# Credit where credit is due

**Liz Allen**, **Amy Brand**, **Jo Scott**, **Micah Altman** and **Marjorie Hlava** are trialling digital taxonomies to help researchers to identify their contributions to collaborative projects.

Research today is rarely a one-person job. Original research papers with a single author are — particularly in the life sciences — a vanishing breed. Partly, the inflation of author numbers on papers has been driven by national research-assessment exercises. Partly, it is the emergence of big and collaborative science, assisted by technology, that is changing the research landscape.

What we cannot tell easily by reading a paper is who did what. That is difficult to decipher by consulting the author lists, acknowledgements or contributions sections of most journals; and the unstructured information is difficult to text-mine[1,2].

Developments in digital technology present opportunities to do something about this. With the right 'taxonomy', manuscript-submission software could enable researchers to assign contributor roles relatively easily in structured formats during the process of developing and publishing a paper. An analogy is the FundRef initiative developed by funders, publishers and manuscript-submission vendors to build direct links between published research and associated funding sources during manuscript submission.

For researchers, the ability to better describe what they contributed would be a more useful currency than being 'author number 8 on a 15-author paper'. Scientists could draw attention to their specific contributions to published work to distinguish their skills from those of collaborators or competitors, for example during a grant-application process or when seeking an academic appointment. This could benefit junior researchers in particular, for whom the opportunities to be a 'key' author on a paper can prove somewhat elusive. Methodological innovators would also stand to benefit from clarified roles — their contributions are not reliably apparent in a conventional author list[3–6]. It could also facilitate collaboration and data sharing by allowing others to seek out the person who provided, for example, a particular piece of data or statistical analysis.

Through the endorsement of individuals' contributions, researchers can start to move beyond 'authorship' as the dominant measure of esteem. For funding agencies, better information about the contributions of grant applicants would aid the decision-making process. Greater precision could also enable automated analysis of the role and potential outputs of those being funded, especially if those contributions were linked to an open and persistent researcher profile or identifier. It would also help those looking for the most apt peer reviewers. For institutions, understanding a researcher's contribution is fundamental to the academic appointment and promotion process.

Such a system could benefit publishers too. Many journals do issue strict guidelines for what constitutes authorship, although there have been calls to overhaul these to reflect the reality of today's research[7,8]. Greater transparency should help to reduce the number of authorship disputes being managed by journal editors, and should cut the time that editors spend chasing listed authors for confirmation of their roles.

## CLASSIFYING CONTRIBUTION

To probe how such a taxonomy might work, we conducted an experiment. Our findings, which are summarized here, set the stage for the development of a system or process that could change how contributions to research output are valued.

In 2012, a small group of journal editors joined forces with Harvard University in Cambridge, Massachusetts, and the Wellcome Trust in London to develop a simple contributor role taxonomy to test with researchers[9]. Some journals, such as those published by the Public Library of Science (PLOS), have been working with basic contribution classifications for a couple of years; the group decided to extend this.

An online survey, live between August and November 2013, was designed to test whether authors' contributions to recent journal articles could be classified using a 14-role taxonomy (see 'Who did what?'). The survey was sent to 1,200 corresponding authors of work published in PLOS journals, Nature Publishing Group journals, Elsevier journals, *Science* and *eLife*. Corresponding authors were asked to indicate the contribution of each author of their article according to the roles in the taxonomy, and to comment on its comprehensiveness; whether there were any significant role descriptors missing; how using the taxonomy compares with current author-contribution assignment; and specifically, how easy or difficult it was to use.

Around 230 authors gave feedback. More than 85% found the taxonomy easy to use and felt that it covered all the roles of contributors to their paper. Furthermore, 82% of respondents reported that using the more-structured taxonomy of contributor roles presented to them was at least 'the same' as (37%) or 'better' (45%) in terms of accuracy than how the author contributions to their recently published paper had actually been recorded.

There is certainly more work to do. The pilot yielded substantial feedback on several themes. These included: how to ensure agreement among authors on their specific contributions; how to prevent supervisors from inappropriately taking credit; whether to distinguish between 'lead', 'supporting' and 'equal' roles; and how to recognize that the significance and relevance of certain roles varies between articles and research areas. Others suggested that more types of contribution should be included in the taxonomy or that some contributions such as 'funding acquisition' and 'project management' might be captured elsewhere in the manuscript-submission process.

There are also methodological caveats associated with this pilot: the sample was relatively small and only corresponding authors were asked for their opinions. The taxonomy was developed and tested in the biomedical and life-sciences community — we have not tested its validity in other fields because we

## WHO DID WHAT?

Respondents were asked to select all roles that applied to each author, as described in the taxonomy below, and to state which of these roles were lead or supporting.

| Taxonomy category | Description of role |
| --- | --- |
| Study conception | Ideas; formulation of research question; statement of hypothesis. |
| Methodology | Development or design of methodology; creation of models. |
| Computation | Programming, software development; designing computer programs; implementation of the computer code and supporting algorithms. |
| Formal analysis | Application of statistical, mathematical or other formal techniques to analyse study data. |
| Investigation: performed the experiments | Conducting the research and investigation process, specifically performing the experiments. |
| Investigation: data/evidence collection | Conducting the research and investigation process, specifically data/evidence collection. |
| Resources | Provision of study materials, reagents, materials, patients, laboratory samples, animals, instrumentation or other analysis tools. |
| Data curation | Management activities to annotate (produce metadata) and maintain research data for initial use and later re-use. |
| Writing/manuscript preparation: writing the initial draft | Preparation, creation and/or presentation of the published work, specifically writing the initial draft. |
| Writing/manuscript preparation: critical review, commentary or revision | Preparation, creation and/or presentation of the published work, specifically critical review, commentary or revision. |
| Writing/manuscript preparation: visualization/data presentation | Preparation, creation and/or presentation of the published work, specifically visualization/data presentation. |
| Supervision | Responsibility for supervising research; project orchestration; principal investigator or other lead stakeholder. |
| Project administration | Coordination or management of research activities leading to this publication. |
| Funding acquisition | Acquisition of the financial support for the project leading to this publication. |

expect that there are field-specific contributor roles. Nonetheless, this feedback provides a springboard to further explore how a system for allocating contributor roles might be implemented.

### SETTING STANDARDS

So what now? Over the next six to eight months, we will be collaborating with bodies such as the National Information Standards Organization to evolve the taxonomy. Through this collaboration, we will consult a broader cross-section of the research community, including researchers from different scientific fields, to see how valid the taxonomy might be beyond biomedicine, and to ascertain the value that greater definition of contributor roles would bring to the research ecosystem. We are mindful that any approach must not add to researchers' burdens in submitting and publishing work, or fuel authorship dissatisfaction. For instance, one respondent described our trial taxonomy as: "more accurate and less 'generous'".

A second workshop on contributor roles is planned for the third quarter of 2014, after which we intend to implement a fuller trial across more research publication outlets and disciplines in 2015. Models of

implementation to be tested could include, for example, integrating a digital taxonomy with manuscript-submission and research-management systems. The latter approach imagines assigning and agreeing on contributor roles before preparing the manuscript for publication, with the potential to profoundly affect the culture and process of doing research. ∎

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