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**A Review of the Literature on Ethical Issues Related to Scientific Authorship**

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ACCEPTED MANUSCRIPT

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ACCEPTED MANUSCRIPT

## **A Review of the Literature on Ethical Issues Related to Scientific Authorship**

### **Abstract**

The article at hand presents the results of a literature review on the ethical issues related to scientific authorship. These issues are understood as questions and/or concerns about obligations, values or virtues in relation to reporting, authorship and publication of research results. For this purpose, the Web of Science core collection was searched for English resources published between 1945 and 2018, and a total of 324 items were analyzed. Based on the review of the documents, ten ethical themes have been identified, some of which entail several ethical issues. Ranked on the basis of their frequency of occurrence these themes are: 1) attribution, 2) violations of the norms of authorship, 3) bias, 4) responsibility and accountability, 5) authorship order, 6) citations and referencing, 7) definition of authorship, 8) publication strategy, 9) originality, and 10) sanctions. In mapping these themes, the current article explores major ethical issue and provides a critical discussion about the application of codes of conduct, various understandings of culture, and contributing factors to unethical behavior.

Keywords: Scientific Authorship, Ethical Issues, Virtues, Values, Obligations, Responsibilities

## Introduction

Due to its relevance to myriads of scholars in academia, scientific authorship is a unique topic that has attracted attention from various disciplines. Scholars from different areas of research have raised questions and discussed issues about the attribution of authorship and responsibilities in their publications. Among these questions and discussions, some issues are called ethical issues, and it is the objective of this review to identify these issues, categorize them in relevant themes and rank them on the basis of frequency of occurrence. In this review, the authors understand these ethical issues to be questions and/or concerns with regard to values, virtues and obligations having to do with reporting, authorship and the publication of research results (what we call *ethical issues related to scientific authorship*). This understanding is broader than a traditional interpretation of ethical issues of authorship, which mainly pertain to who deserves author status, authorship order, and abusive authorship practices. In broadening the scope, this review aims to include tangential issues that are connected to traditional concerns, and provide directions for future research.

Conducting a literature review to map the ethical issues associated with scientific authorship is not an entirely new endeavor. Similar studies have been conducted in the past. The two most cited literature reviews on this topic were undertaken in 2005 and 2011 (Claxton 2005a; Claxton 2005b; Marušić et al. 2011). In his 2005 review, Claxton distinguishes two kinds of problems in scientific authorship, namely:

1. Deceptive practices include different forms of fraud such as fabrication of data, falsification, plagiarism, and “unethical conflicts of interest” (Claxton 2005a, 35).
2. Issues resulted from the difficulties in the allocation of credit such as coercion authorship, mutual support/admiration authorships, gift authorship, ghostwriting,

duplicate production authorships, and assignment and ordering of authorship (Claxton 2005b).

In their 2011 review, Marušić and her colleagues provide a synthesis of research on authorship issues across all research fields. They identify four common problems of authorship:

1. “authorship perceptions, definitions and practices”,
2. “defining order of authors on the byline”,
3. “ethical and unethical authorship practices”, and
4. “authorship issues related to student/non-research personnel-supervisor collaboration”

(Marušić et al. 2011, 1).

Despite providing considerable clarity and insight into some ethical aspects, the two previous reviews have two shortcomings in common. The first one is that they both overlook difficulties in attributing responsibilities and rarely mention these explicitly.<sup>1</sup> This shortcoming seems to neglect the widely accepted notion that scientific authorship is a two-sided coin, with credit on the one side and responsibility on the flipside (Rennie & Flanagin 1994; Biagioli et al. 1999). The second shortcoming the two previous reviews have in common relates to misconceptions about instances of ethical issues, fraud and noncompliance. Whilst neither of the two reviews provides an explicit definition of what an ethical issue involves, they sometimes seem to take ‘ethical issues’, ‘fraud’, and ‘noncompliance’ as synonymous expressions that may baffle scrupulous readers.<sup>2</sup> Although

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<sup>1</sup> For instance, while both studies mention guest/ghost authorship, they only mention the receipt of undeserved credit as a problematic issue about this practice and make no explicit mention of responsibilities.

<sup>2</sup> Two specific examples can help to clarify the problem. 1) Marušić et al.’s third category of common issues in authorship is titled ethical and unethical authorship practices. Various forms of authorship abuse such as

this confusion could be reflective of studies which they reviewed and differences in international policies, it is safe to argue that making a distinction between these issues could help in addressing each more effectively. In addition to addressing the two above-mentioned shortcomings of the previous reviews, the current review also aims to incorporate more recent issues that were debated since the last review in 2011.

This review starts with explaining the search methodology. It subsequently presents the results of the searches. Finally, these will be critically reflected on in the discussion section.

## Methodology

For this review, the Web of Science (Clarivate Analytics 2020) core collection (hereafter referred to as WoS) was used to find relevant sources.<sup>3</sup> In order to retrieve the most useful items that pay specific attention to scientific authorship, two groups of relevant search terms were developed and used (see table 1).

Rationale	Search terms
Referring to the context	1- scien* (scientific, science, scientist) 2- research* (research, researching)

guest/ghost/honorary authorship are mentioned in this category, suggesting that these authorship abuses are examples of ethical issues in authorship. Later, however, in making a reference to one of the reviewed studies they note that “it can be argued that omitting or adding authors on an article represents falsification or fabrication” (Marušić et al. 2011, p.14). Given that fabrication and falsification are strictly forbidden by all codes of conduct, comparing ghost/guest authorship with them would imply that they are instances of noncompliance with codes of conduct and not an ethical issue in the strictest sense. 2) Claxton’s category of deceptive practices has two subcategories: Fraud, including fabrication of data and plagiarism, and, unethical conflict of interest. By making a distinction between unethical conflict of interests and other forms of conflict of interests, Claxton leaves the reader confused about the nature of conflicting interests. He notes that “the evaluation of scientific data and information is never ‘completely independent of the scientists’ convictions or theoretical apparatus’ and is, therefore, influenced by previous knowledge, beliefs, and experiences” (Claxton 2005b, p. 35). Unethical conflict of interests, however, are those that provide “an incentive for fraud and misconduct” (Claxton 2005b, p.35). In other words, according to Claxton, conflict of interests are inseparable from scientific endeavor but some unethical ones lead to fraud. In which case, the unethical conflicts of interests are merely fraudulent and an instance of noncompliance, but not an ethical issue in the strictest sense.

<sup>3</sup> We ran a pilot on PubMed and WoS with the same search terms and combinations. WoS retrieved a higher number of articles, and on that basis, we decided to use WoS.

	3- scholar* (scholarly, scholarship)
Referring to authorship and dissemination	1- author* (authors, authoring, authorship) 2- report* (report, reporting) 3- communicat* (communicate, communication) 4- disseminat* (disseminate, dissemination) 5- writ* (write, writing) 6- publishing 7- publication

Table 1. relevant terms to find resources relevant to scientific authorship

The first group of search terms refers to the context (science, research, and scholarship), and the second group to authorship and dissemination of results. Wildcards (enabled by using the asterisk symbol) that substitute for any other character range were used to increase the likelihood of finding more relevant resources.<sup>4</sup>

In conducting the search, the WoS *Advanced Search* tab was used to create search strings. The search was limited to items published in English. Results were also limited by *document type*, where journal articles, abstracts of published items, books, book chapters, editorial material, letters, and conference proceedings were selected. No filter was applied on the *timespan* to include all the available collections and citation indexes within WoS so that the search results would not be limited to a certain period or index. At the time of conducting the search (December 2018), the largest possible timespan to choose in WoS was 1945 to 2018. By using the aforementioned search terms and Boolean operators, 21 unique strings were created, which are shown in table 2 together with the number of items that these searches yielded in combination with the aforementioned limitations (i.e. language, document type):

<sup>4</sup> For example, by using the term science, the algorithm would not search for scientific, but by using scien\*, the algorithm will consider every word that starts with scien (e.g. science, scientific, scientifically, scientist, etc.).



