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Credit where credit is due? The impact of project contributions and social factors on authorship and inventorship

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ABSTRACT

We examine the extent to which different types of substantive project contributions as well as social factors predict whether a scientist is named as author on a paper and inventor on a patent resulting from the same project. Using unique survey data from over 2000 life scientists, we find that the predictors of authorship differ from those of inventorship. A wider range of project contributions may result in authorship, and social factors appear to play a larger role in authorship decisions than in inventorship decisions. We also find evidence that project contributions and social factors interact in predicting authorship, suggesting that the two sets of factors should be considered jointly rather than seen as independent determinants of attribution. In addition to providing novel insights into the functioning of the authorship and inventorship system, our results have important implications for administrators, managers, and policy makers, as well as for innovation scholars who often rely on patents and publications as measures of scientists' performance.

1. Introduction

The increasing specialization of scientists, the interdisciplinary character of scientific projects, and large resource requirements have turned science into a highly social and collaborative activity (Biagioli, 2003; Katz and Martin, 1997; Laudel, 2002; Wuchty et al., 2007). As a consequence, assessing what kind of substantive contributions listed authors and inventors have made to a project is becoming more and more difficult. Moreover, prior work suggests that authorship may not always reflect substantive contributions but may also be granted on the basis of social factors such as scientific eminence or hierarchical status in an organization (Birnholtz, 2006; Drenth, 1998; Flanagin et al., 1998; Mowatt et al., 2002; Rennie et al., 1997; Zuckerman, 1968). Far from being isolated incidents, such "guest authorships" may be involved in over 20% of papers in top biomedical journals (Flanagin et al., 1998; Wood, 2009). Studies also provide evidence of "ghost authorship", i.e., that individuals who have made important contributions are not included as authors (Flanagin et al., 1998; Laudel, 2002; Sismondo, 2009). While these issues have received considerable attention with respect to publishing, recent work suggests ambiguities in the relationship between substantive contributions and attribution also in the realm of patents (Lissoni and Montobbio, 2008; McSherry, 2003; Seymore, 2006).[1]

Despite significant efforts to document and quantify misattribution in the scientific community (Ducor, 2000; Flanagin et al., 1998; Mowatt et al., 2002), a more general understanding of the

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[1] The terms "guest authorship" and "ghost authorship" invariably require the choice of a standard regarding which kinds of contributions should legitimately be rewarded with authorship. While formal standards have been specified by journal editors (see below), those standards may not be shared by all members of the community. The objective of this paper is not to categorize authorship practices as legitimate versus illegitimate, but to provide empirical insights into the types of contributions and social factors that lead to authorship and inventorship. While much of the use of the terms "guest" and "ghost" in the prior literature is based on formal guidelines as implicit standard, we remain agnostic as to whether there is an ideal standard and what it should look like. Regardless of the choice of standard, however, practices that violate a given standard undermine the functioning of the authorship system, as discussed in Section 2.1. In the final section of this paper, we will discuss mechanisms that may reduce some of the ambiguity inherent in the current system.

determinants of authorship and inventorship status is lacking. The key challenge in empirical work is that systematic information on the types and levels of individuals' contributions is often not available. The order of authorship provides some insights into relative contributions. However, the interpretation of authorship order is often ambiguous (Bhandari et al., 2003; Zuckerman, 1968) and it naturally is of limited use in trying to understand drivers of "ghost authorship". Second, much of the prior work has been concerned with publications and little is known regarding similarities and differences in the factors associated with authorship on publications versus inventorship on patents. It is conceivable that inventorship is defined more strictly than authorship, possibly leading to a stronger link between substantive contribution and inventorship attribution (Ducor, 2000). Finally, while a distinction has been made between substantive contributions and social factors as predictors of attribution, little attention has been paid to potential interactions between contributions and social factors.

We address these gaps using novel survey data on over 2000 life scientists working in Germany and the UK who participated in projects that resulted in both a patent and a paper ("patent–paper-pairs"). While many scientists were listed on the resulting patent as well as the paper, others were not. We relate authorship and inventorship status to scientists' types and levels of project contributions as well as to social factors. Since the publication and the patent are tied to the same project, we are able to directly contrast the determinants of authorship and inventorship controlling for the nature of the underlying research (cf. Ducor, 2000; Lissoni and Montobbio, 2008).

