Credit due: Multiple author attribution for interdisciplinary informatics research groups

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"Author" is increasingly an archaic term: more and more people want to know what it is a person has contributed to a project and not just that they have authored a paper about the findings" [1].

Objective: To understand issues related to multiple authorship in interdisciplinary working groups, and to identify best practices for authorship attribution for a multidisciplinary group.
Problem: Research groups comprised of individuals from diverse disciplines need to identify their own internal agreement and process for authorship attribution.
Methods: Limited literature review
Findings and conclusions: Resources are described and considerations for interdisciplinary working groups are suggested.

Introduction

Author attribution and ranking for multi-author publication has long been an issue of concern, leading to author statements in peer reviewed journals that spell out the nature of contributions, institutional review board (IRB) guidelines, and even institution-wide ethics statements. However, such standards pay less attention to concerns of interdisciplinary groups. Member expertise in a working group conducting informatics research, for example, may include data curation and knowledge management, literature retrieval and synthesis, statistical modeling, examination of data from very different perspectives (e.g., economic or network analysis). Issues relevant to author attribution, including author list ranking, are examined here, from the perspectives of authorship benefits and ethical concerns, concluding with a brief listing of resources and recommendations for action. Medical librarians, who are increasingly involved in supporting and performing interdisciplinary research, may be informed by practices in other disciplines.

Background

The Informatics Research Group (IRG) at Texas Woman's University consists of nearly 20 individuals (faculty, staff, and students from both graduate and undergraduate programs) from different disciplines, including Math and Computer Science, Business, Nursing, Occupational Therapy, Health Studies, and Library and Information Studies. Collaborators

also include a number of librarians and staff from the institution's Office of Sponsored Research, who directly support research methods, analysis, and grant activities. The group has already obtained several internal grants and completed a number of poster and conference presentations, as well as having a systematic review and several research papers in process.

The focus of research efforts at present is the analysis of a large dataset obtained from a regional foundation, whose for-profit arm collects, cleans, and disseminates data to over 90 regional hospital administrators for decision support and reporting, as well as making it available to external researchers. Our particular research area is emergency department utilization by individuals diagnosed with schizophrenia, with questions about health disparities and the intent to model the paths of care for individuals in order to identify bottlenecks and opportunities for intervention. A very incomplete listing of expertise represented by IRG group members includes health systems, data analysis, statistical modeling, management and security, literature and systematic review searching, mental health, digital divide, and community informatics.

The interdisciplinary nature and large size of the group is new to most members, presenting a valuable opportunity to build trust and collaborative partnerships between people working in different areas, presenting several challenges. These include collaborating across disciplinary boundaries with attention to discipline-specific professional communications for research output, including author ranking and content type attributions. Variation between disciplinary norms is a particular problem encountered by the IRG. For some members, publication in particular journals will not count toward tenure, even if they have made substantive contributions, and the same is true for author order. These are potential anti-motivational factors that should play a part in the group's consideration of possible publication venues.

While initially an informal agreement was made between members that all would be listed on every work disseminated, concern about the ethical issues involved have resulted in a need to examine the situation and how we might best address it in future work. As an example, a large working systematic review subgroup is led by a faculty member from Nursing, with members comprised of faculty from Library and Information Studies, Math and Computer Science, and staff from the university's library (one of whom serves as the expert guide). Listed authorship for the eventual publication, per earlier agreement, would include all members of the larger group, yet not all members have had any role in production.

Upon discussion, some group members felt that inclusion of every person as a contributor to every product of the group is an important factor in encouraging ongoing participation

in a new effort. In addition, the argument was put forth that work products are clearly the result of group meetings where members have contributed to discussions about ongoing research, and all group members have been asked for editing feedback for submitted works. However, there are questions to be addressed.

The central question of this limited review is the identification of best practices for authorship attribution for a multidisciplinary group. Sub-questions include the following: Are there levels of collaborative contribution that should be identified? Is contribution to discussion about research products or editing commentary sufficient to warrant inclusion in the author list of the products? If so, how shall contributions to each product be identified and recognized? Does the nature of our collaboration warrant inclusion of every group member's name in every poster, presentation, published research paper, and other disseminated product? In other large workgroups, members may also have wrestled with these questions, but if they share a discipline, questions may be relatively simple to address because journals in medicine, for example, may follow similar standards.