	<b>Search string</b>	<b>Number of found items</b>
1	scien* AND author*	1024
2	scien* AND report*	2714
3	scien* AND communicat*	2681
4	scien* AND disseminat*	282
5	scien* AND writ*	1529
6	scien* AND publication	838
7	scien* AND publishing	807
8	research* AND author*	947
9	research* AND report*	6092
10	research* AND communicat*	4388
11	research* AND disseminat*	657
12	research* AND writ*	1373
13	research* AND publication	1054
14	research* AND publishing	582
15	scholar* AND author*	182
16	scholar* AND report*	119
17	scholar* AND communicat*	569
18	scholar* AND disseminat*	40
19	scholar* AND writ*	288
20	scholar* AND publication	129
21	scholar* AND publishing	498
<b>Total</b>		<b>26,793</b>

Table 2. search strings and the number of items resulted from each query

After searching with these 21 distinct strings, 26,793 items were found (including duplicates). Using the *Combine Sets* function in WoS that automatically removes duplicates, 24,799 items remained. In narrowing down the scope and refining results to only extract the items that are dealing with ethical issues related to scientific authorship, the following search terms were used:

- Three core terms that formed the basis of the definition of ethical issues
  - value\* (value, valued, values)
  - virtu\* (virtue, virtues, virtuous)
  - obligatio\* (obligation, obligational, obligations)
- Three generic terms that are often used in describing ethical issues
  - ethic\* (ethics, ethical, ethically)
  - moral\* (morally, morality, morals)
  - norm\* (norms, normative, normal)
- Responsibility (as a specific issue that was neglected in previous reviews)
  - responsib\* (responsible, responsibly, responsibility)

Accordingly, the following search string was created and used to search within abstracts and keywords:

value\* OR virtu\* OR obligatio\* OR ethic\* OR moral\* OR norm\* OR responsib\*

This led to a list of 2485 titles. The abstracts of these items were screened one by one to check if the selected documents in any significant way addressed issues of obligations, values and/or virtues related to scientific authorship. Given that editorials, commentaries and letters to the editors do not have an abstract, all of these were included for full-text reading. After going through all 2485 documents in the manner described, 403 items were deemed eligible for full-text reading. After reading the selected full-text articles, 79 additional items were

excluded. 61 items did not focus on the ethical issues related to authorship in any significant manner after all. These documents primarily dealt with: Editorial processes and issues (21 items), Impact and citation analysis (8), Readership and open access (7), Science journalism (5), Research with humans and animals (5), Science policy (4), Training material and courses (3), Research ethics committees (3), Style/Language proficiency (2), Predatory publishing (2), Methodology (1). Other reasons for exclusion were: Unretrievable documents<sup>5</sup> (10), Duplicate editorials with different DOIs published in other journals (7), and Report of an investigation of misconduct without a significant ethical argumentation (1).

As a result, 324 items were deemed eligible for the analysis. Figure. 1 depicts a summary of the selection process.

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<sup>5</sup> Despite elaborate and multiple attempts to mobilized our network we were not able to retrieve these items.

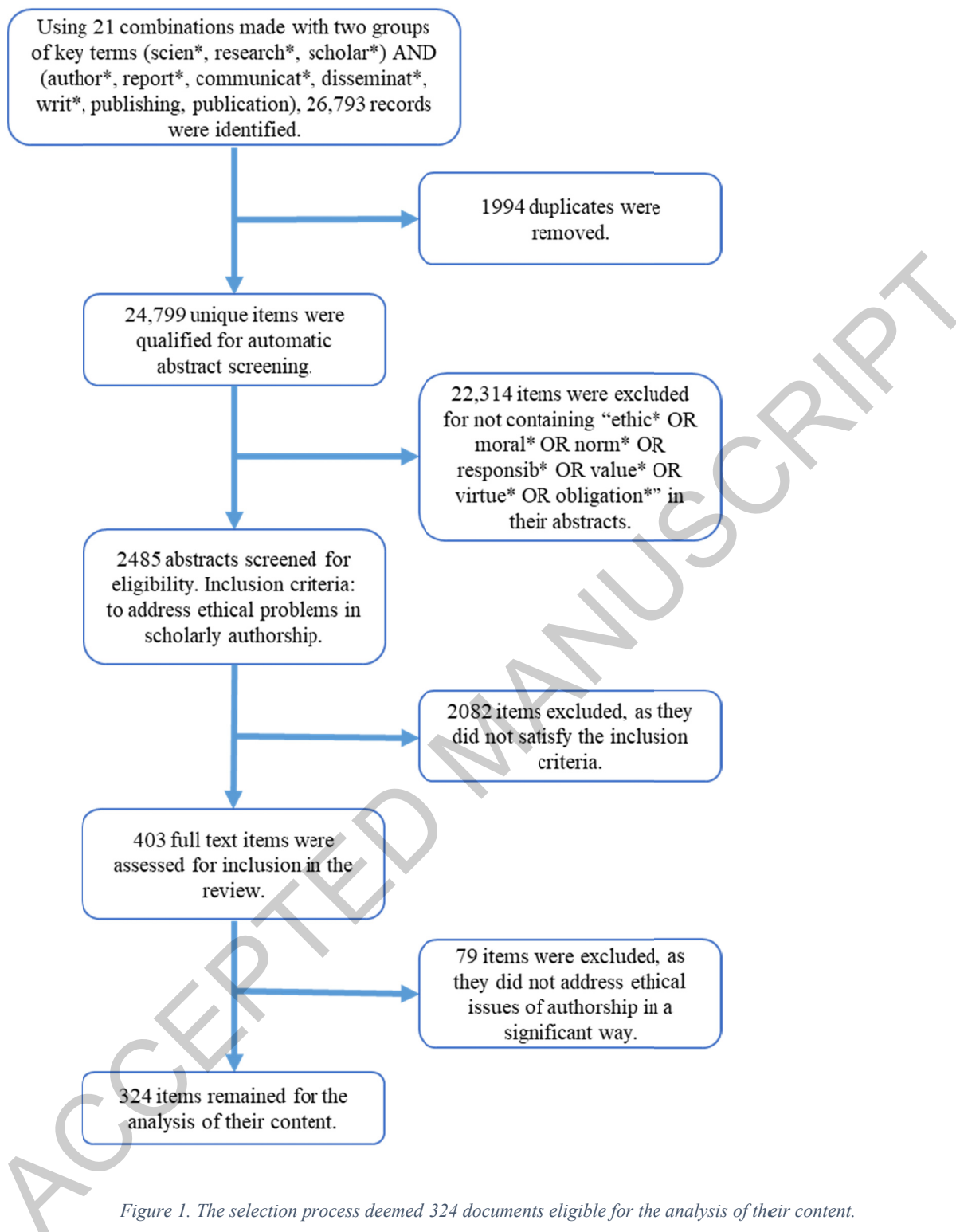


Figure 1. The selection process deemed 324 documents eligible for the analysis of their content.

To start the analysis of the selected sample and the identification of the ethical issues, 50 randomly selected documents were examined independently by both authors. Using an inductive approach, sections that described an ethical issue were highlighted and a label was

created for that part. These labels were then subsumed under themes and accordingly, one or more themes were used to tag each document. Subsequently, the authors discussed and compared the ethical issues that they had identified as related to authorship, and compiled a first set of ethical issues and after reducing overlaps, subsumed issues under ten themes. With the help of this first list of issues, the first author reviewed the 50 randomly selected documents once more, tagging each document in accordance with the issue(s) that were discussed. As a result of this, the list of ethical issues was discussed once again with the second author and further refinements were made. Finally, the list of ethical issues was finalized and all the other papers were reviewed and tagged by the first author (Figure 2). While tagging the entire sample, all the identified issues (including some that were not mentioned in the first 50) could be subsumed under the ten themes. So, no new issues were identified at this stage that necessitated the creation of a new theme altogether. Before drafting the first version of the results section, the first author checked the entire sample with the new list once more and improved the tags.

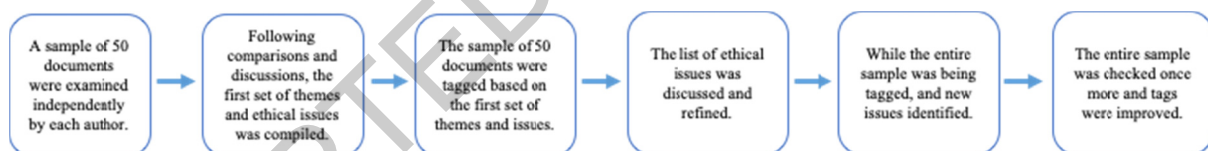


Figure 2. The examination and tagging process

## Results

Given that reflecting all of the raised issues would be impractical in the results section, only those that were discussed more often and/or those that were deemed more relevant to an ethical analysis are added.

## Document types

The makeup – in terms of the document types - of the 324 items eligible for the final analysis is shown in Figure 3.

