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How do authors perceive the way their work is cited? Findings from a large-scale survey on quotation accuracy

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Abstract

It has long been recognized that there are issues with the appropriateness of citations in the academic literature. Citations of sources that do not support the statement they are cited against are known as quotation errors, and there have been many previous studies of their prevalence. The vast majority of these studies rely on researchers evaluating the accuracy of citations in a small sample of the literature, and show large variation in quotation error rates. In this article we report a novel approach to assessing quotation accuracy via an online survey in which 2648 corresponding authors of articles evaluated a real-world citation of their work. Respondents were also asked to categorize the perceived purpose of the citation, and what action, if any, they take when encountering inaccurate citations of their work. We found a quotation error rate of 16.6%, with no significant difference across academic disciplines, suggesting that variation in previous studies may be a result of methodological differences. Only 11.3% of respondents indicated they had taken action after encountering an inaccurate citation of their work. This work reveals reasons contributing to inaccurate quotations and issues with citation practices, and offers suggestions of areas for future research.

1 | INTRODUCTION

In many ways, citations are the bedrock of scholarship. As Blaise Cronin, erstwhile editor of this journal, rather poetically put it, citations are "frozen footprints in the landscape of scholarly achievement...which bear witness to the passage of ideas" (Cronin, 1981, p. 16). The referencing and citation conventions that have evolved to become accepted practice within scholarly publishing fulfill a number of essential purposes. Perhaps most importantly, the inclusion of a citation often serves to validate the statement to which it is applied, providing evidence of its legitimacy. Citations also properly attribute the work and ideas of earlier authors, and situate research in its broader scholarly context. Of course, citations do not necessarily imply endorsement in the sense of agreement with the cited work, but do indicate that the cited work merits attention, either in a positive or negative way.

Given the editorial processes associated with scholarly publishing, which typically include the expert review of submissions as well as oversight from academic editors, it might be natural to assume that the citations we encounter in published research are accurate; that the cited publication exists, and supports the statement against which it has been referenced. Many of us, however, might have had experiences which challenge that assumption. We may have found, while reading a paper, a citation of our own work that has been used to support a statement, or argument, or finding, that we do not believe to be present in that cited work, or that

misrepresents our research in some other way. Or we may have been alerted to a recent citation of our work (perhaps through services such as Web of Science, Google Scholar, or ResearchGate), and out of curiosity clicked through a link to view the citing paper, and found those same issues. These experiences were the catalyst for the research reported here.

Unsurprisingly there is prior research on this topic, through which some key descriptive terminology has emerged. The presence of a citation which does not support the statement to which it is applied is known as a *quotation error* (Bagga et al., 2021). This term is used to apply to all such citations, not just those which directly quote other work. A *quotation error* is generally understood to be distinct from a *citation error*, the latter typically being used to describe instances where the in-text citation itself, or the formal reference in the reference list, is incorrect or incomplete (Fenton et al., 2000; Mahmutoglu et al., 2025). This paper is focused on *quotation errors*, which are often argued to be a more serious issue. Smith and Cumberledge suggest that not only are quotation errors harder to discover than citation errors, but they also represent "a danger because they can result in the propagation of unverified or incorrect information" (Smith Jr & Cumberledge, 2020, p. 1). While this is naturally an issue across all disciplines, it appears to be of particular concern in the fields of health and medicine, where it has been argued that quotation errors might mislead readers (both professional and public), leading to inaccurate information becoming established fact, and thereby negatively affecting patient care (De Lacey et al., 1985; Porrino Jr. et al., 2008; Rivkin, 2020). It has also been noted that quotation errors may affect citation metrics, which now constitute important measures of academic impact (Jergas & Baethge, 2015), although it should be noted that this argument can also apply to citation errors.

The literature, reviewed below, supports our own experience: quotation errors are not a rare phenomenon. While the findings of the many studies that have attempted to calculate quotation error rates vary significantly (a consequence of disciplinary, methodological and terminological differences), figures range from 5% to as many as 40%, with most studies reporting results in the 10%–20% range. If a typical social science article has, on average, 34 references (Sánchez-Gil et al., 2018), the implication is that 3–6 of the citations in the paper will be erroneous in some way.

In this paper we report the findings from a large-scale survey of corresponding authors of scholarly journal articles, across all academic disciplines, in which participants were presented with an actual citation of their work, in context, and asked to assess its accuracy. In this respect the research differs from all recent studies we have found of quotation accuracy, which either have relied on the researchers assessing the accuracy of a sample of citations (this being the approach of the vast majority of prior studies), or, in the one case of prior work that involved authors assessing citations of their own work (Pavlovic et al., 2021), have been limited to a relatively narrow disciplinary field. Participants were also asked to report how often they take action after encountering an inappropriate citation of their work, and what form this action takes, questions that have not been meaningfully addressed in the prior literature. This work therefore serves an important role in potentially validating prior work on the topic, and, in its cross-disciplinary scope, establishing the extent to which quotation errors can be considered a general rather than discipline-specific issue. Combined with new insights into the behavior of authors who encounter inaccurate citations of their research, improved understanding of these issues has the potential to direct future practical work on quotation accuracy.

2 | LITERATURE REVIEW

The bulk of the literature relating to quotation accuracy takes the form of researchers assessing the accuracy of a sample of citations, often focusing on a specific discipline or subdiscipline. There is a long history of such studies, and since 2010 there have been examples covering fields as diverse as educational research (Lazonder & Janssen, 2022), foot and ankle surgery (Luo et al., 2013), history (Cumberledge et al., 2023), psychiatry (Baethge, 2020), orthopedic and sports medicine (Gazendam et al., 2021; Homeier et al., 2024), neurosurgery (Montenegro et al., 2021), library and information studies (Genzinger & Wills, 2017), general science (Smith Jr & Cumberledge, 2020), and acupuncture (Morán et al., 2021). Often the sample of citations for these studies come from a select number of journals, although in some cases the researchers focus instead on highly cited papers. The quotation error rates reported vary quite widely, ranging from 6.6% (Homeier et al., 2024) to 40% (Baethge, 2020), with most in the 15%–20% range. The studies also vary in terms of sample size. While two report evaluation of 400–500 citations (Armstrong et al., 2018; Lazonder & Janssen, 2022), and the largest sample sizes were 804 (Yeung, 2023) and 1082 (Homeier et al., 2024), the majority (19 out of 23 studies) base findings on analysis of fewer than 400 citations. Clearly methodologies that involve researchers themselves evaluating citations face feasibility issues that limit sample size.

