Promoting Integrity as an Integral Dimension of Excellence in Research

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Report on Media Analysis

DOCUMENT DESCRIPTION

Deliverable Number	D III.2
Work Package	WPIII
Task	T 2
Type	Report
Version	Final
Number of Pages	47
Submission Date	9/12/2016
Dissemination Level	Public
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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 665926.

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Abstract

The aim of in-depth Media Analysis, part of WP III, is to investigate media discourse about research integrity and related themes (e.g. research misconduct, fraud) in the Italian and UK daily press. A total corpus of 179 daily press articles for Italy and 674 articles for the UK was collected for the period January 2000-March 2016 and analyzed highlighting the most relevant keywords, the different scientific fields mentioned and the key themes of discussion.

Keywords

Research integrity, scientific misconduct, media analysis, science communication, daily press.

Acknowledgements

This project has received funding from the European Union's Horizon 2020 research and innovation programme, under grant agreement No. 665926 (PRINTEGER).

1. Introduction and state of the art

Media discourse plays a relevant role in shaping perception and framing of socially relevant themes issues. According to classical "agenda setting" theory[1], the greater the emphasis and the amount of media coverage on an issue, the more the public will give salience and priority to it. Moreover, although mass media may not affect public opinion strongly and directly, media discourse frames the discussion around the issues[2]. In turning an event into a news item, journalists employ frames – according to their own understanding, professional routines, medium specificity, editorial policies, and so on – which can structure what the public thinks about an issue or emerging theme of discussion[3].

Beyond this general literature, the background for our study if offered by studies analyzing science media coverage in general[4] or in relation to emerging and controversial issue related to science[5][6]. At present, there are no comprehensive, reference studies analysing the discourse about research integrity and misconduct in newspapers on long-term basis. Most

[1] McCombs, Maxwell E. and Shaw, Donald L. (1972) The Agenda-setting Function in Mass Media, *The Public Opinion Quarterly*, *36*, 2: 176–187.

[2] Marks, Leonie A. et al.(2007), Mass media framing of biotechnology news, *Public Understanding of Science*, *16*, 2: 183-203; Ten Eyck, Toby A. and Williment, Melissa (2003), The National Media and Things Genetic. Coverage in the New York Times (1971–2001) and the Washington Post (1977-2001), *Science Communication*, *25*, 2: 129-152.

[3] Hornig, Susanna (1990), Science Stories: Risk, Power, and Perceived Emphasis, *The Journalism Quarterly, 67*, 4: 767–776; Entman, Robert M. (1993), Framing: Toward Clarification of a Fractured Paradigm, *Journal of Communication, 43*, 4: 51-58; Entman, R. M. (1991), Framing U.S. coverage of international news: Contrasts in Narratives of the KAL and Iran air incidents, *Journal of Communication, 41*, 4: 6-27.

[4] There are few systematic, long term studies of daily press coverage of science and technology issues. For Italy: Bucchi, Massimiano and Mazzolini, Renato G. (2003), Big science, little news: science coverage in the Italian daily press, 1946–1997, *Public Understanding Science*, *12*, 2003, 7-24. For the UK: Bauer, Martin W. et al., (2006) Long-Term Trends in the Public Representation of Science Across the 'Iron Curtain': 1946-1995, *Social Studies of Science*, *36*, 1: 99-131. For a more recent update on science coverage on Italian daily press: Di Buccio, Emanuele et al. (2014), Scienza e tecnologia nei media italiani: tendenze generali e dieci temi ricorrenti, in Bucchi, M. and Saracino, Barbara, eds., *Annuario Scienza Tecnologia e Società 2014*, Bologna: Il Mulino, 51-84. See also Schäfer, Mike S. (2010), Taking stock: A meta-analysis of studies on the media's coverage of science, *Public Understanding of Science*, *21*, August 2012, 650-663; Bauer, M. W. and Bucchi, M. (2007), eds. *Journalism, Science and Society. Science Communication between News and Public Relations.* London-New York: Routledge.

[5] Kurath, Monica and Gisler, Priska (2009). Informing, involving or engaging? Science communication, in the ages of atom-, bio-, and nanotechnology. *Public Understanding of Science, 18*, 559–573; Nisbet, Matthew C. and Goidel, Robert K. (2007), Understanding citizen perceptions of science controversy: bridging the ethnographic—survey research divide, *Public Understanding of Science, 16*, 4: 421-440.

[6] A useful background, particularly for the Italian daily press, is given by the monitoring conducted by Observa Science in Society and published yearly in the *Annuario Scienza Tecnologia e Società*. For example: Lorenzet, Andrea and Giardullo, Paolo (2013), La ricerca emergente nei media: nanotecnologie, neuroscienze, biologia sintetica e proteomica, in Lorenzet A. e Neresini F., eds., *Annuario Scienza Tecnologia e Società 2013*, Bologna: Il Mulino, pp. 39-54; Lorenzet, A. (2012), Il dibattito sull'energia nei media italiani, in Neresini F. e Pellegrini G., eds., *Annuario Scienza Tecnologia e Società 2012*, Bologna: Il Mulino 43-61. See also: Lorenzet, A. (2013), *Il lato controverso della tecnoscienza. Nanotecnologie, biotecnologie e grandi opere nella sfera pubblica*, Bologna: Il Mulino; Lorenzet, A. (2006), Razionalità e retorica: il dibattito sugli OGM nei quotidiani italiani, in Bucchi M. and Neresini, F., eds. *Cellule e cittadini: biotecnologie nello spazio pubblico*, Milano: Sironi editore, 103-122.

of available works are dedicated to media coverage of specific cases like the Hwang case[7], the Wakefield scandal[8] or the Climate-gate[9].

In order to understand media discourse about research integrity, we focused on a series of elements: actors involved (researchers, but also institutions), the context, the causes, the consequences, the solutions, the most discussed issues and definitions of the main concepts[10], trying to answer questions like the following:

- during the 15 years considered, has there been any change in media attitudes to integrity and misconduct?
- do media focus on research integrity or rather on its absence?
- which contexts or episodes trigger media attention on this topic?
- which are the research fields and subfields[11] that receive more attention by the press in case of episodes of misconduct?
- in terms of media representation, what are the main causes of misconduct?
- and what are the consequences on the public perception of science?
-which are the most discussed themes?
- what are, according to media, the best ways to deal with misbehaviors and malpractices in scientific research?
- how is research integrity defined?

[7] See for instance Haran, Joan and Kitzinger, Jenny (2009), Modest witnessing and managing the boundaries between science and the media: A case study of breakthrough and scandal, *Public Understanding of Science*, *18*, 634-652. A partial exception is represented by V&A study of the Swedish media, although limited to scientific misconduct "Misconduct and Confidence. A Media Analysis", 2014 https://www.v-a.se/downloads/va-medieanalys-2014-english.pdf.

[8] For example: Holton, Avery (2012), The Blame Frame: Media Attribution of Culpability About the MMR–Autism Vaccination Scare, *Health Communication, 27*, 7: 690-701; Speers, Tammy and Lewis, Justin (2004), Journalists and jabs: Media coverage of the MMR vaccine, *Communication & Medicine, 1*, 171–181; Lewis, J. and Speers, T. (2003), Misleading media reporting? The MMR story, *Nature Reviews Immunology, 3*, 913-918; Jefferson, Tom (2000), Real or perceived adverse effects of vaccines and the media—a tale of our times. *Journal of Epidemiology and Community Health, 54*, 402–403.

[9] For instance Bowe, Brian J. et al. (2014), Framing of climate change in newspaper coverage of the East Anglia e-mail scandal, *Public Understanding of Science, 23*, 2: 157-169.

[10] A relevant example of how conducting our qualitative media analysis was also Jönsson, Anna Maria (2011), Framing Environmental Risks in the Baltic Sea: A News Media Analysis, *AMBIO, 40*, 2: 121-132.

[11] For a list of fields and subfields, please see pp. 14-17.

2. Methods and data

2.1. Data Collection

Based on a preliminary exploration of data, the period selected was from January 2000 to March 2016, in order to have a time interval long enough to analyse trends in coverage and potential changes in media discourse. The four main quality newspapers for each country were examined: «The Guardian», «The Independent», «Times», «The Telegraph» for the UK; «Corriere della Sera», «La Stampa», «Il Sole24Ore», «La Repubblica» for Italy. Articles were gathered through the internal search engines of each newspaper online archive, since earlier explorations using LexisNexis returned incomplete results. In addition, for the Italian press we also used Observa Science Media Monitor, a system for monitoring coverage of science and technology issues in the daily press[12].

Articles were retrieved via a series of keywords that had to appear in association with terms "scient*" and "research*", in order to exclude articles about integrity and fraud that were not pertinent to the field of scientific research -for example, those related to economic frauds or to other meanings of integrity (moral integrity; integrity of a material). Two set of keywords were chosen: one set of general terms connected to research integrity and misconduct, such as "integrity" and "misconduct", but also "fraud", "ethics"[13] and "retraction". A second set of keywords included specific types of misconduct, such as "plagiarism", "falsification", "fabrication" (FFP definition of misconduct[14]). Other relevant keywords were inductively defined after a preliminary reading of articles content: "conflict of interests", "cherry picking", "retraction" and "manipulation[15]". This because the already collected articles showed that media language specifically uses these words while talking about research integrity: and in fact, the additional research we developed allowed us to find new articles of our concern.

Some language differences obviously had to be taken into account. First, we did not use the word "cherry picking" for Italian newspapers research, due to the fact that there's no a proper translation into Italian of the term. Secondly, the equivalent of the term

[12] http://www.observa.it/science-in-the-media-monitor/?lang=en.

[13] The results collected through this keyword were mostly not pertinent to our research topic. Many gathered articles, that we therefore left out, concerned ethical controversies, such as those related to cloning or, for Italy, to debates about stem cells.

[14] Cf. Horbach, Serge and Halffman, Willem, *Promoting virtue or punishing fraud: mapping contrasting discourses on 'scientific integrity'*, PRINTEGER report.

[15] Manipulation is very much used to indicate image falsification.

"misconduct" is not a single word, but the expression "cattiva condotta" -which is not so frequent.

2.2. Analysis of the articles

Articles were classified on the basis of the keywords through which they had been retrieved. After having deleted duplicates -after taking notes of eventual multiple keywords- and articles that seemed to be off-topic, the result was a corpus of 179 articles for Italy and 674 for UK. Additional data were then associated to each article: newspaper, year, context in which the article was written and main scientific fields of reference[16].

After this preliminary classification, the entire texts of all articles was prepared to be analysed through ATLAS.ti, a text analysis software. While in the first phase each article was considered as a unit, in this phase the research units became paragraphs and sentences, to which various codes were associated.

We initially looked at occurrences of the keywords used in the preliminary research on the newspapers online archives: misconduct, fraud, retraction, research integrity, ethics, plagiarism, falsification, fabrication, conflict of interests, cherry picking and manipulation. This allowed us to know the actual frequency of the terms we were interested in.

Following the classic study by Gamson and Modigliani[17], we aimed at reconstructing media discourse on research integrity by detecting the different "interpretive packages" shaping it. Therefore, code families were conceived as covering the main components of a package – causes, consequences, implications, responsibilities of and solutions to the problem – plus other interesting constitutive dimensions of the discourse.

In light of the questions to be addressed, a first set of code families was used: "consequences", "causes", "people", "discussed themes" and "definition of research

[16] The classification of research fields was based on UNESCO most recent classification (www.uis.unesco.org): Natural Sciences (Mathematics, computer and information sciences, physical sciences, chemical sciences, earth and related environmental sciences, biological sciences, others); Engineering and Technology (Civil engineering, electrical, electronic, information engineering, mechanical engineering, chemical engineering, materials engineering, materials engineering, medical engineering, environmental engineering, environmental biotechnology, industrial biotechnology, nano-technology); Medical and Health Sciences (Basic medicine, clinical medicine, health sciences, health biotechnology, others); Agricultural Sciences (Agriculture, forestry and fishery, animal and dairy science, veterinary sciences, agricultural biotechnology); Social Sciences (Psychology, Economics and business, educational sciences, sociology, law, political science, social and economic geography, media and communications); Humanities (History and archaeology, languages and literature, philosophy, ethics and religion, art).

[17] Gamson, William A. and Modigliani, Andre (1989), Media Discourse and Public Opinion on Nuclear Power: A Constructionist Approach, *American Journal of Sociology*, *95*, 1: 1-37.

integrity". A second group of code families was developed inductively, based on the content itself of the articles: "actual responses"[18], "proposed solutions" and "subfields". The definition process of codes for each family was in both cases -for the first and the second series of codes- inductively based on comprehensive screening of the articles. (e.g. for the code family "causes" the codes are: ignorance of norms; lack of attention; bad communication of research; competition/career; external pressure to alter/delete the findings/data; funding/conflict of interests; personal gain; political reasons; publish or perish; support an evidence or a theory; the rotten apple; the rotten system; unconscious bias).

[18] With "actual responses" we refer to the responses put into place by research institutions -or in some cases by the law.

Table 1 Scheme of the codes used, clustered in families (in alphabetical order).

ACTUAL RESPONSES	All data publication/access to raw data; code/guidelines; criminal inquiry; declaration of interests; demotion; detection software; disclosure of funders; encouraging whistleblowers; exoneration; firing/resignation; formal complaint; hearing; improvement of peer review process; independent inquiry; independent review; investigation; jail; lie detector test; loss of professional license; meta research; none; open access platform; panel set up; parliamentary inquiry; pre-registration; prevention/researchers training; professional tribunal; prosecution under the law; repayment; replication of the study/re-analysis of data; report; retraction; revocation of title; suppression of the study; suspended funding; suspension.
CAUSES	Ignorance of norms; lack of attention; bad communication of research; competition/career; external pressure to alter/delete the findings/data; funding/conflict of interests; personal gain; political reasons; publish or perish; support an evidence or a theory; the rotten apple; the rotten system; unconscious bias.
CONSEQUENCES	Catastrophic results; compromised set-up; confused public opinion; economic loss; false hopes; increased attention/interest; loss of credibility/respect; loss of public trust; studies to be rewritten; risk for health; ruined reputation; scare; scientific scandal; suicide.
DEFINITION OF RESEARCH INTEGRITY	Honesty; absence of interests; transparence; rigor; responsibility.

