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Replication of the methods section in biosciences papers: is it plagiarism?

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Abstract To find out whether replication of methods section in biosciences papers is a kind of plagiarism, the authors firstly surveyed the behavior of authors when writing the methods section in their published papers. Then the descriptions of one well-established method in randomly selected papers published in eight top journals were analyzed using CrossCheck to identify the extent of duplication. Finally, suggestions on preparing the methods sections were given. The survey results show that an author may employ different approaches to writing the methods section within a paper, repeating published methods is more often than give citation only or rewrite complete using one's own words. Authors are more likely to repeat the description of a method than simply to provide a citation. From the samples of the eight leading journals, plagiarize is very rare in such journals; Learning from Science, attachment may be a considerable choice for papers with common methods.

Keywords Publication ethics · Duplication methods

Introduction

Verbatim repetition of another author's words or of the author's own words, without proper acknowledgement, constitutes plagiarism or self-plagiarism (redundant publication) (Council of Science Editors (CSE) 2012). Even when acknowledged, a high proportion of quotation in an article tends to suggest lack of originality. However, the methods sections of research articles pose a particular problem (Zhang 2010a; Zhang and Jia 2012; Jia and Zhang 2013; Tan and Zhang 2013; Zhang et al. 2013). Roig proposes "teaching scientists to paraphrase" to reduce plagiarism in science publishing (Roig 2012); however, in the ensuing correspondence commented that "provided it is properly attributed, the repetition of the standard description of experimental procedures is necessary—even though it is

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likely to be detected by plagiarism detection software—because each instance of paraphrase could lead to a 'procedure drift', causing variations from the original procedures." Obviously, Roig did not omit this point. He had expressed the same argument only under the assumption of the nearly perfect methods description that any additional clarification or elaboration is often unwarranted (Roig 2009).

COPE flowcharts demonstrated that an editor's response to plagiarism should depend on the type and extent of the copying (Committee on Publication Ethics (COPE) 2012). Since the authors started using CrossCheck to detect possible plagiarism in their journal, they have frequently discovered repetition in the methods sections of bioscience papers (Zhang 2010b). In an earlier study by the present authors investigated the attitudes of journal editors towards duplication in the methods section (Zhang and Jia 2012). The results showed that editors generally found it unacceptable to duplicate the description of methods, unless it was either rewritten using the author's own words or properly cited. However, 20 % of journal editors in the biosciences considered it acceptable to include between 20 and 40 % of duplicated content in the methods section. This gave rise to two questions: (1) Does duplication in the methods section constitute a form of plagiarism? (2) Is it permissible in the methods section?

In the present study, firstly, the authors surveyed the behavior of authors when writing the methods section in their published papers. Secondly, the descriptions of one well-established method in randomly selected bioscience papers published in top journals were analyzed using CrossCheck to identify the extent of duplication. Finally, based on the above analysis, we give our own recommendations for preparing the methods sections for biosciences papers.

What authors do?

Survey design

An online survey was created, consisting of five questions on the respondents' language (Q1), publishing experience (Q2), their behaviors in writing the methods section in their three recently published papers (Q3 and Q4), and their experience as reviewers (Q5). In Q4, we classified these behaviors broadly into the categories: repetition (eight forms), provision of citation only, and complete rewriting in the author's own words. Repetition was subdivided according to the nature of the original source (own or others'), whether or not the text had been reworded, and whether or not a citation to the original source was provided.

An email invitation to participate was sent to a total of 2,177 recipients chosen from the authors' journal's own database of international reviewers in the field of biosciences (http://www.zju.edu.cn/jzus/reviewer.php#B) (Zhang 2010c). The reviewers in this database are authors from all around the world, who have published in international journals. Respondents were directed to the survey at SurveyMonkey (https://www.surveymonkey.com) from July 9, 2012 to July 31, 2012.

Survey results analysis

In the survey, respondents were asked to provide details of their three most recently published papers (Q3) and to indicate their writing behaviors in the methods section of these papers (Q4)—thus the answers to each part of Q4 should have been 0, 1, 2 or 3.

However, a few respondents misunderstood the question, and gave numbers >3. Such responses were therefore filtered out, leaving 178 valid responses out of the original 192.

Of the 178 respondents, 101 (57 %) were native English speakers (Q1) while the remains were using other language. According to their answers to Q2, 81 % (145/178) had published >20 papers, while only 6 % (10/178) had published fewer than ten papers.

