016) reported similar negative effects for young scholars in particular.

AUS is the best early career publishing strategy to maximize future career outcomes

The best article publishing behavior leading to a more successful academic career is for an author to publish some of his/her papers in the same journal. Authors who are in this behavior category can simultaneously achieve continuous impact from some journals (where more than one article is published) and also increase their readership and influence in the broader scientific community by publishing in other journals (Abramo et al. 2019). In addition, in many countries, such as China, the hiring, promotion, and tenure of scientists is heavily based on their publication records, in which case following such diversified publishing behavior may mitigate potential negative impacts to researchers in cases where journals' impact factors decrease, leading to their exit from the top quartile.

We also found the following: (1) as different disciplines have different knowledge production practices, disciplinary differences may contribute to the variability of productivity, impact, and collaboration (Sugimoto et al. 2016). Authors in the field of AT, which rapidly developed earlier than CC and NE (i.e., published papers ≥ 10 starting from 1968), had the highest academic age. Authors of NE papers had the least numbers of articles and articles in top journals, and collaborations due to the regionality and timeliness of natural earthquake research. (2) Scientists' career paths are heterogeneous, with some scientists becoming lead authors and others specializing as non-lead supporting authors (Milojevic et al. 2018). SA had the least publications and academic age, as also reported by Milojevic et al. (2018), in which they stated that "while essential, these supporting researchers are suffering from greater career instability and worse long-term career prospects in some fields." It is reasonable that being a CA results in an obvious positive advantage in relation to most of the career success indicators. However, being a FA results in the least collaboration. A potential explanation for this finding may be that many CAs need to guide students and make collaborations with others, while SAs need to join and support others' research.

Our results support previous observations that author behavioral considerations are relevant to modern academic reputation and success systems (Li et al. 2019). For early-career researchers, some important individual factors that led to academic career success were the willingness to be geographically mobile, self-attribution of previous career success, as well as devotion to research and networking (Ortlieb and Weiss 2018). Early career publishing approaches were also well associated with career success. These approaches can be more often opportunistic rather than strategic, affected by advisor decisions, project mission, and variation of journal evaluation indexes. Even if a young researcher strategically aims at some highly selective journals for his/her publications, it is far from guaranteed that he/she would be able to achieve this goal. Even so, early career scholars should be advised to translate the opportunistic event into a strategic choice to maximize career outcomes. Publishing some of an early career scholar's papers in the same journal (AUS behavior) may help to enhance that scholar's academic reputation and promote career success (e.g., achieve more publications, higher *h*-index, and more collaborators). Strong positive relationships exist between these career success metrics (e.g., Lee and Bozeman 2005). In addition, publishing all papers in the same journal (AUO behavior) seems to prolong the academic career of early career scholars. To enhance the impact of a scholar's publications (i.e., average citations per article), publishing each of the papers in different journals (AUD behavior) can be adopted as a publication strategy. While a researcher's productivity and the quality of his/her work are obvious determinants of academic success, he/she must make wise choices regarding the suitable form of publication for every result obtained in his/her early career (Li et al. 2019).