While a range of disciplines are covered in these studies, a majority (17 of 23 studies in our review) relate to medical fields, and as a result, two recent meta-analyses have been published. Jergas and Baethge (2015)

evaluated and synthesized 28 earlier studies of quotation and reference errors in medical journals, finding a startling total quotation error rate of 25.4%. Mogull (2017) conducted a meta-analysis of 15 studies of quotation errors in medical research articles, finding a quotation error rate of 14.5%. Mogull also highlights an important distinction in the way error rates are calculated, noting that some studies present a figure based on the number of articles found to have at least one citation error, which naturally tends to produce a higher figure.

A further subset of the literature reports on research that assesses quotation errors relating to a single article or other document. Glenton and Carlsen (2019) evaluated a specific type of misquotation of an earlier paper they had published; the "misrepresentation of descriptive information as normative." They found 50.7% of the 205 citing articles included this error. Other authors have focused on a single article or publication by other authors, including Martella et al. (2021), who found a quotation error rate of 26% related to an influential active learning paper, and Yeung (2023), who calculated an error rate of 7.8% for quotations of an important neuroimaging meta-analysis guideline. Studies by Curlewis et al. (2023) and Bagga et al. (2021) found error rates of 13% and 19%, respectively, in their studies of quotation accuracy of different articles relating to bone fractures, while Lock and Bearman (2018) found an error rate of 13% when analyzing citation of an earlier book on the Challenger launch decision. The highest error rate found in any study is found in Stang et al.'s study of quotation errors relating to published commentary on the Newcastle-Ottawa scale—a scale used "to judge the quality of observational studies in systematic reviews" (Stang et al., 2018, p. 1025). They found that 98% of indirect quotations of the commentary presented it "as supporting use of the NOS in systematic reviews when, in fact, the opposite was the case." The authors conclude that "the vast majority of systematic review authors who cited this commentary did not read it."

Several papers have discussed a particular form of quotation error, namely the phenomenon of the *empty citation*. Also referred to as "lazy author syndrome" (Gavras, 2002), empty citations are citations of secondary sources (Todd et al., 2010), that is, instances where the article being cited does not support the statement through its own findings, but via citations to other work (McIntyre & Haussmann, 2021). Several studies have categorized empty citations in their analysis of quotation error. In the field of marine ecology, Todd et al. (2010) found that 7.6% of quotations they reviewed were empty, representing more than half of the total quotation error rate (13.6%). Haussmann et al. (2013) found 4.2% of citations to be empty against a total error rate of 10.2%. Analyzing quotation errors in ecology journals, Drake et al. (2013) found an empty citation rate of 8.8%. In the area of polar research it was determined that 9.2% of citations from a sample of articles published in 2018/9 could be classified as empty, and, significantly, that this compared to a rate of 2.6% for article published between 1980 and 2019, suggesting this type of error is increasingly prevalent (McIntyre & Haussmann, 2021). While undoubtedly bad academic practice, it might be argued that empty citations generally represent a less egregious and consequential form of quotation error when compared to the quotation of articles which fail completely to support a statement, or even worse contradict it. The suggestion that the rate of empty citations may have risen in recent years is perhaps linked to ever increasing output demands placed on academics, and in many cases might represent carelessness rather than malice.

One additional quotation error study merits particular attention. A large team of researchers investigated quotation accuracy in the biomedical literature by evaluating a total 7438 citations in 4535 articles which cited one of 27 highly cited articles published by members of the team (Pavlovic et al., 2021). First authors of the cited articles were consulted if an initial review by three members of the team found potential quotation errors. It is, therefore, the only example we have found of research in which evaluations of quotation accuracy involved the authors of the papers themselves. Across both feasibility and verification phases of the study they found a total quotation error rate of 9.2%.

It is notable that many of the studies cited above attempt to determine *degrees* of quotation accuracy and/or *type* of quotation error. For degree of accuracy, the most common approach is to distinguish between major and minor errors (e.g., Bagga et al., 2021; Curlewis et al., 2023; Hui et al., 2020; Lee, 2022; Montenegro et al., 2021). Other papers were found to use an approach that classified citations as either fully, partially, or unsubstantiated (e.g., Gazendam et al., 2021; Smith Jr & Cumberledge, 2020). In some papers, type of quotation error was linked to degree of error. For example, Luo et al. (2013) classify a quotation which contradicted, failed to substantiate, or was irrelevant as a major error, with minor errors relating to misquoting numbers, indirect referencing, oversimplification, and the conclusion not being reached by the cited article. Pavlovic et al. (2021) use a more complex classification scheme, including:

- Citation of nonexistent findings
- Incorrect interpretation of findings
- Incorrectly cited method
- Incorrectly cited numerical data/results

