

# Do biomedical researchers differ in their perceptions of plagiarism across Europe? Findings from an online survey among leading universities

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## Research Article

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# Abstract

## Background

Existing research on perceptions of plagiarism and cultural influences mainly focuses on comparisons between the Western World and the Eastern World. However, possible differences within the Western World have hardly been assessed, especially among biomedical academics. The authors compared perceptions of plagiarism among European biomedical researchers who participated in an online survey .

## Methods

The present work is based on the data collected in a previous online survey done in 2018 among biomedical researchers working in leading European and Chinese universities. Respondents based in Europe were grouped into three geographical regions (northern Europe, southern Europe and northwestern Europe) and their responses were analyzed using logistic regression analysis with adjustments for demographic factors.

## Results

Data were available from 810 respondents (265 northern Europe, 101 southern Europe, 444 northwestern Europe). In addition to their generally similar responses, different perceptions of plagiarism were observed among respondents in the three European regions. The Nordic respondents identified the most types of practices as plagiarism and were the most sensitive to **Copying text with crediting the source, without quotation marks** [aOR<sub>NIS</sub> 1.64 (95% CI 1.02;2.62), aOR<sub>NI<sub>NW</sub></sub> 1.48 (95% CI 1.08;2.02)]. Respondents in northwestern Europe were the least sensitive to **unattributed recycling of one's own dissertation/thesis**, by recycling parts of it [aOR<sub>NI<sub>NW</sub></sub> 3.12(95% CI 2.24;4.35), aOR<sub>SI<sub>NW</sub></sub> 2.22(95% CI 1.38;3.59)] or summarizing it [aOR<sub>NI<sub>NW</sub></sub> 2.48(95% CI 1.77;3.48), aOR<sub>SI<sub>NW</sub></sub> 1.99(95% CI 1.22;3.22)], but more successful than their southern counterparts in identifying **plagiarism of text**(aOR<sub>SI<sub>NW</sub></sub> 0.18, 95% CI 0.04;0.80), **plagiarism of image**(aOR<sub>SI<sub>NW</sub></sub> 0.26, 95% CI 0.10;0.67), and other practices. The southern respondents were the most sensitive to **recycling of previously rejected research proposal** [aOR<sub>NIS</sub> 0.34 (95% CI 0.16;0.68), aOR<sub>SI<sub>NW</sub></sub> 3.12 (95% CI 1.62;6.03)] and least to **plagiarism of image** [aOR<sub>NIS</sub> 3.23 (95% CI 1.22;8.60), aOR<sub>SI<sub>NW</sub></sub> 0.26 (95% CI 0.10;0.67)], **plagiarism of online source** [aOR<sub>NIS</sub> 5.21 (95% CI 1.55;17.56), aOR<sub>SI<sub>NW</sub></sub> 0.26 (95% CI 0.09;0.74)].

## Conclusions

In spite of a general similar response pattern, the present study indicates different perceptions of plagiarism among European biomedical researchers. These intra-European differences should be considered when addressing plagiarism.

## Introduction

Plagiarism is considered one of the most serious breaches of research integrity, on a par with data fabrication and falsification<sup>1-3</sup>. In contrast to data manipulation, however, the understanding of plagiarism is not always obvious, and, moreover, plagiarism is thought to be influenced by culture, education, and other factors<sup>4-6</sup>.

Plagiarism has a substantial negative impact on the scientific community<sup>7</sup>. It has been claimed that the Western world and other cultures (mostly Asia) differ in their regard of plagiarism because of “cultural” and educational differences<sup>8-11</sup>. Such culturally determined differences in perceptions of plagiarism, if any, could have a great impact, especially in view of the growth of research collaborations across cultures. However, only limited evidence from empirical research is available to support that scientific professionals from different cultures diverge in their perceptions of plagiarism<sup>9,12,13</sup>.

To provide more solid empirical data to fill this knowledge gap, we conducted, in 2018, an online survey about perceptions of plagiarism and collected responses from more than 1,000 biomedical researchers based in Europe and China. We initially focused on possible differences between European and Chinese researchers and, in an earlier publication<sup>14</sup>, we reported that both groups had a generally good understanding of obvious plagiarism with only slight differences appearing between the perceptions of European and Chinese respondents.

In discussions about cultural differences, the “Western world” is often seen as a single homogeneous entity, ignoring the existence of social and cultural disparities across Europe<sup>15-17</sup>. Yet, it is conceivable that plagiarism is perceived differently within Europe. This led us to further analyze the responses obtained in our survey to determine similarities and dissimilarities in perceptions of plagiarism within biomedical researchers working in different countries within Europe.

## Methods

The current analysis is based on a subset of replies received to an anonymous online survey in which a questionnaire was sent in 2018 to European and Chinese biomedical researchers, as described in a previous publication<sup>14</sup>. Only the replies received from biomedical researchers working in Europe were the object of the present analysis.

## Survey instrument

The survey instrument was a self-designed questionnaire (see Additional file 1) based on the TURNITIN definition of plagiarism<sup>18</sup> and our research team's previous work<sup>19,20</sup>. It was elaborated using a procedure similar to that used by Liao et al.<sup>21</sup> and finalized after a series of modifications based on feedback from experts and international researchers, as detailed in our previous paper<sup>14</sup>.

The questionnaire was administered in English and consisted of three parts, beginning with questions to obtain demographic data, such as age, gender, academic position, and overseas research experience. The following section (Section 1) enquired about respondents' general opinions on plagiarism, such as their

perceptions on what it takes to identify a plagiarism practice. The final section (Section 2) examined respondents' understanding of plagiarism, listing seven groups of practices and asking respondents to indicate which ones they thought were plagiarism.

## **Selection and invitation of respondents**

Biomedical researchers (researchers active in medicine, pharmaceutical sciences, and life sciences) from leading research universities in Europe and China responded to the initial survey: 13 universities from the League of European Research Universities<sup>22, 23</sup> and 33 universities (with biomedical schools) from China's Class A Universities of the Double First Class University (see Additional file 2)<sup>24, 25</sup>.