Study limitations

Some limitations are noteworthy regarding this study. (1) While our dataset from Scopus was comprehensive, it was not exhaustive and did not include all journals available worldwide. Additionally, only journal articles were included in our analysis, while reviews, books, and conference proceedings, for example, were not included. In addition, we defined authors and derived their metrics from this dataset alone, therefore, our results are valid within that scope. Some of these authors may have published part of their work in journals which are not indexed by Scopus or have additional publications focusing on other topics. This incompleteness will reduce the metrics and affect the determination of authorship role (either author types or author categories) (Milojevic et al. 2018). However, since the analyses in this study were relative, the incompleteness will not affect some research topics or authors more than the others (Milojevic et al. 2018). (2) Our study did not exclude self-citations from the analysis process. Doing so would yield a more accurate assessment of article importance and impact, as self-citation is a practice that benefits specific authors (Costas et al. 2010; Cameron et al. 2013). (3) Our analysis adopted only six proxies to quantify scientific career success. Some other important indicators (e.g., article visibility, and number of first author publications) may also highly correlate with academic success (McCabe and Snyder 2014; van Dijk et al. 2014; Tahamtan et al. 2016). Additionally, some non-publication factors, such as the scientists' gender and the prestige of their institutions, that play important roles in career aspects involving institutional and job roles (hiring, tenure, and promotion) (Fox 2005; van Dijk et al. 2014; Milojevic et al. 2018), were not included in this study. Moreover, the SCIMago Journal Ranks that were adopted in this study were available only from 1999, and provided journal ranks and quartiles significantly changing over time. Some journals might experience title changing or publication suspension. Considering only the 2018 edition of SCImago Journal Ranks might misestimate the count of articles in top journals and should be treated as a rough proxy of journal quality, although it might be miscounted relatively equally between different research fields. We have tried to mitigate these limitations, but there is always room for improvement.

Conclusion

Young scientists may choose targets for their early career publications with the guidance of their research advisors or for opportunistic reasons. However, during the first five years of a scholar's career, it is better for future career outcomes to diversify journal targets to some extent and strive to take up active publication roles, such as become a corresponding author whenever possible. Scholars will benefit from increasing bibliometric indicators when exhibiting publishing behavior or choosing a strategy of publishing some of their papers in the same journal (AUS behavior) or publishing each of their papers in different journals (AUD behavior) in the first five years of their careers. Future research into publishing choices could more precisely answer questions raised by this study (Larivière et al. 2013). Why do authors who publish all of their papers in the same journal (namely AUO) have higher academic age but fewer citations and collaborations? Furthermore, are there other characteristics of the three kinds of authors that contribute to disparities in career success, and are there other aspects that reveal a different story regarding article publishing behavior or strategy that are influential to academic career success?

Acknowledgements This work uses Scopus data provided by Elsevier B.V. The authors appreciate the anonymous referees and the handling editor for their valuable suggestions that have helped improve this paper substantially. The authors are indebted to David Nielsen at AEREA Inc. (http://aereainc.com/), Shouhua Xu at the Institute of Soil and Water Conservation, Northwest A&F University, and Juan Li at Chinese Research Academy of Environmental Sciences, for making suggestions. This study was funded by the International Partnership Program of the Chinese Academy of Sciences (161461KYSB20170013) and the Chinese Academy of Sciences "Light of West China" Program. Data and codes used in the study are available upon reasonable request.

References

Abramo, G., D'Angelo, C., & Costa, F. (2019). Diversification versus specialization in scientific research: Which strategy pays off? *Technovation, 82–83,* 51–57.

Acuna, D. E., Allesina, S., & Kording, K. P. (2012). Future impact: Predicting scientific success. *Nature, 489,* 201–202.

Aria, M., & Cuccurullo, C. (2017). bibliometrix: An R-tool for comprehensive science mapping analysis. *Journal of Informetrics, 11,* 959–975.

