Team Diversity and the Impact of Scientific Publications

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Purpose

This study examines scientific teams at the National High Magnetic Field Laboratory (NHMFL) to investigate the diversity of science teams and the impact of research publications.

Why the diversity of scientific teams?

•The production of scientific knowledge has evolved from a process of inquiry largely based on the activities of individual scientists to one grounded in the collaborative efforts of research teams

•Recent studies show that impacts of scientific teams are higher than that of individual scientist. Multi-authored publications are now cited more frequently than single-authored publications

Why the impact of scientific publications?

•Peer-reviewed publications serve as key knowledge outcomes of scientific inquiry

•Bibliometric studies of scientific publications and/or their authors have often downplayed the impact of author team characteristics, such as seniority and affiliation diversity, on the impact of the final knowledge outcome

Why the NHMFL?

•The NHMFL is the world's largest and most highly powered magnet laboratory

•The NHMFL hosts over 900 scientists per year

Above: Scientists building a test coil for a 32 tesla superconducting magnet

Research Questions

RQ1: What is the relationship between author group seniority and article impact?

RQ2: What is the relationship between author affiliation diversity and article impact?

Methodology

Data: Citation information and author demographics for all the articles published in the *Physical Review Letters* (PRL) from 2004 to 2006 by scientists using the NHMFL. By selecting only articles in PRL, the sample is primarily composed of research in condensed matter physics and, therefore, controls for variation in scientific discipline.

Sample: The study examined 123 articles authored by 476 scientists. The sample was obtained from the NHMFL's online publication page in June 2010. Information from the American Physical Society's publication database and the Thomson Reuters Web of Knowledge were used to obtain information about authors' institutional affiliations and citation counts for each article during the first three years following from the article's publication year.

The affiliation diversity of scientific teams and seniority diversity were both measured using normalized entropy measures. In addition, the arithmetic mean of the team members' seniority codes was used a measure of the average seniority diversity

Methods: A Shapiro-Wilk normality test indicated that the variables examined were not normally distributed. Therefore, nonparametric statistical methods, such as Spearman correlation and quantile regression analysis, were used to analyze the data.

Findings

The results of the median regression analysis showed an increase in team seniority may have a negative effect on publication impact (see Table 1).

No statistically significant relationships were found between the normalized entropy measures of member affiliation nor seniority diversity and the quality of scientific publications.

Finally, Spearman correlation analysis found a negative interaction between group affiliation diversity and seniority diversity, and a positive interaction between average seniority and affiliation diversity. That is, multi-institutional author teams in the sample tend to be more senior and less diverse on seniority.

TABLE 1: Quantile regression results (* p<0.05)

Variable	Definition	Coef.	Std. Err.
Affiliation diversity	Normalized entropy of member affiliation	-2.46	3.75
Seniority diversity	Normalized entropy of member seniority	-2.84	4.31
Average seniority	Arithmetic mean of member seniority codes	***-3.04****	1.39
Size	Size of the article's author group	-0.58	0.33
	Pseudo R2	0.04	

Limitations

Data was obtained from internal documents such as facility user directories, annual publication lists, and publically available citation databases. Collecting additional types of data through observations, interviews or surveys of team members and key institutional stakeholders may provide additional information regarding the factors that impact the quality of scientific teams.

The impact of peer-reviewed publications was measured as the number of citations in the first three years after publication. Additional measures of impact and/or a longer post-publication horizon may impact the nature of the relationships explored in this study.

Future research may find it beneficial to examine additional measures of publication impact and quality and team diversity characteristics. Furthermore, future studies may include additional publication outlets in order to examine whether such relationships are consistent across scientific fields and disciplines.

Conclusions

This study provides evidence to governmental funding agencies, administrators in research laboratories, and the broader science and research policy communities regarding the effects of team seniority on the impact of peer-reviewed publications produced by collaborative teams.

The study's findings suggest that including services for analyzing and visualizing the demographic and structural properties of scientists and teams can be useful in planning and facilitating successful teams and collaborations.

Future Research

Future research related to the current study will investigate dynamics of scientific teams, the structure and types of member relationships, and motivations for joining the team. Scientists will be observed and interviewed to collect additional data. All these should help build a more nuanced and comprehensive model of scientific teams.

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