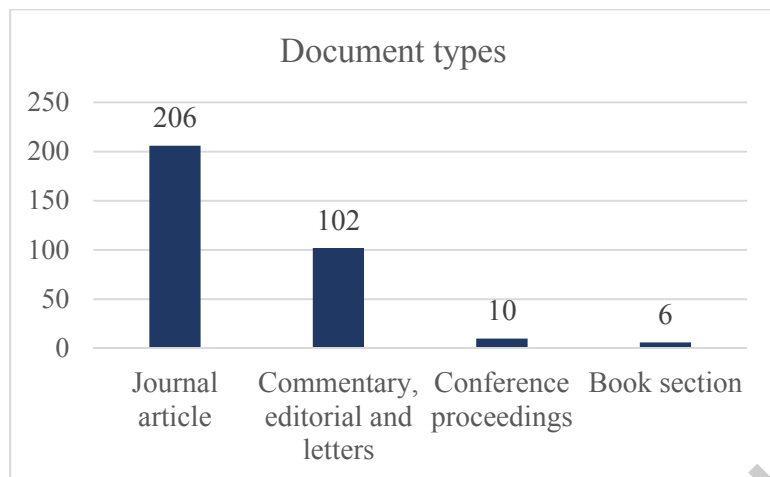


Figure 3. makeup of the 324 documents considered for analysis.

## Number of publications over time

Furthermore, the review shows a rapid increase in the number of items published in the last 15 years (Figure 4).

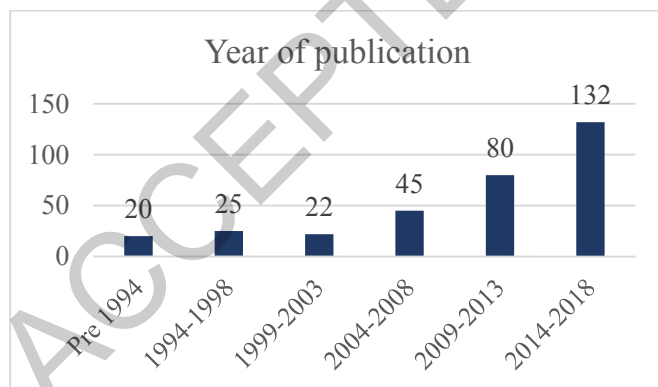


Figure 4. Years of publication of the documents considered for analysis.

### Most common keywords

Within the selected sample, 124 items had explicitly tagged keywords. Figure 5 shows the top 10 most common keywords among these items.

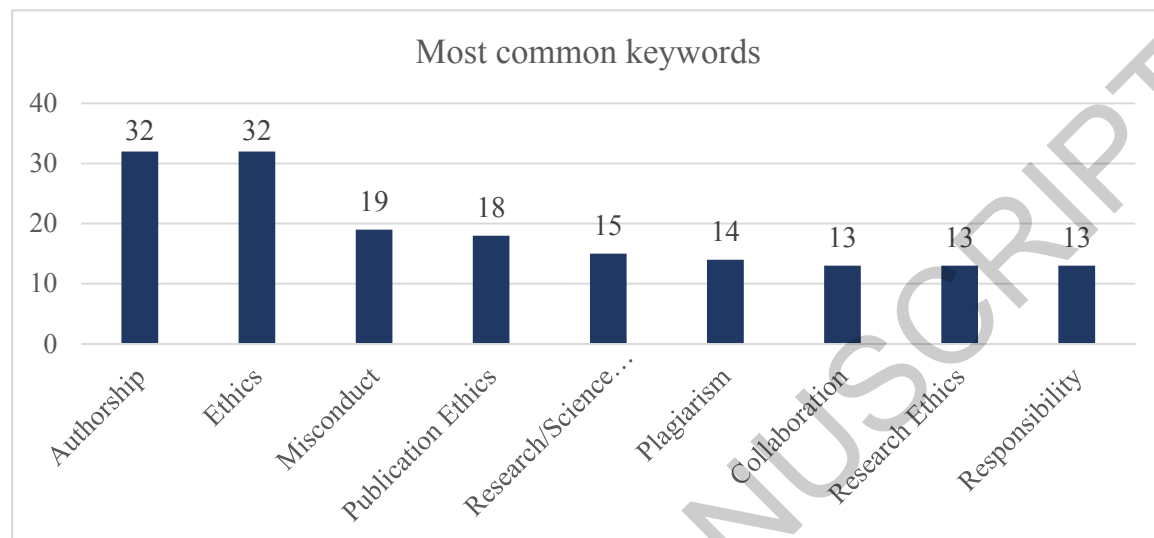


Figure 5. Most common keywords within the sample.

### Most common ethical issues

A close reading of the selected sample resulted in the identification of 10 core themes that each contain several issues and questions. Figure 6 shows the ranking of themes based on the number of documents that mention these issues.<sup>6</sup> It should be noted that some documents mention more than one issue.

<sup>6</sup> Although specific discussions within each theme might have changed over time, it has not been the focus of this review to explore these changes from a quantitative perspective.

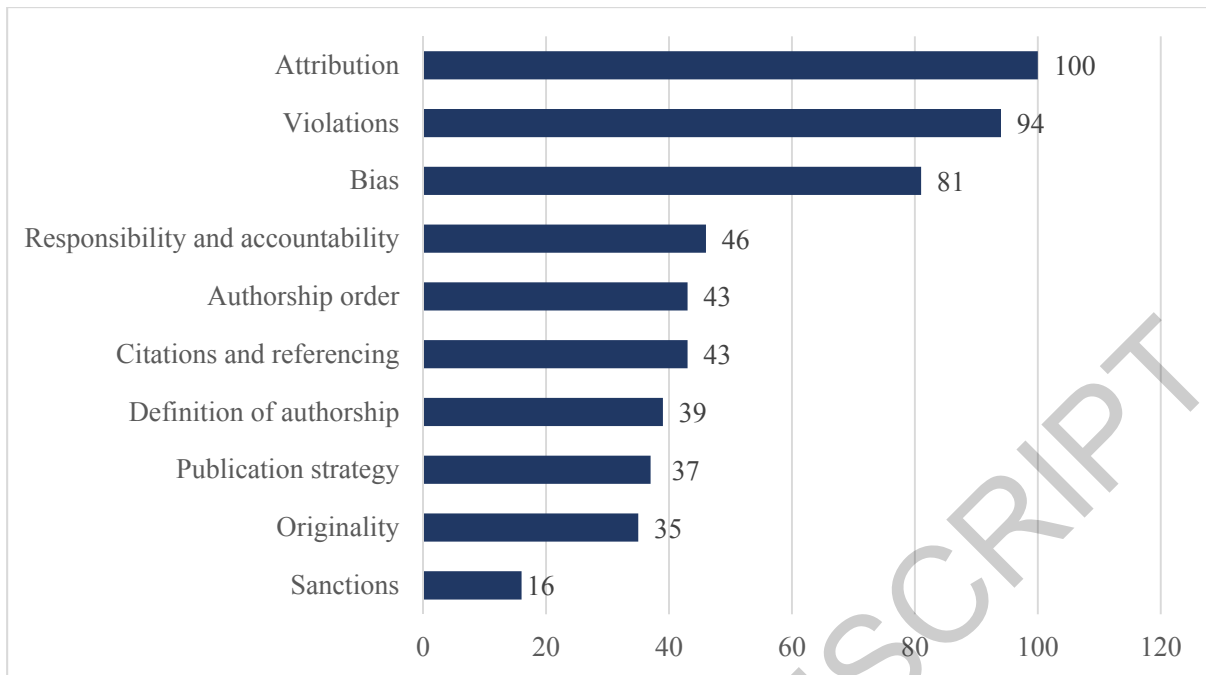


Figure 6. Ethical issues ranked on the basis of their occurrence in the literature.