Methods

In order to understand the issues and to identify discipline-specific practices in attribution for interdisciplinary research groups, limited literature searches were performed in Google Scholar to retrieve materials addressing multi-author attributions in research literature across multiple disciplines. Next, the most pertinent articles retrieved during the initial literature retrieval phase were entered into the Web of Science database to find citations and their citing articles, and all were examined to identify common words or phrases. These were used to construct a search statement restricted to the title field (TI) only (shown in Table 1), in order to limit retrieval in the interest of time. Citations for pertinent articles were examined and articles retrieved in order to understand issues involved in attribution and differing disciplinary practices. As this work is not a systematic review, use of a second reviewer was not needed.

Search statement	**Results**
(((TI=(author* OR multiauthor* OR multi-author* OR co-author*)) AND (TI=(interdisciplin* OR collaborat* OR interprofess* OR multidisciplin*))) NOT (TI=(authority OR authoriz* OR authoris*))) *AND* **LANGUAGE:** (English) *Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, BKCI-S, ESCI Timespan=All years*	380
The set was further limited to 2000-2018	225

Table 1. Search statement, Web of Science, 10/4/2018.

Exclusion criteria

Items focused primarily on the topics listed:

- Network analysis
- Bibliometric analysis
- Impact ranking
- Literary studies focused on author collaborations
- Mapping studies examining author citedness in a discipline or topic
- Collaborative authorship not focused on the issue of authorship attribution, i.e. international collaborative research and publication.

Inclusion criteria

Items addressing:

- trends in collaborative authorship
- policies of particular journals or association statements
- ethics of author attribution

Reviewing titles only, 48 items were identified. Abstracts (or, in situations where these were unavailable, the item introduction) were then reviewed based on the above criteria. Those that did not clearly address the question of authorship attribution were not considered, resulting in 32 items. This subset of articles (available upon request) was reviewed, framing the review.

Findings and Limited Review of Literature

The issue of author attribution in work groups has increasingly been discussed as a concern needing exploration and agreement within professions (particularly in medicine), but also more broadly in the social sciences [2] and problematically in the sciences, where there has been corresponding growth in research misconduct [3]. In 1993, a letter to the editor published in BMJ described a growing trend of multiple authorship in 15-year increments from 1935-1990. Comparing medical and scientific papers, there was a fourfold increase in multi-authorship over the period for medical literature, compared to a twofold rise for scientific papers [4]. While early on, some condemned the practice as unethical, others have found that due to trends in the complexity of research, multiple contributors were increasingly necessary. At the same time, the ethical expectation of 'substantive' contribution to justify author attribution has been expressed:

> An alternative explanation for our findings is that science has become less of a cottage industry and now requires larger collaborative groups. If this is so multiple

> authorship is justifiable. Clearly, all authors should have played a substantive part in the project reported, otherwise authorship becomes meaningless (pp.1345) [4].

Other justifications for group authorship include the need to collect large amounts of input from multiple locations (for medical research, with patients recruited for increasingly large studies); the growing involvement of students in research; and growing sub-specialization involvement in interdisciplinary research has required collaboration and subsequent recognition [5]; the ability to contribute from a distance thanks to web-based document preparation and distance conferencing; and for top publications in particular fields, increased competition [6][7].

However, problems have arisen from the practice. "Ghost authors" is a term referring to those who have contributed to the work of research but were never recognized in the final product, whereas "honorary authors" are those named in recognition of their support of work efforts, who have not otherwise contributed to the work [8]. In the early 1980s, a scandal arose from the publication of research whose authors had made no real contribution at Emory and Harvard universities [9], resulting in a recommendation for change by leaders in the International Committee of Medical Journal Editors (ICMJE). Sometimes referred to as the Vancouver protocol, the standards are used by many universities and across most medical disciplines [10].

While ICMJE is now widely cited as a standard for literature in medical disciplines, other disciplines vary in their approach, and the path has not been smooth. In disagreeing with the ICMJE proposal and pointing out that bibliographic databases such as PubMed do not differentiate authorship order in terms of contribution, Cappell argued in the pages of JMLA that mentors should merit inclusion on the author list as the last author named [11]. Cooper, then JMLA editor, contended that the practice might encourage coercion, and pointed to the existence of demands by editors (undoubtedly including ICMJE among them) that authors spell out unique contributions of each and stated that those who had not "contributed significantly to the execution of the project and the writing of the manuscript" (pp.365) should instead be named in an acknowledgment [12]. Author ranking conventions have changed over time, a reality that argues in favor of spelled-out attributions at least in research group process documentation and in preparation for a publishing environment lacking universal standards [13].

Authorship of research publications is recognized as a benefit to authors for a number of reasons. Among them are: contribution to a body of knowledge, personal achievement, evidence of intellectual effort, enhancement of professional reputation, contribution to academic promotion and tenure, research funding, and recognition among professional colleagues [5]. In many disciplines, rank placement in publication is of central importance

in tenure and review, based on the agreed-upon expectation that placement denotes level of responsibility and participation.