DISCUSSED TOPICS	Declared interests only when submitting a paper; do we need a regulation? which one?; open access; open data/open science; peer review system; private funders?; role of the media; the rotten apple; the rotten system/the tip of an iceberg; who should investigate?; what is research integrity?; public trust in science.
KEYWORDS	Cherry picking, conflict of interests, ethics, falsification, fabrication, fraud, manipulation, misconduct, plagiarism, retraction, research integrity.
PEOPLE	Bauman; Bohannon; Boldt; Carpinteri; Chen; Diederik Stapel; Dong-Phou Han; East Anglia University – Climate Research Unit; Eaton; Fiorucci; Frijter; Fujii; Gaddafi's son; Goodall; Guttenberg; Hauser; Hwang; Infascelli; Jefferys; Latchman; Macchiarini; Hauser; Briggs; Ninov; Obokata; Pachauri; Francis; Piltdwon hoax; Raj Persaud; Reuben; Gallo; Schön; Smeesters; Stapel; Sudboe; Vannoni; Von der Leyen; Wakefield; Wolpert.
PROPOSED SOLUTIONS	All trials, all data (transparency; negative results published); balanced hierarchy; code/guidelines; committee/council; detection software; disclosure of funders; double blind peer review; encourage and protect whistleblowers; good communication of research; independence of research; independent trials; meta-analysis; monitoring and investigation; more public funds; new criteria for evaluation; open access; open data/opens science; better peer review; pre-registration; preprints; public register of funders; quantity vs quality of studies; records of procedures and data; replication of studies/re-analysis of data; notice of retraction; sanctions; self-correcting science; team selection/trustworthy staff; training/promotion of integrity.

SUBFIELDS	Agricultural sciences; anthropology; archeology; astrophysics; biology; biotechnology; chemistry; economy; geo-engineering; history; law; medicine/biomedicine; paleontology; philosophy; physics; psychiatry; psychology; sociology; pharma.
SPECIFIC THEMES	Archaeoraptor; cancer; climate change; climategate; cloning; cold fusion; fossil fuels; examples of fraud from the past; GMO; homeopathy; MMR; neutrinos; questionable practices; science journalism; stem cells; tobacco; trials.

3. Results

3.1. General Trends in Coverage

The number of articles per year shows a clear trend towards increased attention to research integrity in conjunction with specific cases of misconduct (proved or suspected), particular in the last 5-6 years[19]. In UK the peak of articles in 2010 is in conjunction with the Climategate scandal and the retraction of Wakefield study: from 62 articles in 2009 the number increased up to 117 articles in 2010 and then decreased to 59 in 2011. In Italy, it was the Stamina case between 2013 and 2014 that marked a significant increase in media attention: 27 articles in 2012, 43 in 2013, down again to 24 in 2014.

[19] As mentioned, data for 2016 only cover January-March 2016. The increase in attention to cases of misconduct does not seem attributable to a general increase in the salience of news related to science and technology. According to the Science Media Monitor data, the salience index of ST news on the total of news in the four Italian newspapers considered remained substantially stable between 2008 (11,1%) and 2015 (9,2%). See Di Buccio E. et al. (2014), cit.; Observa Science in the Media Monitor, http://www.observa.it/science-in-the-media-monitor/?lang=en.

Figure 1. Number of articles/year about research integrity in UK daily press

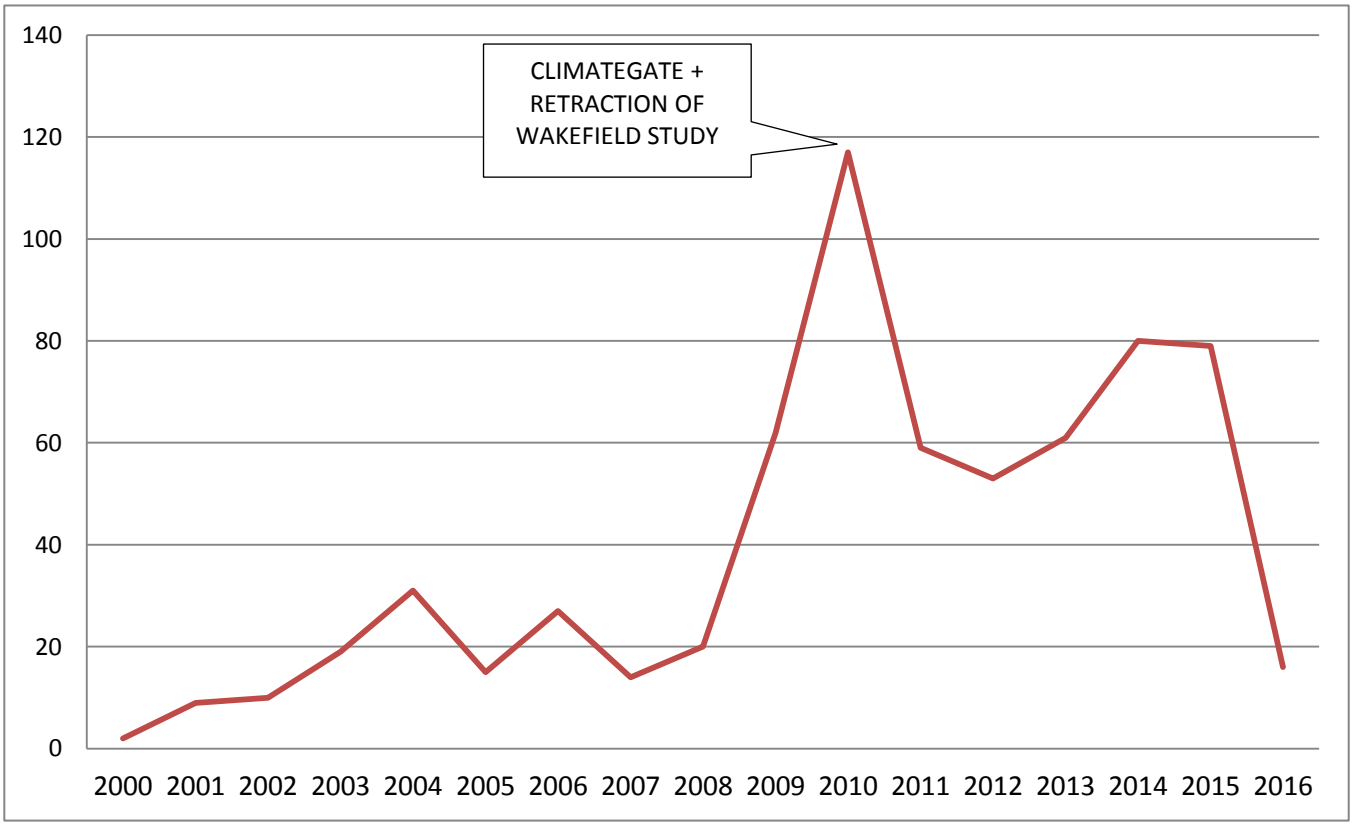
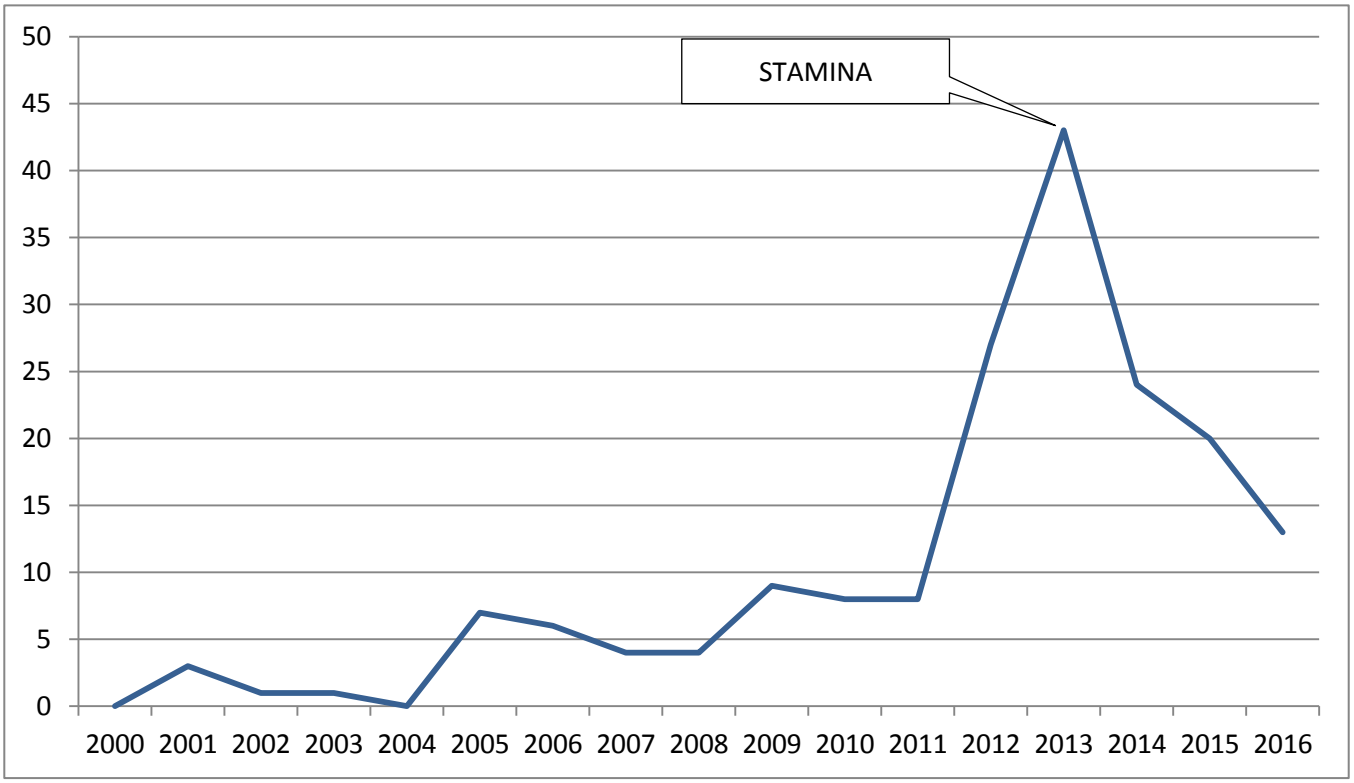


Figure 2. Number of articles/year about research integrity in the Italian daily press



3.2. Keywords

Analysis of keyword occurrences underlines the clear disproportion between the frequency of negative terms such as "fraud" or specific types of misconduct and the frequency of positive terms, such as "ethics" and "research integrity". In UK articles, the keywords "fraud" and "misconduct" occur 450 and 418 times, "plagiarism" 318 times, whereas "research integrity" occurs only 89 times. For what concerns Italian articles, the most frequent terms turn out to be "fake" and "falsification" (182 times), while the term "research integrity" had only 26 occurrences. In short, media discourse is substantially dominated by an attention to lacks of integrity and only seldom involves 'positive' definitions of integrity.

Figure 3. Keyword occurrences in the UK daily press coverage of research integrity

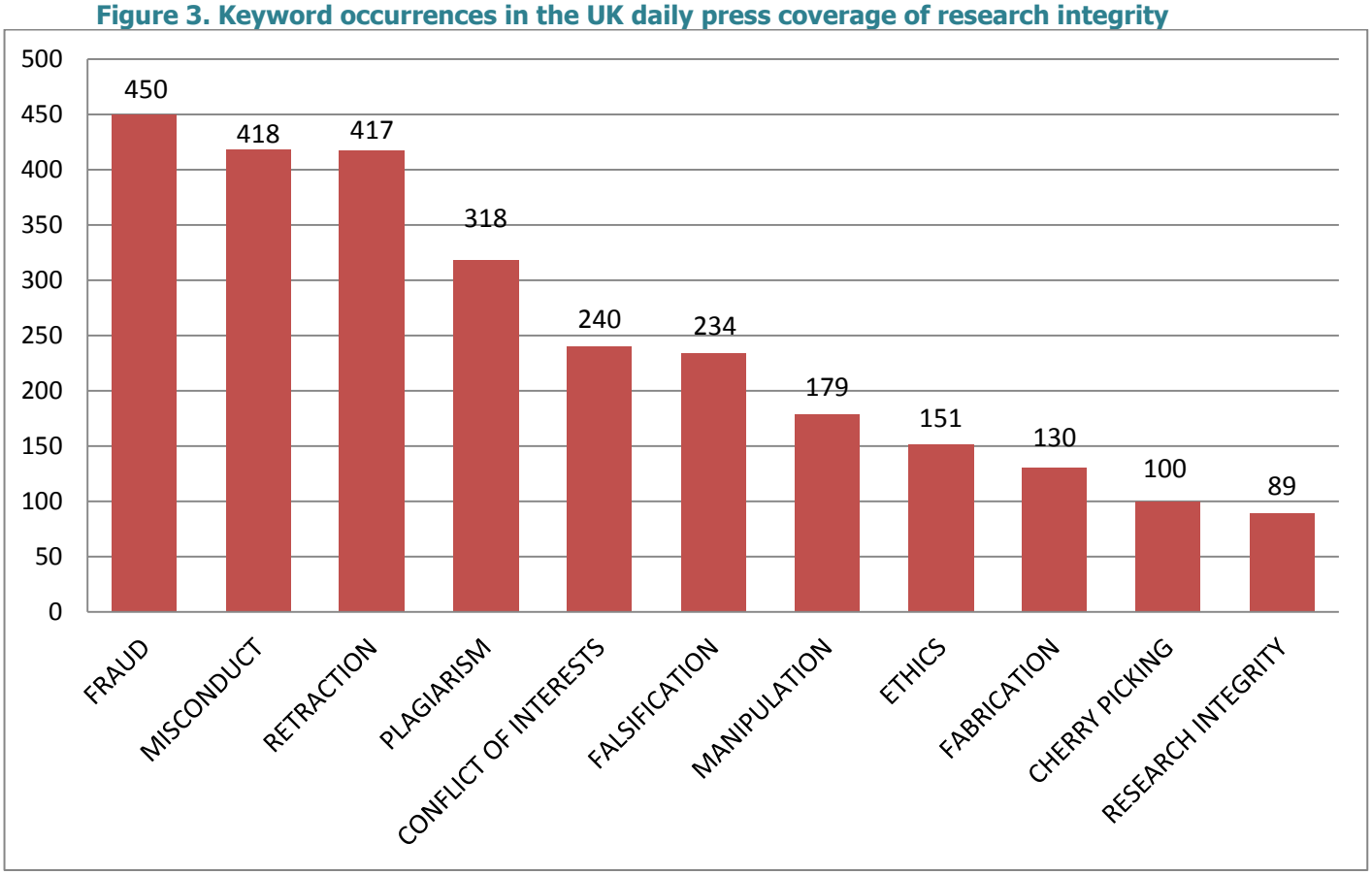
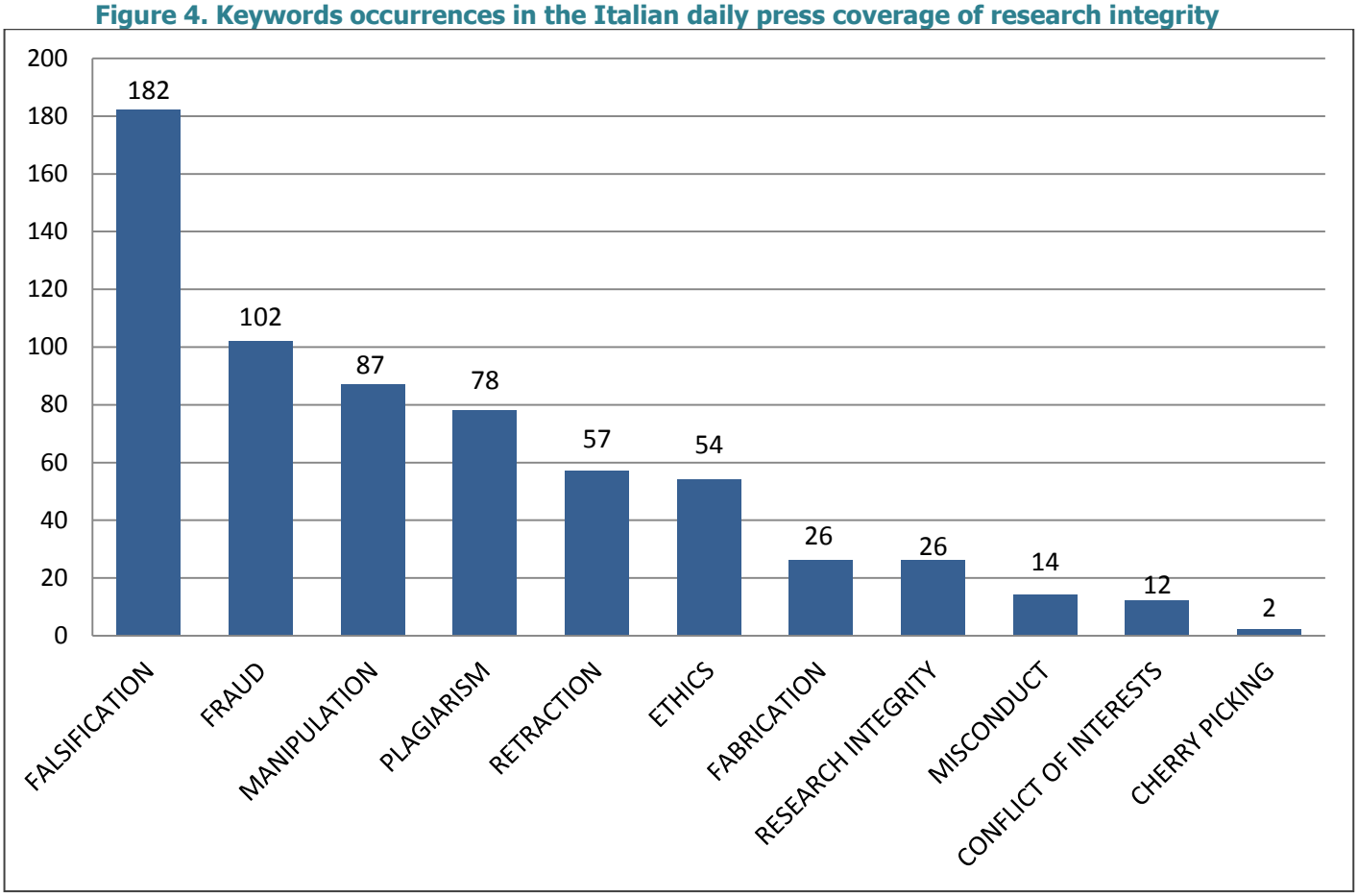


