



Research Integrity Supervision Practices and Institutional Support: A Qualitative Study

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Abstract

Scientific malpractice is not just due to researchers having bad intentions, but also due to a lack of education concerning research integrity practices. Besides the importance of institutionalised trainings on research integrity, research supervisors play an important role in translating what doctoral students learn during research integrity formal sessions. Supervision practices and role modelling influence directly and indirectly supervisees' attitudes and behaviour toward responsible research. Research supervisors can not be left alone in this effort. Research institutions are responsible for supporting supervisors in being more aware of their RI function, and in supporting responsible supervision practices to have a positive cascading effect on supervisees' research practices. We interviewed 22 European research supervisors to investigate how they perceive their role as research integrity trainers and their real-life supervision practices. Moreover, we investigated their points of view concerning the role of research institutions in supporting supervision practices. Although there are different commonalities in supervisors' perception of their research integrity-related role, differences are emphasised depending on the supervisors' characteristics such as academic domain, seniority, working country and gender. In addition, supervisors' way of mentoring depend also on supervisees' learning curve. Overall, all supervisors agreed on institutions playing an important role in support their supervision effort and practices. This study aims to be a starting point for better understanding research integrity supervision practices and the role of institutions in supporting them. Moreover, it puts the basis to further investigate differences in supervision practices depending on supervisors' characteristics.

Keywords Research integrity · Good research practices · Research supervisor · Mentor · Supervision practices · Mentorship · Institutional support

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Introduction

Promoting research integrity (RI) and responsible research practices is increasingly important to foster a healthy and responsible research climate (Science Europe Working Group on Research Integrity, 2016). When looking at the high percentage of researchers who admit research misconduct and questionable research practices (QRPs) (Fanelli, 2009; Gopalakrishna et al., 2022; Pupovac & Fanelli, 2015; Xie, Wang & Kong, 2021), one can understand why RI is gaining importance in science. RI intends to address the problem by performing research according to responsible research practices, and in line with high professional, methodological and ethical standards (Science Europe Working Group on Research Integrity, 2016). Raising RI awareness and promoting responsible research practices is a collective and multifactorial responsibility (Bouter, 2018), and it has to be done at an individual and a collective level. This can be done by promoting the organisation of courses and workshops, but also by responsible supervision practices (Resnik, 2012). Responsible supervision is essential for the promotion of RI, both individually and collectively, as supervisors act as role models for research practise and collaboration (Embassy editorial team et al., 2021).

Research supervisors are responsible for engaging in the discussion on RI, with their supervisees (e.g. PhD candidates) and for enhancing the RI climate (ALLEA, 2017; Bell, 2015; Forsberg et al., 2018; Mejilgaard et al., 2020). Supervisors are not only responsible for transferring technical skills related to the research process and career advice, but they play also a pivotal role in fostering RI awareness and modelling fundamental attitude toward responsible research practices (Bell, 2015; Whitbeck, 2001). Besides instructing directly about good research practices and boundaries about what can be done or not, supervisors are exemplars for their doctoral candidates (Bell, 2015; Fisher, Fried & Feldman, 2009; Resnick, 2012; Rose, 2003; Weil, 2001). By acting as role models and showing specific virtues and characteristics, supervisors can influence and shape the behaviour and attitude of their PhD candidates (Abedin et al., 2012; Antes, Mart & DuBois, 2016; Gray & Jordan, 2012; Löfström et al., 2015; Rose, 2003). However, supervisors' characteristics, practices, attitudes and behaviour can influence on supervisees' research practices and understanding in terms of RI (Moncur, 2013; Muthanna & Alduais, 2021; Tjldink et al., 2016). It is not yet clear how other type of supervision (e.g. administrative, career, technological and supportive) other than ones RI-related, can influence PhD candidates' behaviour and the entire research climate. Moreover, to our knowledge, empirical literature on possible differences depending on gender, seniority or discipline of supervisors and other variables is lacking.

Although responsible supervision practices are main responsibility of the research supervisors, research institutions are responsible to support, help and assist supervisors in promoting RI practices, enhancing the general RI climate and putting them into the condition to fulfil at the best their role (Bird, 2001; Hauer et al., 2005). Dedicated training for supervisors and recognition for their efforts by institutions seems to be some of the needed steps for supporting supervisors (Bird, 2001; Kornfeld, 2012; Ripley et al., 2012; Titus & Ballou, 2014; Rose, 2003). While there are different conceptual papers on the importance of research institutions in supporting supervisors and responsible supervision (Bird, 2001; Hauer et al., 2005), to our knowledge, qualitative studies addressing supervisors' opinions on what institutions can do to support them are missing.

This study aims to fill the empirical knowledge gap on how responsible supervision can influence individual responsible research and improve RI climate directly and indirectly, and whether differences in gender, seniority, discipline and other variables can have an impact on supervision practice. In addition, we want to preliminary explore empirically supervisors' perspectives concerning the role of institutions in supporting responsible supervision. To this end, we conducted an interview study involving European research supervisors on these topics.

