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ResearchGate, an effective way to improve the academic dissemination for highly cited researchers?*

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1 Introduction

Academic dissemination and communication play a great role in promoting scientific progress. Traditionally, most researchers disseminated their work through journal articles, books, and conference presentations (Mas-Bleda et al., 2014). With the development of the Web 2.0, the emergence of social websites, such as Facebook, Twitter, Wechat, provides an alternative way to help researchers presenting their current work, opening views, personal skills, and expertise; meanwhile, followers can get the updated information by following their interested researchers. Although social websites were not very popular among researchers (Mas-Bleda et al., 2014), researchers using social media could obtain several benefits, especially for the ability to communicate quickly (Rowlands et al., 2011).

Among the various social websites, academic social networking site (ASNS) is specially designed for researchers, which could be used to share publications, establish connections, and follow other scholars (Nández and Borrego, 2013; Elsayed, 2016). Moreover, ASNS has been developed to discover recommended research papers, follow discussion groups, and track metrics relating to interest in their work (El-Berry, 2015), and even to share negative results that may not be published, upload raw data sets, gain peer reputation and collaboration (van Noorden, 2014; Yu et al., 2016).

ResearchGate (RG) and Academia.edu are the most popular ASNS for scholarly communication (Manca, 2018). There have been many studies focusing on the influences of ASNS on the paper, journal, and even university levels (Nicholas et al., 2015). Chakraborty (2012) found that Facebook and RG had no role on research and education from pure science think based on a survey of North Eastern Hill University. *Nature* e-mailed tens of thousands of researchers to ask how they used social networks and other popular profile-hosting or search services and received more than 3500 responses from 95 different countries. As results, RG is the most certainly well-known. More than 88% of scientists and engineers said that they were aware of it with little difference between countries. Just under half said that they visit regularly, putting the site second only to Google Scholar, and ahead of Facebook and LinkedIn. Some researchers found that it is much easier to find the latest relevant papers on RG than by following journals (van Noorden, 2014). However, it is still not clear about the impact on personal level.

In this paper we take RG as example to explore the following three questions:

(1) How to evaluate scholars' academic dissemination ability?

(2) Is there any difference of the academic dissemination ability between the scholars using RG and not-using RG?

(3) Whether using RG or not will influence the scholars' literature citation performance?

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2 Methods

2.1 Object grouping and screening

To obtain a group of researchers with relatively consistent academic level, we downloaded the Highly Cited Researchers (HCR) 2016 List from Clarivate Analytics, which is an annual list recognizing leading researchers in the sciences and social sciences from around the world (https://clarivate.com/hcr).

In order to eliminate the influence between disciplines, we chose "Engineering" category for further analysis. All the researchers were divided into two groups, group RG_Yes (registered on RG) and group RG_No (not registered on RG) by searching the full-name on RG website from Sept. 13, 2017 to Sept. 23, 2017; the searching results were confirmed according to the authors' affiliation, country, and some of the publications; the *h*-indices and literature numbers on RG were recorded. Meanwhile, all the researchers were searched on Scopus by the last name, first name, and affiliation; the *h*-indices (excluding the self-citations), annual increased citations of 2014 (N_{2014}), 2015 (N_{2015}), 2016 (N_{2016}), and 2017 (N_{2017}), and the total citation (N_T) were recorded. Self-citations were excluded to eliminate the influence from the researchers themselves; book-citations were included considering the impact of books. We calculated the annual total citation growth rates (K) of 2014, 2015, 2016, and 2017, marked as K_{2014}, K_{2015}, K_{2016}, and K_{2017}, respectively, according to the following equations:

$$K_{2014}=N_{2014}/(N_T-N_{2014}-N_{2015}-N_{2016}-N_{2017}), \quad (1)$$

$$K_{2015}=N_{2015}/(N_T-N_{2015}-N_{2016}-N_{2017}), \quad (2)$$

$$K_{2016}=N_{2016}/(N_T-N_{2016}-N_{2017}), \quad (3)$$

$$K_{2017}=N_{2017}/(N_T-N_{2017}). \quad (4)$$

Considering that the newly published papers will gain a particularly high increase of citation in a short term, which will greatly affect the K-value, we calculated the percentage ($P_{2015–2017}$) of the last three years' citation (2015–2017) to the total citation, and the researchers of $P_{2015–2017}>65\%$ were removed. Furthermore, we found that a few of scholars' literature number on RG is much less than that on Scopus, and these researchers were also excluded.

2.2 Statistic analysis

The statistical analysis was performed using IBM SPSS statistics version 22 (SPSS, Chicago, IL, USA). The comparisons between groups RG_Yes and RG_No were performed using independent sample *t*-test and comparisons among multiple sample sets were analyzed using one-way ANOVA test. $P<0.05$ was considered significantly different.

3 Results and discussion

The HCR 2016 List includes 3265 scholars who are mainly from USA (n=1529), UK (n=324), Germany (n=187), China (n=184), etc. The top four countries account for more than two-thirds. All the researchers are assigned to 21 broad disciplines, including Clinical Medicine (n=377), Chemistry (n=215), Plant & Animal Sciences (n=208), Biology & Biochemistry (n=203), Molecular Biology & Genetics (n=187), etc. In order to eliminate the influence between disciplines, researchers in Engineering (n=145) were chosen for further analysis.