Figure 4. Keywords occurrences in the Italian daily press coverage of research integrity



3.3. Context of the articles

Both for the UK and Italy, many articles were triggered by specific cases of misconduct, such as the already mentioned Climategate, the MMR vaccine case or the Stamina case. However, a relevant proportion of articles also deal with fraud and integrity more in general, for example reporting the results of a survey, the incidence of malpractices or about flaws in the research process. Very little attention, in the UK, seems to be given to the publication of new codes of conduct or guidelines about research integrity. In Italy, a limited number of articles deals with the personal stories of researchers involved in cases of misconduct.

Figure 5. Context of the articles about research integrity (UK)

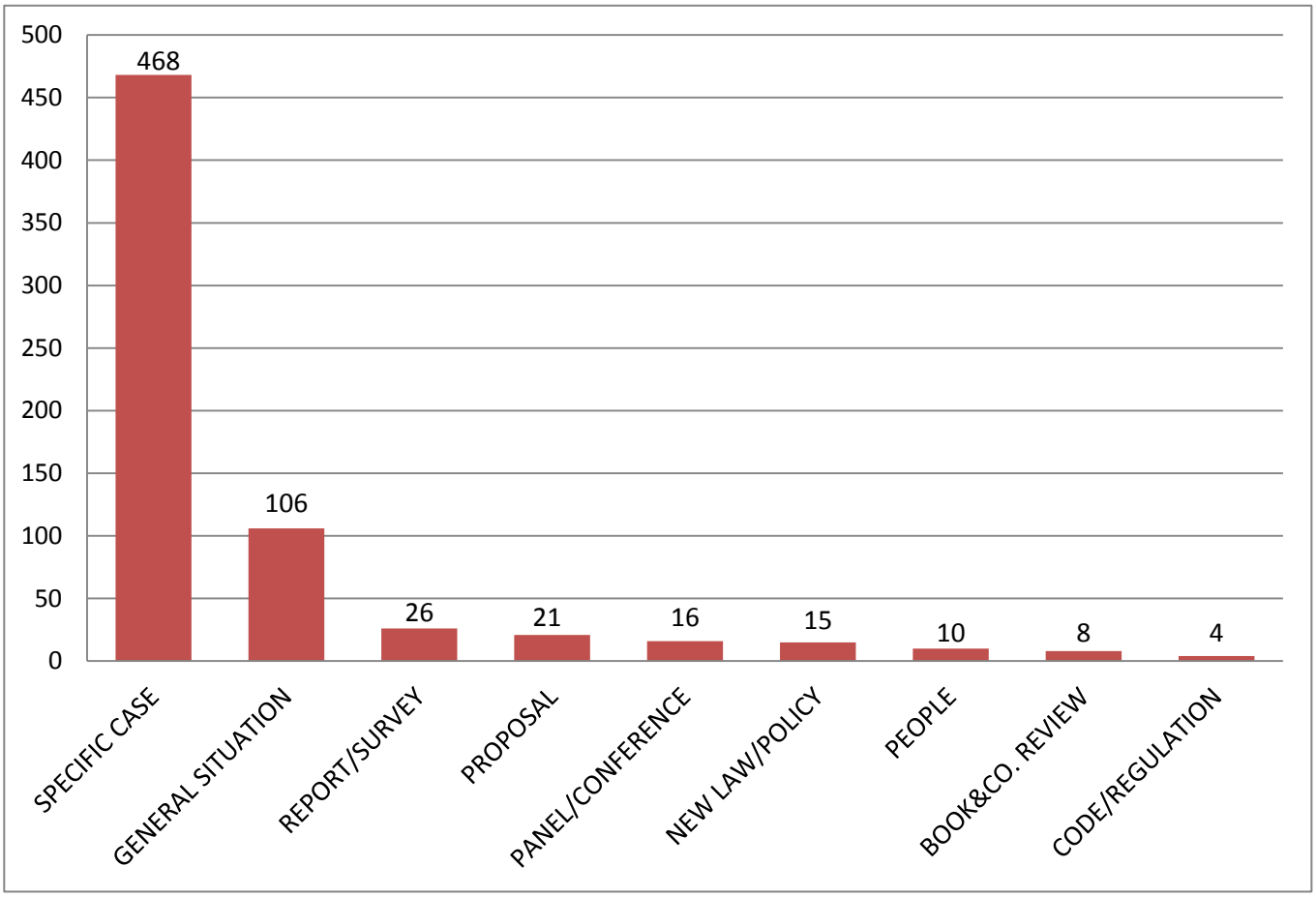
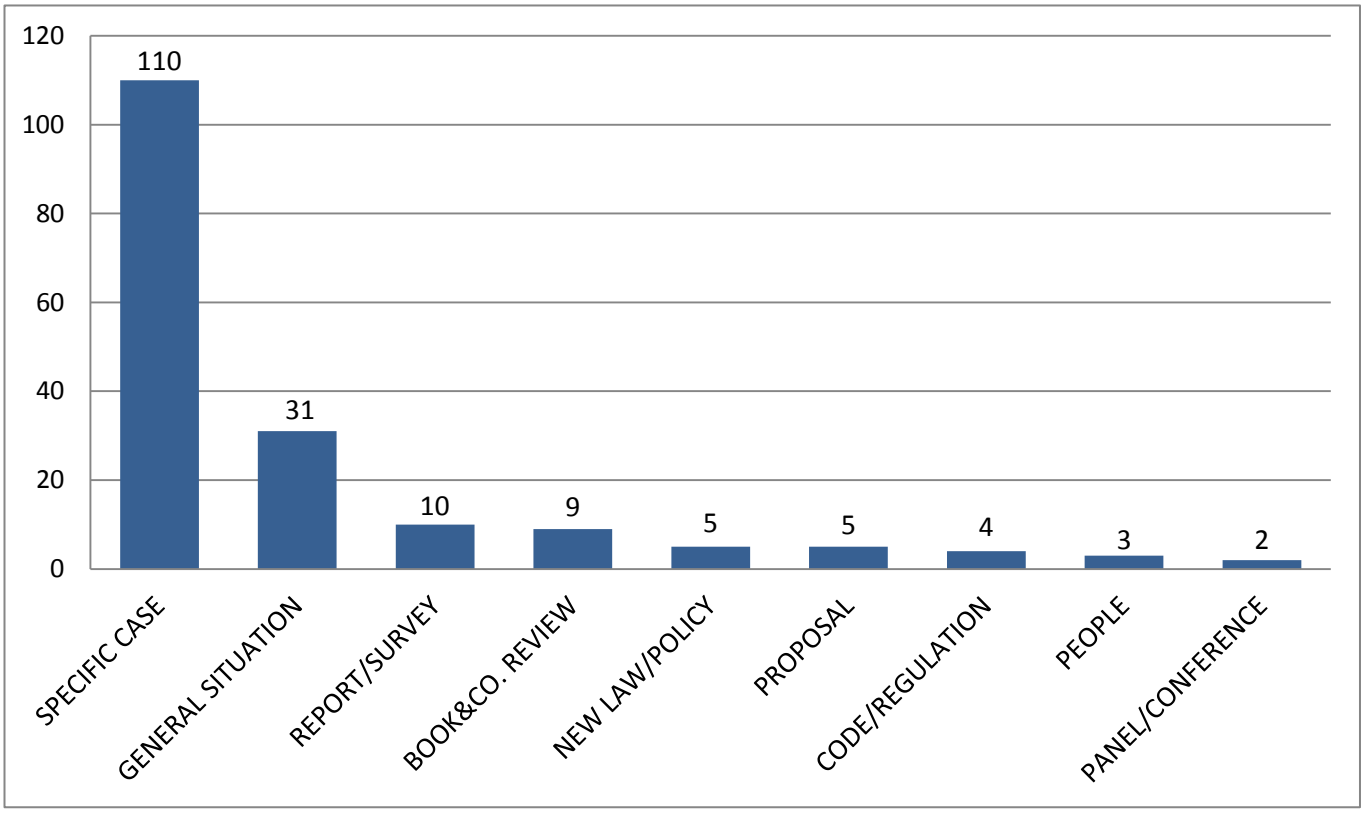


Figure 6. Context of the articles about research integrity (Italy)



3.4. Fields and Subfields

Both in Italy and in the UK, about half of the articles deal with research in the Medical and Health sciences (43% for UK and 58% for Italy). This is also confirmed by the fact that the most of individual cases – such as the Stamina or MMR vaccine case- receiving greater attention relate to this area (see Figure 1 and Figure 2). One should also take into account, however, that even standard coverage of science by the daily press has been dominated by biomedicine since the Eighties[20].

A relevant proportion of articles published in the UK relate to the broad field of Natural Sciences: in particular, several articles deal with the theme of climate change.

In Italy, on the other hand, about one-fifth of the articles does not relate to a specific field.

In both countries, attention to the social sciences is mainly triggered by article about psychology, as well as to a few cases of plagiarism: the German Minister accused of having plagiarized the doctoral thesis (the defense minister, Karl-Theodor zu Guttenberg, PhD in Law) and the case of Zygmunt Bauman, suspected of self-plagiarism. Agricultural Sciences

[20] See Bucchi, M. and Saracino, B., eds. (2014), cit.; Bucchi, M. and Mazzolini, R.G. (2003), cit.. See also Bucchi, M. (2010), *Scienza e Società. Introduzione alla sociologia della scienza*. Milano: Raffaello Cortina Editore, 156.

(3% both in UK and Italy articles) include mostly articles on GMOs. Finally, Humanities (5% in Italy, 1% in UK) include articles on the case of alleged plagiarism involving another German Minister, the education minister Ursula von der Leyen, PhD in philosophy.

With regard to specific subfields, Earth Sciences account for most of the articles relating to Natural Sciences (mostly because of the Climategate scandal), while pharmaceutical research and biotechnologies dominate the Medical and Health Sciences.