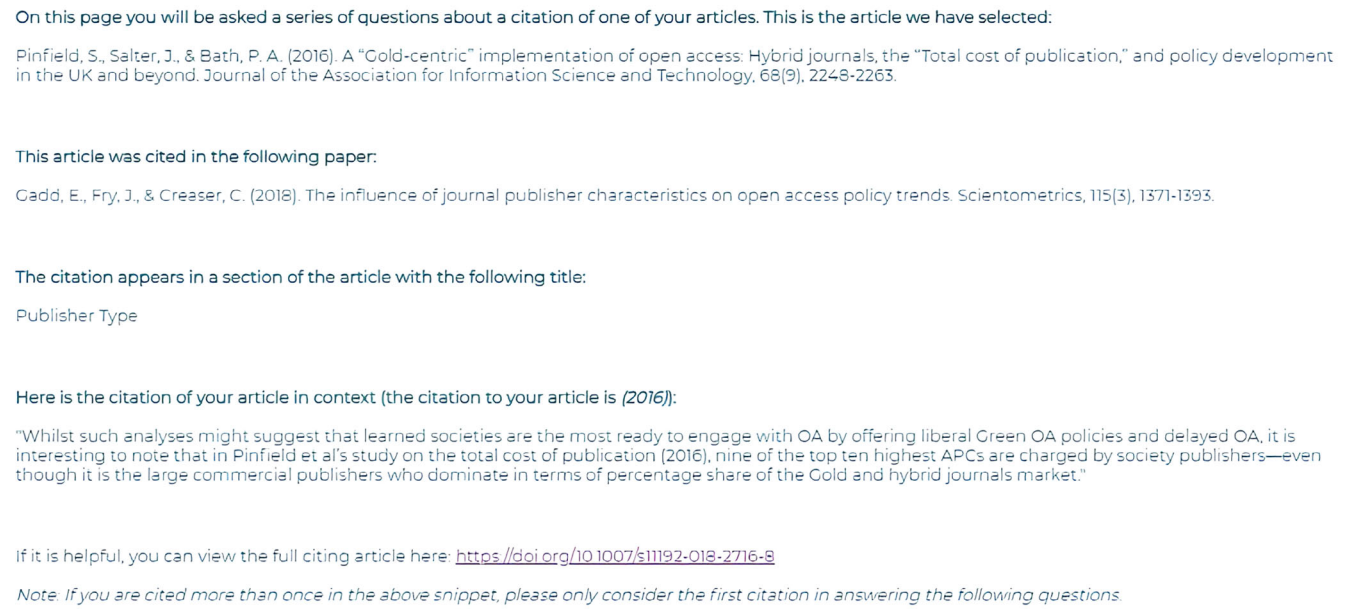

FIGURE 1 Representative example of the citation information presented to survey participants. Note that this was personalized for each respondent.

- Citation of nonexistent numerical data/results
- Wrong context
- Cited findings from another source

A small number of studies use other dimensions for analysis. Baethge (2020) classifies quotations according to the degree of importance in the citing paper (low/medium/high), while Lazonder and Janssen (2022) note the specificity of the citation (direct quotation/paraphrase/summary/broad statement). One notable gap in the literature is any prior work related to what action, if any, authors take on encountering inaccurate citations of their work. While a number of studies of quotation accuracy refer in passing to mechanisms for correcting academic articles (such as contacting authors, editors, or publishers), we have been unable to find any empirical research on the extent to which the scholarly community is proactive in identifying and correcting quotation errors post publication.

3 | METHOD

The goal of our study was to conduct a large-scale survey of authors to determine how they perceived citations of their work. This enabled us not only to calculate quotation error rates across a range of disciplines, but also to explore perspectives on citation practices more generally. The main part of the questionnaire involved the presentation to the respondent of an actual citation of an article for which they were corresponding author. Figure 1 shows an example of this information as presented to survey participants, using the dummy example of a citation form one of the authors of this paper.

Constructing this data collection instrument involved four steps.

3.1 | Extracting citations in context

A member of the research team wrote scripts to automatically scrape journal articles from five major publishers: BioMed Central (BMC), Frontiers, Hindawi, PLOS, and Springer Open. Only open access publishers were considered, to ensure the script could access the full text of articles. The script scraped articles published in between 2018 and 2020. For each article, the script also extracted all citations to articles published since 2017. For each citation, we extracted the paragraph containing the citation, the section title, and information about the cited articles. Table 1 shows the number of journals and articles scraped for each publisher, and the number of citations extracted.

The following data was captured for each citation:

- Citing article full reference
- Citing article DOI
- Cited article full reference
- Cited article DOI
- Section where the citation was located (e.g., "Method" + "2.1")
- Paragraph of text containing the citation
- Text identifying the citation (e.g., Smith & Jones, 2020 or "[16]")

TABLE 1 Number of journals, articles, paragraphs, and citations scraped from publisher websites.

Publisher	Number of journals	Number of articles	Number of paragraphs	Number of citations
BMC	320	110,160	1,155,584	439,257
Frontiers	46	15,475	206,661	117,135
Hindawi	124	1952	8079	4874
PLOS	6	121,201	422,608	153,834
Springer Open	174	14,822	123,574	50,280
Total	670	263,610	1,916,506	765,380

3.2 | Data filtering

The resulting data set of 765,380 citations was then further refined. Matches between authors of the citing paper and authors of the cited paper were identified and excluded from the sample to remove potential self-citations, and records where the captured paragraph was >2000 characters or <40 characters were excluded (in the first case due to a limitation of the survey tool used, in the second case because the paragraph potentially provided insufficient context for the citation). From the remaining data, one citation was randomly selected from each section of the scraped article. This left 208,040 citations in the data set.

3.3 | Identifying cited author email addresses

Using the DOI of the citation article, a script was used to scrape the online article content to collect the corresponding author's email address(es). Where this information is unavailable, the *Scopus* database was used to identify corresponding email addresses. The Scopus advanced search at the time of the research allowed batch searching by DOI, returning bibliographic data including corresponding author email addresses where available. Not all cited articles in the scraped and filtered dataset were in Scopus, and of those that were, not all had corresponding author email addresses. In some cases, email addresses appeared more than once, and in those cases, the most recent cited article was retained. The final dataset consisted of 127,928 records.

3.4 | Developing the online questionnaire

The online survey tool SoGoSurvey was used to develop and deliver the questionnaire. The tool allowed for extensive personalization, meaning that each recipient could be presented with the information shown in Figure 1. After this introductory section, the questionnaire asked a series of questions relating to the citation. These questions covered the following dimensions (see Appendix A for the full questionnaire):

- Reason the article is cited (categories adapted from Dong & Schäfer, 2011)
  - Background
  - Fundamental idea
  - Comparison
  - Technical basis
  - Definition
- Sentiment of the citation (categories adapted from Zhang et al., 2013)
  - Positive
  - Negative
  - Neutral
- Extent to which the cited article supports the statement in the citing article
  - Fully supports
  - Partially supports
  - Contradicts
  - Unrelated
- Element of the cited article to which the citation refers
  - Central element
  - Important but not central element
  - Background element
  - Minor element
  - Something not covered in the cited article

Respondents were also asked the extent to which they agreed with a series of statements about the citation, which covered potential issues such as oversimplification and inappropriate generalization, and captured the overall perceived appropriateness of the citation. Participants were also afforded an opportunity to make additional free-text comments about the specific citation of their work.