#### 1- Attribution (100 documents)

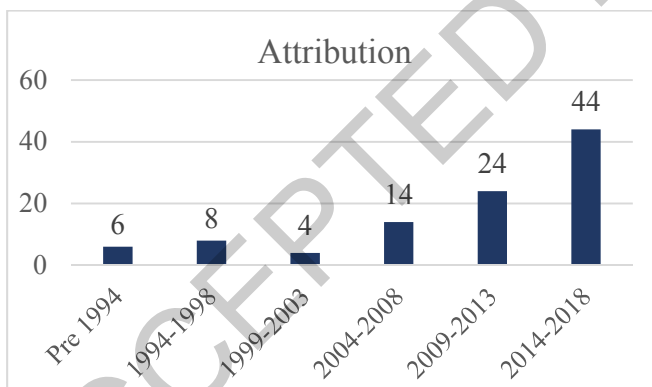


Figure 7. Frequency of occurrence in the sample- Attribution

Ethical issues related to attribution involve factors that should be considered in recognizing contributors' efforts and confirming their contributions to publications. This confirmation implies that the contributor's work was regarded as necessary/useful for the publication, which entitles them to receive some form of credit. The credit can take various forms, such as authorship status, being mentioned in the acknowledgment section of a publication. An



improper distribution of credit either leads to giving credit to those who do not deserve it or withholding credit from those who actually deserve it (Chen 2011; Anderson 2013; Youtie & Bozeman 2014; Adeney 2015; Bozeman & Youtie 2016).

The discussion about attribution of contributions involves two more specific debates. The first discussion is about the type of recognition that different kinds of contributions deserve. Some authors suggest that inherent ambiguities about collaboration to modern scholarly projects complicate the recognition of contributors' work and making a clear distinction between various tasks (Wagner et al. 1994; Eisenberg et al. 2014; Rajasekaran et al. 2014; Syed et al. 2015). The notion of intellectual contribution and its differences with non-intellectual contributions is among the most contentious issues that might complicate the recognition of some tasks (Colledge et al. 2013; Helgesson 2015; Hammer & Miaskowski 2017). For example, tasks such as writing assistance provided by professional writers are deemed as substantial for improving clarity and structure, but they can be seen as non-intellectual, and are usually not rewarded with any kind of recognition beyond monetary compensation (Morley 2013; Shashok 2013; Wager et al. 2014). The so-called nonauthor contributions (e.g. enrolling patients for clinical trials) are another group of tasks that seem often overlooked and not sufficiently credited in publications (Mentzelopoulos & Zakynthinos 2017).<sup>7</sup> Furthermore, what contributions justify different forms of credit seem to vary significantly across disciplines (Mendez & Angeles Alcaraz 2015; Jabbehdari & Walsh 2017; Logan et al. 2017), which is seen as a factor that complicates the attribution of credit in multidisciplinary projects (Hays 2010; Cutas & Shaw 2015; Galdas 2016).

The second debate is not about the kind of contribution but the extent to which one must contribute to a certain task, in order to be eligible to receive various forms of credit. In other

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<sup>7</sup> Attitudes towards some non-author contributions are changing. For more on this topic and an example, see the last subheading in the discussion section titled 'Future research, from author to contributor'.

words, after having decided the issue of which type of contribution deserves a certain kind of credit, the second question is concerned with the extent of contribution that is required to deserve that particular type of credit (Bebeau & Monson 2011). Various factors are considered in these discussions. For instance, the notion of a *significant* or *substantial* contribution as a requirement for authorship has triggered extensive discussions (Lynch 1994; Jeffery 2014). Some maintain that researchers have developed “rules of thumb” regarding what constitutes a significant contribution, which in some cases might bend depending on the value of possessed resources by different parties (Louis et al. 2008, 105). Furthermore, a bias towards overestimating one’s own inputs (Lissoni et al. 2013), and inaccurate perceptions about the extent and importance of others’ contributions are believed to complicate measuring the extent of the contributions of different collaborators (Ivanis et al. 2011; Jian & Xiaoli 2013).

## 2- Violations (94 documents)

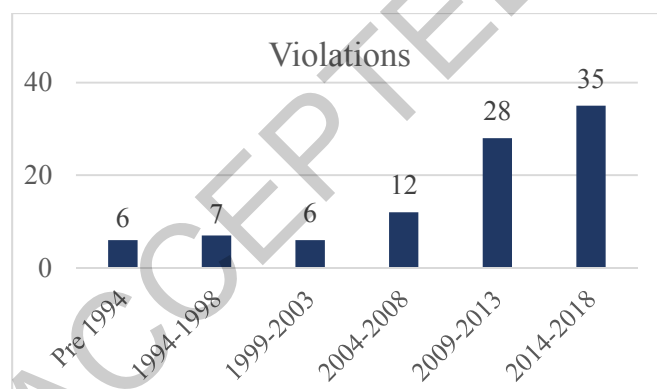


Figure 8. Frequency of occurrence in the sample - Violations

Discussions on this topic mainly center around the precise nature of violations of norms of authorship and the best solutions for tackling them. Regarding the nature of violations, one question is the difference between serious violations and questionable practices as well as the

difficulties in drawing a line between the two (Fenton & Jones 2002; Marcovitch et al. 2010; Matthes et al. 2015; Pickett & Roche 2018). While serious violations are linked with fabrication, falsification and plagiarism, the so-called questionable practices are believed to be much harder to identify, and difficult to frame as a violation (Steinbok 1995; Price et al. 2001; Das & Biradar 2016). For example, exploiting research subordinates to publish more, adding honorary authors, or self-citations are among questionable practices that have no immediate effect on the veracity or quality of scientific claims but are problematic all the same. These problematic practices are called misdemeanors (Badaway 1996) or questionable practices (Rubenstein et al. 1989). Similarly, a failure to raise ethical concerns or report misbehavior of others is not always easy to identify and frame as a violation (Wenger et al. 1999; Satalkar & Shaw 2018).

When it comes to the proposed solutions to tackle violations, disagreements are noticeable. Some believe that by improving current authorship guidelines and promoting them (Horner & Minifie 2011; Chattopadhyay 2014; Jawaid 2015), or by making them more specific, the rate of violations will go down (Wager & Kleinert 2013). However, others believe that without having stricter control mechanisms in place to make sure that policies are implemented and enforced, guidelines are not likely to be effective (Berardo 1993; Rizk 2007; Lissoni & Montobbio 2015). One problem with using guidelines as a solution for tackling violations (especially in international projects) is the disagreement between different guidelines in terms of their definition of misconduct (Rockwell 2002; Redman 2013; Vasconcelos & Roig 2015).

Another difference of opinion among experts concerns proposals to initiate early conversations among contributors to specify authors and order of names. Some take early conversations to be a reasonable measure to mitigate unfairness and bias towards contribution types that may be due to disciplinary preferences (Smith & Master 2017) and avoiding

disputes (Hess et al. 2015). Others claim that authorship “cannot be determined until a publication is developed” (Wager et al. 2014, 7), and that the presence of unequal relationships challenges the effectiveness of early agreements (Bozeman & Youtie 2016).

The (reasonably) successful application of technology in detecting plagiarism suggests that software programs might also be used to improve the planning and supervision of projects, and minimize mistakes/mishaps that contribute to violations (DeTora et al. 2015; Das & Biradar 2016; Shinyaeva & Tarasevich 2017). While supporting whistle-blowers is seen as an effective solution in extreme cases (Beisiegel 2010; Bonito et al. 2012), the suggested longterm solution is moving away from detection and retraction towards prevention of violations (Marušić 2005). In fact, training programs and researcher education are often mentioned as effective solutions for preventing violations (Benos et al. 2005; Arda 2012; Fang et al. 2012; Cabral et al. 2015).

### 3- Bias (81 documents)

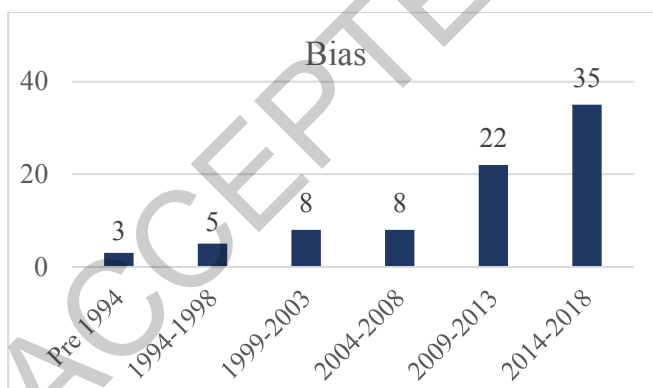


Figure 9. Frequency of occurrence in the sample - Bias

In principle, issues related to bias in authorship are framed as a financial or non-financial conflict of interests (COIs). Financial COIs are often explored in parallel with discussions about collaborations between academia and industry, and sponsors’ influence on authors’

independence (Edwards & Bhopal 1999; McComas 2008; Adams 2009; Moeller 2009; Miller et al. 2017). Lack of clear definitions (Patel et al. 2011), inadequate guidance on compliance (Rohwer et al. 2017), and discrepancies between institutional and national guidelines or between various universities and societies are seen as factors that complicate compliance with guidelines about COI (Hillman et al. 1991; Lanken et al. 1995; Woteki 2006).