The first author (NY) manually retrieved the e-mail addresses from the university websites and sent invitation e-mails (see Additional file 3) to all of the target researchers via her personal KU Leuven e-mail address (except for the researchers at KU Leuven, who received the invitation from the university). E-mails were sent in groups by university, but the names of the receivers were obscured, ensuring participant anonymity. After two and four weeks, reminders were delivered (except for the researchers at KU Leuven, where one reminder was sent by the university after 2 weeks). In total, emails were dispatched to 14,757 researchers in Europe. All replies were gathered from March to July 2018.

In our survey, we asked the country in which the researcher worked. For the present analysis we defined three regions of interest based on the respondent's workplace: Nordic countries (Denmark, Finland, and Sweden), Northwestern European countries (Belgium, France, Germany, the Netherlands, Switzerland, and the UK), and Southern European countries (Italy and Spain). Only those whose country of work fell inside one of the three regions were considered for further analysis. The three regions - Nordic countries, Northwestern European countries and Southern European countries - would be abbreviated to N, NW and S, respectively.

## **Ethics approval**

The study was approved by the Social and Societal Ethics Committee of the KU Leuven (dossier G- 2017 08 885).

The action of completing the questionnaire constitutes informed consent to participate in the study.

## **Statistical methodology**

The percentage of respondents choosing an option or answering yes to a question was computed (the number of respondents choosing the option/the total number of valid responses × 100) and displayed in tables and figures. For continuous variables, means and standard deviations were calculated and displayed.

The Chi square test was used to compare responses from the three regions for binary and categorical variables [age (in 10-year categories), gender, mother tongue, current academic position, PhD degree, year of obtaining PhD degree (in 10-year categories), and international research experience]. The Mann-Whitney U test was used to compare responses from the three regions for continuous variables (age). For binary and ordinal variables, logistic regression models and proportional odds models were used to compare respondents in the three regions (by pairwise comparisons of each two regions), correcting for age differences. The adjusted odds ratios (aORs) were calculated and their 95% confidence intervals (CIs) were

reported. Some aOR values with subscripts, such as  $aOR_{N|S}$ ,  $aOR_{N|NW}$  and  $aOR_{S|NW}$  mean that the aOR value of N, N and S was calculated with the region S, NW, NW as the reference, respectively.

The null hypothesis was that the proportions of responses to the questions would not differ significantly between the three regions. When the two-tailed P value was less than 0.05, the null hypothesis was rejected.

SAS 9.4 was used to analyze the data.

This study's reporting adheres to STROBE statement<sup>26</sup>.

## Results

With a response rate of 5.6%, we received 826 valid responses from the European respondents. We included 810 responses for further analysis based on each respondent's reported working country. In the collected responses, one respondent selected two of the countries of interest, and her/his response was examined as a response for both countries. Another respondent selected one of the aforementioned countries and one non-European country, and her/his response was examined as a response for the aforementioned country of interest. Responses that did not specify a specific country of work were excluded. Table 1 provides more information.

Because invalid answers were removed, the total number of responses to several demographic questions does not sum up to 810. Only responses with fewer than two incorrect answers were considered valid and analyzed. Tables 2 provides the exact figures.

## Demographic characteristics

The demographic characteristics of the respondents are listed in Table 2. The age, mother language, and academic positions of respondents differed between regions, with differences being generally larger between southern Europe and the other two regions than between the latter two regions.

Respondents from southern Europe were over 50 years old on average (52.8 y, SD 11.1), i.e. significantly older than those from northern Europe (46.1 y, SD 12.9) and northwestern Europe (42.8 y, SD 11.4). Male respondents (55.3%) outnumbered female respondents, with no significant differences between the three regions. English was the mother tongue of a minority of respondents (15.9%) (8.7% in Northern Europe, 1.0 % in southern Europe, and 23.6% in northwestern Europe,  $P < 0.05$ ). Professors (25.1%), associate professors (19.4%), and postdoctoral researchers (24.7%) made up the majority of the respondents. In southern Europe, the proportion of senior researchers (professors 38.6%, associate professors 32.7%) was higher ( $P < 0.05$ ) than in other two regions. Four-fifths of those surveyed held a doctorate, the majority of which had been obtained since 1999 (67.6%). Around two-thirds of the respondents had more than six months of international research experience.

We conducted all logistic regression analyses correcting for age to create adjusted odds ratios (aOR) with 95% confidence intervals (CI), taking into account demographic patterns in the three regions.

# Responses

## Understanding of particular practices

In summary, the vast majority of responders (over 95% of the total) were successful in identifying the most evident types of plagiarism, including **Copying text from someone else's publication without crediting the source** (98.6%), **Copying an image from someone else's publication without crediting the source** (96.3%), **Copying text from an online source without crediting the source** (97.4%), **Putting together pieces from different publications, and presenting the result as one's own work** (95.3%), **Republishing others' work in another language without crediting the source** (98.4%). Compared to blatant plagiarism, such as copying and pasting text (without attribution), other practices appeared more dubious and were viewed as plagiarism by fewer respondents, such as **Rephrasing another person's work without crediting the source** (83.4%), **Copying text from an online source that has no list of authors, and without crediting the source** (81.5%), **Using idea(s) from someone else's publication without crediting the source** (67.4%) and **Copying text from someone else's publication with crediting the source, but without quotation marks** (51.4%) (Figure 1; Table 1, Additional File 4).

The aforementioned questions elicited similar responses from respondents in the three regions. However, in several circumstances, respondents from the three regions differed in their likelihood of not considering particular actions as plagiarism.