It is important to recognize that on an interdisciplinary team, some will not receive credit in review or tenure evaluation if they are not listed among first, second, or third authors in works disseminated, or if work is not published in particular journals recognized by the discipline. Neither problem is addressed by current standards across disciplines. In some disciplines (e.g., math and physics), authors are commonly listed in alphabetical order by surname [14]. A recent survey of institutions across the United States in biomedical engineering, biology, and bioengineering disciplines (n=102, or 18% response rate) asked participants to rank contributions in terms of perceived importance, with the result that "time spent conducting experiments, coming up with a hypothesis, analyzing data, and writing the manuscript were selected as the four most important criteria for both determining one's authorship status and rank" [15]. Other contributions named, in ranked order, were total time spent, uniqueness of techniques (particular techniques such as GIS could rank here), quality of contribution to the manuscript, background/literature review, editing/proofreading, applying for funding, and coding.

Identification of individual contributions is of particular importance to the promotion and tenure process, but here there tends not to be any universal standard. According to Klein and Falk-Krzensinski [16], decisions may often be made at the academic component level, further supporting the need agreed-upon within-group standards. Criteria often rests upon promotion and tenure standards, which may not have dealt with increasingly interdisciplinary work, or provide only vague guidance (pp.1057). However, it may not be desirable or possible to achieve complete standardization, due to well-established promotion and tenure criteria within disciplines and institutions, meaning that research groups bear primary responsibility for arriving at their desired practice of attribution.

Correct attribution has been called a 'public responsibility' in that participants represent their work to readers as the product of author investigations [5]; therefore, each member of the group is responsible as a representative of the integrity of works published or otherwise disseminated, and willing to respond to challenges based on its content. As well, finding agreement on collaborative attribution is non-trivial to the ongoing success of the research group, since

> […] determining who should be listed as the authors of a publication, and in which order, could be often critical to the overall success of a research collaboration. Publication is a major product of a collaboration. Successful, agreeable determination of publication authorship can increase the likelihood of converting a one-time collaboration into a long-lasting research team [17].

Considering that group members bring unique expertise to projects, the issue of critical evaluation of publications, including understanding the authority of contributors with regard to specific contributions made, may be of primary importance to sustainable research collaborations. If, for example, one or more group members perform statistical analysis or other forms of data analysis, it seems commonsensical to attribute this part of a work to the individuals involved not only for credit, but for follow-up: errors or questions can thus be brought to the attention of the appropriate people. At the same time, all named authors have a responsibility to be familiar with the work overall, and to participate in the editing and revision processes.

By far, the most widely adopted attribution set of standards, based upon this limited review, appears to be the documentation provided by the ICMJE. The literature of most disciplines has not specifically addressed the issue of interdisciplinary, multi-author attribution, perhaps due to existing tenure and promotion standards, but many follow similar policies in publication. Itself adapted from earlier guidelines, the current ICMJE statement provides support for decision making, without mention of interdisciplinary author teams. ICMJE recommends the following 4 criteria for inclusion as an author:

- Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work; AND
- Drafting the work or revising it critically for important intellectual content; AND
- Final approval of the version to be published; AND
- Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved [10].

In addition, the organization specifically recommends that the following NOT constitute rationale for authorship inclusion: “acquisition of funding; general supervision of a research group or general administrative support; and writing assistance, technical editing, language editing, and proofreading” [10]. Those who have contributed to the work but do not meet the 4 criteria should be recognizedwith an acknowledgment. Specific wording is suggested for acknowledgments:

> Those whose contributions do not justify authorship may be acknowledged individually or together as a group under a single heading (e.g. "Clinical Investigators" or "Participating Investigators"), and their contributions should be specified (e.g., "served as scientific advisors," "critically reviewed the study proposal," "collected

> data," "provided and cared for study patients", "participated in writing or technical editing of the manuscript").
>
> Because acknowledgment may imply endorsement by acknowledged individuals of a study's data and conclusions, editors are advised to require that the corresponding author obtain written permission to be acknowledged from all acknowledged individuals. [10].