Figure 7. Percentage of articles about research integrity / research field (UK)

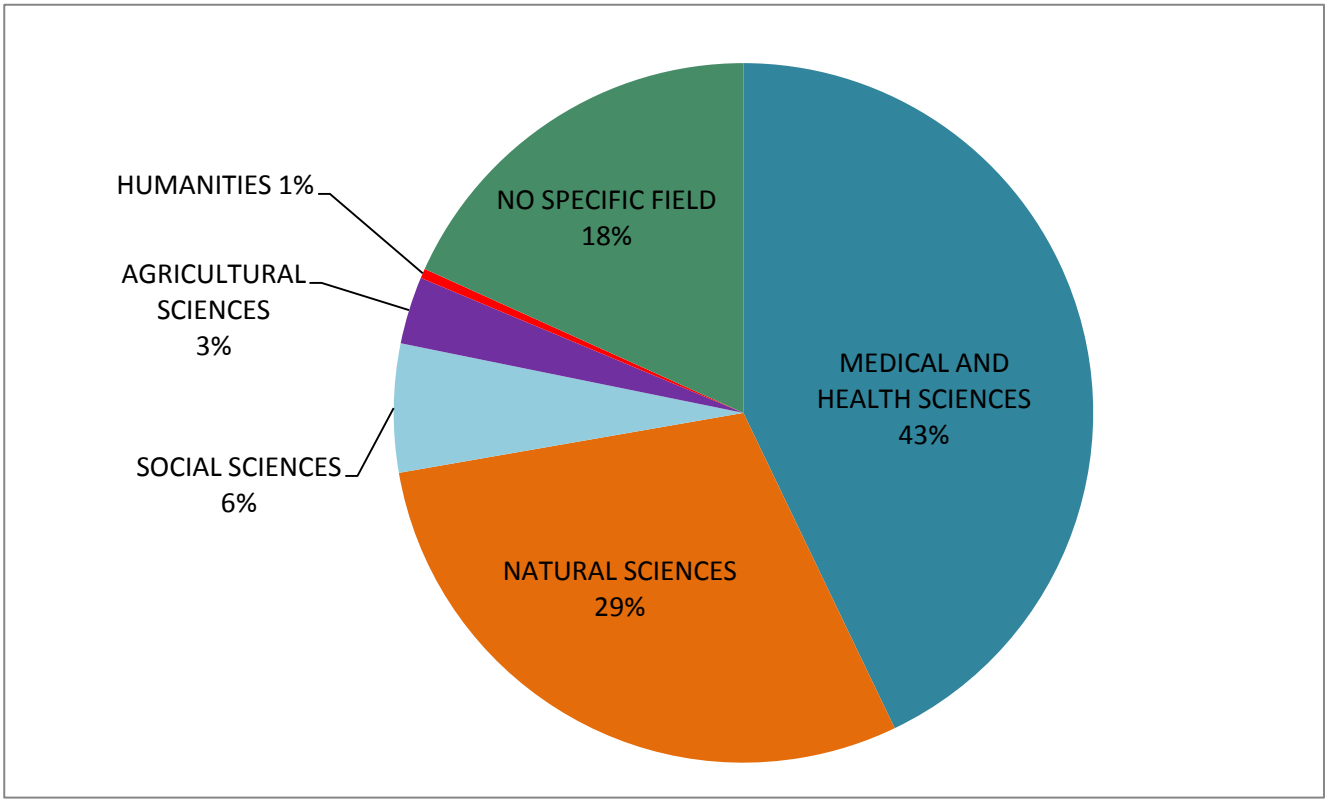
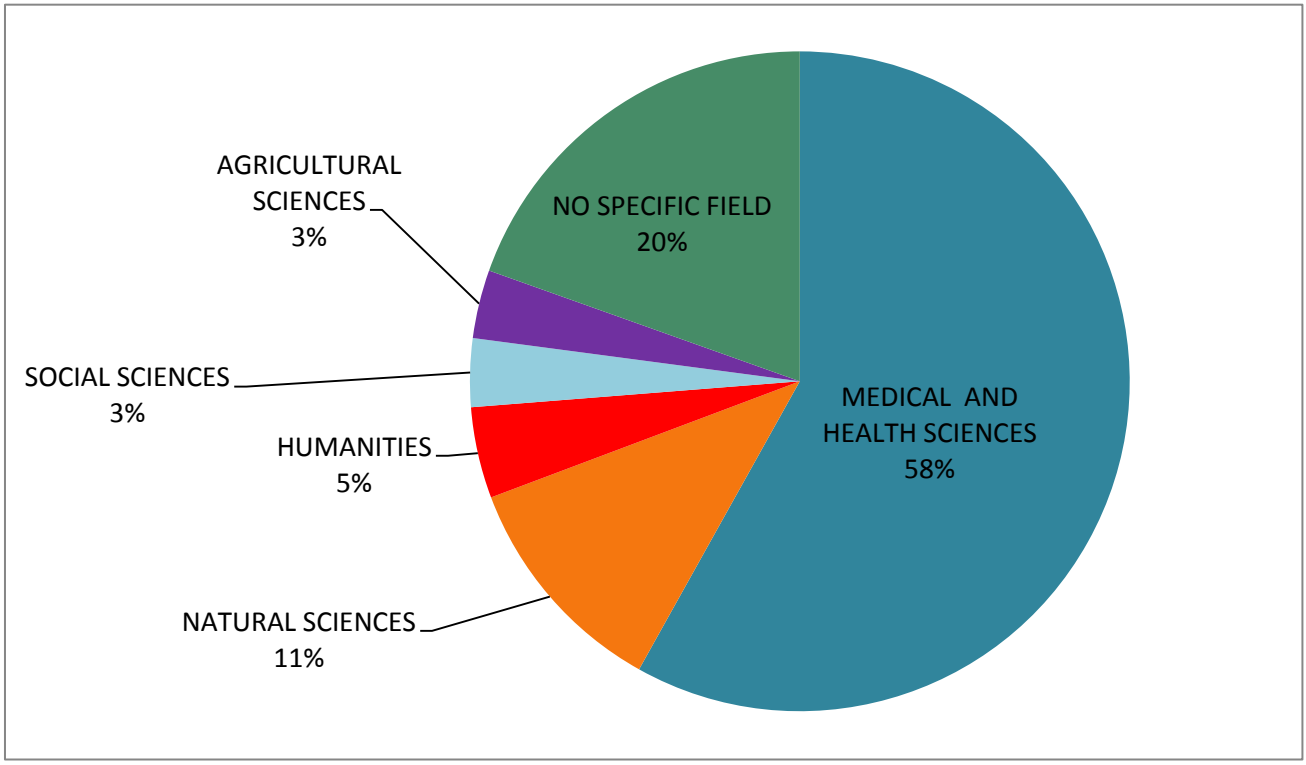


Figure 8. Percentage of articles about research integrity / research field (Italy)



The situation is quite similar in Italy. Biotechnologies, medicine and pharmaceutical research are the most frequently featured subfields. Earth Sciences are relevant also in Italy, but more because of general interest in climate change than due to the Climategate scandal. Within Italian coverage, physics is well represented (6th place): this is due to the case "Piezopoli" (as defined by a journalist of "La Repubblica") involving piezonuclear experiments conducted by engineer Alberto Carpinteri.

Figure 9. Occurrences of research subfields in UK daily press coverage of research integrity

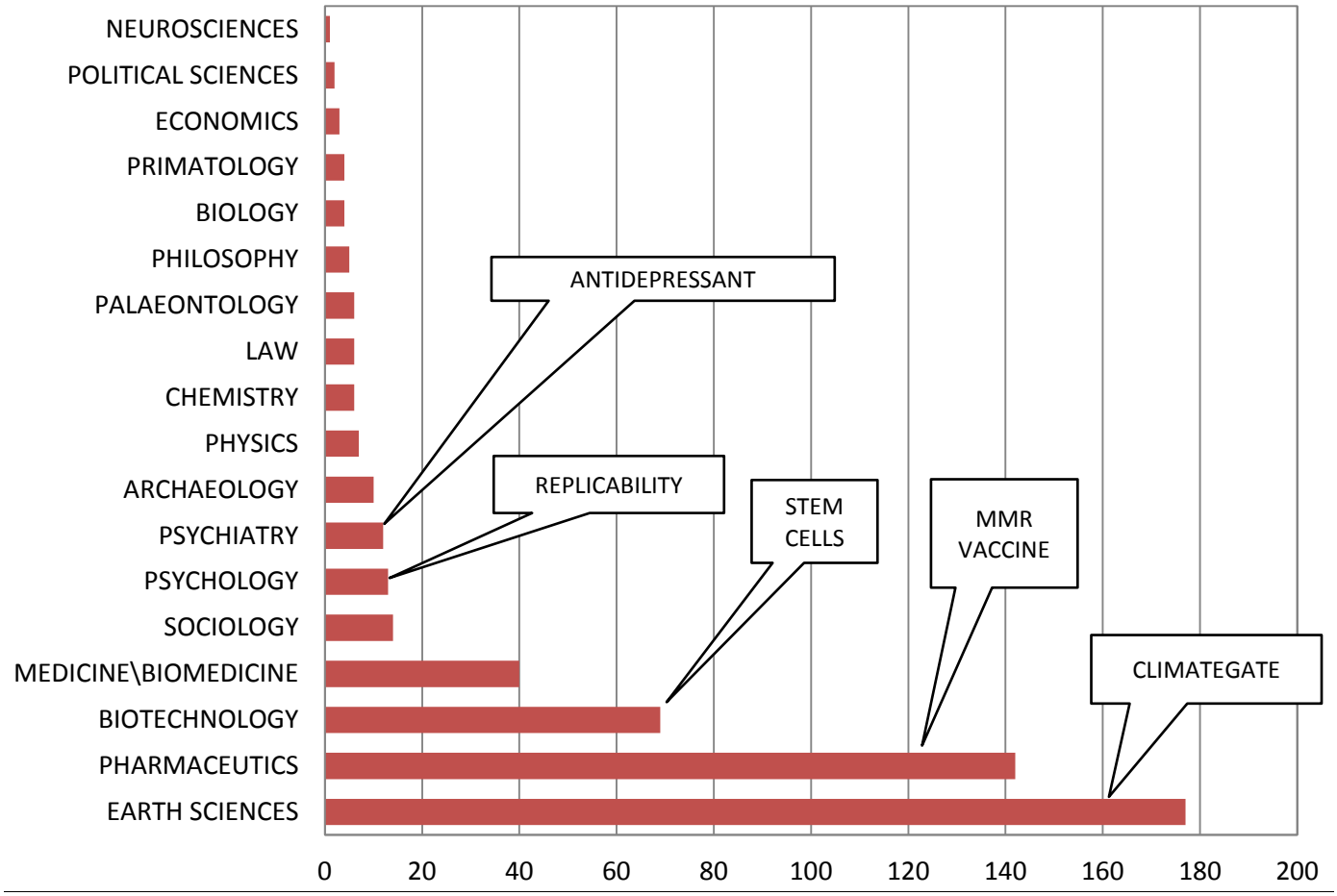
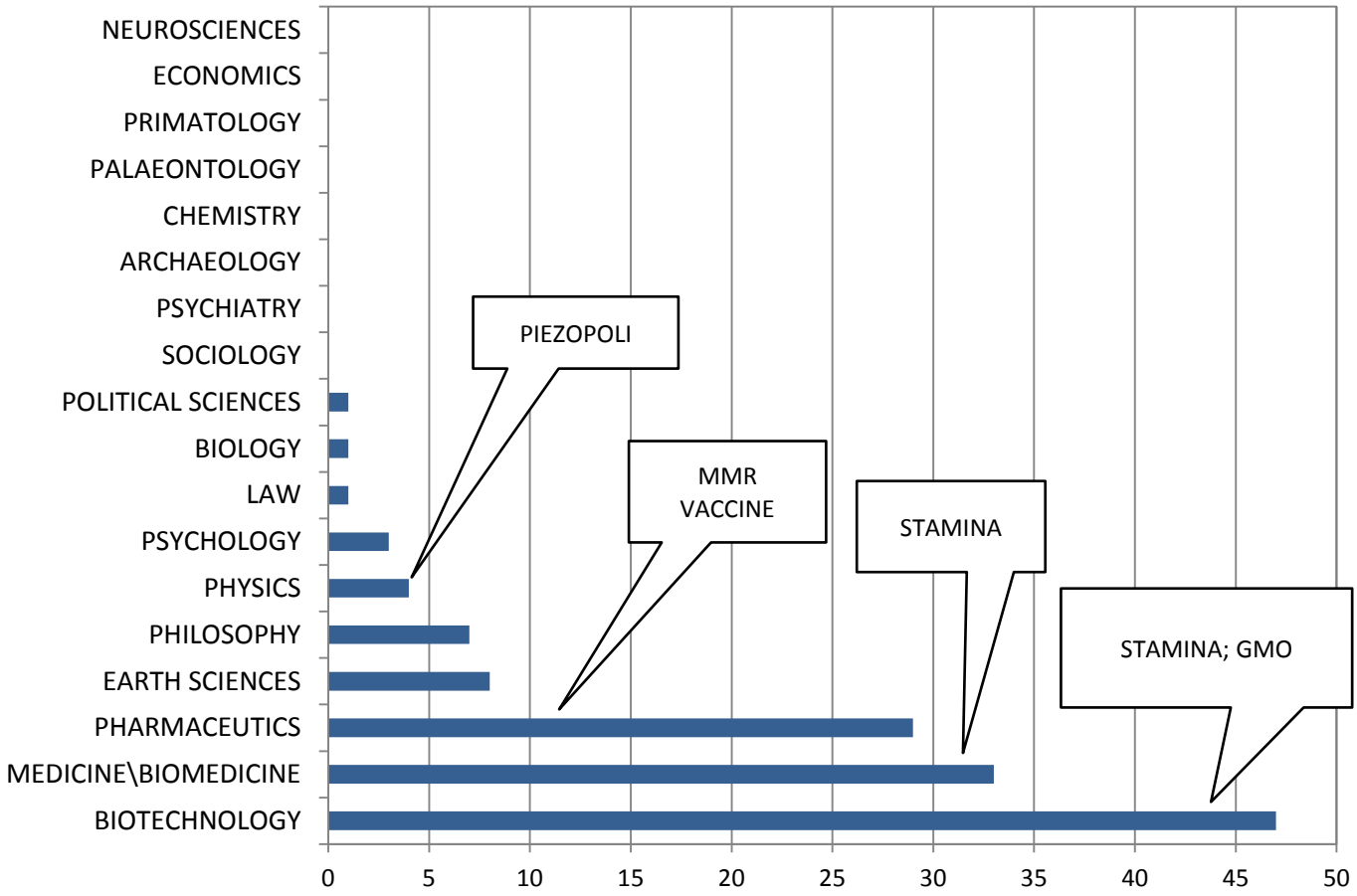


Figure 10. Occurrences of research subfields in the UK daily press coverage of research integrity



3.5. Causes of misconduct

One of the main aims of our in-depth analysis was to identify what are the causes of misconduct in scientific research according to the media.