While some COIs might be inevitable (e.g. in case of scientists who move between academia, industry, and government), disclosure and providing extra information is believed to empower readers to place credence on presented data (Marcovitch et al. 2010). That said, it is also argued that disclosing sources of funding might not reveal much about funders' actual pressure on researchers (Kukla 2012; Morley 2013), or their economic interests (Pardo-Hernandez et al. 2018). Furthermore, in some cases the disclosure of financial sources might actually worsen reporting bias, as it may increase authors' inclination to exaggerate results "in anticipation of reader discounting brought about by financial disclosure" (Johnson 2013, 2244).

Discussions about non-financial COIs involve a broad range of issues, five of which are mentioned here. The first is bias in hypothesis-based studies. It is argued that since hypothesis-based studies rarely reject their initial hypothesis (Stern & Simes 1997; Hall et al. 2007; Rost & Ehrmann 2017), and many studies do not even mention their hypothesis, identifying bias in hypothesis-based studies is challenging (Kilkenny et al. 2009). Not publishing negative results and zero-relations (so-called file-drawer problem) is an issue, which a range of non-author parties bear responsibility for, such as the editorial staff and the readers of journal articles who might not accept, or read/cite these articles (Jennings & Van Horn 2012; Kepes et al. 2014; Meerpohl et al. 2015; Mueller 2018). While determining the methodology in advance (Marco & Larkin 2000) and preregistration of studies are suggested as possible solutions for addressing bias (Schmucker et al. 2014), even preregistered studies

with negative results might be published in ways that convey a positive outcome (Dawson & Dawson, 2018). Another form of biased hypothesis is called “HARKing”(Hypothesising After the Results are Known), which leads to false-positive and improbable interpretations (Kerr et al. 2015, 225).

Discussions about the second issue, the biased use of language, analyze the text from a reader’s perspective, highlighting linguistic features that could mislead the reader. Examples of language bias include the use of confusing, inaccurate, equivocal, metaphoric, euphemistic and exaggerated statements (Schreiber 2005; Walcott et al. 2012; Kueffer & Larson 2014; Abrams et al. 2015; Vinkers et al. 2015). The requirement to use formal language and portray the research process as ultimately planned and predicted is believed to result in a constructed text that misleads readers about what actually happened (Webster 2003). While using the passive voice is sometimes believed to mislead readers about individual contributions and responsibilities (e.g. *1 kg of topsoil was taken instead of* “The technician took 1 kg of topsoil”) (Webster 2003, 218 [part in italics added]), using the active voice would not always guaranty ethical behavior and an accurate reflection of research process (Gray 2017).

The third issue being discussed is the biased interpretation of results and their difference with outright falsification (Finney 1995). For example, unethical use of statistical methods that leads to favoring/cherry-picking specific aspects of results is seen as a biased interpretation of results (Irwin 2009; Kilkenny et al. 2009; Wicherts et al. 2011; Wang et al. 2018).

Furthermore, while changing a key variable to improve results is seen as falsification, omitting necessary information to make the interpretation appear relevant and sound is seen as an ethical issue pertaining to biased interpretation of results (Payne & Ireland 2015).

The fourth issue involves scientific visuals. Correcting, improving, or manipulating images to exaggerate findings, or present a prejudiced view of results are frowned upon (Zietman

2017). Questions about the acceptability of various degrees of correction, and what distinguishes acceptable improvements of an image from unacceptable ones (image manipulation) are mentioned in some studies (Carraway 2009; Jernstedt 2014). Illustrating selected results or summarising preferred parts of the results in figures are among other problematic uses of visuals (Reiss 2014).

Discussions about gender bias, the last issue mentioned here, focus on disparities between male and female authors in relation to the attribution of credit and rewards. For example, authors' positions in the byline (Walsh-Bowers 1995; Araújo & Fontainha 2017; Lerchenmüller et al. 2018) and chances for receiving grants are sometimes believed to be influenced by gender (Pereira & Diaz 2016). Another example of gender bias occurs when the gender composition of a group of authors is said to influence the way in which certain topics are addressed in research (Andersen et al. 2016).

#### *4- Responsibility and accountability (46 documents)*



*Figure 10. Frequency of occurrence in the sample – Responsibility and accountability*

Responsibility and accountability are mainly discussed in the context of collaboration and co-authorship. Not being able to hold contributors accountable when problems arise is believed to have an adverse effect on the quality of findings (Wray 2006) and society's trust in science

(Cronin 2001). Thus, clear responsibilities in relation to content, which can later be used to hold individual contributors accountable for certain elements of what is published is seen as an essential aspect of authorship (Tobin 2000; Kukla 2012; Jeffery 2014; Adeney 2016; McNutt et al. 2018).

In research projects that include a variety of tasks or very large tasks with numerous contributors, responsibilities might be difficult to disentangle and hence, holding individuals accountable could be challenging (Saxon 2001; Carraway 2009; Mongeon et al. 2017). Given the broad spectrum of specialties involved in large research projects, expecting contributors to know the exact details and quality of work done by others (and vouching for it) is impractical, if not impossible (Schechter et al. 1989; Jones 2003; Clement 2014; Smith & Master 2017). Consequently, the rationale behind the idea of holding all contributors accountable for the entire work is questioned (Relman 1990; Smith et al. 2014).

Responsibility is sometimes interpreted in terms of the obligations and duties of senior authors in mentoring and protecting young scholars (Hays 2010). This interpretation of responsibility obligates senior researchers to guide/usher young scholars in the process of authorship and help them beyond what policies and guidelines offer (Netting & Nichols-Casebolt 1997; Syed et al. 2015; Bozeman & Youtie 2016). Furthermore, senior figures have a responsibility to ensure that the contributions of young scholars are acknowledged (Welfare & Sackett 2011; Andes & Mabrouk 2018).

Junior researchers are believed to lack a thorough awareness of guidelines and their application, and consequently, their responsibilities are believed to be different from senior researchers (Street et al. 2010; Chen 2011). In addition, having uncertain career prospects and often working without a permanent contract, early-stage researchers might fear to raise



questions or concerns about abusive behavior that involves figures of authority (Newman & Jones 2006; Karani et al. 2013).

#### 5- Authorship order (43 documents)

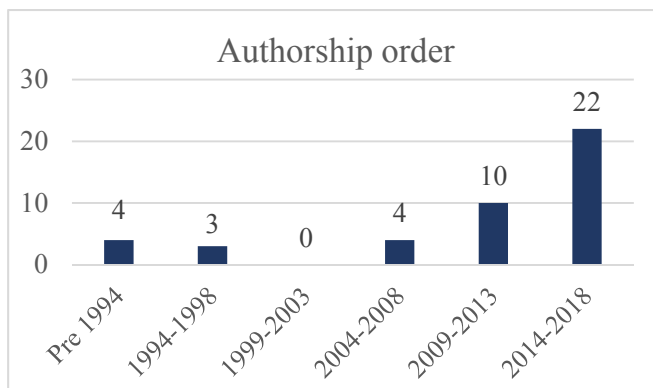


Figure 11. Frequency of occurrence in the sample - Authorship order

Three questions dominate the discussion about the authorship order. The first is about the criteria that should be used to decide in which order to list authors' names, for example, alphabetical or relative to the contribution (Smith et al. 2014). Disciplinary differences in terms of meaning and/or implications of the sequence in which authors are listed are seen as factors that complicate a universal understanding of authorship order (Garfield 1978; Maciejovsky et al. 2008; Cutas & Shaw 2015; Kassis 2017; Stvilia et al. 2017). While some authors propose user-friendly systems for listing authors' names that would be useful/acceptable to all disciplines (Baerlocher et al. 2007; Jawad 2013; Warrender 2016), others believe there is no simple solution for authorship order quandaries (Jeffery 2014).

The second question concerns power dynamics and how unequal relations affect authorship order (Washburn 2008; Street et al. 2010; Bozeman & Youtie 2016; Hammer & Miaskowski 2017). Given that some positions are more coveted than others (e.g. first or last position), competition for occupying these places contributes to tensions that will ultimately be affected

by negotiation skills (Lissoni et al. 2013) and may result in unfair treatment of less powerful authors (Jian & Xiaoli 2013; Lerchenmüller et al. 2018).