Details of the three most recently published papers from the 178 respondents are as shown in Table 1 (Q3). The 2011 impact factors of these journals were obtained by searching the database of Journal Citation Reports (Thomson Reuters 2012). Seven papers were published in six leading journals with impact factors (IFs) >30: *The New England Journal of Medicine*, *The Lancet*, *Cell*, *Science*, *Nature*, and *The Journal of the American Medical Association* (*JAMA*); four papers were published in four journals with IFs of between 20 and 30. The most frequently mentioned journal was *PLoS One*, with 22 papers.

From the above information, we can infer that most of the respondents are experienced authors in the field of biosciences. Their indicated behaviors when writing the methods section of their listed papers (Q4) are as shown in Fig. 1.

More than half (53.4 %) of the respondents reported that they utilized more than three possible behaviors in their three papers; this suggests that an author may use more than one style in the methods section of a single paper (e.g. when describing different methods). In the survey, the most three commonly reported behaviors are:

1. Completely use one's own words (294 cases, 31.1 %);
2. Repeat one's own published methods with some rewording and citation (216 cases, 22.9 %);
3. Repeat others' published methods with some rewording and citation (116 cases, 12.3 %).

Some form of repetition (535 cases) was more common than complete rewriting using one's own words (294 cases) or providing a citation only (115 cases). This is easy to understand, as many bioscience methods are frequently used in a variety of different studies. At this circumstance, most respondents (82.6 %, 442/535) provide a citation to the previously published source of the description, whether written by themselves or others.

Table 1 Journal information of the three most recently published papers from the 178 respondents (Q3)

2011 IF	No. of papers	No. of Journals	Journal title (No. of articles)
>30	7	6	*N. Engl. J. Med.* (1), *Lancet* (1), *Cell* (1), *Science* (2), *Nature* (1), *JAMA* (1)
20–30	4	4	*Cancer Cell* (1), *Nature Immunol.* (1), *Lancet Oncol.* (1), *Nature Med.* (1)
10–20	22	17	*Nature Cell Biol.* (1), *J. Clin. Oncol.* (2), *Ecol. Lett.* (1), *PLoS Med.* (1), *Nature Neurosci.* (1), *Circulation* (1), *Mol. Cell* (1), *J. Am. Coll. Cardiol.* (3), *Adv. Mater.* (1), *J. Clin. Invest.* (2), *Nature Struct. Mol. Biol.* (1), *Gastroenterology* (1), *Hepatology* (1), *Genes Devel.* (2), *Ann. Neurol.* (1), *Trends Mol. Med.* (1), *J. Cell Boil.* (1)
5–10	95	71	*PNAS* (4), *Arterioscler Thromb. Vasc. Biol.* (4), *Plant Physiol.* (4), *J. Neurosci.* (3), *Anal. Chem.* (3), *J. Immunol.* (3), Other journals not listed
3–5	184	121	*PLoS One* (22), *J. Biol. Chem.* (6), Other journals not listed
<3	196	159	Journals not listed
None	26	26	Proceedings or journals not indexed in JCR or Science Citation Index
Total	534	404	Above