Quite surprisingly, in UK coverage the frame of the "rotten apple" – meaning that individual cases do not account for general trends - does not seem particularly relevant for the representation of misconduct. On the other hand, media reports and discussion display an interesting awareness of those factors that could lead a researcher to commit fraud, starting (26 occurrences) with the pressure exercised by private funders:

«What gives rise to dishonesty? One motive is money. Grants depend on publication and studies funded by industry tend to be biased in favour of the result the sponsor wants.» (*Climate scientists must be absolutely honest about data*, "The Guardian", 4 March 2010)

A second possible cause of misconduct (24 occurrences) is seen in the extreme competition for career, particularly due to the lack of funding and resources, that exacerbates rivalry among researchers:

«Burdens on modern scientists include fierce competition for scarce resources.» (*Is the spirit of Piltdown man alive and well?*, "Telegraph", 7 September 2005)

«This is happening because the entire way that we go about funding, researching and publishing science is flawed. As Chris Chambers and Petroc Sumner point out, the reasons are numerous and interconnecting:
• Pressure to publish in "high impact" journals, at all research career levels;
• Universities treat successful grant applications as outputs, upon which continued careers depend;
• Statistical analyses are hard, and sometimes researchers get it wrong;
• Journals favor positive results over null findings, even though null findings from a well conducted study are just as informative;
• The way journal articles are assessed is inconsistent and secretive, and allows statistical errors to creep through.» (*Scientific fraud is rife: it's time to stand up for good science*, "The Guardian", 2 November 2012)

As this last citation shows, some articles argue that instead of the already cited "rotten apple" paradigm (5 occurrences), it would be better to focus our attention on "the rotten system" (24 occurrences), meaning also increasing pressures for positive results and publications on high-impact journals:

«These scandals highlight deeper cultural problems in academia. Pressure to turn out lots of high-quality publications not only promotes extreme behaviours, it normalises the little things, like the selective publication of positive novel findings – which leads to "non-significant" but possibly true findings sitting unpublished on shelves, and a lack of much needed replication studies. Why does this matter? Science is about furthering our collective knowledge, and it happens in increments. Successive generations of scientists build upon theoretical foundations set by their predecessors. If those foundations are made of sand, though, then time and money will be wasted in the pursuit of ideas that simply aren't right.» (*Scientific fraud is rife: it's time to stand up for good science*, "The Guardian", 2 November 2012)

Malpractice is presented as "academic", due to a system that seems to be rewarding it:

«The only way to stop academic malpractice is to eliminate the culture that rewards it. Science today faces a serious challenge in the form of academic fraud, as Alok Jha has highlighted. As easy as it is to decry and punish fraud, the real challenge is to understand what it means, why it happens and how we can prevent it.» (*Replication is the only solution to scientific fraud*, "The Guardian", 14 September 2012)

According to media coverage, "publish or perish" appears to be much more than a common motto, being frequently reported as one of the main causes of misconduct:

«The "publish or perish" environment of today's academia means young - and not so young - academics can only scale the career ladder and build a reputation if they produce a certain number of papers in highly-regarded publications each year. "If you are expected to turn out six to eight papers a year, you can't exactly start from scratch each time," says Carroll.» (*When plagiarism is academic*, "The Guardian", 30 October 2007)

Among the causes associated to exclusively personal reasons, the most widespread is the desire by researchers to support their own theory (14 occurrences) or confirm a hypothesis into which they have invested time and resources:

«In psychology research, there is a particular problem with researchers who selectively publish some of their experiments to guarantee a positive result. "Let's say you have this theory that, when you play Mozart, people want to pay more for musical instruments," says Simonsohn. "So you do a study and you play Mozart (or not) and you ask people, 'How much would you pay for a piano or flute and five instruments?'".» (*False positives: fraud and misconduct are threatening scientific research*, "The Guardian", 13 September 2012)

«We might learn to embrace "slow science" and not be pressured into publishing too much and too quickly. We could all be trained to be more aware of confirmatory bias, that is, the over-eager acceptance of results that we want to see. This would lead us to be more vigilant about our own data and results, both retrospectively and prospectively. We apparently cannot inhibit this bias via some automatic procedure, and can only counteract it with effort.» (*A question of trust: fixing the replication crisis*, "The Guardian", 28 May 2014)

Significantly, the confirming bias of researchers happens to be presented as a human weakness - «It's only human to look for evidence of our views of ideas» - , in a sort of justifying tolerance:

«When you have a theory that you have invested a lot of time and effort into, maybe even a whole career, then you'd obviously be reluctant to discard all of that because of some stupid "evidence". You'd find some rationale to dismiss the new evidence, no matter how reliable it may be, or just ignore the new information altogether. It's only human to look for evidence of our views of ideas.» (*Ducks are nature's Tories, and other fun with cherry-picking*, "The Guardian", 29 April 2013)

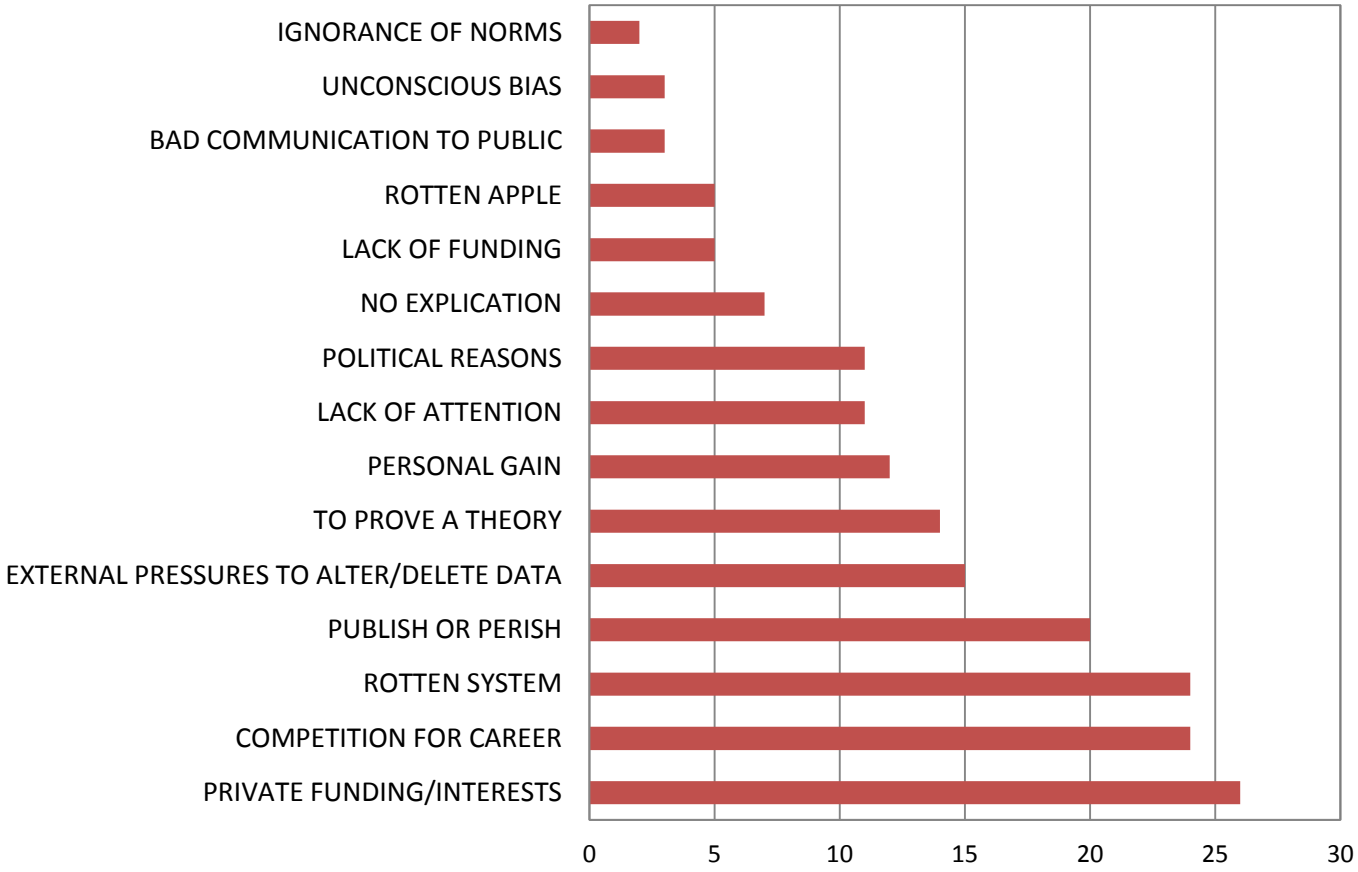
Personal gain (12 occurrences), meaning financial or career benefit, is also mentioned as a possible driver of misconduct. For instance:

«It's likely that the banal motivation behind this is money, in this case (Stap) public funding.» (*Academics Anonymous: scientific publishing is a license to print money, not the truth*, "The Guardian", 4 July 2014)

In some cases, the lack of integrity seems to have no explanations at all:

«He said that Eaton had not gained financially but the court was offered no motive for why Eaton had manipulated.» (*Scientist jailed for faking medicine test results*, "Telegraph", 17 April 2013)

Figure 11. Causes of misconduct according to UK newspapers

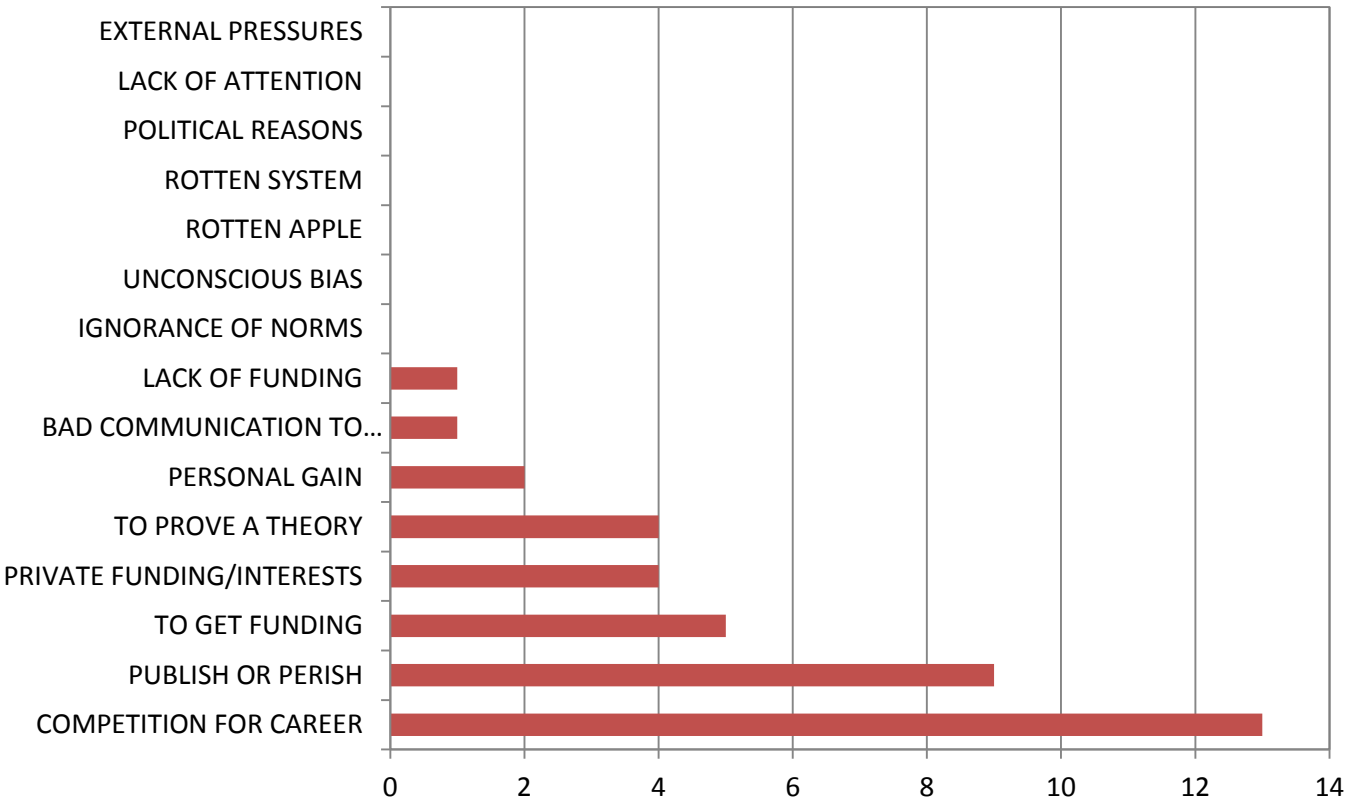


Similar results emerge from the analysis of Italian articles, where the main cause of misconduct is seen as the competition for career, as well as the «publish or perish» imperative. Bias in favors of a hypothesis or personal gain are considered less relevant, confirming that the frame "rotten system (or of a system that significantly induces to misbehave) is stronger than the idea that fraud and misconduct are researchers' fault or responsibility – rotten apples that would refer to isolate cases. For instance:

«"But today there is an enormous pressure to publish, and to do it quickly, because the career of a scientist depends on that. Thereforem, many times no one replicates the experiment. And frauds, and errors in good faith thus happen".» (*Giovanni Boniolo: "To much pressure to publish paves way to frauds "*, "La Repubblica", 30 March 2015)[21].

[21] Translated from italian: «Ma oggi c'è un'enorme pressione a pubblicare, e a farlo in fretta, perché è da quello che dipende la carriera di uno scienziato. Così molte volte nessuno replica l'esperimento. E scappano frodi, ed errori in buona fede".» (*Giovanni Boniolo: "Troppa pressione a pubblicare: le frodi sfuggono"*, "La Repubblica", 30 March 2015)

Figure 12. Causes of misconduct according to Italian newspapers



3.6. Proposed solutions and actual responses

The most interesting aspect emerging from an analysis of proposed solutions and responses as outlined in the media is clearly the discrepancy between, on the one hand, the proposed solutions and, on the other hand, the actual responses put into place by research institutions[22]. In the UK coverage, for instance, the most recurrent proposed solution (165 occurrences) refers to the need of improving the peer review system, but the actual responses put into place in that sense seem very limited (only 33 mentions). Similar considerations can be made for the improvement of the research process (86 vs 20) and the proposal of codes of conduct and guidelines[23]. In the Italian coverage, instead, improvement of the peer review system occurs more frequently among actual institutional responses than among proposed solutions. Conversely, the improvement of research process occurs 24 times as a proposed solution, but only 8 times as actual response.

[22] Cf. Horbach, S. and Halffman, W., *Promoting virtue or punishing fraud: mapping contrasting discourses on 'scientific integrity'*, PRINTEGER report.

[23] In order to better compare solutions and responses, we merged the different codes in more generic super-codes. See Table 1 and Figure 13 and 14.

However, both in the UK and Italy, the most common reported institutional reaction is an investigation (177 occurrences within UK articles and 34 in Italian ones) followed by sanctions or monitoring (138 occurrences for UK, 37 for Italy), both of which rarely feature among the proposed solutions. Finally, the promotion of integrity comes up very rarely within both proposed solutions and actual responses.