The third question concerns the relationship between authorship order and the assumed responsibility from one's place in the sequence. It is argued that in the absence of contributorship statements, the responsibility of authors is not always clear from the occupied sequence (Endersby 1996; Mongeon et al. 2017). Since authorship order might also be used to indicate seniority (e.g. last position), occupying a particular position could obscure responsibilities (Lissoni & Montobbio 2015). Suggestions to list middle authors randomly (Kremenak 2010) or listing all/some of the co-authors alphabetically across all disciplines are also believed to obscure responsibilities (Youtie & Bozeman 2014).

#### 6- Citations and referencing (43 documents)

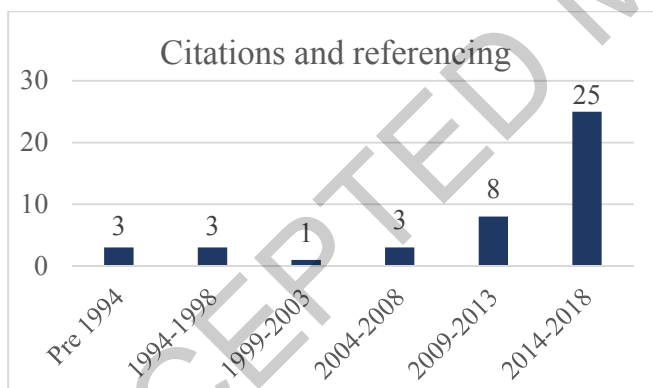


Figure 12- Frequency of occurrence in the sample – Citations and referencing

The debate about citations and referencing focuses on four major issues. The first concerns the employment of various methods to increase citations. An example is excessive self-citations and how such a practice differs from appropriately citing one's own work in subsequent research (Bilic-Zulle 2010; Fong & Wilhite 2017). While sometimes self-citations are necessary, the publication of several short papers to facilitate more self-citations is

considered excessive (Flatt et al. 2017). Teaming up with some co-authors to only cite articles of a certain group, the so-called citation cartels (Zietman 2017), and selective citations that involve a careful selection of available evidence to corroborate desired claims<sup>8</sup> are other examples of unethical use of previously published work (Cope & Allison 2010; Neusar 2015). Another problematic method to increase citations is called coercive citation that is imposed by peer-reviewers or journal editors to improve reviewers'/editors' citations or the journal's ranking (Statzner & Resh 2010; Lee & Jun 2014; Gasparyan et al. 2015).

The second issue is concerned with how researchers interact with the referenced material and sources (Rudolph 2015). For instance, wrong citations, copy-pasting references, using a publication or dataset without acknowledging it (citation amnesia), and referring to publications without (a full) reading/comprehension are among reproached behaviors (Garfield 1982; Dayton 1992; Stoker 1996; Mooney 2011; Liang et al. 2014).

The third issue is when extended lists of references become superfluous. At a certain point adding more references might not improve the validity of claims (also called padding). Accordingly, this would then mainly be seen as an attempt to increase the chances for publication or to give an impression of thoroughness (Statzner & Resh 2010; Chattopadhyay 2014; Neusar 2015).

The last issue pertains to plagiarism. While verbatim plagiarism is a clear-cut violation of codes of conduct and considered a fraudulent practice, other forms of appropriation can be problematic as well (Saha 2017; Vassallo 2018). Examples are patch-writing that involves combining borrowed and original text, using extended paraphrases, copying the structure of other texts (Cameron et al. 2012; Dougherty 2017), and rewording old ideas to make them sound new (Sly 1997). These practices would not always be identified, let alone be treated as

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<sup>8</sup> If available resources are selectively used to make one point of view look more supported/justified, or make desired conclusions, this issue can also be seen as a form of bias.

plagiarism (Swaan 2010). Other forms of plagiarism include self-plagiarism, which is generally understood as researchers reusing their own previously published text without acknowledgment (Daroff 2007; Dixon 2014; Vasconcelos & Roig 2015), and translational plagiarism that involves copying text from sources in another language (Qu & Wiwanitkit 2015; Baydik & Gasparyan 2016). Some authors stress the importance of intentions in considerations about plagiarism and make distinctions between flat-out wrongs and regrettable but understandable mistakes (Gotterbarn et al. 2006; Noyori & Richmond 2013).

#### 7- Definition of authorship (38 documents)

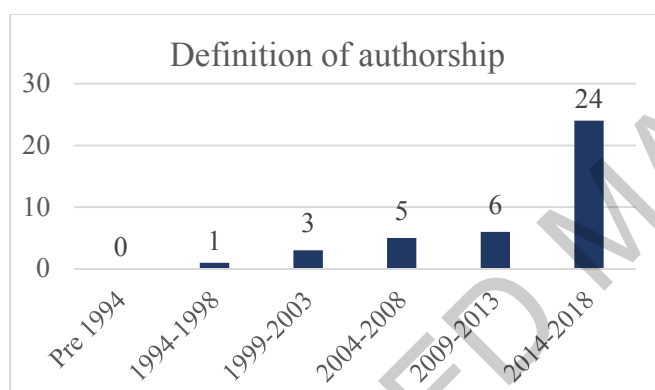


Figure 13. Frequency of occurrence in the sample - Definition of authorship

Debates about the definition of authorship are concerned with different criteria for accrediting authorship status and the challenges of reaching a consensus about how to apply and uphold them (Teixeira da Silva 2015; Tang 2018). One of the questions discussed is how to interpret the differences between the standard requirements for authorship, and the way authorship is awarded in practice (Jones 2003; Louis et al. 2008; Bebeau & Monson 2011; Moffatt 2011; Shashok 2013). While some studies consider researchers' awareness about the details of authorship criteria as a positive indicator (Alshogran & Al-Delaimy 2018), others believe that mere awareness is not helpful because these criteria are often unworkable in practice (Sheikh

2000). In particular, due to the steady increase in the average number of co-authors per publication (Cronin 2001; Ludvigsson et al. 2018), strict application of definitions of authorship to modern research contexts is becoming impractical (Garcia et al. 2010). Since a blind application of authorship criteria may lead to exclusion of some contributors, in practice, some researchers may find it reasonable to make their own interpretations of authorship criteria to avoid tension (Gollogly & Momen 2006; Uijtdehaage 2018).

It is also common to criticize authorship criteria and compare different definitions of authorship with each other to find out which would be the most appropriate to cope with the challenges of attributing authorship in different disciplines (Colledge et al. 2013; Teixeira da Silva & Dobránszki 2016). For instance, the definition provided by the International Committee of Medical Journal Editors is compared with definitions provided by other influential organizations such as those by the World Association of Medical Editors to explore their adequacy in coping with authorship irregularities in various disciplines (Logan et al. 2017; Moffatt 2018). Sometimes a specific research methodology (e.g. sociological participatory research with non-academic collaborators) is chosen to expose the shortcomings of authorship definitions in crediting all the contributors (Sarna & Wojcicki et al. 2017).

#### 8- Publication strategy (37 documents)



*Figure 14. Frequency of occurrence in the sample - Publication Strategy*

In planning to increase their publications' visibility or success, researchers might get involved in strategic behavior (Hayer et al. 2013) that sometimes makes them look more like entrepreneurs rather than serious scholars (Zwart 2005). Several kinds of strategic behavior are discussed in the literature. Discussions about the necessity for a full disclosure of all the available results are often debated in the context of collaborations between academia and the industry. For example, there are worries about hiding and censoring information, or partial publication of results (Song et al. 2009; Matheson 2016; Miller et al. 2017). When it comes to the disclosure of methodologies, concerns are raised about leaving vital parts out to cover flaws (Mack 2018), and not sharing unique methods or the underpinning software that were integral to the findings (Cech et al. 2003; Gavaghan 2018). A reluctance to publish all the available data, methods, or results is linked with the fear to have errors and biases exposed (Wicherts et al. 2011), or to help the competition to catch up (Bunnett 1983; Munro 1993).

Choosing the time of publication merely to improve impact, is also seen as a strategic decision that might be problematic (Rost & Ehrmann 2017). Other examples pertaining to questionable practices regarding the time of publication include the publication of intermediate but unverified results (Keohane et al. 2014), the reporting of results only after having registered a patent (Lissoni & Montobbio 2015), or the delayed communication of novel methods to avoid competitors from catching up (Boyer 2014).