In general, the Nordic respondents were the most likely to perceive some actions as plagiarism. In comparison to respondents from southern Europe, more Nordic respondents viewed the following practices as plagiarism: **Copying text from someone else's publication with crediting the source, but without quotation marks** (aOR<sub>NIS</sub> 1.64, 95% CI 1.02;2.62), **Copying an image from someone else's publication without crediting the source** (aOR<sub>NIS</sub> 3.23, 95% CI 1.22;8.60), **Copying text from an online source without crediting the source** (aOR<sub>NIS</sub> 5.21, 95% CI 1.55;17.56), **Copying text from an online source that has no list of authors, and without crediting the source** (aOR<sub>NIS</sub> 2.36, 95% CI 1.35;4.12), **With permission from the original author, using another's text without crediting the source** (aOR<sub>NIS</sub> 3.27, 95% CI 2.01;5.31). In contrast to respondents from the northwest, Nordic respondents were more likely to identify the following practices as plagiarism: **Copying text from someone else's publication with crediting the source, but without quotation marks** (aOR<sub>NI<sub>NW</sub></sub> 1.48, 95% CI 1.08;2.02), **Copying text from someone else's publication with crediting the source and with quotation marks** (aOR<sub>NI<sub>NW</sub></sub> 2.11, 95% CI 1.11;4.00), **Rephrasing text from someone else's publication without significant modification of the original, but with crediting the source** (aOR<sub>NI<sub>NW</sub></sub> 1.82, 95% CI 1.23;2.70), **One has submitted work as dissertation/thesis, and submits parts of it to a journal afterwards without crediting the source** (aOR<sub>NI<sub>NW</sub></sub> 3.12, 95% CI 2.24;4.35), **One has submitted work as dissertation/thesis, and submits a summary of it to a journal afterwards without crediting the source** (aOR<sub>NI<sub>NW</sub></sub> 2.48, 95% CI 1.77;3.48). Only for one practice were Nordic respondents less likely than southern respondents to report the specific practice as plagiarism - **Reusing one's own previously rejected research proposal for another funding application without crediting the source** (aOR<sub>NIS</sub> 0.34, 95% CI 0.16;0.68); for another practice they were less likely than

northwestern respondents - **Using idea(s) from someone else's publication without crediting the source** (aOR<sub>N|NW</sub> 0.62, 95% CI 0.45;0.85) (Figure 1; Table 1, Additional File 4).

There were also differences between northwestern and southern Europe. Southern European respondents were less inclined than their northwestern European counterparts to identify certain acts as plagiarism, including **Copying text from someone else's publication without crediting the source** (aOR<sub>S|NW</sub> 0.18, 95% CI 0.04;0.80), **Copying an image from someone else's publication without crediting the source** (aOR<sub>S|NW</sub> 0.26, 95% CI 0.10;0.67), **Copying text from an online source without crediting the source** (aOR<sub>S|NW</sub> 0.26, 95% CI 0.09;0.74), **Copying text from an online source that has no list of authors, and without crediting the source** (aOR<sub>S|NW</sub> 0.55, 95% CI 0.33;0.92), **Rephrasing another person's work without crediting the source** (aOR<sub>S|NW</sub> 0.56, 95% CI 0.32;0.98), **With permission from the original author, using another's text without crediting the source** (aOR<sub>S|NW</sub> 0.25, 95% CI 0.16;0.41). Southern European respondents were, on the contrary, more sensitive to a few other behaviors than their counterparts in the northwest: **When writing a literature review, using the same framework of others' review, without crediting the source** (aOR<sub>S|NW</sub> 1.67, 95% CI 1.05;2.66), **Reusing one's own previously rejected research proposal for another funding application without crediting the source** (aOR<sub>S|NW</sub> 3.12, 95% CI 1.62;6.03), **One has submitted work as dissertation/thesis, and submits parts of it to a journal afterwards without crediting the source** (aOR<sub>S|NW</sub> 2.22, 95% CI 1.38;3.59), **One has submitted work as dissertation/thesis, and submits a summary of it to a journal afterwards without crediting the source** (aOR<sub>S|NW</sub> 1.99, 95% CI 1.22;3.22) (Figure 1; Table 1, Additional File 4).

Among the three regions, the Nordic respondents were the most sensitive to **Copying text with crediting the source, without quotation marks** [aOR<sub>N|S</sub> 1.64 (95% CI 1.02;2.62), aOR<sub>N|NW</sub> 1.48 (95% CI 1.08;2.02)]. The northwestern respondents were the least sensitive to **One has submitted work as dissertation/thesis, and submits parts of it to a journal afterwards without crediting the source** [aOR<sub>N|NW</sub> 3.12(95% CI 2.24;4.35), aOR<sub>S|NW</sub> 2.22(95% CI 1.38;3.59)], and **One has submitted work as dissertation/thesis, and submits a summary of it to a journal afterwards without crediting the source** [aOR<sub>N|NW</sub> 2.48(95% CI 1.77;3.48) , aOR<sub>S|NW</sub> 1.99(95% CI 1.22;3.22)]. The southern respondents were the most sensitive to **Reusing one's own previously rejected research proposal for another funding application without crediting the source** [aOR<sub>N|S</sub> 0.34(95% CI 0.16;0.68), aOR<sub>S|NW</sub> 3.12 (95% CI 1.62;6.03)] while the least to **Copying an image from someone else's publication without crediting the source** [aOR<sub>N|S</sub> 3.23 (95% CI 1.22;8.60),aOR<sub>S|NW</sub> 0.26 (95% CI 0.10;0.67)], **Copying text from an online source without crediting the source** [aOR<sub>N|S</sub> 5.21 (95% CI 1.55;17.56), aOR<sub>S|NW</sub> 0.26 (95% CI 0.09;0.74)], **Copying text from an online source that has no list of authors, and without crediting the source** [aOR<sub>N|S</sub> 2.36 (95% CI 1.35;4.12), aOR<sub>S|NW</sub> 0.55 (95% CI 0.33;0.92)], and **With permission from the original author, using another's text without crediting the source** [aOR<sub>N|S</sub> 3.27 (95% CI 2.01;5.31), aOR<sub>S|NW</sub> 0.25 (95% CI 0.16;0.41)] (Figure 1; Table 1, Additional File 4).

## Other perspectives on plagiarism

The survey examined more general perspectives on plagiarism in addition to understanding specific behaviors.

Some respondents believed that several variables were important in determining whether or not an act would be plagiarism. More precisely, 77.5 %, 51.4 %, and 42.6 % of respondents, respectively, regarded **the intention, the length of the copied text, the part of the copied text** to be crucial. In contrast to respondents from southern and northwestern Europe, more Nordic respondents tended to believe that the length of copied text was important [aOR<sub>NIS</sub>: 1.84 (95% CI 1.15; 2.95), aOR<sub>NINW</sub> 1.58 (95% CI 1.16; 2.16)] (Figure 2; Table 2, Additional File 4).