After excluding the researchers with lower *h*-indices, less literature numbers in RG website, or $P_{2015–2017}>65\%$, 123 scholars of Engineering discipline were left, including 67 in group RG_Yes and 56 in RG_No (Fig. 1). Table 1 shows the basic statistics of HCR scholars' *h*-indices. There is no difference of *h*-index between groups RG_Yes and RG_No ($P>0.05$), indicating that the academic influence of these scholars is consistent between the two groups.

In the pre-study, cross-tabulation analysis was used to reveal the relation between the changes of the annual citation (increase or decrease) and the registration of RG (groups RG_Yes and RG_No) using the Pearson Chi-square test (data not shown). However, no significant difference was found between them. This indicates that the registration of RG website is not sufficient to affect the increase or decrease of annual citation, which mainly depended on the quality and quantity of articles published in previous years. Therefore, we introduced the concept of annual total citation growth rate (K), which is a specific value that can rule out the influence of the article number and reflect the trend of the annual citation increase.

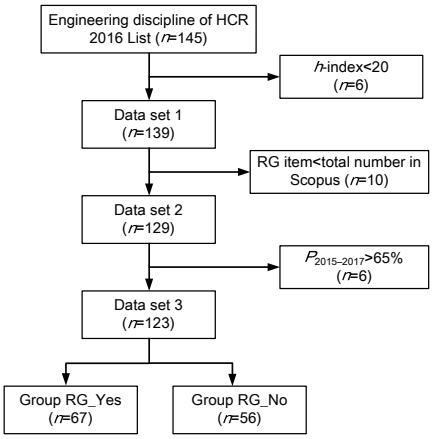

Fig. 1 Flow chart of the scholar screening process

Table 1 Statistics of HCR scholars' *h*-indices

Group	Number	Mean	Std. deviation	*P*
Total	123	56.85	20.16	
RG_Yes	67	56.13	20.39	
RG-No	56	57.71	20.03	>0.05

The independent sample *t*-tests showed that K_{2014}, K_{2015}, and K_{2016} values were significantly different ($P<0.05$, $P<0.01$, and $P<0.01$, respectively) between Groups RG_Yes and RG_No; however, there is no significant difference in K_{2017} between groups ($P>0.05$) (Fig. 2). The annual total citation growth rates of highly cited researchers decrease slightly every year and tend to be a same value for both groups (Fig. 2). Furthermore, K_{2014}, K_{2015}, and K_{2016} of group RG_No were almost equal to the K_{2015}, K_{2016}, and K_{2017} of group RG_Yes, respectively. It seems that the decreasing trend in the *K*-value of the RG_Yes group was delayed by one year. Traditionally, the scholarly information lifecycle was mainly depended on the published article or book; however, the growth of ASNS enhanced that cycle and expanded the reach of a scholar's ideas in new and, very importantly, interactive ways (Ali and Richardson, 2017). Although it is hard to say that RG played a key role in this process, we can speculate that scholars in the RG_Yes group have participated more in the academic promotion and dissemination during this period, and RG is at least one of the ways.

To test the validity of *K*-value, we compare the scholars in lists both of RG_Yes and RG_No to the HCR 2017 List and the HCR 2018 List separately. We find that more scholars in RG_No (17.9% (10/56)) are removed from the 2017 List than those in RG_Yes (9.0% (6/67)). After that, a similar number of scholars of 14.9% (10/67) and 16.0% (9/56) in RG_Yes and RG_No, respectively, are removed from the 2018 List. It seems that the Journal Citation Report (JCR) citation performance of the scholars in the RG_Yes is better than that in RG_No in the next year (2017), and this difference will be reduced in 2018. This result is consistent with the previous inference that decreasing trend of *K*-value in RG_Yes is delayed by one year.

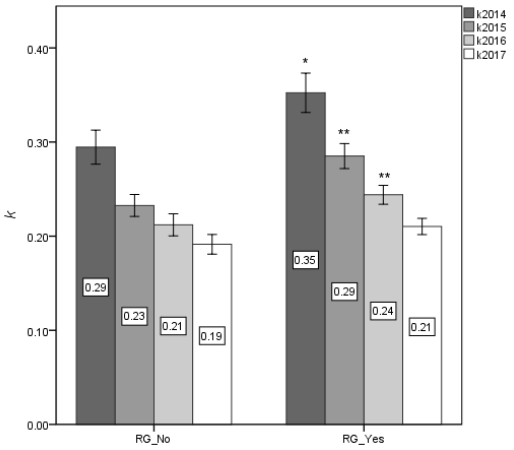

Fig. 2 Comparisons of annual total citation growth rates (*K*) from 2014 to 2017 between groups RG_Yes (*n*=67) and RG_No (*n*=56)

* $P<0.05$; ** $P<0.01$. All the data are expressed as mean± standard error of the mean (SEM)