Figure 13. Proposed solutions and actual responses to research misconduct (UK)

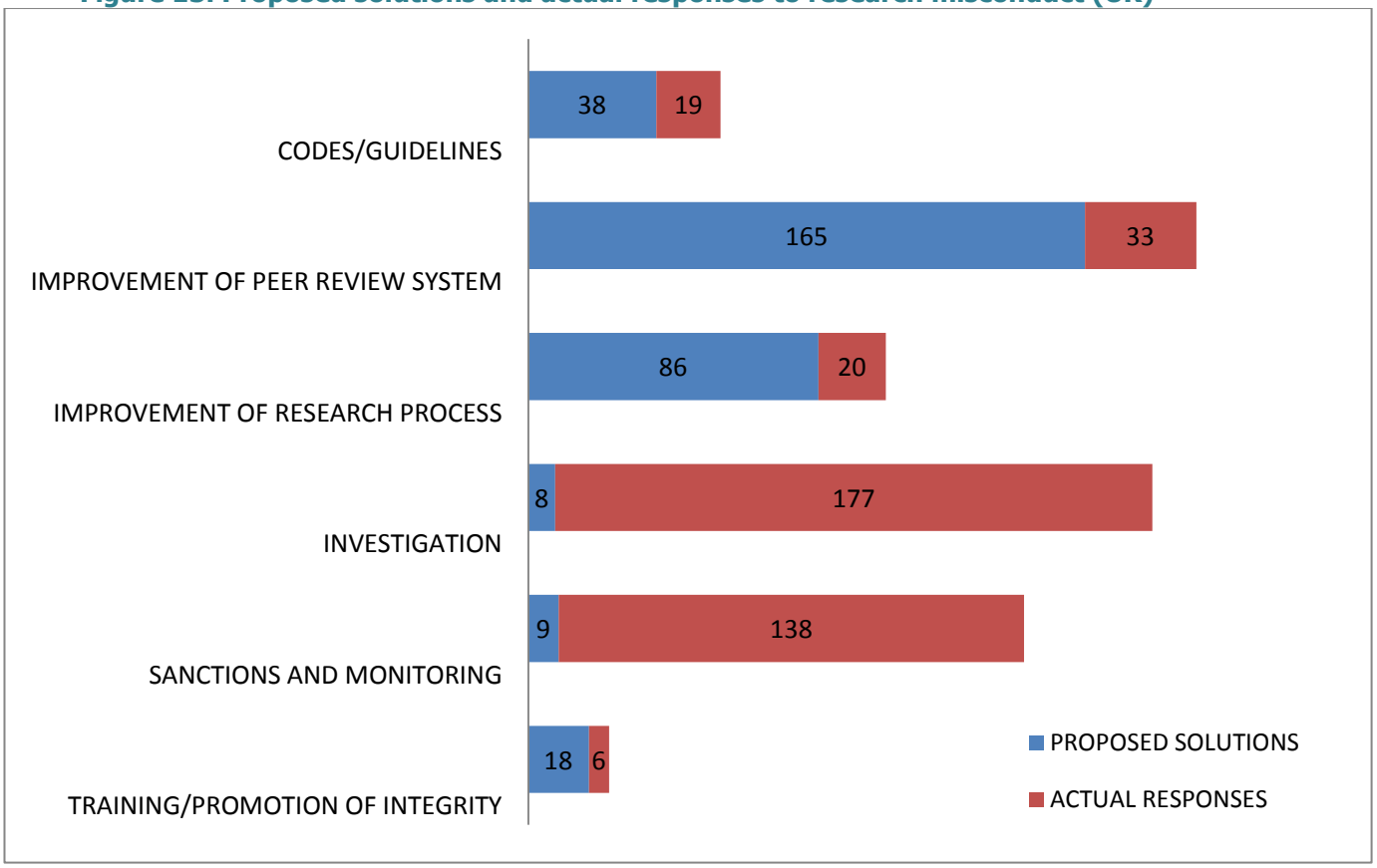
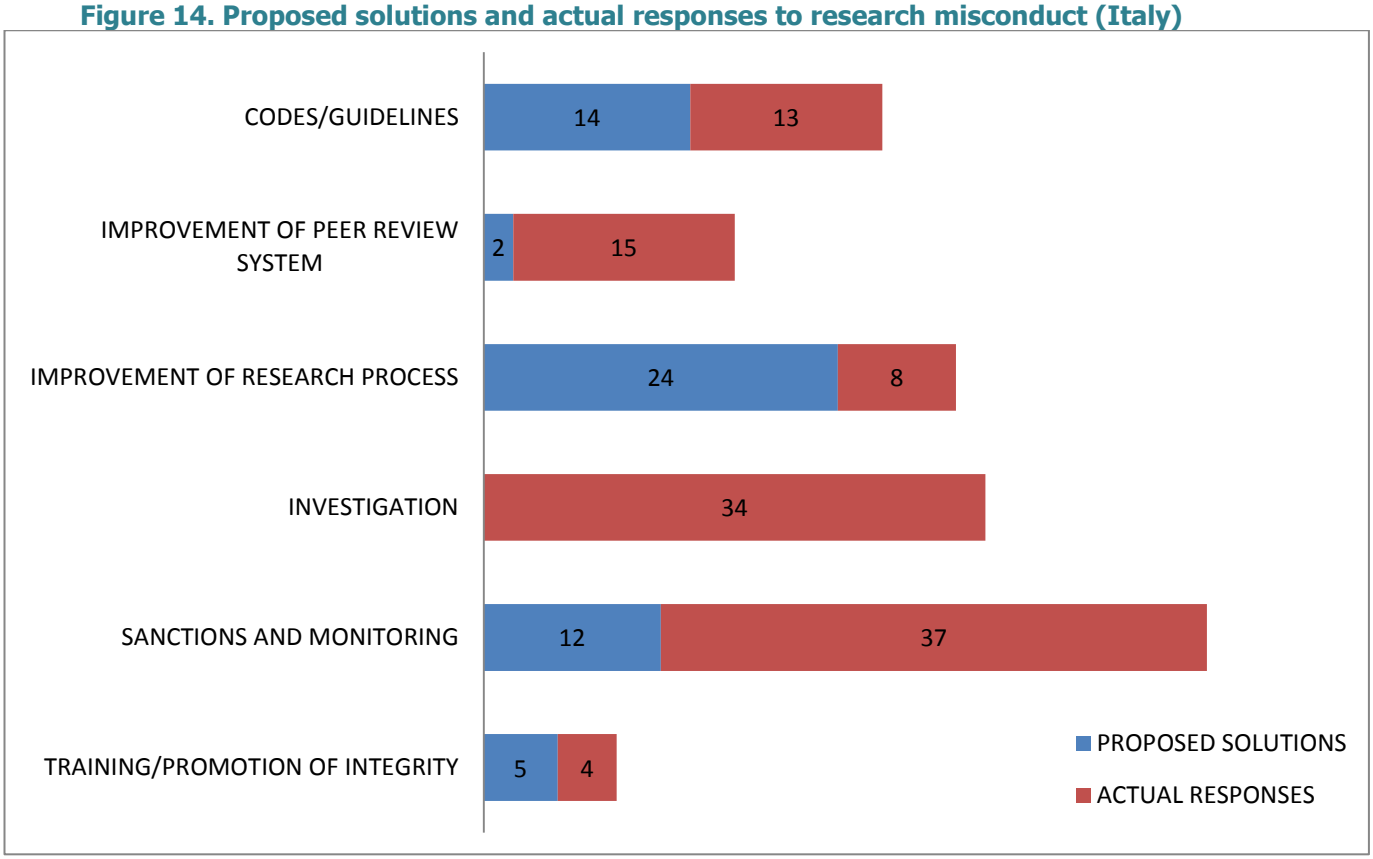


Figure 14. Proposed solutions and actual responses to research misconduct (Italy)



These six categories can be also clustered into two macro-codes: sanctions and preventions. The overall result is that facing scientific misconduct is mostly considered in terms of negative sanctions against the individual (such as firing or formal complaint) or codes of conduct introduced after relevant cases of misconduct. On the other hand, the importance of preventing misconduct is prominent among the proposed solutions, e.g. in terms of the need of improving the peer review system or the research practice more in general. Finally, the relevance of the training of young researchers and the promotion of integrity seems largely neglected both among actual responses and proposed solutions.

4. Key themes

Some key themes emerge from the analysis of media coverage. Three of these themes seem to deserve special attention:

- The first one is the theme of **public trust in science**, that often comes out relating misconduct discussions to the broader question of science in society relationships.
- The second is **the peer-review system**, that appears to be one of the most frequently debated issues in relation to fraud and integrity in research.
- The third theme is the **definition of research integrity**, which relates to the core aims of the PRINTEGER project.

4.1. The public trust in science

The articles analyzed consider public trust in science and in scientists as an essential element to reflect on misconduct and its consequences. The lack of research integrity is often associated to the worrying loss of trustworthiness and credibility of researchers and institutions in the eyes of public; such loss of credibility is perceived as a serious damage that needs to be quickly addressed and then solved, or even prevented if possible. For instance:

«One biologist said he had found a "surprising and alarming" volume of duplicated results that could lead to a crisis of confidence in science and might even put lives at risks if patients were treated based on false results. » (*1 in 4 papers on cancer research 'is misleading'*, "The Times", 20 June 2015)

«More worryingly, sweeping aside poor research or dubious activities can also erode the public's trust in science». (*The problem with science journalism: we've forgotten that reality matters most*, "The Guardian", 30 December 2015)

«Public trust in science has been "seriously undermined" by work of such poor quality that scientists regularly lose track of the number of rats on which they are working.» (*Billions are lavished on flawed medical research*, The Times, 5 January 2016)

«Consequences of misconduct are the squandering of public money and a climate of suspect and mistrust towards science and those who practice it.» (*The good-example against fraud*, "Il Sole 24 Ore", 5 April 2015)[24]

Claims about the relevance of public trust in scientific research, seen as a fundamental condition for a positive relationship between science and society, are usually made by actors directly involved in research:

«"Science has the potential to address some of the most important problems in society and for that to happen, scientists have to be trusted by society and they have to be able to trust each other's' work," Fang says. "If we are seen as just another special interest group that are doing whatever it takes to advance our careers and that the work is not necessarily reliable, it's tremendously damaging for all of society because we need to be able to rely on science."» (*False positives: fraud and misconduct are threatening scientific research*, "The Guardian", 13 September 2012)

«This is unacceptable, undermining public trust, slowing the pace of medical advancement and potentially putting patients at risk," said Andrew Miller, chair of the Commons science and technology committee.» (*Publish all clinical trial data*, MPs argue, "The Telegraph, 17 September 2013)

«Professor Sir Ian Kennedy, who will chair the board responsible for overseeing the panel, said: "The UK's research community needs to demonstrate its integrity in the conduct of research. The poor practice and misconduct of a few undermine public confidence and can put volunteers and patients at risk.» (*Panel to expose fraudulent medical research,* "The Guardian", 12 April 2006)

«At this point, the concern of Dr. Remuzzi is ours, "There is a real risk that these small and big cheating hopelessly drive the general public away from science.» (*The epidemic of «fixed» researches*, "Corriere della Sera", 28 May 2006)[25]

«The penalty? A formal warning, and two of them required for the next two years to obtain the authorization of the director of the department to publish with their university affiliation. It seems little, and so it is, if you think about the high school teacher fired for doing pee in a bush. At stake there is the pact of honesty which the scientific enterprise is based on, the credibility of science in public opinion, and even the possibility that

[24]Translated from italian: «Le conseguenze della cattiva condotta sono lo sperpero di soldi pubblici e un clima di sfiducia sospetto nei riguardi della scienza e di chi la pratica.» (*Il buon esempio anti-frode*, "Il Sole 24 Ore", 5 April 2015)

[25] Translated from italian: «La preoccupazione del dottor Remuzzi, a questo punto, è nostra: «C'è il concreto rischio che questi piccoli e grossi imbrogli allontanino irrimediabilmente dalla scienza il grande pubblico». (*L'epidemia delle ricerche «taroccate»*, "Corriere della Sera", 28 May 2006)

political decisions are influenced by false evidences to the detriment of the country.» (*Scientific fraud is not punished*, "Corriere della Sera", 14 February 2016)[26]

Even in relation to relevant and visible cases of misconduct, one of the main concerns seems to be the decline of public trust in science. For example with regard to the MMR vaccine case, the same relevance is given to the safety of patients and the trust of parents in vaccine and doctors:

«The risk is that the GMC case against Dr Wakefield will reinforce the view that there is a conspiracy by the Government, drugs companies and the medical establishment to promote the MMR vaccine and discredit a doctor whose only sin was to raise questions about its safety.» (*MMR: Moment of truth for man behind the scare*, "Independent", 27 March 2008)

The same applies to Climategate and all the related discussions about climate change:

«Public loses faith in climate change science after leaked emails scandal» (*Public loses faith in climate change science after leaked emails scandal*, "The Guardian", 7 February 2010)

«Meteorology needs bold leadership to build public trust in climate research» (*Meteorology needs bold leadership to build public trust in climate research*, "The Guardian", 8 January 2013)

«In a highly critical written submission to the committee, the Institute of Physics said the emails raised "worrying implications... for the integrity of scientific research in this field and for the credibility of the scientific method".» (*Climate scientist admits sending 'awful emails' but denies perverting peer review*, "The Guardian", 1 March 2010)

We must also underline that in some cases the solutions proposed to face the raising of retractions or data falsification and manipulation are presented as positive inasmuch as capable of maintaining and improving the public trust. This is what we see, for example, in these three extracts from Guardian's articles, which talk about open access and pre-registration:

[26] Translated from italian: «La sanzione? Un richiamo formale, e per due di loro l'obbligo per i prossimi due anni di ottenere il nulla osta del direttore di dipartimento per pubblicare con il nome dell'ateneo. Sembra poco e lo è, se si pensa al professore di liceo licenziato per aver fatto pipì in un cespuglio. In gioco c'è il patto di onestà su cui si regge l'impresa scientifica, la credibilità della scienza presso l'opinione pubblica, e persino la possibilità che le decisioni politiche vengano condizionate da false prove a danno del Paese.» (*La frode scientifica resta impunita*, "Corriere della Sera", 14 February 2016)

«Open access will be crucial to maintain public confidence in science. Making research papers freely available is about much more than breaking the monopoly of rich academic publishers» (*Open access will be crucial to maintain public confidence in science*, "The Guardian", 20 April 2012)

«Trust in science would be improved by study pre-registration» (*Trust in science would be improved by study pre-registration*, "The Guardian", 5 June 2013)

«Moves to greater openness will enable the scientific community to take complete, collective responsibility for quality control and help to build trust in science outside the confines of academia». (*Who governs science?*, "The Guardian", 15 August 2014)

Sometimes, as in the following excerpt from "Corriere della Sera", the judicial pursuit of scientific fraud is criticized arguing that it would diminish the public trust in research:

«This is why, according to Buttha, those guilty of scientific fraud should be prosecuted. Not everyone, however, agrees and someone advocates a more preventive than punitive attitude, believing that criminalization could undermine confidence in scientific research.» (*Publications based on false data. The proposal of criminal sanctions*, "Corriere della Sera", 19 July 2014)[27]

Finally, the integrity of scientific research is regarded as the most efficient way –if not the only one- to develop and preserve public confidence in the work of scientists:

«[...] there has been wrongdoing by scientists simply erodes trust and confidence in research and is a disservice to the public [...] As someone who cares passionately about engaging the public in a debate about science, my greatest sadness is that in the absence of evidence, implying that bias exists and that there has been wrongdoing by scientists simply erodes trust and confidence in research and is a disservice to the public.» (*Yes, I work with the food industry, but I doubt they see me as a friend*, "The Guardian", 13 February 2015)

«Only with such integrity will the public, which funds our work, have confidence in us.» (*US scientists admit the truth - new discovery was an elementary fabrication*, "The Guardian", 15 July 2002)

«As for human embryonic stems (which we study for upcoming clinical trials on Parkinson), in this case science confronts us with new and interesting perspectives, often accompanied by ethical, philosophical and