Our empirical findings suggest that substantive contributions as well as social factors significantly shape attribution patterns. However, the drivers of authorship differ from those of inventorship. More specifically, inventorship reflects primarily substantive contributions in the form of idea conception, while authorship may also reflect technical contributions and the provision of data or materials. Controlling for substantive contributions, prior scientific accomplishments strongly predict authorship but not inventorship, perhaps because an eminent co-author increases the chances of publication and visibility of a paper. Hierarchical status in an organization increases the likelihood of inventorship but not of authorship. In addition to the independent effects of substantive contributions and social factors, we find that the two sets of factors interact in predicting authorship: contributions in the forms of carrying out technical steps or laboratory work are more likely to be rewarded with authorship when made by scientists with higher hierarchical status or prior scientific accomplishments.

Our insights have important implications for institutional mechanisms that rely on a close link between substantive contributions and attribution, such as the reward system of science or the patent system as a mechanism to incentivize inventive effort. Our results also have important implications for social scientists who rely on patents and publications to measure constructs such as individuals' innovative performance (e.g., Levin and Stephan, 1991; Sauermann and Cohen, 2010), labor mobility across organizations or regions (e.g., Agarwal et al., 2009; Marx et al., 2009), or the composition of research teams (e.g., Bikard and Murray, 2011; Singh and Fleming, 2010).

In the following section, we briefly discuss the importance of authorship and inventorship and develop predictions regarding the influence of substantive contributions and social factors on the two types of attribution. In Section 3, we describe the data and measures. In Section 4, we discuss our main results as well as a series of auxiliary analyses and robustness checks. Section 5 provides a summary of the results as well as a discussion of implications and opportunities for future research.

2. Project contributions and social factors as drivers of attribution

2.1. The importance of authorship and inventorship attribution

Publications and patents are important elements of the institution of science and of national innovation systems. Their effective role in these institutions, however, depends on the degree to which authorship and inventorship attribution reflect substantive contributions to the production of new knowledge.

In the typical view of the institution of science, scientists share new knowledge in a timely manner with the community through publication. In return for their contribution, authors receive peer recognition, which in turn translates into additional benefits such as job security (tenure), higher salaries, funding for future research, or opportunities to monetize knowledge via consulting (Cole and Cole, 1967; Haeussler et al., 2011; Merton, 1973; Stephan, 2012). The important role of publications is reflected in notions such as "publish or perish" or of publications as a "currency" in the scientific community. Publications and the resulting indirect benefits thus serve as incentives to invest effort into the generation of new knowledge. At the same time, authorship also establishes responsibility and serves as a basis for sanctions in cases of scientific misconduct. Given these important functions, a weak link between substantive contributions and authorship can undermine incentives for research (Lane, 2010; Rennie et al., 1997) as well as the community's ability to enforce its norms and quality standards (Zuckerman, 1988).

Inventorship attribution on patents plays a similarly important role. In particular, inventors who are listed on the patent have the right to prevent others from using the invention and can typically secure a share of the financial value that might result from their work. Moreover, patents can be interpreted a sign of scientific productivity and may help the inventor to gain recognition in the professional community (Butkus, 2007; Dasgupta and David, 1987). These potential payoffs serve as an important incentive for research (Arora et al., 2008; Scotchmer, 2006). Flaws in the assignment of inventorship may thus directly affect the distribution of financial and nonfinancial returns and dilute incentives for future innovation. Moreover, in some countries such as the United States, patents with an inventorship defect may be invalid or unenforceable (e.g., Section 35 U.S.C. 102 (f)).[2]

2.2. Project contributions

Most scientific projects are collective efforts (Wuchty et al., 2007) and typically involve a division of labor. As such, different individuals are engaged in different (combinations of) tasks, such as the conception and design of the study, lab work and data acquisition, or the writing of the manuscript (Hackett, 2005; Latour and Woolgar, 1979; Laudel, 2002). Moreover, Latour (1987) reminds us that scientific activity is embedded in larger networks and that various external actors can also have positive (or negative) impacts

[2] Two common defects are "non-joinder" (individuals who should be listed on the patent are omitted) and "misjoinder" (individuals are listed but did not conceptually contribute). For example, in one case, Dr. Ellenbogen of American Cyanamid asked doctors at the University of Colorado to conduct a study on iron absorption for two prenatal multivitamin formulations. In the process, the CU scientists discovered a reformulation that increased absorption. The patent naming Dr. Ellenbogen as sole inventor was declared non-enforceable due to a non-joinder defect (see University of Colorado Foundation v. American Cyanamid, 342 F.3d 1298 (Fed.Cir.2003)). In another example, the court of Appeals of the Federal Circuit decided that a student who conducted experiments but neither discovered nor understood their underlying principle, is not an inventor (see Stern v. Trustees of Columbia University, 434 F.3d 1375 (Fed.Dir.2006)).