Sometimes journals are chosen strategically for the submission of manuscripts. Choosing journals that have less rigorous editorial and peer-review procedures, or journals where authors have close relations with the editors (to speed up the publication process) are among the mentioned examples (Chen 2011). Another example is publishing controversial or sensitive issues in journals with less visibility to minimize the likelihood of being noticed by media, public or lawyers (Rier 2004). While publishing in journals that promote a political

agenda attracts both support and critique (Glick et al. 2015), publishing manuscripts in journals with a higher impact factor, which do not reach the appropriate target audience is frowned upon (Rowlands et al. 2004).

Another example of questionable behavior is being possessive and territorial about research topics and projects. Using personal authority to stop others from entering a scientific field (Sheikh 2000), and cherrypicking authors/collaborators merely due to their reputation or gender and thereby controlling who will enter a certain field or gets involved in interesting projects are among mentioned examples (Charlton 2008; Araújo & Fontainha 2017; Johal et al. 2017; Stvilia et al. 2017).

#### 9- Originality (35 documents)

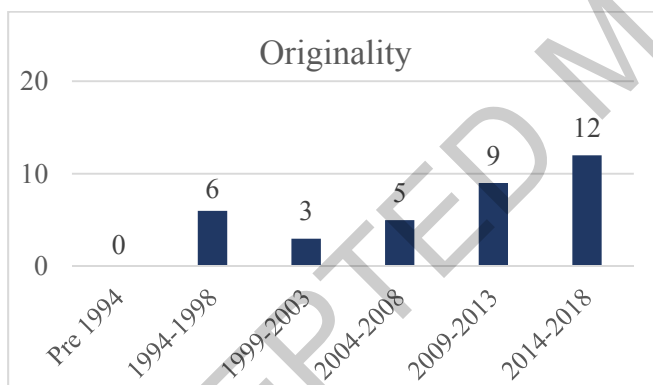


Figure 15. Frequency of occurrence in the sample - Originality

Discussions about originality are concerned with the noteworthiness and importance of new findings (Interrante & Reichmanis 2005; Mueller & Soares 2017). Tangible improvements compared to previous publications and extending available knowledge are considered as necessary requirements of originality, and a prerequisite for publication of new material (Steinbok 1996; Jerrells 2001; Larivière & Gingras 2010). In contrast, attempts to publish manuscripts that have substantial similarities with previous publications (Amos 2014),

massaging data that was used in previous publications to publish a new article (Chanson 2009; Rohwer et al. 2017), or publishing a series of small articles that include very thin slices of information are seen as unethical (Svensson & Andersson 2013; Meyer et al. 2016; Flatt et al. 2017). Furthermore, hiding similarities with other studies or not disclosing them when there are substantial overlaps (to make the study look original) are regarded as clandestine efforts that increase the noise-to-signal ratio in the academic record (Barker 1994; Riis 1994).

#### *10- Sanctions (16 documents)*

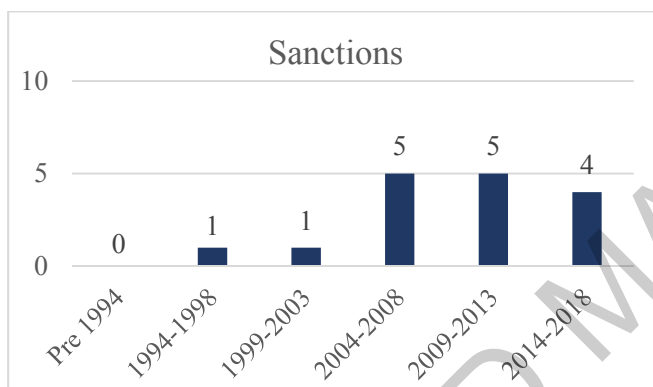


Figure 16. Frequency of occurrence in the sample - Sanctions

What should happen to the culprits of scientific misconduct? What are proportionate sanctions? Increasing the social and personal costs of trespassing norms of scientific integrity is sometimes seen as an appropriate punishment that also deters malpractice (Cotter & Shattil 2006; Horner & Minifie 2011). For instance, some authors propose using strict or permanent punitive measures (Gotterbarn et al. 2006; Wong & Hui 2015), enforcing zero-tolerance standards (Goldberg 2006), or even criminalizing scientific misconduct (Pickett & Roche 2018). However, others believe that shaming culprits has not been effective and is not likely to improve research behavior (Hatcher 2011; Saurin 2016). While some studies highlight the complexities of making sanctions proportional to the severity of violations (Price et al. 2001),



others simply go ahead and rank different forms of misbehavior and their appropriate sanctions (Marcovitch et al. 2010; Levin 2011; Foo & Wilson 2012).

## **Discussion**

### *The role of codes of conduct and guidelines*

The debate demonstrates disagreement when it comes to reliance on codes of conduct. Some authors (Gandy, 2007; Freedman 2008; Cohen et al. 2012; Shewan & Coats, 2012; Dhammi & Ul Haq 2017) focus on various forms of misconduct (e.g. guest/ghost authorship) and fraud (e.g. data fabrication), which are clearly banned in codes of conduct. Accordingly, ethical authorship is understood as steadfastly following the prescriptions of codes of conduct. Often followed by references to various codes and guidelines, researchers are reminded of the fact that when it comes to authorship of scientific results, certain norms should be taken into account and as long as these are being upheld, ethical problems will be prevented. The proponents of this view seem to assume that prescriptions are sufficiently relevant to practice and clear enough to serve their purpose. Under this assumption, scientific authors have the necessary instructions to make ethical decisions regarding the authorship of research results, and the transgressors are guilty of not having followed the available prescriptions (Hodge et al. 2012).

In contrast to the above understanding, the ethical issues related to authorship are sometimes interpreted as complicated matters in grey areas that cannot be fully captured by codes of conduct (Bulger 2004; Svensson & Andersson 2013). Hence, researchers cannot make correct judgments about them by simply relying only on codes or guidelines (Tabbara & Al-Kawi 2006). In this interpretation, researchers would have to rely on resources other than codes of conduct (e.g. intuition, experienced colleagues, role models, etc.) to find out what is the right

thing to do. Issues such as authorship order or what counts as a significant (intellectual) contribution to a paper cannot be readily clarified using codes of conduct.

The first approach seems to expect codes of conduct to provide “the decision support mechanism necessary to address ambiguous and complex ethical dilemmas” and enable ethical decision making (Hatcher 2011, 145). Accordingly, certain features are required for codes of conduct to facilitate the making of (ethical) decisions. These features include ease of adherence to their prescriptions (Alshogran & Al-Delaimy 2018), ease of understanding the provided prescriptions (Nambiar et al. 2014), sensitivity to structural issues (Jabbehdari & Walsh 2017), objectiveness (Pellizzon et al. 2007), and explicitness (Lissoni & Montobbio 2015). This approach can be regarded as based on a deontological conception of ethics where norms should be obeyed, and non-compliance amounts to immorality.

The second approach seems to favor the view that codes of conduct provide no specific guidance on how we should act in every single situation because there are myriads of unique situations that cannot be covered by codes (Welfare & Sackett 2011). In other words, there are no universal action-guiding principles that are applicable to all different scenarios and disciplines. Proponents of this approach claim that codes of conduct should identify values and beliefs, discuss concepts (Matheson 2016), and promote moral and social values (Stichler 2014). This view of the role of codes of conduct seems more in line with a virtue-centered approach to ethics and views codes of conduct as aspirational documents.

*What can be achieved with codes of conduct and guidelines?*

The aforementioned difference in the envisaged role of codes of conduct is also mirrored in discussions regarding what can be achieved with them. The first group of studies regards the lack of adherence to guidelines as a major contributing factor to ethical problems in relation

to authorship. Whether through current guidelines or improved ones, having a set of principles and heavily promoting them seem necessary (and sometimes sufficient) for preventing these ethical problems (Wester 2011; Hernandez-Ruiz 2016; Kassis 2017; Ludvigsson et al. 2018; McCuen 2018). The idea of using guidelines as the ultimate solution for tackling ethical issues and violations also suggests that for these authors, creating the perfect guideline does not seem to be an unreasonable idea. In terms of ethical theories, this view is consistent with a deontological approach.

The second group of authors consists of those who believe that relying on codes and guidelines has not been successful and therefore, other alternatives such as putting more stress on self-regulation (Hatcher 2011; Barrios et al. 2017), and the promotion of virtues and role models should be taken more seriously (Pitak-Arnop et al. 2011). While not denying the importance of codes of conduct, these authors propose using other methods that would help to internalize good practice (Tobin 2000; Levin 2011; Penders 2017). Examples are fostering discussions and negotiations (Galdas 2016; Sarna & Wojcicki et al. 2017), creating awareness via training and modern educational techniques (Buckwalter et al. 2015; Payne & Ireland 2015; Rosenkrantz & Ginocchio 2016; Rost & Ehrmann 2017), as well as using role-models to motivate reflection and adjustment (Agoramoorthy 2014; Rohwer et al. 2017; Eisenberg et al. 2018). This focus on internalizing good practice is in accordance with virtue ethics.