Overall 34% reported to have been unsure whether they had been plagiarizing, but with Nordic respondents (26.8%) being less likely than northwestern respondents (39.6%) to **doubt whether they had been plagiarizing** (aOR<sub>NINW</sub>: 0.59, 95% CI 0.42; 0.83) (Table 2, Additional File 4).

In general, the majority of respondents agreed (or strongly agreed) that plagiarism was a higher threat to biomedical research than **submitting a manuscript to more than one journal simultaneously** (70.5%) and **granting co-authorship to someone whose contribution doesn't justify it** (70.8%), but a lesser hazard than **data falsification** (82.7%) (Figure 3; Table 3, Additional File 4). When compared to data falsification, respondents in the northwest disagreed the most that plagiarism constituted a higher threat to biomedical research, while those in the south disagreed the least. When comparing plagiarism to multiple submission, respondents from the northwest disagreed more than respondents from the north that plagiarism was a higher concern.

## Discussion

The initial goal of our survey was to explore biomedical professionals' general perceptions in Europe and China, as well as the similarities and contrasts between the two regions<sup>14</sup>. Like others<sup>27-29</sup>, we focused on the similarities and differences on perceptions of plagiarism between the Western World and the Eastern World, and did not address potential disparities within Europe. However, it was also apparent that the responses from European respondents exhibited geographical heterogeneity. Fortunately, the data we gathered allowed for more in-depth research into perceptions of plagiarism across Europe. The present subsequent analysis provides additional novel empirical evidence about commonalities and disparities in the views held by biomedical researchers with regard to plagiarism.

Here, we did not repeat association analysis because it was covered in the 2020 article<sup>14</sup>. The purpose of the present analysis was to compare and contrast responses in three European regions: the Nordic countries, southern Europe, and northwestern Europe.

Not unexpectedly, the main conclusions of the subsequent analysis are very comparable to what we found in our 2020 article<sup>14</sup>. For example, in general, the perceived harm of plagiarism lies between that caused by data falsification and inappropriate authorship, multiple submission. Furthermore, the existence of intent was deemed more relevant than the part or length of the copied text in identifying a plagiarism act. A similar tendency was also observed in the present study about perceptions of specific practices: most respondents in the three European regions correctly identified the blatant plagiarism practices, but they identified the subtle ones less correctly. Nonetheless, even the most blatant forms of plagiarism, such as appropriation of

another's text or image without PROPER attribution, which are clearly classified as plagiarism in many widely accepted guidelines<sup>30-32</sup>, were not identified by all of the respondents.

Nevertheless, the proportions of respondents who did not identify some specific practices as plagiarism varied across three geographical regions within Europe. In other words, the comparison of the three regions reveals some intra-European divergent perspectives on plagiarism, despite showing broadly similar response patterns.

In summary, among the three European regions, Nordic respondents were the most inclined to recognize dubious practices as plagiarism. The southern respondents were the most sensitive to recycling of one's previously rejected research proposal but least to plagiarism of image and online source. The comparisons also revealed that northwestern respondents were more sensitive to common types of plagiarism than their southern counterparts.

Earlier studies on plagiarism and research misconduct were generally conducted by researchers from English-speaking countries<sup>7,8,33-36</sup>, and cultural factors were primarily focused on Western and Asian countries<sup>34,37</sup>. Some recent research has begun to focus on intra-European differences, and distinctions have been identified. The project IPPHEAE, whose conclusions have been documented in scientific articles and reports<sup>37-42</sup>, is one of the most significant projects.

The IPPHEAE project investigated higher education institutions (including students and staff) in 27 countries across Europe to see how they dealt with plagiarism and academic misconduct. Despite limited response rates in a few nations, the project yielded a wealth of data for cross-sectional comparison, even taking into account potential limitations in terms of representativeness.

When presenting the outcomes of the IPPHEAE project, Glendinning<sup>37</sup> noted "great variability in understanding what constitutes plagiarism and what was deemed acceptable academic practice" and pointed out that "the lack of consensus over what constitutes plagiarism is perhaps one of the major barriers to academic integrity across the EU."

Although it is a country-based research project, IPPHEAE revealed a general trend: the Nordic respondents (especially those in Finland and Sweden) were more likely to identify the two specific practices [(a) *40% word-for-word copied work with no quotations*, (d) *40% copied work, with some words changed with no quotations, references or in text citations*.] as plagiarism than their counterparts in northwestern Europe (especially those in France, Germany, and the Netherlands), while the latter were more likely than their counterparts in southern Europe (quantitative data is available from Spain and unavailable from Italy), which was generally consistent with their reported training experience<sup>40,41,43-46</sup>.

Foltýnek and Čech<sup>38</sup> observed significant disparities in attitudes toward plagiarism between western and post-communist countries based on the answers of students and teachers in six European countries: Bulgaria, Great Britain, Czech Republic, Poland, Cyprus and Lithuania (with the Czech Republic included in the group of western countries).

A few more studies, in addition to IPPHEAE, also looked into perceptions of plagiarism across Europe, with or without providing detailed data.

Kayaoğlu et al. examined students' perceptions of plagiarism in three countries: Turkey, Germany, and Georgia, and discovered that German students were more sensitive to plagiarism and better at detecting it<sup>9</sup>. The disparity, according to Kayaoğlu et al.<sup>9</sup>, is due to Turkey's "textbook-based" teaching strategy and exam-driven education system, as well as Georgia's similar cultural learning tradition with Asia.

Pupovac et al. studied four European nations and discovered that students in Bulgaria and Croatia were more tolerant of exam cheating than their counterparts in the UK<sup>47</sup>. They also believe that their findings support Magnus' conclusion<sup>48</sup> that tolerance for academic misbehavior was greater in post-communist countries. When given an example of plagiarism ("40% of student's submission copied without any quotation or reference"), respondents from the Czech Republic, the UK, Poland, and Cyprus were more successful in identifying it as plagiarism, whereas Lithuanian and Bulgarian respondents were more lenient, especially if some words were changed.