In addition, participants were asked a series of background questions relating to their academic discipline,

TABLE 2 Respondents by broad discipline.

Discipline	*N* (%)
Engineering, technology, and applied sciences	98 (3.7%)
Health sciences	941 (35.5%
Life sciences	1195 (45.1%)
Physical and environmental sciences	213 (8.0%)
Social sciences and humanities	156 (5.9%)
No discipline stated	45 (1.7%)
Total	2648

TABLE 3 Geographical distribution of respondents.

Country in which you currently work	*N*	%
United States	550	20.8%
United Kingdom	296	11.2%
Germany	245	9.3%
Australia	242	9.1%
Canada	132	5.0%
France	132	5.0%
Spain	83	3.1%
Italy	72	2.7%
Netherlands	70	2.6%
Switzerland	65	2.5%
China	61	2.3%
Sweden	51	1.9%
Norway	48	1.8%
Other countries (59)	412	15.6%
No response	189	7.1%

the country in which they work, and research experience. They were also asked questions about their general experiences encountering inappropriate citations of their work, and what action (if any) they take in those circumstances. A final free-text question asked for comments about general citation practices.

A total of 127,928 email invitations were sent in mid-2022. We received 2648 responses. The reason for a relatively low response rate was likely due to difficulties with the security settings of the survey, which caused the invitation emails to be either blocked or flagged as spam by recipient organizational email services. The breakdown of respondents by broad discipline is shown in Table 2.

16.3% of respondents considered themselves an Early Career Researcher (ECR), while responses to a question asking for the number of years the respondent has been publishing research revealed that participants tended to be experienced researchers, with 71.4% indicating that they had been publishing research for more than 15 years. The geographical distribution of responses is shown in Table 3, with 72 countries represented and responses from the US, UK, Germany, and Australia being most common. While it is notable that the number of responses from Chinese and Indian researchers is very low, we note that authors from these countries were likely represented proportionately in terms of the authors of citing articles.

Data analysis was conducted using SPSS and Excel. Statistical tests were used to determine the significance of differences between respondent groups where appropriate. Free text comments were thematically analyzed.

4 | FINDINGS

After being presented with the citation of their work in context, respondents were asked to indicate the reason they believed their article had been cited. A small number (1.8%) selected the "Cannot tell from the paragraph selected" option, and have been excluded from the data presented in Table 4. Just under half of respondents (47.0%) indicated that their citation was used to provide background. Citations made to support a fundamental idea (18.0%) were next most common, followed by those made on a technical basis or for comparison purposes (both 14.5%). When asked "Which of the following best describes the sentiment of the citation?," a majority of respondents (59.5%) chose "The citing article is neutral about my article," with 36.9% ($n = 960$) finding it positive. Only 28 respondents (1.1%) said the citation was negative.

TABLE 4 Which of the following categories best describes the apparent reason your article is cited in the above example?

Reason	% (*N*)
Background (the citation of your article is used to provide background to the main topic on the whole, or describe a study or approach in a general way)	47.0 (1221)
Fundamental idea (the citation of your article is used to demonstrate previous work which inspired or gave specific hints on the current work)	18.0 (469)
Technical basis (the citation of your article is used to reference important tools, methods, data and other resources used or adapted in the citing work)	14.5 (378)
Comparison (the citation of your article is used to compare methods or results with the citing work)	14.5 (378)
Definition (the citation of your article is used to support the definition of a term or concept)	3.0 (78)
None of the above	2.9 (76)

When asked about the extent to which the citation related to a central element of the cited work, 48.7% of respondents indicated that it related to a central element (Table 5). Just under a fifth of respondents (19.8%) stated that the citation related to a minor or background element of their work, while 3.4% said the citation related to something not covered in their article.

The questionnaire then asked about the extent to which the cited article supports the statement in the citing article. Overall, just under two thirds of respondents (62.4%) indicated that their article fully supports the statement, with just under one third (29.5%) indicating their article partially supports the statement. In a small number of cases (1.6%) the respondent felt that their article contradicts the citing article's statement, and a further 6.5% of respondents said their article was unrelated to the citing statement. A Kruskal–Wallis test revealed no statistically significant differences between disciplines (Figure 2).

TABLE 5 To what extent does the citation relate to a central element of your article.

Element of article	%
The citation relates to a central element of my article	48.7
The citation relates to an important but not central element of my article	28.1
The citation relates to a minor element of my article	10.3
The citation relates to a background element of my article	9.5
The citation relates to something not covered in my article	3.4

Respondents were asked the extent to which they agreed or disagreed with a series of statements relating to the citation of their work they had been presented. Table 6 shows results for the first four of these statements. A Kruskal–Wallis test revealed no statistically significant differences across disciplines. Across all participants, almost a quarter (24.2%) agreed to some degree that the citing article oversimplified their work, while 15.3% agreed that their work was inappropriately generalized. 12.7% of respondents felt that the citation was misleading for the reader, and 16.9% agreed that they were surprised to see their article cited in this way. Responses to the final statement about whether the citation is appropriate show 71.1% agreeing or strongly agreeing, while 16.6% disagree or strongly disagree. We view this question as the best comparison point for other studies of quotation error. While a variety of terms and labels have been used in prior research into quotation accuracy, it is reasonable to think that the word "appropriate" in this context means that the quotation is accurate and suitable, and therefore by extension that any citation judged by the author to not be appropriate is a quotation error. We therefore interpret this finding as indicating a 16.6% quotation error rate in our study. Table 7 shows this error rate measure by discipline. While there are some differences, a Pearson's chi square found them not to be statistically significant ($p = 0.185$).