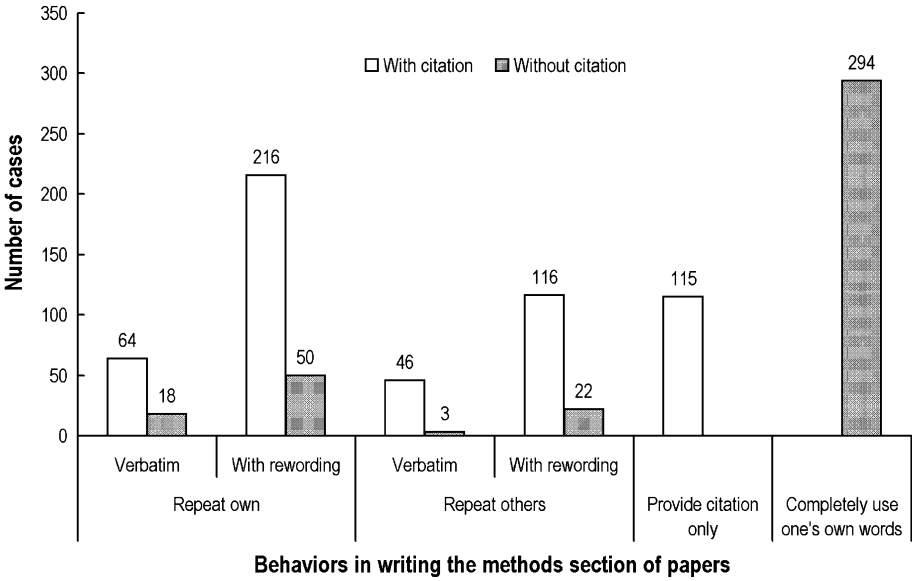

Fig. 1 Author behaviors in the methods sections of the above listed three most recently published papers (Q4)

In the 131 cases of verbatim repetition of the description of methods section, 84 % (110/131) of these gave a citation and 16 % (21/131) did not (13.7 % in reusing their own description and 2.3 % in reusing another author's description). Verbatim repetition was less common with others' work than with one's own.

In the 404 cases of repetition with rewording, 82 % (332/404) of these provided a citation and 18 % (72/404) did not (12.4 % in reusing their own description and 5.4 % in using another author's description).

From the above analysis, it is clear that an author may employ different approaches to writing the methods section within a single paper. Authors are more likely to repeat the description of a method than simply to provide a citation. When they do repeat a published description, authors are more often to take it from a previously published paper of their own than someone else's; authors are more likely to make some modifications than to copy verbatim; and in the majority of cases they do provide a citation to the previously published source. Authors are more likely to provide a citation when repeating the description of a method verbatim, than when they have done some rewording.

What top journals do?

To ascertain the extent to which existing published descriptions were replicated, with or without citation, we examined the practice as exemplified in the treatment of one particular well-established method in a sample of articles from eight leading journals.

Methods

The increasingly widespread use of CrossCheck, in recent years, to detect potential plagiarism has highlighted the extent of textual duplication in the methods sections of journal

papers, particularly in the biosciences (Zhang and Jia 2012; Miller 2011). To establish best practice in the field, the authors selected eight leading bioscience journals and surveyed their articles.

The journals selected, mostly from among those listed by respondents to the first survey, were those with the highest impact factors in the field, from which the full text of relatively recently published articles was available to the authors for analysis (in some cases the PubMed database did not contain the most recent articles). These criteria led to the selection of the following journals: *Cell*, *The Journal of the American Medical Association*, *The Lancet*, *Nature*, *Nature Biotechnology*, *The New England Journal of Medicine, PLoS Biology*, and *Science*.

One most commonly used methods, 'western blot' (also known as western blotting, electrophoretic transfer of proteins from sodium dodecyl sulfate–polyacrylamide gels to unmodified nitrocellulose and radiographic detection with antibody and radioiodinated protein A (Burnette 1981), was selected, and articles in the eight selected journals were identified in PubMed by searching the PubMed database using the term 'western blot*'. This search produced a total of 512 articles. For each journal, the ten most recently published available articles were downloaded and the methods sections were analyzed.

The methods sections were classified as falling into one of the following categories: 'description', 'citation' and 'attachment'. For those articles which fell into the 'description' and 'attachment' categories, CrossCheck was run on the relevant part of the methods section to ascertain whether previously published text was replicated, with or without citation.

Analysis of methods sections in the ten most recent available articles from each journal

Three types of expression were found for the methods section relating to western blot. These were classified as 'description' (fully described the procedures used), 'citation' (simply provided a citation to a previously published description or website), and 'attachment' (supplied the detailed description as an attachment, rather than in the main text).

All three types of expression were found in *the Lancet* and *the New England Journal of Medicine,* but only two out of three in the six remaining journals; *Science* used the 'attachment' approach in all but one case. Table 2 shows the results of this analysis.