The Council of Science Editors (CSE) discusses the issue at some length, providing examples of author attributions for large working groups, and recommendations to editors, bibliographic database editors, and working groups [18]. Recognizing that the current lack of standardization leads to problems such as those previously identified, CSE also points out that problems with miscalculations of citation statistics and retrieval due to mis-citing authorship are likely, and suggests the inclusion of attribution to *group* affiliations as shown in the following options (bolding is the author's):

> Smith SQ, Suzuki Y, Mann JT, Schulze KT, DeAngelo C, Davis C, Jones KJ, Cunningham TL, Snyder MJ, Gutierrez AM; **and the Generic Coalition Group**. A randomized trial of chemoradiotherapy of esophageal cancer. J Onc Dis. 2004;183:1763-1770.
>
> Smith SQ, Suzuki Y, Mann JT, Schulze KT, DeAngelo C, Davis C, Jones KJ; **Generic Coalition Group.** A randomized trial of chemoradiotherapy of esophageal cancer. *J Onc Dis*. 2004;183:1763-70.

Aside from the help provided by the ICMJE, the American Psychological Association has also recognized concerns with attribution, and provides useful decision support tools for inclusion and ranking that may be particularly helpful if students are contributing to research efforts. Their rubric, entitled 'Authorship Determination Scorecard' breaks down and assigns a point value to activities from conceptualizing to the submission process, with writing being more detailed. A second helpful tool is their 'Authorship tie-breaker scorecard' [20], which provides an even more specific listing of possible contributions, including literature searching, IRB document preparation, and document or data management processes.

Conclusion and Recommendations

It is a reality that publication requirements will differ based on the venue for publication, and that an interdisciplinary team represents diverse scholarly expectations for promotion and tenure. Because of this, there is a need to be flexible, and to set guidelines for discussion, rather than rules. The concerns identified do call for discussion and

agreement, preferably at the start of a project. Like all research, planning early in the process – before data analysis even begins – benefits the long-term success of the project (or in the case of an interdisciplinary group, the ongoing viability of the group itself), leading to trust based on clear expectations. Coming to agreement at the start does not preclude the need to revisit the group's guidelines; it is also very likely that as work evolves, group members may also grow in understanding of the factors involved in project planning and output management.

Any collaborative efforts that may lead to formal dissemination, including abstracts, presentations, and full research papers submitted for publication, should consider the following issues, regardless of the requirements of the venue.

1. Agreement between group members should be reached before research begins, and should be documented.
2. Clear differentiation of contributions in publications. Records identifying contributions should be kept to support review, promotion and tenure efforts of members.
3. Awareness of review, promotion and tenure criteria needs to be the responsibility of each of the affiliated group members.
4. Members should also be responsible for representing their own needs when considering venues for publication of research papers, in particular.
5. Direct authorship should be attributed only for substantive contributions, including agreed-upon types of input.
6. If author attribution is ranked, agreed-upon ranking criteria should be used and documented (level of contribution, type of contribution, or other).
7. While publication processes will usually ask for a corresponding author, it will help to also identify specific contact information for authors who 'own' responsibility for unique components, such as analysis methods that require considerable expertise.
8. Creation and inclusion of a template paragraph recognizing the entire group is encouraged, or if possible, agreement on wording to be included in the authorship listing.

For those interested in more in depth exploration of this topic, recommended reading includes Klein and Falk-Krzesinski [16] whose review of author attribution is focused on tenure and promotion at academic institutions. The article also includes a list of recommendations and discussion of multiple medical association and journal standards. Also worth review are the recommendations of both the ICMJE [10], the American

Psychological Association [19,20], and the Council of Science Editors (CSE) [18]. A special issue on interdisciplinary research assessment published in 2006, in the journal *Research Evaluation* [21] may be informative, adding yet another layer of complexity to the issues with its titular focus on interdisciplinary research evaluation. For a succinct discussion of some of the basic issues, see Chapter 3 of the freely downloadable monograph published by the National Academies of Science, which is devoted to the topic [22].

Limitations and further research needed

This document makes no claims to generalization because the literature review and thus the subsequent discussion of issues involved are incomplete. The search process was non-exhaustive due to time limitations and the vagaries of natural language searching. There was no attempt to reproduce the searches by another person.

Future research specific to interdisciplinary research groups might involve efforts to identify and compare publication statements as well as citation counts based on author ranking. As well, examination of professional associations such as engineering, chemistry, and more might be informative. The present work was limited to the use of Web of Science and Google Scholar, and those disciplines more pertinent to the Informatics Research Group at one institution, and in the interest of time, allowed to stop there.

In performing interdisciplinary informatics research where the establishment or creation of a workable research data environment requires considerable effort, the question also remains whether these efforts constitute author-level contributions. This single example demonstrates the need for further discussion for both interdisciplinary and informatics research. Ensuring that credit due is given to those who increasingly are moving from support roles to research collaboration is an issue for our profession.

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