#### *Codes of conduct and guidelines in international collaborations*

Things become more complicated in the context of co-authorship within international collaborations where authors may use/know dissimilar codes of conduct. For instance, some studies highlight the absence of a global understanding of issues such as authorship criteria (Cronin 2001; Moffatt 2018), the order of authors (Jian & Xiaoli 2013), or conflicts of

interest in the context of international multidisciplinary projects (Rohwer et al. 2017). However, since most of these studies also confirm the presence of different norms and practices across disciplines or local protocols, it is not clear whether creating a global code of conduct would be possible, or, helpful at all. Even if creating a global code of conduct that equally applies to all partners in international collaborations would be possible, adherence to such a code would be a much more complicated matter. Where international standards currently do exist, they are not uniformly endorsed or equally enforced by all partners in international collaborations. For example, in cases where discrepancies between journal guidelines and national society ethics codes (Elliott et al. 2017; Logan et al. 2017), or, institutional guidelines and international standards do exist (Colledge et al. 2013) selecting one guideline over another may become a matter of personal preference.

*Different understandings of culture and its role in shaping individual conduct*

Although culture is often seen as an important factor in shaping individuals' behavior, within the explored sample, the term 'culture' is sometimes under-defined and used without appreciating its complexities. This can lead to ambiguities about 1) the extent to which researchers can alter their behavior, 2) the extent of researchers' autonomy, and 3) the responsibilities of individual researchers when it comes to upholding ethical norms. By making a distinction between different interpretation of culture and their moral implications, this research suggests that a more attentive use of the word 'culture' in debates on ethical issues related to scientific authorship is warranted.

1) In relation to whether researchers' behavior is changeable, culture is sometimes used to highlight differences in the norms and values of researchers from different countries.

Accordingly, culture brings with it a set of norms and values that are automatically instilled

into individuals brought up in that culture. Thus, individuals' understanding of norms of authorship is formed by, for instance, "Confucian-influenced cultures" (Cameron et al. 2012, 52), "local culture" (Cronin 2001, 567), or "national culture" (Tucker et al. 2011, 2). An important implication of this understanding of culture is that the moral reasoning and behavior of researchers within a certain culture are controlled and regulated – to a certain extent – by the moral fabric of that culture. These interpretations of culture seem to suggest that the behavior of researchers from certain cultures might be difficult to change simply because of their cultural imprint.

2) In addition to geographic descriptions of culture, there are notions of culture that are primarily associated with certain institutions or academic disciplines. In this understanding, culture seems to be something that individuals acquire during their professional lives and eventually absorb it. Examples of this notion of culture are "general scientific culture" (Holm & Hofmann 2018, 1), "institutional culture" (Rohwer et al. 2017, 1), "disciplinary culture" (Smith & Master 2017, 4). In this understanding of culture, researchers largely agree with the accepted norms and values of their working environment. Along with this understanding, researchers are seen as having limited autonomy because by default they simply tend to comply with available disciplinary and institutional norms.

3) Finally, culture is sometimes used in ways that suggest researchers have no other option than to condone malpractice. For instance, in discussions about the attribution of authorship credit, culture refers to unwritten rules of authorship attribution, which seem to be globally prevalent. These unwritten rules are seen as side-effects of modern science, which thwart ethical behavior but nevertheless, researchers play along with them (Barrios 2017). For example, according to Noyori and Richmond the "winner-take-all culture of science", which refers to judging researchers purely based on the "production of successful results", may

create an incentive to cheat (2013, 5). A “culture in which the first author feels the need to pay back, or flatter” hints at the prevalence of undeserved authorship and promotion of contributors from the acknowledgment section to the authors list merely due to their positions (Zietman 2017, 276). A “culture of misattribution” is used to highlight the tolerating of credit misattribution, especially in collaborations between academia and industry, and ghost-authorship practices (Matheson 2016, 32). According to the mentioned understandings of culture, even the most ethical researcher might eventually feel inclined to subscribe to lower standards in order to progress in academia. The view that researchers turn a blind eye on malpractices (whether individually or collectively as a group) seems to imply that accumulation of authorship credit to build or maintain a successful career takes precedence over responsibilities as a good researcher in academia.

*Unethical behavior: external contributing factors and personal motivations*

Often, unethical behavior is connected with situational factors imposed by external circumstances, whereas motivations are seen as individual factors that serve researchers' personal interests. For instance, among the most discussed contributing factors to unethical behavior are the disconnect between codes and practice (Logan et al. 2017; McNutt et al. 2018), competition in academia, and the pressure to publish (Tijdink et al. 2014, 2016; Vinkers et al. 2015; Flatt et al. 2017). Also, the importance of authorship order for evaluation and promotion, and the focus on impact rather than quality (Shapiro et al. 1994; Avanzas et al. 2011; Noyori & Richmond 2013; Miller et al. 2017), and difficulties of dealing with

smaller contributions and longer bylines are regarded as factors contributing to various kinds of unethical behavior (Hammer & Miaskowski 2017; Mongeon et al. 2017).<sup>9</sup>

In contrast, motivations are mainly described as personal or career-related aspirations. Examples are the desire for visibility and professional development (Jeffery 2014; Stichler 2014), eagerness to gain power (Charlton 2008; Levin 2011), and strategic plans for improving impact and citation (Chattopadhyay 2014; Flatt et al. 2017). Furthermore, temptations to take shortcuts (Buckwalter et al. 2015; Reid & Cress 2016), and aspirations to increase the chances of publications, are regarded as motivations for meddling with research results and authorship lists (Mack 2018).

In the absence of comprehensive research on the relative weight of contributing factors and motivations for unethical behavior, it is not clear addressing which issue should be prioritized. Furthermore, personal motivations and external factors seem to be entangled to such an extent that they cannot be explored independently from each other. For example, while mentioned personal motivations such as eagerness to succeed, thirst for more publications and power can be seen as signs of egotism; they can also be seen as efforts to survive in a competitive environment and being under pressure to publish, both of which are seen as external factors.

*Future research, from author to contributor*

Within the body of analyzed studies, there is a strong focus on exploring the difficulties of using the definition of authorship as the sole indicator of contributions. Issues pertinent to

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<sup>9</sup> As one of the anonymous peer-reviewers highlighted, although it is common to think that a focus on quantity might negatively affect quality, taking a more nuanced view should be encouraged. For instance, it is argued that some prolific senior authors also end up producing the most note-worthy publications (Larivière & Costas 2016). Off course, noteworthiness and high impact are not synonymous with high quality, the point is that there obviously are prolific authors who produce high quality and/or high impact research.

using the definition of authorship such as notions of substantial contribution, intellectual contribution and authorship order are discussed at great length. Given the importance of authorship credit for tenure and promotion (Larivière & Gingras 2010; Shapiro 1994) this focus seems reasonable. However, reports about lack of adequate attribution of credit in one context, does not imply that it happens in all publications all the time.<sup>10</sup>

Attitudes towards authorship change regularly and some of these are reflected in modern solutions that are believed to improve the attribution of credit and responsibilities. The development of contributor role taxonomies and ontologies (e.g. CRediT and OpenVIVO's Contributor Role Ontology) is an evidence for the regular change of attitude towards authorship. In fact, within the reviewed items five studies mention the CRediT taxonomy and highlight advantages of its application for the attribution of credit and responsibilities (Galdas 2016; Smith & Master 2017; Kumar 2018; McNutt et al. 2018; Uijtdehaage et al. 2018).

It is safe to assume that using these new solutions for describing contributions could contribute to ethical problems of a different kind than those that arise from using definitions of authorship. It is pivotal, therefore, that these new solutions receive more consideration and are explored more critically in the discussions about ethical issues related to scientific authorship. For instance, highlighting their strengths and weaknesses in terms of capturing complexities of collaboration in different disciplines would help journal editors and research administrators to choose the most suitable model for their respective contexts.

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<sup>10</sup> We thank the anonymous reviewer for their suggestion to add more nuance here and providing some references that show a change of attitude towards crediting citizen scientists (see Resnik et al. (2015) and Ward-Fear et al. (2020)).



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