We also examined the difference between countries and disciplines to some extent. The country distribution of RG-registered scholars was counted and the top five countries were China, USA, Canada, Australia, and Germany, as shown in Fig. 3a. The overall percentage of RG-registered scholars in Engineering is 54.5% (79/145). In China, the percentage of RG-registered scholars is 46.15% (18/39); however, the registered percentage of Chinese scholars who had only one affiliation in mainland China was only 31.25% (5/16) (Fig. 3a). We enrolled the scholars in the disciplines of Chemistry, Biology & Biochemistry, and Clinical Medicine, and got similar results (Fig. 3b). We also found that the average percentage of registered scholars on RG is about 40% and the percentages of the USA, UK, Germany, and China are 38.65%, 38.96%, 30.77%, and 36.71%, respectively. Similar results were found by van Noorden (2014)

that almost half of 3000 scientists and engineers were aware of RG site and visit it regularly. The scholars from all over the world are encouraged to register on RG and should pay more attention to the academic dissemination, which is helpful to make their works to be searched, read, and cited successfully.

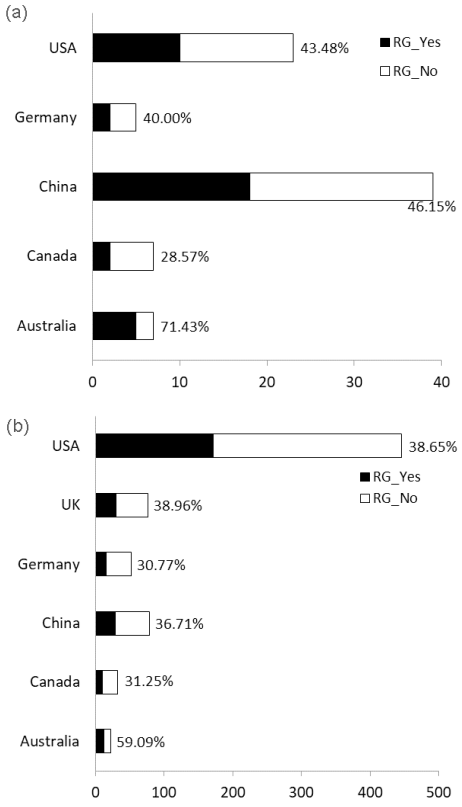

Fig. 3 Country distributions of RG-registered scholars in discipline of Engineering (a) and in disciplines of Chemistry, Biology & Biochemistry, Clinical Medicine, and Engineering (b)

There are some limitations in this study, which should be considered in our further research. (1) Differences may exist between the disciplines; however, we only focus on one discipline because it takes plenty of time to acquire and check the scholars' data manually. Because the registration situation will change over time, if we want to finish the search of the entire list in short period time, we must rely on new computer technology to automate data crawling, which cannot provide accurate search results as far as we know. (2) The results of the study are limited to the highly cited researchers, and the situation of general scholars is not clear. (3) The results may be affected by the co-authors of the researchers in group RG_No, who may help to upload the papers by themselves; meanwhile, RG website itself will sometimes upload papers with no-registered authors. (4) The results may be affected by the use of other ASNS, e.g. Google Scholar, Academica.edu, and Mendeley.

4 Conclusions

Annual total citation growth rate (K) is a good indicator for evaluating scholars' academic dissemination ability. Using RG or not has a significant correlation to the K-value of highly cited researchers and will influence the scholars' literature citation performance in a one-year period. The influential researchers are encouraged to make full use of ASNS so that their work will be effectively publicized and easily accessible (Mas-Bleda et al., 2014), and research management and academic journals should promote and help scholars to register personal information on ASNS, upload papers (post-print format), share research results, and discuss with other researchers. It is best to rely on a professional academic platform, where RG may be a good choice.

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中文概要

题　目：ResearchGate，一种促进高被引学者学术传播的有效方法？

概　要：为了探索学术社交网站对高被引学者的学术传播的作用，本研究引入了年度总引文增长率（*K*）的概念。基于 2017 年 9 月 13 日到 9 月 23 日从 ResearchGate（RG）和 Scopus 网站获取的数据对高被引学者的发文量、逐年引用次数、*h* 指数和 RG 网站注册情况使用独立样本 *t* 检验和单因素方差分析进行统计学分析。结果表明，2014~2016 年期间，高被引学者的 RG 网站注册情况与 *K* 值的相关性具有统计学意义，并且注册 RG 的高被引学者的 *K* 值下降趋势会有一年的延迟。因此本文认为，注册 RG 的高被引学者在本研究的统计时间内更多地参与了学术推广和传播活动，而 RG 至少是这些传播活动的一种媒介。我们鼓励所有学者、研究机构以及学术期刊更加注重学术成果的传播，包括在 RG 网站上登记研究人员的信息，在不侵犯原文版权的情况下上传“在线”论文，分享研究成果并与其他研究人员开展讨论。这些活动都将提高研究成果的被检索、阅读和引用的可能性。

关键词：ResearchGate（RG）；学术社交网站；学术传播；高被引学者