Table 6 shows the proportion of respondents who indicated that the citing article oversimplified their work

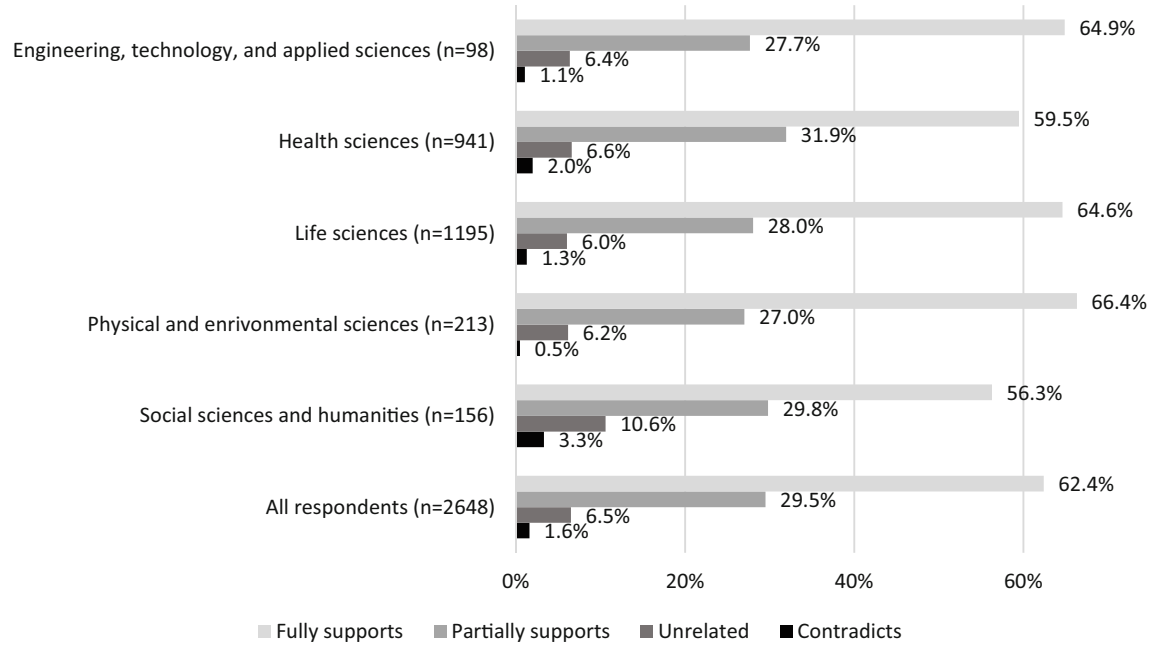

FIGURE 2 To what extent does your article support the statement which it is being cited to support?

TABLE 6 Percentage agreement/disagreement with statements relating to the presented citation.

	Strongly disagree %	Disagree %	Neutral %	Agree %	Strongly agree %
The citing article oversimplifies my article	20.2	30.2	25.5	17.7	6.4
The citing article inappropriately generalizes my article	31.2	37.2	16.3	11.1	4.2
The citation of my article is misleading for the reader	43.9	34.2	9.2	8.5	4.1
I am surprised to see my article cited in this way	35.8	33.5	13.7	11.8	5.1
I consider this an appropriate citation of my article	6.5	10.1	12.2	35.1	36.0

TABLE 7 Quotation error rate by discipline.

Discipline	Disagree %
Engineering, technology, and applied sciences	20.4
Health sciences	18.2
Life sciences	15.4
Physical and environmental sciences	13.1
Social sciences and humanities	18.6

to be higher than the proportion of respondents who were surprised at the citation, considered it misleading, and considered it inappropriate. In fact, 44.2% of respondents who believed the citation of their work to be an oversimplification were not surprised by the citation. Likewise, 50.9% of those who felt the citation to be an oversimplification did not believe it to be misleading for the reader, and 43.7% believed the citation to be appropriate despite being an oversimplification. These findings suggest that a considerable proportion of readers accept some degree of oversimplification of their work to be acceptable within scholarly norms.

Kruskal–Wallis tests revealed statistically significant differences (all at <0.005) in relation to responses to all the statements when classified by perceived reason for the citation. Oversimplifications were most prevalent in citations used for background purposes and definitions, and substantially less prevalent for citations with a technical basis (Table 8). Generalizations were also most commonly identified for background citations, while citations with a definitional purpose were more likely to be considered misleading for the reader than other types of citation. Background and definitional citations were the least likely to be considered appropriate citations of the respondent's work.

A Kruskal–Wallis test also revealed statistically significant differences ($p < 0.001$) in terms of the perceived appropriateness of the citation and the extent to which it related to a central element of the cited article. 83.2% of citations relating to a central element of the cited article were deemed appropriate, compared to 52.8% of citations relating to a minor element and 38.7% of citations relating to a background element of the cited paper.

A free-text question allowed participants to make additional comments about the citation of their work that they had been asked about. While many were evidently pleased to see their work cited appropriately ("This is a very fair citation that is relevant to the subject of the paper"; "My paper is the best example of the phenomenon these authors are exploring further. If the authors had not cited my paper, I would have been upset"), thematic analysis of responses identified a number of distinct issues with citation practices:

- **Inappropriate generalization**. Some respondents highlighted that the citing article makes an inappropriate generalization from the cited article (e.g., "The citation of our article contains accurate information describing that macrophages clear debris, but does not mention this is only in young settings").
- **Unclear what statement the citation is supporting**. In some cases, often due to the use of multiple references at the end of compound statements, respondents found it hard to determine which statement the citation of their paper was intended to support ("It is not clear what 'fact' this article is attributing to our paper").
- **Other article(s) would have been more appropriate to cite**. In these cases respondents felt that it would have been more appropriate to cite other articles, either because their article was not specifically focused on the topic (e.g., "The citation refers to a tangential aspect of this article; there are much more relevant articles") or because their article itself cited another paper to support the same point, and is therefore an empty citation (e.g., "The citation should have been to the original research article that my paper cited. It is not misleading or incorrect but it is not my study that supported the statistic").

TABLE 8 % of respondents agreeing or strongly agreeing with the statements, by reason for citation.