In comparison to their northwestern counterparts, the Nordic respondents had lower degree of self-doubt of their research practices. Indeed, the Nordic respondents did identify the most plagiarism practices compared to their counterparts in the other two regions. But the fact that scientists' self-confidence was not always positively associated to their knowledge was discovered in our study<sup>49</sup>. Similarly, the IPPHEAE project discovered that self-confidence was not necessarily favorably correlated with perceptions or training of plagiarism<sup>41,43,45</sup>. Yaniv et al.<sup>50</sup> reported a dissociation between confidence and accuracy, whereby people tend to have confidence in consensus, even it is less accurate. As a consequence, it is possible that the respondents who reported to be confident with their research practices had experienced more consensus, regardless of how correct it was, on plagiarism definitions and practices. Besides, education and training experiences on the topic of plagiarism might lead those scientific researchers to assume that they had already developed a good understanding of it.

## Enlightenment by cultural differences across Europe

It is a crucial step to realize the existence of intra-European differences on perceptions of plagiarism, and to understand what underlies the differences. An examination of the social-cultural similarities and differences across the three European areas (and the countries involved) could provide useful insights. Hereby we have made an initial endeavor to interpret our findings with available studies on European cultures. However, due to the limited data and different research subjects, the interpretation might not be that strong.

Waehning et al.<sup>16</sup> compared four European countries - Great Britain, Germany, France, and Spain - regarding four cultural value dimensions using data from the World Values Survey (WVS). We suggest that their two dimensions, "openness to change" and "conservation", might be related to some of the findings in our survey.

"Openness to change" is one of the cultural value dimensions, and it includes the values "stimulations" and "self-direction", as well as the tendency to "do things their own way"<sup>16</sup>. It is possible that people who score

higher on this dimension are more confident in their own actions and are less likely to doubt about plagiarism practices. Another dimension, “conservation”, involves the tendency to “behave ‘properly’”, choose to live in secure surroundings and avoid anything that might be risky or dangerous<sup>16</sup>. It is plausible that people who score higher on this dimension are more sensitive to (seemingly) inappropriate behaviors and are more prone to interpret specific ambiguous behaviors of plagiarism. For both of the two dimensions, in the Waehning et al. survey<sup>16</sup>, Great Britain had the highest mean scores, followed by Spain, France, and Germany. We believe that this ranking might also be reflective of researchers’ self-confidence in their own research practices and researchers’ judgments of dubious practices.

In our analysis, we found that Nordic respondents (in Denmark, Finland and Sweden) were more self-confident than their northwestern counterparts (in Belgium, France, Germany, the Netherlands, Switzerland and the UK), and that southern respondents (in Italy and Spain) were more sensitive to some undefined practices, such as recycling of one’s previously rejected research proposal, than their Nordic and northwestern counterparts. Unfortunately, our comparison, which is region-based, cannot allow for further verifications. It would be worth studying to see whether detailed investigations at the level of individual countries could generate consistent results.

## Comparison with China

In spite of the fact that we had already compared the European responses and Chinese responses in our original article<sup>14</sup>, it was also of interest to compare the response pattern of each European region with that found for China. However, the comparisons of responses to each question, did not lead to a clear conclusion. On the whole, China did not appear to be consistently more similar or different from one of the European regions (Additional File 5-1, 5-2, 5-3).

More specifically, when we checked the percentages of respondents selecting the specific option (without statistical analysis), discrepancy between Europe and China can sometimes be observed as in our previous work<sup>14</sup>: for example, compared to the three European regions, the Chinese respondents were more likely to indicate paid or unpaid ghostwriting (statement 20a, 20b) as plagiarism and less likely to perceive the intention as an important factor in determining a plagiarism practice (question 15c). Besides, less discrepancy between Europe and China was noticed in other cases, where the percentage of respondents identifying the practice as plagiarism in China ranked in the middle among the four regions (i.e., north Europe, southern Europe, northwestern Europe and China), such as misappropriation of images and ideas (statement 17d, 17e).

It is worth mentioning that, as in the last work, the main goal of our comparative analysis was to help understand different research behaviors, rather than making judgements of researchers’ perceptions of plagiarism.

With increasing globalization of scientific communications, as in many other areas nowadays, researchers with different cultures and backgrounds are very likely to face the same judgement criteria of research

practices. We suggest that understanding the differences is critical for understanding practical differences and addressing plagiarism more effectively.

## Limitations

We made great efforts to compare biomedical researchers in the three European regions about their perceptions of plagiarism, nevertheless, there are limitations that we should be aware of when interpreting the findings.

One of the most typical biases in surveys on sensitive topics is response bias, and the respondents of our survey were researchers from leading universities, which can lead to the outcome being an estimation of “a better condition”. As a result, we should be cautious in extrapolating the findings. Our sampling strategy leads to the results of each region being more reflective of particular countries (and no data from central and eastern European countries), which might limit the study's representativeness.

The Turnitin definition of plagiarism<sup>18</sup> and our previous work<sup>19,20</sup> were used to design and improve our survey instrument. Despite the fact that we had it improved by consulting experts and performing a trial survey, we nonetheless acknowledge that the instrument had not been formally validated.

The current study was based on replies gathered in 2018, which was more than three years ago. Given that people's perceptions regarding plagiarism may have shifted, especially in light of the increased public spotlight on research integrity and misconduct, it would be ideal if more up-to-date figures were accessible. To our knowledge, however, there are few prior studies that have sought to quantitatively analyze how biomedical scientists perceive plagiarism and compare responses across European nations, especially with such a large number of replies. As a result, we believe this research does still yield insightful and useful results.

## Conclusion

The present study has observed overall good understanding of plagiarism, particularly the evident ones, among European biomedical researchers. Although the three European areas have a comparable understanding of most practices, there are differences across them. In summary, the Nordic researchers were the most sensitive to dubious practices. The respondents in northwestern Europe were the least sensitive to unattributed recycling of one's own dissertation/thesis, but more successful than their southern counterparts in identifying evident plagiarism practices. The southern respondents were the most sensitive to recycling of one's previously rejected research proposal but least to plagiarism of image and online source. When it comes to plagiarism and research misconduct, these similarities and differences throughout Europe should be taken into account.