Methods

We employed a qualitative methodology and organised a set of in-depth semi-structured interviews. We developed an interview guideline (Supplement 1-interview guideline) based on preliminary work on the topic (Pizzolato & Dierickx, 2022a). The interview guide has been created by using two main research questions. The first one is about *exploring how supervisors' behaviour and different practices can influence supervisees' research practices and related behaviour*. The second one is about *how research institutions can support supervisors and responsible supervision to help them to promote RI and responsible research*. During the interview, participants were also asked to rank pre-selected explicit and implicit supervision practices. These practices are described in the theoretical and empirical literature on the topic (Alfredo & Hart, 2011; Anderson et al., 2007; Brown & Treviño, 2014; Bukusi, Manabe & Zunt, 2019; Faden et al., 2002; Fisher, Fried & Feldman, 2009; Kornfeld, 2012; Titus & Ballou, 2014; Wright, Titus and Cornelison, 2008). Participants were also asked to indicate which virtues they think are important to act as a good supervisor and a role model, by choosing among virtues highlighted in the European Code of Conduct and literature (ALLEA, 2017; Character traits: Scientific virtue, 2016; Tomić, Buljan & Marušić, 2022).

We followed the Consolidated Criteria for Reporting Qualitative Research guidelines (COREQ) to report the results of the study (Tong, Sainsbury & Craig, 2007). Not all the 32 criteria are met, namely experience and training of the research team, presence of non-participants, repeated interviews, and participant checking. The [methods](#) section is divided as follows: recruitment, data collection, data analysis and ethics.

Recruitments

To get insights regarding supervisors' perceptions of their role as RI trainers and role models, we searched for supervisors with different characteristics. The potential interviewees were selected based on the following criteria: gender, country workplace, academic domain, seniority and whether they hold/held a European research grant(s) (e.g. European Research Council (ERC) grants, Coordinators of European Union (EU)-funded projects). We started the recruitment by asking for potential interested supervisors within our research network. Following a random sampling, we adopted a purposive sampling to identify and select supervisors with specific characteristics (e.g., gender, country workplace, academic domain, seniority and whether they hold/held a European research grant(s)). We invited them by email and by using an information letter describing the aim of the study (Supplement 2- Information letter). However, not to anticipate the real aim of the study and drive

interviewees' answers before starting the interview, we titled and described the study differently. We described the study as we were exploring supervisors' role in the development of their PhD candidates, without mentioning the topic of RI. Supervisors interested in participating were asked to sign the informed consent and to fill in a brief demographic questionnaire (Supplement 3- Demographic questionnaire). We asked participants to choose among three academic fields, namely social sciences and humanities, life sciences, and physics and engineering. To avoid overlaps due to the multidisciplinary nature of some research, we decided to use the division used by the European Research Council (ERC- https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/wp-call/2022/wp_horizon-erc-2022_en.pdf). To assess the seniority of participants, we asked them the number of PhD candidates they have supervised, and the number of PhD candidates and post-doctoral researchers they are currently supervising (at the time of the interview). For the benefit of clarity and the writing process, we refer to supervisors who have supervised or are supervising less than ten PhD candidates in total as juniors and the ones more experienced as seniors.

Data Collection

We conducted 22 in-depth semi-structured interviews between October 2021 and January 2022. Due to the Covid-19 crisis, we carried out all the interviews online using Microsoft Teams. After 10 interviews, we adjusted the interview guidelines by adding one more question at the end of the interview (Supplement 1a- Modified interview guideline). During the first 10 interviews, some supervisors start discussing briefly the differences between being a good researcher and a good supervisor. Therefore, although quite late during the study, we decided to ask explicitly supervisors their opinion on the correlation between being a good researcher and a good supervisor. The interviews lasted on average one hour. After transcribing the interviews, no member checks were conducted.

Data Analysis

The data analysis was based on the thematic analysis approach and organised in two steps (Braun & Clarke, 2006; Vandemeulebroucke et al., 2019). Both authors participated in the analysis and coding of the interviews. In the first step, the transcripts were analysed by following the interview guideline and using a thematic inductive approach (Boyatzis, 1998, Vears and Gillam, 2022). This first step was performed alongside the interview process. The data were broadly coded with different colours to identify the main overarching themes. In the second step, the transcripts were re-analysed by using a deductive approach and narrowly coded to identify specific sub-themes (Crabtree & Miller, 1992). All the analysis process was carried out by using QRS NVivo 12 (NVivo qualitative data analysis software; QSR International Pty Ltd. Version 12).