[27] Translated from italian: «Ecco perché, secondo Buttha, chi si rende responsabile di una frode scientifica, andrebbe perseguito penalmente. Non tutti, però, sono d'accordo e auspicano un atteggiamento più preventivo che punitivo, ritenendo che la criminalizzazione possa minare la fiducia nella ricerca scientifica.» (*Pubblicazioni basate su dati falsi. La proposta di una sanzione penale*, "Corriere della Sera", 19 July 2014)

social dilemmas, all equally interesting. I believe that this regards the "tasks" of science. And that these dilemmas are to be taken seriously (when justified), because they are essential to build a relationship between science and society based on transparency, integrity, consistency of thoughts and behaviors of those who make science, those who study or administer it and those who believe and have hope in it. But never turning away from knowledge» (Rules and limits can only be defined by advancing in knowledge, "La Repubblica", 20 April 2015)[28]

4.2. The peer review system

Although one might think that the discussion about the peer review system is an issue of sole interests to the experts, the theme is significantly featured in media coverage. In general terms, peer-review is seen as a guarantee of "good science", the "quality control mechanism" that protects scientific research from errors or misconduct:

«This process of peer review is the primary quality control mechanism applied to the results of new scientific research.» (*Moment of truth for GM crops*, "The Guardian", 10 April 2003)

«All the data used was peer reviewed and we are certain it is fully reliable. » (*Climate change scientists face calls for public inquiry over data manipulation claims*, "The Telegraph", 24 November 2009)

«The cornerstone of maintaining the quality of scientific papers is the peer review system. Under this, papers submitted to scientific journals are reviewed anonymously by experts in the field. Conducting reviews is seen as part of the job for academics, who are generally not paid for the work. The papers are normally sent back to the authors for improvement and only published when the reviewers give their approval. But the system relies on trust, especially if editors send papers to reviewers whose own work is being criticised in the paper. It also relies on anonymity, so reviewers can give candid opinions.» (*Climate change emails between scientists reveal flaws in peer review*, "The Guardian", 2 February 2010)

«The antidote used by science to defend itself from fraud and mistakes is called "peer review", and is a filter used by magazines to publish only studies *errors free*. Before being printed, the drafts of the experiments are sent to two or three experts (the "referees") who write their evaluation anonymously and free of charge. "It is a task which is taken very seriously - explains Paolo Giubellino, physicist at CERN and INFN who's referee for

[28] Translated from italian: «Come per le staminali embrionali umane (alle quali si guarda per le prossime sperimentazioni cliniche sul Parkinson), anche in questo caso la scienza ci mette di fronte a nuove e interessanti prospettive, spesso accompagnate da dilemmi etici, filosofici, sociali altrettanto interessanti. Io credo che anche questo sia compreso fra i "compiti" della scienza. E credo che questi dilemmi siano da prendere seriamente (quando giustificati) perché indispensabili per costruire un rapporto tra scienza e società basandolo sulla trasparenza, sull'integrità, sulla coerenza dei pensieri e dei comportamenti di chi fa scienza, di chi la studia o la amministra, di chi crede e spera in essa. Senza però mai disconoscere la conoscenza.» (*Solo avanzando nella conoscenza potremo stabilire regole e limiti*, "La Repubblica", 20 April 2015)

several journals - and implies two or three days of work. Reading the draft article is not enough, you have to make sure that the method is correct. Reproducing the results, though, that is objectively impossible".» (*When researchers go wrong: stories of incorrect science*, "La Repubblica", 24 February 2012)[29]

«The scientific quality of a publication is supposed to be ensured by the peer review, where equally-qualified colleagues anonymously examine the research results submitted to the journal by the authors.» (*Academics Anonymous: scientific publishing is a license to print money, not the truth*, "The Guardian", 4 July 2014)

«The University of Bristol said that the research relied on robust evidence and had been peer-reviewed.» (*Coca-Cola and PepsiCo funded study of diet drinks*, "The Times", 19 January 2016)

On the other hand, several articles point out that the peer review is far away from being a perfect system:

«The peer review system is one of the mainstays of science, a process designed to ensure that only research of sufficient quality is published. When scientists finish their work, they submit their findings to a journal. If deemed interesting, an editor sends it to independent experts to review. They read through the paper, looking for shoddy experimental methods or misinterpretations of data, and then recommend publication, suggest revisions or reject the paper entirely. The goal is to subject research to independent scrutiny before it is widely disseminated, to prevent obvious errors or misjudgments. It is not perfect — deliberate fraud is especially hard to spot — but it is a way of keeping scientific standards high.» (*Subterfuge that brought success*, "The Times", 22 December 2010)

Furthermore, the cracks and the weaknesses of the peer review process are often underlined and discussed, revealing a clear attention by the media to existing debates within research communities:

«Cracks in the system have been obvious for years. Yesterday it emerged that 14 leading researchers in a different field - stem cell research - have written an open letter to journal editors to highlight their dissatisfaction with the process. They allege that a small scientific clique is using peer review to block papers from other researchers.» (*Climate change emails between scientists reveal flaws in peer review*, "The Guardian",

[29] Translated from italian: «Il vaccino che la scienza usa per difendere se stessa da frodi e sbagli si chiama "peer review", ed è un filtro usato dalle riviste per pubblicare solo studi a prova di errore. Prima di essere stampate, le bozze degli esperimenti vengono inviate a due o tre esperti (i "referee") che anonimamente e gratuitamente scrivono la loro valutazione. "È un compito che viene preso molto sul serio - spiega Paolo Giubellino, fisico del Cern e dell'Infn che ha svolto il ruolo di referee per diverse riviste - e comporta due o tre giorni di lavoro. Non basta leggere la bozza dell'articolo, bisogna assicurarsi che anche il metodo seguito sia corretto. Quanto a riprodurre i risultati, però, quello è oggettivamente impossibile".» (*Quando sbagliano i ricercatori le storie della scienza inesatta*, "La Repubblica", 24 February 2012)

2 February 2010)

«The dissemination of false in the scientific field is a phenomenon that highlights a weakness of the control systems, including those that are based on the peer review method. It happens always more frequently within open access publishing, which requires a fee for the publication of a manuscript, to find a less stringent level of selection with more risks on the revised material.» (*How to write a false paper*, "La Stampa", 27 February 2014)[30]

«There is a case too for opening up the processes of peer review, already begun by some journals. Though an important component of scientific quality control, peer review is hardly free from error. By tradition the identity of reviewers is concealed from the authors of submitted papers but while this enables reviewers to critique freely — an important safeguard particularly — the cloak of anonymity can be abused by reviewers too lazy or preoccupied to do a thorough job or those seeking to settle scores or gain a competitive advantage. It has been argued that peer review reports (and any response from authors) should be published, even if reviewer identities are still concealed, since this would encourage a more professional approach to the task.» (*Who governs science?*, "The Guardian", 15 August 2014)

«Every researcher I know has at least one tale of woe about their experiences at the hands of unreasonable or incompetent peer reviewers. Michael Eisen, a biologist at the University of California Berkeley, has described peer review as "conservative, cumbersome, capricious and intrusive". Richard Smith, a former editor of the British Medical Journal, has studied the practice more systematically than most and concluded that "it is ineffective, largely a lottery, anti-innovatory, slow, expensive, wasteful of scientific time, inefficient, easily abused, prone to bias, unable to detect fraud and irrelevant." [...] Questions about the efficacy of peer review keep coming up. The most selective journals, which one might suppose to have the most rigorous peer review, are also those with the highest rates of retractions (papers deleted from the published literature due to serious errors or fraud.» (*Peer review, preprints and the speed of science*, "The Guardian", 7 September 2015)

«In all the recent controversies the phrase "peer review" has been on everyone's lips. Of course, peer review is a vital part of the scientific process but it is not the final guarantor of scientific veracity and probity. The best review of a scientific paper is the work that follows, when researchers try to replicate or build on the findings. Some recent cases of scientific fraud were published in the best peer-reviewed journals.» (*Climate science's chinese whispers. The books that separate global warming fact from fiction*, "Independent", 23 April 2010)

This awareness often stems from highly visible cases of misconduct, which directs attention to the failures of the peer review system:

[30] Translated from italian: «La diffusione dei falsi in ambito scientifico è un fenomeno che evidenzia una debolezza dei sistemi di controllo, incluso quelli che si basano sul metodo peer review. Capita più spesso però nell'editoria open access, che richiede un compenso per la pubblicazione di un manoscritto, di riscontrare un livello meno rigoroso di selezione con maggiori rischi sul materiale revisionato.» (*Come costruire un falso articolo scientifico*, "La Stampa", 27 February 2014)

«Like other academic fields, physics polices itself through a peer review system. When a physicist submits a paper for publication, the editor sends it out to be judged by specialists in the author's field. These referees recommend publication (sometimes with revision) or rejection. The system is designed to weed out substandard work, and to improve promising submissions and make them publishable. It's supposed to keep things honest [...] The Schön affair has besmirched the peer review process in physics as never before. Why didn't the peer review system catch the discrepancies in his work? A referee in a new field doesn't want to "be the bad guy on the block," says Dutch physicist Teun Klapwijk, so he generally gives the author the benefit of the doubt. But physicists did become irritated after a while, says Klapwijk, "that Schön's flurry of papers continued without increased detail, and with the same sloppiness and inconsistencies."» (*Big trouble in the world of 'Big Physics'*, "The Guardian", 18 September 2002)

Despite all the problems and criticisms, however, an often invoked argument with regard to peer review is that «it's hard to find anything better»:

«Peer review – where articles submitted to an academic journal are reviewed by other scientists from the same field for an opinion on their quality – has always been recognised as problematic. It is time-consuming, it could be open to corruption, and it cannot prevent fraud, plagiarism, or duplicate publication, although in a more obvious case it might. The problem with peer review is, it's hard to find anything better.» (*Bad Science: Peer review is flawed but the best we've got*, "The Guardian", 12 September 2009)

«A profound expert of the Italian system of peer review, the pathologist Paolo Bianco, who has worked extensively at the National institues of Health (NIH) and is part of NIH registry of evaluators, is used to say of this procedure what Churchill said of democracy: it is the worst system, apart from all the others. To the conclusion that there is no better system for assessing the quality of publications and research projects, also came two in-depth studies studies on how limiting costs and improving the peer review processes, conducted by the British Research Council and by the NIH in theUS. » (*Do not empy the «peer review»*, "Il Sole 24 Ore", 14 June 2009)[31]

«And even if retractions are not that many (in 2011 concerned 35 items per 100,000), they are likely to cast a shadow on the effectiveness of the peer review process. The problem is that we do not have anything better than this.» (*Scientific research. The scam of fake data and the performance anxiet,* "La Repubblica", 13 March

[31] Translated from italian: «Un profondo conoscitore italiano del sistema di peer review, l'anatomopatologo Paolo Bianco, che ha lavorato a lungo ai National Institues of Health (Nih) e fa parte del registro Nih dei valutatori, è solito dire di questa procedura quello che Churchill diceva della democrazia: è il peggior sistema,a parte tutti gli altri. Alla conclusione che non esiste sistema migliore di valutazione della qualità delle pubblicazioni e dei progetti di ricerca, sono giunti anche due approfonditi studi su come limitare i costi e rendere più efficienti processi di peer review, condotti dai British Research Councils e i NIH negli Usa.» (*Non svuotate la «peer review»*, "Il Sole 24 Ore", 14 June 2009)

2016)[32]

Newspapers also explore the specific problems of the peer review system.
Firstly, the fact that the reviewers obviously don't repeat the whole research and they don't even verify raw data and their processing. Usually, they just «check plausibility -and not the truth- of the claims». Secondly, the lack of anonymity can lead to favoritism or corruption, as well as competition might push reviewers to obstructs others' researches:

«But journals do not have their control methods? "Yes, and they are the so-called referees: experts evaluating the article before the publication. But they look at the method, redo the accounts, check the statistics. But they do not repeat the research. After all, doing the referee takes already much time. Moreover, in specialised fields the experts are just a few, sometimes only four or five. Therefore, as far as they are anonymous, you can figure out who they are and they can figure out who's the author of the research they are evaluating. That may lead to problematic mechanisms, such as the delay of the publication of a rival".» (*Giovanni Boniolo: "To much pressure to publish paves way to frauds"*, "La Repubblica", 30 March 2015)[33]

«Nature and the BMJ, like all serious scientific journals, rely on peer review to establish the authority of the papers they publish, and peer review, it appears, is less reliable than it sounds. Some journals rely on too narrow a group of reviewers who are all too human. In highly specialised fields, self-interest may influence their review. Peer review anyway has limits. Reviewers are not expected to check the raw data, only the way it has been used. And then there is the conspiracy of hope. It is only human to want there to be, say, a way of stimulating ordinary cells so that they behave like stem cells (the research Nature has had to retract).» (*The Guardian view on the end of the peer review*, "The Guardian", 6 July 2014)

«People talk of peer review. I've been peer reviewed twice: in gastroenterology and developmental paediatrics. Such reviews check plausibility, not the truth of the claims. When I was reviewed, I had to insist that journal staff checked my facts.» (*Think Tank: A warning shot for the cheats in white coats*, "The Times", 9 January 2011)

[32] Translated from italian: «E anche se le ritrattazioni non sono molte in assoluto (nel 2011 riguardavano 35 articoli su 100.000), rischiano di gettare un'ombra sull'efficacia del processo di peer review. Il problema è che non ne abbiano uno migliore.» (*Ricerca scientifica. La truffa dei dati ritoccati e l'ansia da prestazione*, "La Repubblica", 13 March 2016)

[33] Translated from italian: «Ma le riviste non hanno i loro metodi di controllo? "Sì, e sono i cosiddetti referee: esperti che valutano l'articolo prima della pubblicazione. Solo che questi guardano il metodo, rifanno i conti, controllano la statistica. Ma non ripetono la ricerca. Del resto, fare il referee porta via tempo già così. Poi in settori molto specifici gli esperti sono pochi, anche quattro o cinque. Per cui, per quanto coperti dall'anonimato, si può capire chi siano mentre loro possono capire a chi appartenga la ricerca che stanno valutando. Questo può aprire a meccanismi problematici come il ritardo della pubblicazione di un rivale".» (*Giovanni Boniolo: "Troppa pressione a pubblicare: le frodi sfuggono"*, "La Repubblica", 30 March 2015)

Other serious flaws of research processes and practices are also featured in media discourse. Impact factor and other quantitative indicators are criticized for biasing towards quantity rather than quality of publications. Also, journals tend to prefer to publish novel and positive results, rather than negative or replicative: this habit seriously undermines research integrity[34]. The pressure to get results published quickly and to have positive results is seen as a factor potentially leading to manipulate data or results.