	Background	Fundamental idea	Technical basis	Comparison	Definition
The citing article oversimplifies my article	27.2	20.9	15	24	25.7
The citing article inappropriately generalizes my article	17.2	12.6	10.5	11.4	14.7
The citation of my article is misleading for the reader	12.8	11.8	10.5	7.8	13.0
I am surprised to see my article cited in this way	17.2	14.0	14.1	13.3	17.9
I consider this an appropriate citation of my article	68.9	77.1	75.9	74.7	67.9

- **Exaggeration of findings from cited paper**. A number of comments pointed out that the citing article had exaggerated or overstated the findings in their cited work (e.g., "The citation is accurate but goes slightly too far. We describe a strong correlation that they represent as causation"; "The authors claim that I found 'high' abundances, which might be an exaggeration").
- **Oversimplification or omission of key details**. In these cases, respondents noted that important information about their work was missing from the citing paper. Depending on the context, for some this did not constitute an inappropriate citation ("Overall, the citation is not misleading but important information about the cited study is missing"), while for others it represented a significant issue ("important information is withheld from the reader about our study, and that affects the validity of the citation").
- **Misunderstanding or misrepresentation of cited paper**. Some respondents were clear that the citing article misrepresented or misunderstood their work in a way that meant the citation was obviously inappropriate (e.g., "The citation of my article was grossly inaccurate in two places"; "It is weird that they chose to cite our work which precisely contradicts their idea").
- **Cited article is not relevant**. Some responses stated that their article was simply not relevant to the statement it was cited to support. Most attributed this to a citation error (e.g., "The citation is completely irrelevant—I can only guess it was a mistake"), although some respondents suggested it might be a case of the citing authors not reading beyond the title of the cited article (e.g., "The use of our article as a citation is based solely on the title of our paper that happens to contain the word 'transporter'"). Interestingly, several respondents alluded to something of a gray area relating to the validity of the citations of their work. While they noted that there were issues with the framing or precision of the citation, they still felt it was, overall, appropriate: "the fine details are slightly lost and may not give the reader sufficient insight. Yet, overall, it is a correct citation of my work"; "There's obviously more nuance than their statement but it's good enough."

TABLE 9 How often do you review citations of your work? This could be a result of encountering a citation of one of your articles by chance, or following up on a citation notification.

Frequency	%
More than once per week	12.0
A few times per month	27.5
A few times per year	41.1
Less than once per year	12.3
Never	7.1

4.1 | Encountering inappropriate citations

The final questions in the survey related to general practices, and first asked how often respondents reviewed citations of their work. Table 9 shows considerable variation in the responses, with 12% of respondents reviewing citations more than once per week, and 7.1% never doing so. The most common response was a few times per year (41.1%).

Participants were then asked whether they had previously encountered a citation of their work that they deemed inappropriate, and if so, what action they took. While 43.0% of respondents said they had never encountered an inappropriate citation of their work, 46.4% said they had, but had taken no action. 9.3% of respondents said they had contacted the authors of the citing article that inappropriately cited their work, while 3.1% said they had contacted the journal editor, and 0.7% the publisher (Table 10). Overall, 11.3% of respondents indicated

TABLE 10 Have you ever taken further action after encountering a citation that you feel misrepresents your work in some way? (select all that apply).

Response	%
I have never encountered an inappropriate citation of my work	43.0
I have encountered inappropriate citations of my work, but have never taken any action	46.4
I contacted the author(s) of the citing article	9.2
I contacted the editor of the journal that published the citing article	3.1
I contacted the publisher of the journal that published the citing article	0.7

that they had taken some form of further action after encountering an inappropriate citation of their work, with a Mann–Whitney U test revealing a significant difference between ECRs and more experienced researchers in this regard. Just 4.5% of ECRs said they had taken further action, compared to 12.6% of other respondents ($Z = 4.826$, $p < 0.001$).

4.2 | Final comments

The last question in the survey asked whether participants had any final comments. A total of 447 substantive free text responses were received, from which the following key themes emerged.

4.2.1 | Lack of citation

Some respondents suggested that an obvious issue they see relating to citations is for their work not to be cited when it should be: "The main problem I encountered was not to be cited at all in a relevant article." This is clearly the source of significant annoyance to many researchers, and speaks to the fundamental role citations should play in recognizing the contribution of prior work. The most egregious form of missing citation was seen to be "when an article makes claims of priority or discovery" while failing to cite work that would counter these claims—something that several respondents claimed to have experienced. It is notable that this form of quotation issue (i.e., omission of a relevant citation) negatively impacts the author not being cited, while other forms of quotation error often actually benefit the author being mis-cited, in the sense that measures of research impact are often citation-based.

4.2.2 | Causes of quotation errors

Some respondents made comments suggesting that quotation errors were symptomatic of diminishing standards of scholarship. This was often linked to the ever-increasing number of journals, and by extension articles published each year, which has led to "a decline in the quality of research that is getting published." In relation to quotation accuracy, poor scholarship was seen to manifest itself in practices like citing articles "without reading the entire article, but from an abstract or just adding a reference that another article has" or "citing based on 'keywords' and not the actual content." Many respondents were careful to moderate their criticisms of the quality of scholarship, noting, for example, that it is in large part of direct consequences of an "academic culture that prizes quantity over quality work," and that "there are a lot of incentives to cite your own work, and few rewards for citing deeply or correctly." Quotation errors were seen by some as being because of "lack of diligence," while for others "most poor citations occur in the context of a citing author who is less familiar with the topic area." Many respondents believed that "most of the time people are doing their best" rather than "intentionally misrepresenting others work." Several respondents also pointed out that a quotation error may in fact be "a reflection on the quality of the cited paper"; in other words, that a lack of clarity or poor writing in the cited article may be the cause of the misunderstanding, and hence the quotation error.

4.2.3 | Dealing with quotation errors

Some respondents stated that they did not have the time or inclination to check the accuracy with which their work is cited: "I generate a lot of papers so I really do not spend time looking at where they are being cited and whether or not those citations are appropriate. I do not see that as a useful expenditure of my time"; "there is a lot of poor practice out there, but life's too short to get that worried about it." Another point echoed a theme of the earlier free text responses, namely that there is a gray area related to citation accuracy whereby a citation may be an oversimplification, or lacking nuance, and therefore technically erroneous, but at the same time broadly appropriate within academic conventions. This sort of quotation error, therefore, was not seen as meriting with any further action. As one respondent put it: "Often citations are superficial rather than appropriate engagement with the actual scientific content of a work, but this is very far from misconduct (misrepresentation) requiring action."