## Abbreviations

FFP: fabrication, falsification and plagiarism;

N: Nordic countries; NW: Northwestern European countries; S: Southern European countries

OR(s): odds ratio(s); aOR(s): adjusted odds ratio(s); CI(s): confidence interval(s); SD: standard deviation

## **Declarations**

### **Ethical approval and consent to participate**

All methods were performed in accordance with the Declaration of Helsinki.

The study was approved by the Social and Societal Ethics Committee of the KU Leuven (dossier G- 2017 08 885). The action of completing the questionnaire constitutes informed consent to participate in the study.

### **Consent for publication**

Not applicable.

### **Availability of data and materials**

The datasets used during the current study are available from the corresponding author on reasonable request.

### **Competing interests**

The authors declare no competing interests.

### **Funding**

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This funding body had no role in the design of this study, collection, analysis, interpretation of data, and in writing the manuscript.

### **Authors' contributions**

NY contributed to the conception and design of the work; and contributed significantly to the acquisition, analysis, and interpretation of data; and have drafted the work.

BN contributed significantly to the conception and design of the work; and contributed significantly to the analysis and interpretation of data; and have substantively revised the work.

KD contributed significantly to the conception and design of the work; and contributed to the analysis and interpretation of data; and have substantively revised the work.

All authors have read and approved the final manuscript; and have agreed both to be personally accountable for the author's own contributions and to ensure that questions related to the accuracy or integrity of any part

of the work, even ones in which the author was not personally involved, are appropriately investigated and resolved.

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## Tables

**Table 1** The number of responses of each country and of each region

Region	Country	The number of valid responses by country	The number of valid responses by region
<b>Nordic countries</b>	<b>Denmark</b>	2	265
	<b>Finland</b>	42	
	<b>Sweden</b>	221	
<b>Northwestern Europe</b>	<b>Belgium</b>	72	444
	<b>France</b>	16	
	<b>Germany</b>	93	
	<b>the Netherlands</b>	64	
	<b>Switzerland</b>	66	
	<b>the UK</b>	133	
<b>Southern Europe</b>	<b>Italy</b>	56	101
	<b>Spain</b>	45	
<b>Total</b>			<b>810</b>

**Table 2** Demographic characteristics of the respondents

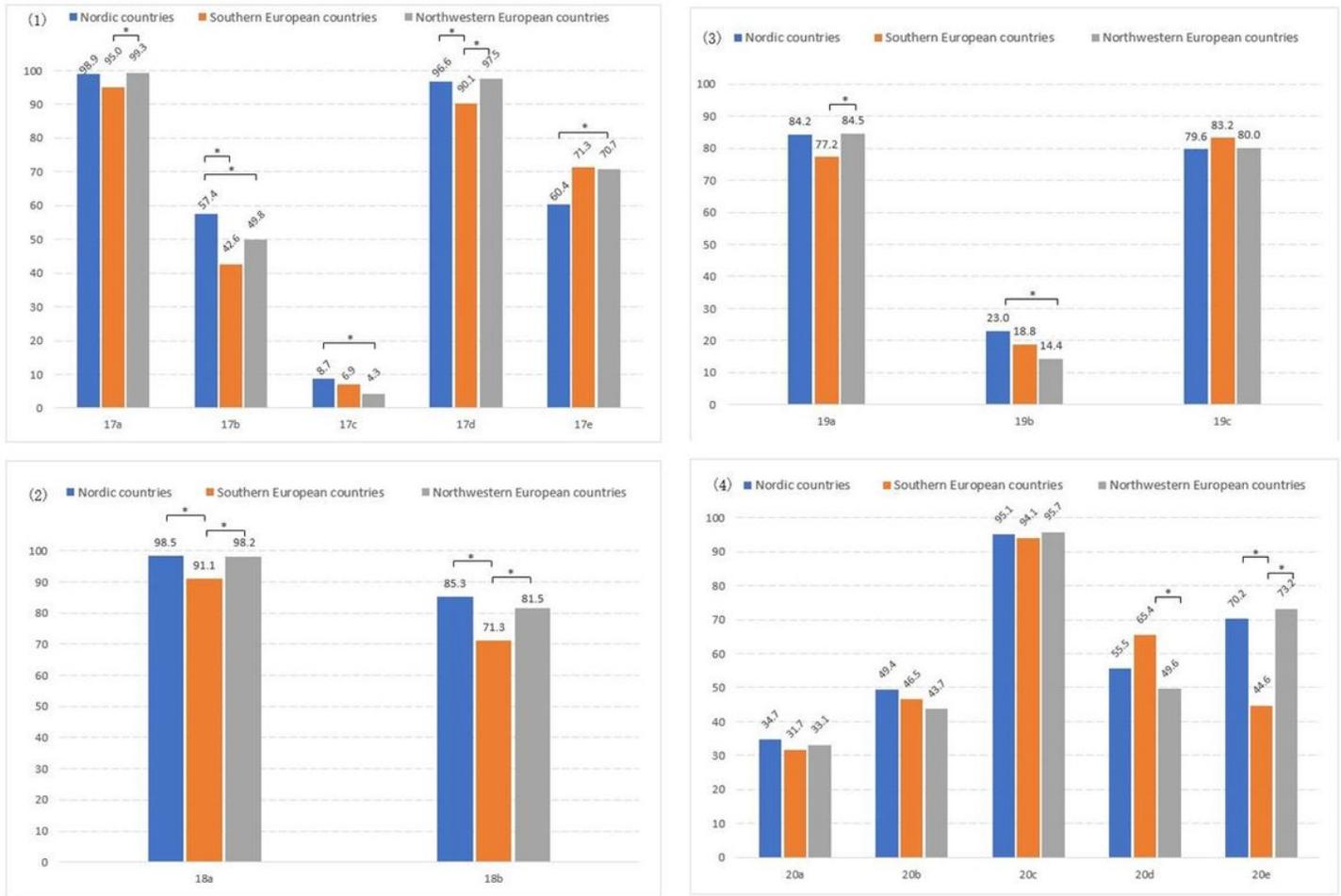
Variables	Percentage of respondents (%)				P value <sup>a</sup>		
	Total	N	S	NW	N VS. S	N VS. NW	S VS. NW
<b>Age (n=808)</b>							
<=30y	11.0	7.6	5.0	14.4	<0.001	<0.001	<0.001
31-40y	32.6	36.5	10.9	35.4			
41-50y	22.0	20.2	22.8	23.0			
51-60y	21.5	18.2	34.6	20.5			
>60y	12.7	17.5	26.7	6.8			
<b>Age (n=808)</b>	N	263	101	444	<0.001	0.002	<0.001
	Mean	46.1	52.8	42.8			
	Std	12.91	11.11	11.42			
<b>Gender (n=809)</b>							
Female	44.6	47.4	45.5	42.8			
Male	55.3	52.6	54.5	57.2			
<b>Mother tongue (n=810)</b>							
Chinese	2.7	5.3	0	1.8	0.001	<0.001	<0.001
English	15.9	8.7	1.0	23.6			
Other	81.4	86.0	99.0	74.6			
<b>Current academic position (n=810)</b>							
Professor	25.1	18.9	38.6	25.7	<0.001	0.001	<0.001
Associate professor	19.4	23.8	32.7	13.7			
Assistant professor	10.6	8.3	19.8	9.9			
Postdoc	24.7	27.6	3.0	27.9			
Other	18.4	17.7	5.9	21.6			
Not a scientific researcher	1.8	3.8	0	1.1			
<b>PhD degree (n=810)</b>							
Yes	82.7	88.3	80.2	80.0	0.005	0.016	
Current PhD candidate	8.9	6.8	5.0	11.0			
No	8.4	4.9	14.8	9.0			