Bornmann, L., & Leydesdorff, L. (2014). Scientometrics in a changing research landscape. *EMBO Reports, 15,* 1228–1232.
Cameron, E. Z., Gray, M. E., & White, A. M. (2013). Is publication rate an equal opportunity metric? *Trends in Ecology & Evolution, 28,* 7–8.
Carpenter, C. R., Cone, D. C., & Sarli, C. C. (2014). Using publication metrics to highlight academic productivity and research impact. *Academic Emergency Medicine, 21,* 1160–1172.
Costas, R., van Leeuwen, T. N., & Bordons, M. (2010). Self-citations at the meso and individual levels: Effects of different calculation methods. *Scientometrics, 82,* 517–537.
De Battisti, F., & Salini, S. (2013). Robust analysis of bibliometric data. *Statistical Methods and Applications, 22,* 269–283.
de Winter, J. (2013). Using the Student's *t* test with extremely small sample sizes. *Practical Assessment, Research & Evaluation, 18*. http://pareonline.net/getvn.asp?v=18&n=10.
Fortunato, S., Bergstrom, C. T., Börner, K., Evans, J. A., Helbing, D., Milojević, S., et al. (2018). Science of science. *Science, 359,* eaao0185. https://doi.org/10.1126/science.aao0185.
Fox, M. (2005). Gender, family characteristics, and publication productivity among scientists. *Social Studies of Science, 35,* 131–150.
Hirsch, J. (2005). An index to quantify an individual's scientific research output. *Proceedings of the National Academy of Sciences of the United States of America, 102,* 16569–16572.
Kolesnikov, S., Fukumoto, E., & Bozeman, B. (2018). Researchers' risk-smoothing publication strategies: Is productivity the enemy of impact? *Scientometrics, 116,* 1995–2017.
Larivière, V., & Costas, R. (2016). How many is too many? On the relationship between research productivity and impact. *PLoS ONE, 11,* e0162709. https://doi.org/10.1371/journal.pone.0162709.
Larivière, V., Ni, C. Q., Gingras, Y., Cronin, B., & Sugimoto, C. R. (2013). Bibliometrics: Global gender disparities in science. *Nature, 504,* 211–213.
Lee, S., & Bozeman, B. (2005). The impact of research collaboration on scientific productivity. *Social Studies of Science, 35,* 673–702.
Li, W., Aste, T., Caccioli, F., & Livan, G. (2019). Reciprocity and impact in academic careers. *EPJ Data Science, 8,* 20. https://doi.org/10.1140/epjds/s13688-019-0199-3.
McCabe, M. J., & Snyder, C. M. (2014). Identifying the effect of open access on citations using a panel of science journals. *Economic Inquiry, 52,* 1284–1300.
McDonald, J. H. (2014). *Handbook of biological statistics* (3rd ed.). Baltimore, MD: Sparky House Publishing.
Milojevic, S., Radicchi, F., & Walsh, J. (2018). Changing demographics of scientific careers: The rise of the temporary workforce. *Proceedings of the National Academy of Sciences of the United States of America, 115,* 12616–12623.
Ortlieb, R., & Weiss, S. (2018). What makes academic careers less insecure? The role of individual-level antecedents. *Higher Education, 76,* 571–587.
Petersen, A. M. (2015). Quantifying the impact of weak, strong, and super ties in scientific careers. *Proceedings of the National Academy of Sciences of the United States of America, 112,* E4671–E4680.
Sekara, V., Deville, P., Ahnert, S. E., Barabasi, A.-L., Sinatra, R., & Lehmann, S. (2018). The chaperone effect in scientific publishing. *Proceedings of the National Academy of Sciences of the United States of America, 115,* 12603–12607.
Sugimoto, C. R., Sugimoto, T. J., Tsou, A., Milojević, S., & Larivière, V. (2016). Age stratification and cohort effects in scholarly communication: A study of social sciences. *Scientometrics, 109,* 997–1016.
Tahamtan, I., Afshar, A. S., & Ahamdzadeh, K. (2016). Factors affecting number of citations: A comprehensive review of the literature. *Scientometrics, 107,* 1195–1225.
van Dijk, D., Manor, O., & Carey, L. B. (2014). Publication metrics and success on the academic job market. *Current Biology, 24,* R516–R517.
Waltman, L. (2012). An empirical analysis of the use of alphabetical authorship in scientific publishing. *Journal of Informetrics, 6,* 700–711.
Wuchty, S., Jones, B. F., & Uzzi, B. (2007). The increasing dominance of teams in production of knowledge. *Science, 316,* 1036–1039.
Yeo, I., & Johnson, R. (2000). A new family of power transformations to improve normality or symmetry. *Biometrika, 87,* 954–959.