A number of respondents reported that they had attempted to have an erroneous citation corrected, but without success. This appeared to apply to both editors and authors: "I have often written to journal editors asking for these errors to be corrected, but journal editors do not care one iota to correct these mistakes"; "The few times in my scientific life when I contacted the authors or the editor for a misrepresentation of my work, I received no answer and obviously noticed no action." Several respondents also noted that most academics are seeking to maximize citations of their work, and so are unlikely proactively to seek to challenge citations of their work unless they are particularly damaging in some way.

4.2.4 | Potential solutions

A number of comments included suggestions for ways that quotation errors could be reduced. One theme was the importance of properly training PhD students and ECRs in correct citation practices. As one respondent noted, "My impression is that learning to cite is one of the more difficult skills for a young researcher to master." A significant number of respondents, though, seemed to consider the responsibility for catching quotation errors to lie with peer reviewers and editors. Many commenters were unequivocal about this: "it's the job of peer reviewers and editors to identify malicious or inaccurate citations and to challenge authors"; "I strongly feel that insufficient review is done at the editorial level to ensure appropriateness and inclusion of relevant article." Others, however, noted limitations in what can reasonably be expected of peer reviewers. As the number of articles requiring review increases, so researchers are being asked to review papers where they are "only familiar with the general research area and not specific papers within it," and so "peer-review standards are becoming very low." Some commenters, however, rejected the notion that it was the responsibility of peer reviewers to police quotation accuracy: "Two or 3 peer reviewers with no compensation when reviewing a journal article cannot possibly take on the job of making sure the best and fairest composition of references are used in a manuscript they review." If peer review in its traditional form, then, is not a practical way of checking for and correcting quotation errors, the solution may lie in "some form of open and public review process." A number of respondents discussed services like PubPeer, and many supported the idea of tools and platforms that support "open, post-publication community review" being the best means of catching citation issues.

5 | DISCUSSION

Our overall implied quotation error rate of 16.6%, based on 2648 responses from authors of cited articles across a range of disciplines, is in line with the middle range of previous studies. We do, however, note that our sample excluded self-citations, in line with many other studies of quotation accuracy. Interestingly, while we found some variation in error rates between disciplines (ranging from 13.1% in Physical and environmental sciences, to 20.4% in Engineering, technology, and applied sciences), a Pearson's chi square showed the differences were not statistically significant, suggesting that disciplinary effects are small. Although there are clearly differences in some scholarly practices and conventions across disciplines, our findings indicate that citation practices may not be among them, and that the practices and processes that lead to and allow quotation errors are in place across the whole scholarly system.

Our findings also offer a potential explanation for the variation found in the error rates of previous studies. It is notable that substantial numbers of respondents indicated that the citation of their work was an oversimplification, or generalization, yet also agreed that the citation was appropriate. The suggestion here is that there is no clear consensus on what constitutes a quotation error; accuracy is in the eye of the beholder, with some authors clearly more forgiving of what others might consider inappropriately superficial or insufficiently nuanced uses of their work. Given that prior work on quotation error has typically relied on small numbers of researchers coding citations, it seems likely that the natural variation in perspective we found across our participants is mirrored in the researchers who have investigated quotation errors. Indeed, in asking authors to assess citations of their own work we are asking the people perhaps most likely both to value the contribution of the cited work, and understand its nuances, and therefore potentially be more likely to be sensitized to what they perceive as quotation errors. Overall, then, variation in error rates found in other studies may very well reflect the different standards by which those researchers are judging what constitutes an error, rather than error rates in an objective sense.

We also found that a plurality (47.0%) of the randomly selected citations in our sample were considered by authors to be used as background to the citing article's study (see Table 4), and furthermore that such citations were significantly more likely to lead to quotation errors than citations made for other reasons. This result is important, because it links closely to the comments left by respondents to free text questions, which indicated that quotation errors were most often a result of poor scholarly practices by citing authors. Many of our respondents

suggested that inappropriate citations of their work were cases when citing authors had extracted information from abstracts, or even titles, and cited without engaging in depth with the content of the cited article—examples of Gavras's "lazy author syndrome" (Gavras, 2002). Such practices would seem most likely to occur when authors are using citations in that broad background context, rather than when there is a more obvious requirement to have closely understood the article (such as when it is informing a technical aspect of the study).

Our study represents the first data we are aware of relating to author actions on encountering quotation errors. Responses to these questions, when combined with free text comments, suggest that authors for the most part see little reason to seek corrections to published articles in which their work is mis-quoted. Several commenters noted that in a system when citation metrics play an important role in research evaluation processes, there is little incentive for authors to dispute citations of their work. The extent to which the research system is self-correcting, therefore, needs to be recognized to have limitations, at least with regard to citations. It is notable here that some respondents emphasized that their principal issue with citation practices were instances where they felt their work should be cited, but was not. Our study did not explore what action (if any) authors take in these circumstances, something that future research could usefully explore.

On encountering inaccurate citations of their work, when cited authors do take action, it is most often to contact authors of the citing article, rather than editors or publishers, and it is not unreasonable to wonder what incentive those contacted authors have to engage with a process of correction, even if they agree that such action is required. Our survey comments provide anecdotal evidence that even when journal editors *are* contacted, authors rarely see corrections made. This low possibility of retrospective action only serves to highlight the importance of quotation errors being identified and corrected prior to publication. While many respondents to our survey viewed peer review as the most appropriate stage for this work, others highlighted the impracticalities of expecting reviewers to carefully check each and every citation in an article. So, although it may be of some benefit for editors to encourage their reviewers to pay closer attention to quotation accuracy, more meaningful solutions may come through a combination of better training of ECRs in good citation practices and post-publication systems that facilitate community commentary on articles. In the case of the latter, a number of existing platforms and publication models already facilitate this. PubPeer, for example, is a platform specifically supporting the anonymous discussion of scientific articles after their publication, while many publishers include a comment function alongside their online articles, albeit with only limited levels of engagement (Wakeling et al., 2020).