<b>Year of obtaining PhD degree (n=643)</b>						
<1979	2.8	3.5	8.0	1.2	<0.001	<0.001
1979-1988	7.6	6.2	14.7	7.0		
1989-1998	21.9	18.1	38.7	20.8		
1999-2008	28.1	29.5	22.7	28.4		
2009-2018	39.5	42.7	16.0	42.5		
<b>International research experience (&gt;6 months) (n=810)</b>						
Yes	61.7	61.5	54.5	63.5		
No	38.3	38.5	45.5	36.5		

<sup>a</sup> P values based on Chi square tests of pairwise comparisons between the three regions. P values are only listed when P<0.05.

N, S and NW stand for Nordic countries (Denmark, Finland, and Sweden), Southern European countries (Italy and Spain), and Northwestern European countries (Belgium, France, Germany, the Netherlands, Switzerland, and the UK).

## Figures



**Figure 1**

Percentage of respondents who regarded the practice as plagiarism

(1) Statement 17. Appropriation of others' text, image and ideas

- a. Copying text from someone else's publication without crediting the source.
- b. Copying text from someone else's publication with crediting the source, but without quotation marks.
- c. Copying text from someone else's publication with crediting the source and with quotation marks.
- d. Copying an image from someone else's publication without crediting the source.
- e. Using idea(s) from someone else's publication without crediting the source.

(2) Statement 18. Appropriation of online sources

- a. Copying text from an online source without crediting the source.
- b. Copying text from an online source that has no list of authors, and without crediting the source.

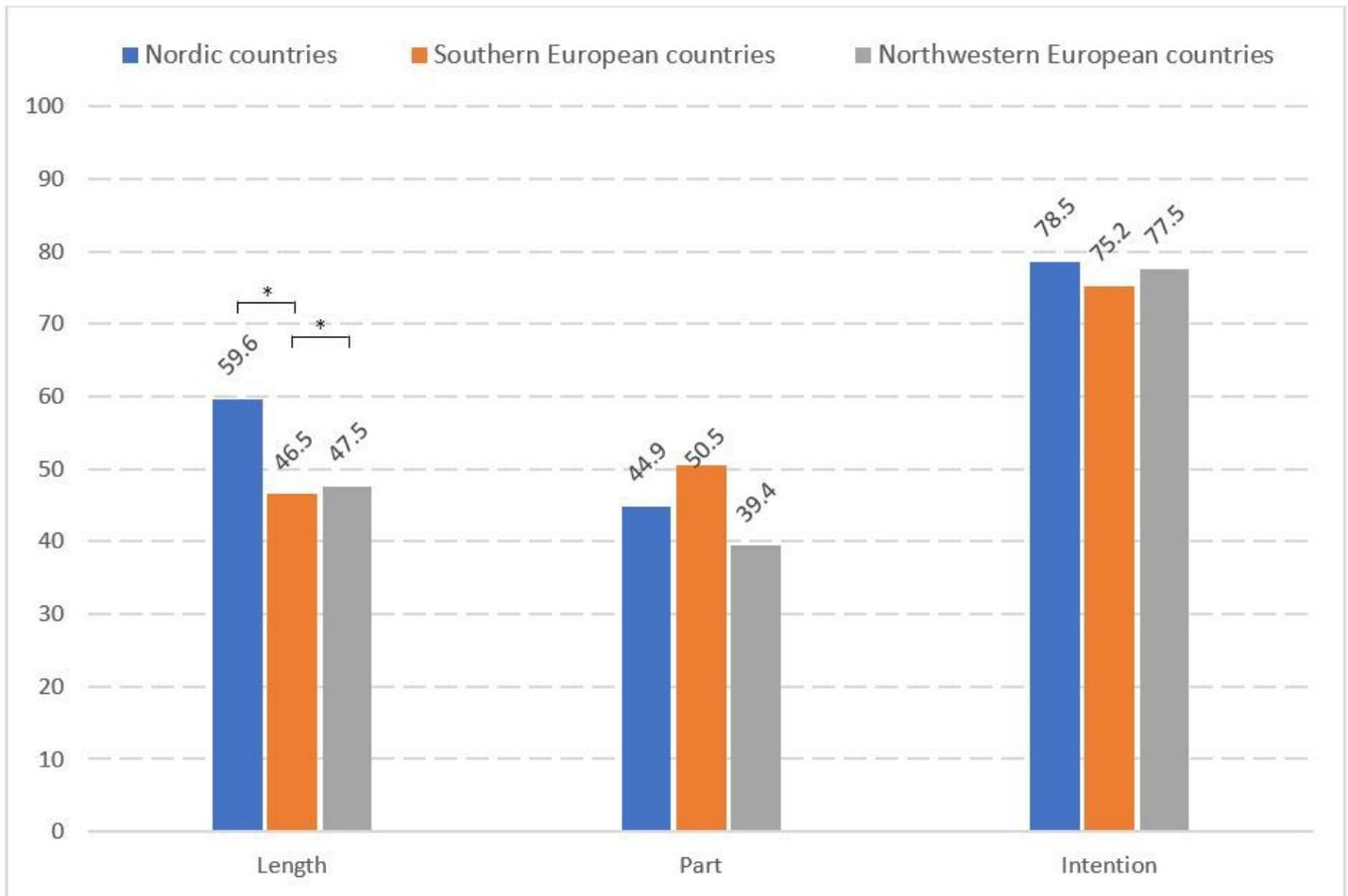
(3) Statement 19. Rephrasing or summarizing another person's work