4.3. What is research integrity?

On the basis of the media coverage analyzed, we can easily conclude that the daily press usually talks about the integrity of research through a negative lens, mostly in relation to its breaches, than in a positive/constructive way. Moreover, positive definitions of integrity are usually related to the issuing of new codes of conduct or guidelines; and even in those occasions, articles mostly report scientists' declarations about such code/guidelines. This happened in the UK, for example, in 2011, in occasion of the *Draft Guidelines in Biomedical Research*:

«• Researchers should be honest in respect of their own actions in scientific research and in their responses to the actions of other researchers. This applies to the whole range of scientific work, including experimental design, generating and analyzing data, applying for funding, publishing results and acknowledging the direct and indirect contribution of colleagues, collaborators and others.
• Plagiarism, deception or the fabrication or falsification of results should be regarded as a serious disciplinary offence. • Researchers are encouraged to report cases of suspected misconduct and to do so in a responsible and appropriate manner.» (*Draft guidelines on Good Practice in Biomedical Research*, "The Guardian", 24 August 2001)

A similar pattern emerged in 2006 and 2007, when the " Rigour, Respect and Responsibility" code was proposed by the Royal Society together with the UK Chief Scientific Adviser - who also signed an article in "The Guardian". Research Integrity is here defined in terms of rigour, honesty, respect and responsibility:

[34] Cf. Fanelli, D. (2013) Positive results receive more citations, but only in some disciplines. *Scientometrics*, *92*, 2: 701-709.

«It calls for rigour, honesty and integrity among scientists, who should take steps to prevent corrupt practices and professional misconduct and declare conflicts of interest. Scientists should ensure that their work is lawful and justified, they should "minimise and justify any adverse effect" their work may have on people, animals and the natural environment.» (*Ethics code seeks to regulate science*, "The Guardian", 5 January 2006)

«The title of the code - Rigour, Respect and Responsibility - provides a simple summary of the values that each of us espouses as practicing scientists; it should also demonstrate to the public that scientists take ethical issues seriously. There are already other, more detailed codes for more specific situations: for example, for engineers in the construction industry. The universal ethical code represents an overarching framework standing over these.» (*Rigour, Respect and Responsibility*, "The Guardian", 20 March 2007)

A similar trend applies also to Italy. Articles in 2015 and 2016 refer to the first national code for research integrity[35] issued by the National Council for Research (CNR). These guidelines address issues such as dignity, responsibility, fairness, rightness and diligence:

«The main principles adopted are: dignity, responsibility, fairness, honesty and diligence. They are followed by a rich enunciation of behaviors that promote integrity in research and thus the behaviors to be avoided as illicit, dubious or irresponsible.» (*The 5 values of integrity against fraud*, "Il Sole 24 Ore", 14 February 2016)[36]

Research integrity is also described as the most important thing for a laboratory:

«"There is nothing more important for a laboratory than scientific integrity," Mr Shank told laboratory employees.» (*US scientists admit the truth - new discovery was an elementary fabrication*, "The Guardian", 15 July 2002)

Or as an instrument of every day practice of a researcher:

«Bioethics and research integrity are not only causes for reflection, but also some of the tools that a good researcher uses every day.» (*«Today, only knowledge can make us richer»*, "Il Sole 24 Ore", 13 March 2011)[37]

[35] Cf. «When in 2013 "Nature" reported another episod of misconduct (the case of the oncologist Alfredo Fusco), the serious delay of Italy in the field of the codes for research integrity emerged» (*Scientific fraud is not punished*, "Corriere della Sera", 14 February 2016). Translated from italian: «Quando nel 2013 "Nature" aveva riferito di un altro episodio di cattiva condotta (il caso dell'oncologo Alfredo Fusco) era emerso un grave ritardo dell'Italia nel campo delle norme sull'integrità della ricerca scientifica.» (*La frode scientifica resta impunita*, "Corriere della Sera", 14 February 2016).

[36] Translated from italian: «I principali principi adottati sono: dignità, responsabilità, equità, correttezza e diligenza. Ad essi fa seguito una ricca articolazione di condotte che promuovono l'integrità nella ricerca e quindi i comportamenti da evitare in quanto illeciti, discutibili o irresponsabili.» (*I 5 valori dell'integrità antifrode*, "Il Sole 24 Ore", 14 February 2016)

There are also some articles that speak about integrity of science like something that is threatened by, for instance, political pressures or by misconduct itself. From this perspective, research integrity is meant to be a value that needs to be preserved:

«As political advocates we should understand that using science as a true/false bludgeon to score points in public debates chips away little by little at the integrity of science. Knowledge is always provisional and often contextual. Of course, we should also understand that there are always going to be researchers and reporters among those political advocates looking to wage political battles through science. Securing scientific integrity and winning a political fight are not always the same thing. Thus, scientific integrity needs its own champions.» (*Fooling ourselves with science: hoaxes, retractions and the public*, "The Guardian", 2 June 2015)

«In some cases, gaming of research practices can reach the point where it threatens the integrity on which science so crucially depends.» (*The games we play: A troubling dark side in academic publishing*, "The Guardian", 12 March 2015)

Finally, only in one case we have a definition of research integrity in relation to a specific scientific practice, i.e. clinical trials. The following article, however, highlights how integrity means different things to different actors. For researchers and ethics committees, it means "intensive vigilance of institutional ethics", while for clinicians it means " a ceaselessly inquiring":

«Doctors must pause to think if the evidence-based treatment we think we are practicing has been acquired from research conducted with total integrity. For researchers and ethics committees, this means intensive vigilance of institutional ethics. For clinicians, it means applying a ceaselessly inquiring mind to the reams of data thrust upon us everyday and not being afraid to acknowledge that in many areas of medicine, there is no one right answer.» (*We need clinical trials but we must remain vigilant*, "The Guardian", 5 January 2016).

[37] Translated from italian: «Bioetica e integrità della ricerca non sono solo aree di riflessione, ma parte degli attrezzi che usa quotidianamente un buon ricercatore.» («Oggi solo il sapere può farci più ricchi», "Il Sole 24 Ore", 13 March 2011)

5. Research integrity in the daily press: summary and final remarks

5.1 Key trends and results

The analysis conducted for this report should mainly be seen as a preliminary step to investigate media representations and societal discourse about research integrity, with a view also to guide further steps within the PRINTEGER work programme - e.g. the identification and selection of those case studies having triggered relevant media attention, themes for focus group discussions and survey research.

Nevertheless, some indications emerge from the analysis:

- attention to and coverage of research integrity by the daily press has increased over time, particularly during the last 5-6 years both in Italy and (even more visibly) in the UK, mostly in conjunction with specific cases of misconduct (proved or suspected);
- media discourse is substantially dominated by a 'negative' frame, paying most attention to misconduct/breaches of integrity rather than to 'positive' definitions of integrity;
- rare, positive definitions of integrity mostly refer to the issuing of new codes of conduct or guidelines;
- both for the UK and Italy, many articles were triggered by specific cases of misconduct; however, a relevant proportion of articles also deal with fraud and integrity more in general: e.g. reporting the results of a survey, the incidence of malpractices or about alleged flaws in the research process.
- in terms of research fields, the Medical and Health sciences dominate coverage of research misconduct both in Italy and in UK, with about one article out of two referring to this field (43% for UK and 58% for Italy);
- responses to research misconduct are mostly defined by the press in terms of negative sanctions against the individual (such as firing, formal complaint) or codes of conduct introduced after relevant cases of misconduct;
- the importance of preventing misconduct is prominent among the proposed solutions, e.g. in terms of the need of improving the peer review system or the research practice more in general;
- the relevance of education and training of young researchers and the active promotion of integrity seem largely neglected both among actual responses and proposed solutions;

- media reports and discussion display an interesting awareness of those factors that could lead a researcher to commit fraud, starting with the pressure exercised by private funders;
- public trust in science and in scientists is often mentioned as an essential element to reflect on misconduct and its consequences.
- discussions about the adequacy and effectiveness of the peer review process in contemporary research, that may in principle seem an issue of exclusive interest to experts and policy makers, are actually significantly covered in the daily press.

5.2 Research integrity in the press and its connection with the discussion in other contexts

The data collected and analysed for this report provide an interesting opportunity to connect to the report by Horbach and Halffman and their reference to the dichotomy “promotion vs. repression”.

On the basis of our analysis, it seems that both in the Italian and UK daily press the key dichotomy is actually "prevention vs sanctions", with a more accentuated attention for the prevention of misconduct within institutions, rather than for sanctions and punishments of researchers.

Another relevant difference has to be seen in the fact that while their report found limited reference to “data”, the term being «hardly used in all the documents», a relevant number of newspaper articles refer for example to the need for "raw data" to be available; the expression "open data" comes out often and the keywords "fake/falsification" are employed in association with the word "data"[38].

Finally, and consistently with their results, the daily press places relevant emphasis on the themes related to "finance" of the research, as Horbach and Haffman call them. For instance, the expression "conflict of interests" is one of the most recurrent keyword in UK articles, and financial interests and private funding are considered one of the main causes of misconduct, both by UK and Italian newspapers.

[38] More precise accounts of the occurrences of the word can be provided on request.

Another element emerging from media analysis is that newspapers usually report episodes of misconduct through the voice of journalists: in journalistic terms, misconduct cases are thus often framed as general news cases, rather than specific to the world of science. On the other hand, when talk about integrity of research –or even the flaws of peer-review system, the weaknesses of scientific research and possible solutions- reflections on the issues are abdicated to scientists themselves. Reasons of this tendency are certainly manifold[39].

We shall highlight the fact that malpractices seem to be perceived like something that urgently need to be told to the public and then discussed with the whole society, because of their immediate repercussions on everyone's life. Conversely, the debates about how to limit the incidence of misconduct and to improve the system of scientific research is seen like an issue that can be only solved and therefore presented/intepreted by scientists. Newspapers still talk about these themes, but with no relevant mediation of journalists, who simply report scientists' views and opinions on the subject.

As Cinzia Caporale, head of the research integrity committee at CNR (Italian National Research Council), noted[40], research integrity and related issues are relatively recent themes, which are emerging within the public debate since the last few years. This means that, unlike other topics such as GMO or vaccines or climate change debates, there's a reduced amount of available contents. The available ones are mainly provided by researchers or research institutes themselves, which journalists are forced to rely on by the lack of other sources[41]. As a consequence, it is more likely that newspapers articles report the debates as they are developing within scientific community, with no relevant deviation to considerations or discourses that did not have yet time to emerge among the general public.

This hypothesis is substantially confirmed by our results: for example, the way newspapers talk about the problem of public confidence in science, which emerged as a recurrent key-theme throughout the collected articles, often substantially reflect the way this is discussed within the scientific community[42]. The same applies to criticism of the peer review system

[39] On this topic see for instance Reed, Rosslyn (2001), (Un-)Professional discourse?: Journalists' and scientists' stories about science in the media, *Journalism, 2*, 279-298.

[40] The interview was conducted by Ilaria Ampollini on Tuesday 15th November 2016.

[41] Even if there's no literature regarding this hypothetical theoretical framework, we still want to propose the persuasive interpretation suggested by C. Caporale.

[42] Recent reflections on the theme of public trust and confidence in science include: Arimoto, Tateo and Sato, Yahushi (2012), Rebuilding Public Trust in Science for Policy-Making, *Science, 337*, 1176-1177; Gauchata, Gordon (2012), Politicization of Science in the Public Sphere. A Study of Public Trust in the United States, 1974 to 2010,

(the flaws and the weaknesses of the process underlined by newspapers are mainly identical to which the scientific literature discuss[43]) and to the definitions of "research integrity", that are often directly borrowed from the guidelines and the codes promoted by the institutions.

5.3 Research integrity as a boundary object?

Public discourse and communication about science, particularly under certain conditions, can be described as centered on key discursive 'boundary objects' (e.g. 'gene', 'DNA', 'Big Bang', AIDS) lying at the intersection between the specialist and popular levels. Such objects make communication possible without necessarily requiring consensus, for an object may be interpreted and used in quite different ways within different types of discourses. 'Gene' could thus be seen as a boundary object, a label employed in both specialist and public contexts and thereby providing a common language although translated in different ways in a laboratory conversation and in a car advertisement[44].

From a certain point of view, on the basis of the data collected for this study, we could consider research integrity as a boundary object. Research integrity, as presented in the media, allows discussion across different disciplinary areas and among different actors: scientists, institutions' managers, policy makers, funders, media and society at large. It

American Sociological Review, 77, 2: 167-187; Critchley, Christine R. (2008), Public opinion and trust in scientists: the role of the research context, and the perceived motivation of stem cell researchers, *Public Understanding of Science, 17*, 3: 309-327; Friedman, Paul J. (2002), The impact of conflict of interest on trust in science, *Science and Engineering Ethics, 8*, 3: 413-420; Haerlin, Benny and Parr, Doug (1999), How to restore public trust in science, *Nature, 400*, 499; Lidskog, Rolf (1996), In Science We Trust? On the Relation Between Scientific Knowledge, Risk Consciousness and Public Trust, *Acta Sociologica, 39*, 1: 31-56. The cited Swedish study (Vetenskap & Almanhet 2014) does not find a correlation, however, between coverage of scientific misconduct and loss of confidence in science in public opinion.

[43] For example: Lee, Carole J. et al. (2012), Bias in peer review, *Journal of the Association for Information Science and Technology, 64*, 1: 2-17; Abramo, Giovanni and D'Angelo C. Andrea (2011), Evaluating research: from informed peer review to bibliometrics, *Scientometrics, 87*, 3: 499-514; Južnič, Primož et al. (2010), Scientometric indicators: peer-review, bibliometric methods and conflict of interests, *Scientometrics, 85*, 2: 429-441; Resnik, David B. et al. (2008), Perceptions of Ethical Problems with Scientific Journal Peer Review: An Exploratory Study, *Science and Engineering Ethics, 14*, 3: 305-310; Smith, Richard (2006), Peer review: a flawed process at the heart of science and journals, *Journal of the Royal Society of Medicine, 99*, 4: 178-182.

[44] See Bucchi, M. (2004), Can Genetics Help us Rethink Communication? Public Communication of Science as a 'Double Helix'". *New Genetics and Society*, *23*, 3:269-283; Bucchi, M. (2008), Of Deficits, Deviations and Dialogues: Theories of Public Communication of Science, in Bucchi, M. and Trench, B., *Handbook of Public Communication of Science*, London: Routledge, 57-76. The concept of 'boundary object' was introduced by Star and Griesemer (Star, Susan Leigh, Griesemer, James R. (1989), Institutional ecology, 'translations' and boundary objects, amateurs and professionals in Berkeley's Museum of Vertebrate Zoology, 1907-39, *Social Studies of Science*, *19*, 3:387-420). Boundary objects are objects «plastic enough to adapt to local needs and constraints of the several parties them, yet robust enough to maintain a common identity across different sites. They are weakly structured in common use and become strongly structured in individual-site use [...]. They have different meaning in different social worlds but their structure is common enough to more than one world make them recognizable, a means of translation. The creation and management of boundary objects The creation and management of boundary objects is a key process in developing and maintaining coherence across intersecting social worlds» (*op. cit.*, p. 393).

allows also these actors to discuss – through research integrity – about themes that would be otherwise rarely be discussed in such a broad context: funding mechanisms, peer review systems, publication practices, trust in science and scientists.

This line of inquiry and interpretation, however, should be developed and substantiated in the context of other project work packages and in future research more in general.

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