6 | CONCLUSION

This article has reported the findings of a large-scale multi-disciplinary survey of 2648 corresponding authors relating to their perceptions of a specific citation of their work. We found an overall quotation error rate of 16.6%. While error rates in previous studies—almost all of which rely on researchers assessing quotation accuracy of other people's articles—vary extensively, our figure is broadly in line with the median error rate. The fact that we found no statistically significant differences across disciplines suggests that the variation found in previously calculated figures is more likely a consequence of methodological and interpretive differences rather than distinct disciplinary citation practices.

Free-text responses reveal that many respondents acknowledge issues with citation practices and identify a number of ways in which quotations can be inaccurate. They also suggested that authors who take further action to correct a quotation error (by contacting the authors or journal editor) rarely achieve any meaningful outcome. While many respondents identified peer review as the stage at which quotation errors should be identified, others recognized that this may be asking too much of an already stretched system.

There are several potential areas for future research. While naturally we do not claim that our study constitutes definitive proof that there are not significant disciplinary differences in quotation error rates, we do suggest that the existing body of research on this topic is large enough to mean that future research could most usefully work towards a better understanding of why such errors occur, and how the scholarly community might improve quotation accuracy. For example, some respondents in our study who believed the citation to represent an oversimplification of their work did not consider this to be an inappropriate citation. Similarly, the free text comments revealed some variation in interpretation of what exactly constitutes a meaningful quotation error. Further work could therefore explore expectations around citation practices in this regard, with a view to guiding authors, peer reviewers, and editors. The role of peer reviewers is also potentially crucial in identifying quotation errors, and research exploring peer review practices related to validating quotation accuracy would be helpful in determining the extent to which journal editors can feasibly define expectations in this regard, as well as what might constitute reasonable expectations of reviewers, and provide support for the process if necessary.

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DATA AVAILABILITY STATEMENT

Data available on request from the authors.

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APPENDIX A: SURVEY QUESTIONS

A.1 | Introduction

On this page you will be asked a series of questions about a citation of one of your articles. This is the article we have selected: [Full reference of cited article].

Your article was cited in the following paper: [Full reference of citing article].

Here is the paragraph containing the citation of your article in that paper: [Paragraph of text including citation].

The citation to your article is indicated by the following: [In-text citation indicator].

The citation appears in a section of the article with the following title: [Title of section in citing article where citation occurs].

If it is helpful, you can view the full citing article here: [hyperlink to citing article].

A.2 | Questions

1. **Which of the following categories best describes the apparent reason your article is cited in the above example? (Select one option)**
   - Background (the citation of your article is used to provide background to the main topic on the whole, or describe a study or approach in a general way)
   - Fundamental idea (the citation of your article is used to demonstrate previous work which inspired or gave specific hints on the current work)
   - Technical basis (the citation of your article is used to reference important tools, methods, data and other resources used or adapted in the citing work)
   - Comparison (the citation of your article is used to compare methods or results with the citing work)
   - Definition (the citation of your article is used to support the definition of a term or concept)
   - Cannot tell from the paragraph provided
   - None of the above
2. **Which of the following best describes the sentiment of the citation? (Select one option)**
   - The citing article is POSITIVE about my article
   - The citing article is NEUTRAL about my article
   - The citing article is NEGATIVE about my article
   - Cannot tell from paragraph provided
3. **To what extent does your article support the statement which it is being cited to support? (Select one option)**
   - My article fully supports the statement
   - My article partially supports the statement
   - My article is unrelated to the statement

- My article contradicts the statement
- Cannot tell from paragraph provided

4. **To what extent do you agree or disagree with the following statements regarding the above citation of your article? (Answer options are "Strongly agree," "Agree," "Neutral," "Disagree," "Strongly disagree" for each statement)**
   - The citing article oversimplifies my article
   - The citing article inappropriately generalizes my article
   - The assertion in the citing article contains inaccuracies, but these do not change the underlying meaning
   - The citation of my article is misleading for the reader
5. **Consider the citation of your article in the above example. To what extent does the citation relate to a central element of your article? (Select one option)**
   - The citation relates to a central element of my article
   - The citation relates to an important but not central element of my article
   - The citation relates to a minor element of my article
   - The citation relates to a background element of my article
   - The citation relates to something not covered in my article
6. **To what extent do you agree with the following general statements about this citation of your article? (Answer options are "Strongly agree," "Agree," "Neutral," "Disagree," "Strongly disagree" for each statement)**
   - I am surprised to see my article cited in this way
   - I consider this an appropriate citation of my article
7. **Do you have any comments about this citation of your work?**

   [Free text response]

8. **Which of the following options from the drop-down list best describes the academic discipline of your article?**

   [List of 23 academic disciplines drawn from Scopus subject areas]

9. **In which country do you currently work?**

   [List of countries]

10. **Do you consider yourself an early career researcher (ECR)? (Select one option)**
    - Yes
    - No
    - Don't know
11. **For how many years have you been publishing research? (Enter number of years)**

    [Field to enter numeric value]

12. **Approximately how many research outputs (articles, books, conference papers etc.) did you publish in 2020? (Enter number)**

    [Field to enter numeric value]

13. **How often do you review citations of your work? This could be a result of encountering a citation of one of your articles by chance or following up on a citation notification (e.g., from Google Scholar ResearchGate, etc.) (Select one option)**
    - More than once per week
    - A few times per month
    - A few times per year
    - Less than once per year
    - Never
14. **Have you ever encountered a citation of your work that you feel misrepresents your work in some way? (Select one option)**
    - Yes
    - No
    - Don't know
15. **Have you ever taken further action after encountering a citation that you feel misrepresents your work in some way?**
    - No, I have never encountered an inappropriate citation of my work
    - No, I have encountered inappropriate citations of my work, but have never taken any action
    - Yes, I contacted the author(s) of the citing article
    - Yes, I contacted the editor of the journal that published the citing article
    - Yes, I contacted the publisher of the journal that published the citing article
    - Other (Please specify) _____
16. **Do you have any comments about any of the above questions or about citation practices more generally?**

    [Free text response]