CrossCheck results

Description

This was by far the most frequently adopted style of the methods section for all of the journals studied, apart from *Science*. For the 55 articles containing a 'description', a CrossCheck was run on the relevant part of the methods section. Three articles—1 article in *Lancet*, 1 in *JAMA*, and 1 in *Nature Biotechnol.*—were found to contain paragraph matches, i.e. nearly no less than one paragraph matched with previously published materials. In the case of both *Lancet* and *Nature Biotechnol.*, the articles studied and the articles replicated were by one or more of the same authors (neither of the sources of the replicated text was cited where it appeared); in the case of *JAMA*, although there was no common author, the article replicated was cited elsewhere in the text; however, the replicated text was nearly 60 words long. No other articles, in any of the journals, contained

Table 2 Analysis of expression styles used in methods section

Journal title	Total articles	No. articles utilizing each style		
		Description	Citation	Attachment
Cell	10	8	2	0
The Journal of the American Medical Association	10	9	1	0
Nature	10	8	2	0
Nature Biotechnology	10	8	2	0
PLoS Biology	10	7	3	0
Science	10	1	0	9
The Lancet	10	7	2	1
The New England Journal of Medicine	10	7	1	2

any obviously replicated content in the relevant part of the methods section. Table 3 shows the results for the 'description' category of articles.

Attachment

For the articles in *Science*, 'attachment' (the inclusion of supplemental materials describing the method in detail) was by far the most frequent style of expression in methods sections; 9 of the 10 articles searched (all published since 2002) were found to use this approach. By contrast, just one article in *Lancet* and two in *N. Engl. J. Med.* used the

Table 3 CrossCheck results for articles using 'description'

Journal title	No. articles	No. articles with paragraph matches	Replicated text		Remark on replicated text
			With citation	Without citation	
Cell	8	0			
JAMA: the journal of the American Medical Association	9	1	1		Replicated a section of c. 60[a] words from previously published article (uncited but cited elsewhere in the article under study)
Nature	8	0			
Nature Biotechnology	8	1		1	Replicated a section of c. 45 words from previously published article by same authors (uncited)
PLoS Biology	7	0			
Science	1	0			
The Lancet	7	1		1	Replicated a section of c 45 words from previously published article by same authors (uncited)
The New England Journal of Medicine	7	0			

[a] As CrossCheck could not distinguish some symbols like "μ" "χ" and so on, the number of repeated words is a approximate number

same approach, while it did not occur at all in the sample articles from the other journals studied. A CrossCheck was carried out on the text included in the 12 attachments.

Of these 12 articles, 3 (all in *Science*) were shown to include paragraph matches—entire sections of replicated text from elsewhere. In two cases, the original source of the replicated text was not indicated. In one case, although there was no common author, the article replicated was cited elsewhere in the text; however, the source of the replicated text was not indicated where it appeared.

Figure 2 shows the remarkably high similarity scores (Meddings 2011) that resulted from this check. In three articles out of the nine, the similarity score was above 30 %—in one it was above 50 %. In some cases, the replicated material was from articles by other authors, and the source was cited elsewhere in the article, although it was not indicated where it appeared; in others it was from previously published articles by the same authors, but without citation. It would appear that, in *Science* at least, authors and editors are less concerned about replication of text in supplemental materials than in the main text.

Results analysis

The study showed that the eight leading journals differed in their handling of the description of a well-established method. While description in the main text was the most common approach (55 articles out of 80), and citation only was the next most common (13 out of 80), attachment of the description as supplemental material (12 out of 80 overall) was the strongly preferred approach in *Science* (9 out of 10 articles).

CrossChecks demonstrated a relatively low incidence of textual replication where the 'description' approach was adopted(although a few papers' citation practice is not very