- a. Rephrasing another person's work without crediting the source.
- b. Rephrasing text from someone else's publication without significant modification of the original, but with crediting the source.
- c. Summarizing another person's work without crediting the source.

(4) Statement 20. Text resources of article writing

- a. Paying someone else to write a paper without granting authorship.
- b. Having someone else to write a paper for free without granting authorship.
- c. Putting together pieces from different publications, and presenting the result as one's own work.
- d. When writing a literature review, using the same framework of others' review, without crediting the source.
- e. With permission from the original author, using another's text without crediting the source.

\* There is significant difference after correction for age differences.



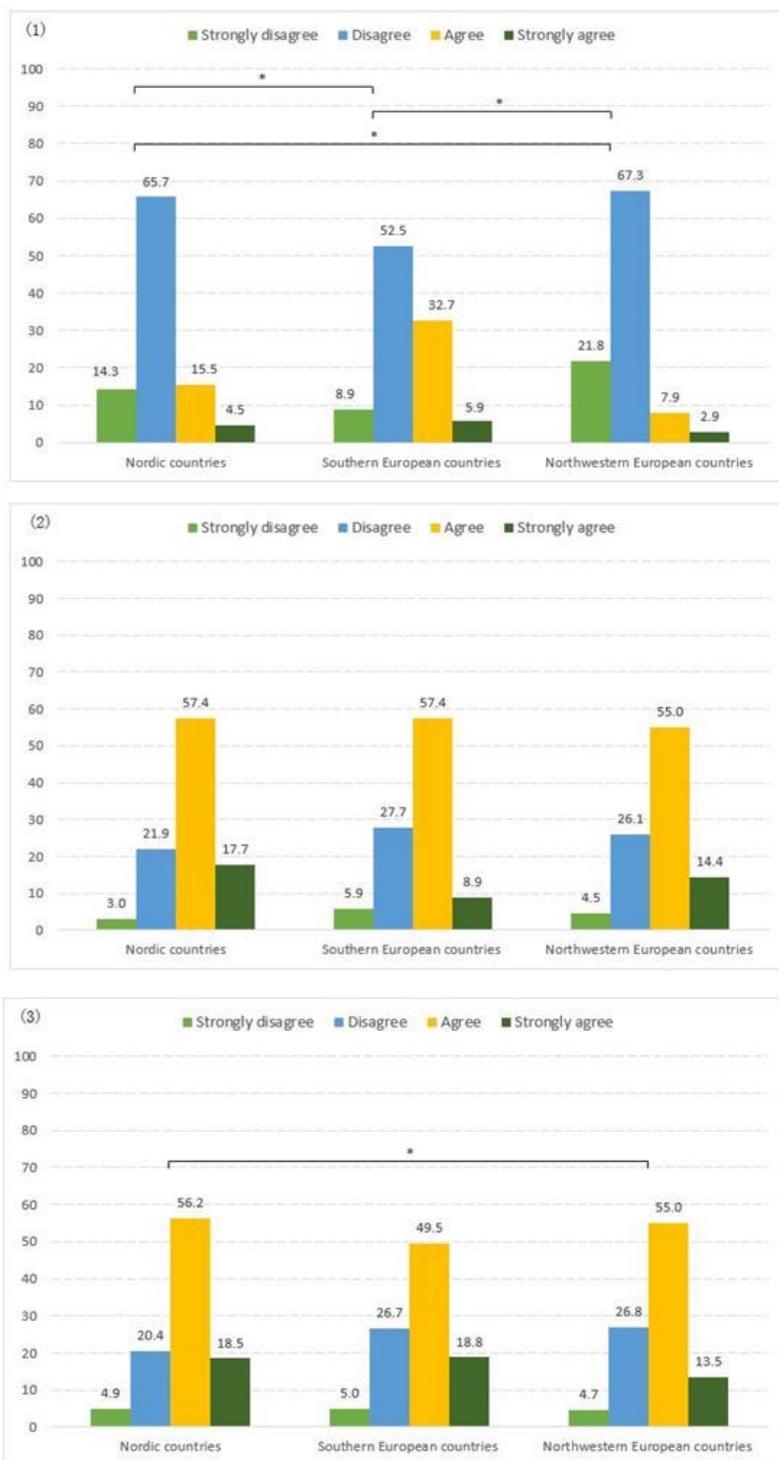
**Figure 2**

Percentage of respondents who selected each option to Question 15

Question 15: **Which factor(s) do you think decide whether a body of copied and unattributed text constitutes plagiarism or not?**

- a. The length of the copied text
- b. The part of the copied text
- c. The presence of an intention to copy without attribution

\* There is significant difference after correction for age differences.



**Figure 3**

Percentage of respondents who selected each option to Question 12-14

(1) Attitudes to statement 12 "**Plagiarism** is a greater threat to biomedical research than **data falsification**".

(2) Attitudes to statement 13 "**Plagiarism** is a greater threat to biomedical research than **granting co-authorship to someone whose contribution doesn't justify it**".

(3) Attitudes to statement 14 “**Plagiarism** is a greater threat to biomedical research than **submitting a manuscript to more than one journals simultaneously**”.

\* There is significant difference after correction for age differences.

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