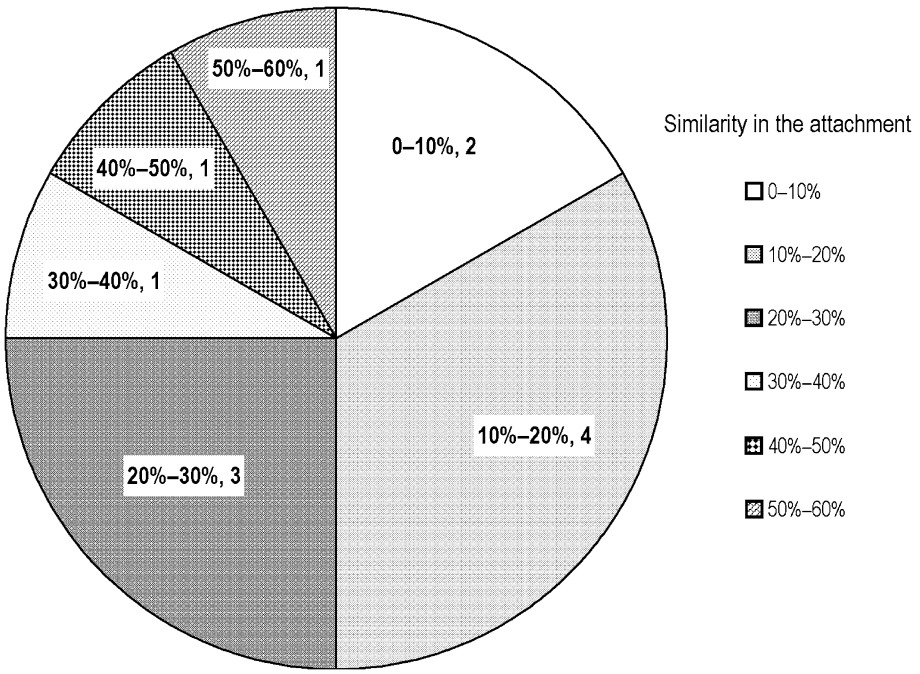

Fig. 2 Similarity scores for attachments (supplemental materials)

standard in these cases as mentioned above). However, where the 'attachment' approach was adopted (mainly in *Science*), the level of textual replication was extremely high, and the original sources were rarely indicated.

From the study of the eight leading journals, plagiarize is very rare in such journals. And learning from Science, attachment may be a considerable choice for papers with common methods. However, whether high similarity scores in attachments are acceptable, a conclusion could not be drawn yet. Further researches still need to be done.

Discussion and suggestions

In the field of biosciences, most journals require that a research article has a section named "Materials and Methods" (or a similar section) to show how the work is carried out. Kallet (2004) proposed that the methods section should provide sufficient information to enable readers to judge the validity of a study: "a clear and precise description of how an experiment was done, and the rationale for specific experimental procedures, are crucial aspects of scientific writing."

To tutoring authors in preparing the manuscript, some journals (e.g. *Genome Biology*, *The EMBO Journal*, *PLoS Genetics*, and *Journal of Endocrinology*) clearly stated the requirement to the Materials and Methods section for research articles in its Instruction for Authors.

As shown by the survey results, authors can express the methods to readers in different ways in one paper. This may attributed to the method itself, since well-established methods are familiar and easy for readers to understand, and new methods are usually need detailed description for readers to understand.

In the eight leading journals sampled in this paper, the preferred approach when describing a well-established method was to use the author's own words. If some or all of the description is replicated verbatim from a previously published article (whether by the same or different authors), appropriate acknowledgement and citation indeed have been given to the original publication as Wager stressed (Wager et al. 2009; Wager 2012), but this was not observed in any of cases studied, for example, in attachment cases. Alternatively, unless the methods used are totally novel, a phrase such as 'by well-established method' or 'as previously described' plus appropriate citation may be used. However, the editors of Science, as stated in the journal's author guidelines (http://www.sciencemag.org/site/feature/contribinfo/prep/prep_online.xhtml), prefer the attachment of supplemental material (in the present authors' view, the requirement for acknowledgement and citation should be no less in the case of an attachment than in a description).

No matter what citation behaviors in scientific papers have been analyzed by Ramos et al. (2012), how to avoid accusations of duplication in the method section of life science papers should be clarified. Based on the survey results and discussion, we can give the following suggestions for authors preparing the methods section of bioscience papers:

1. Wherever possible, authors should use their own words to describe the method.
2. If all or part of a previously published description—whether by the same or different authors—is unavoidably repeated, the repeated text should be clearly identified (e.g. by indentation or quotation marks), and a full citation given to the original source.
3. Different journals prefer different approaches. Some require the use of a phrase such as 'by well-established method' or 'as previously described', plus appropriate citation to an existing description for any well-established method, and only require a detailed

description if the method used is totally novel. Others again require authors to attach a description of the method as part of the supplemental materials or attachment as the sample from Science; in this case, the same rules should be followed as in point 2 above. Otherwise, in the life science field, when authors have to depict some repeated methods, journal editors can generally agree to use "attachment" as a way in this section of biosciences papers in the future. Yes, *Science* has already done so.

If these guidelines are followed, readers will be given enough information to evaluate the study described in the paper and, if necessary, to replicate it. At the same time, not only will tools such as CrossCheck not find high levels of similarity with the authors' own or others' work, but more importantly the authors will have avoided committing the unethical practices of plagiarism or self-plagiarism.

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Conflict of interest None.

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