Ethics

The interviews were performed after having obtained ethics approval by the Social and Societal Ethics Committee (SMEC) of KU Leuven under file number G-2021-3922. All the interviews were video-recorded and verbatim transcribed. After transcription, the video

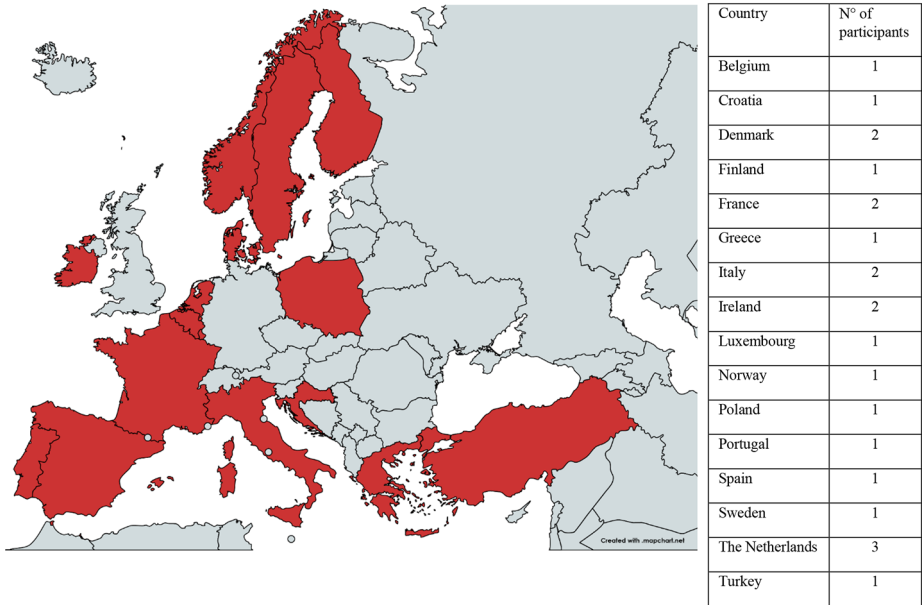


Fig. 1 Country distribution

Table 1 Demographics

Characteristics	Number of participants
Gender	
Female	11
Male	11
Participants for each academic domain	
Social sciences & Humanities	8
Life sciences	7
Physics and Engineering	7
Seniority	
Senior	12
Junior	10
EC Grants	
Yes	11
No	11

recordings were destroyed and the transcripts will be kept in a secure shared KU Leuven J-drive, accessible only to the researchers involved in the study.

Results

We performed 22 interviews with supervisors based in 16 countries (Fig. 1- Country distribution and Table 1- Demographics).

During the interviews, supervisors discussed seven different themes related to their role and practices, namely supervisors' role, supervisors' responsibility level, supervisors' practices concerning RI, supervision style, explicit practices, implicit practices and virtues expressed in role modelling. In these themes, the role of supervisors in promoting RI and how supervision practices can influence supervisees' research practices are central. The results describe attitudes, behaviour and practices that can influence directly and indirectly RI at the individual and the collective level. Moreover, supervisors discussed three other themes related to the responsibilities of institutions in supporting supervision practices, namely training, institutional support and good supervision practices as criteria for assessment and promotion. An extra theme was discussed about the relation between being a good researcher and a good supervisor. Interesting quotes for each theme are collected in Table 2.

In the [results](#) section, we highlight supervision-related differences depending on gender, discipline, seniority and country. However, there were no supervision-related differences concerning whether supervisors hold/held a European research grant.

Supervisors' Role

Most supervisors agreed on their main role being supervising PhD candidates as individuals and the development of their competencies. Supervisors should help, support and encourage PhD candidates in becoming intellectually independent as researchers during what was defined as "vocational training" (P12). Supervisors should make sure to train PhD candidates in strengthening their communication skills and their ability to work in teams. The latter was brought up mainly by supervisors working in the life sciences, engineering and physics. As highlighted by one supervisor, their main role is "to train the next generation of researchers" and "to train them how to navigate the academic landscape" (P20).

A few senior supervisors highlighted how they should act on the development of a relationship with PhD candidates "based on trust and mutual respect" (P 5).

So it's really about finding the balance between guiding and letting someone develop himself (the PhD candidate). It's a question of trust, and it's not the same strategy for every candidate (P11).

Another emphasised role by some female supervisors is being of "emotional support" (P18). Supervisors should emotionally take care of their PhD candidates by supporting them in stressful periods and in looking after their "mental health" (P21). Moreover, knowing whether something is happening within the personal sphere of the PhD candidates is important because can influence the PhD work.

A few supervisors also mentioned their role in supporting PhD candidates with administrative formalities, role modelling regarding the work-life balance and with their future career steps.

While discussing their different roles, some supervisors working in the field of engineering discussed the necessity to be good at recruiting PhD candidates to maximize the chances of success in both directions and to enable the completion of the project.

Table 2 Interesting quotes per topic

THEME	QUOTES
Supervisors' role	<i>So, it's really about finding the balance between guiding and letting someone develop himself (the PhD candidate). It's a question of trust, and it's not the same strategy for every candidate (P11)</i> <i>The supervisor should communicate effectively as regards the standards, rules and procedures, including the legal ones and some customary rules of academy integrity and academic honesty (P5)</i>
Supervisors' responsibility level	<i>I would feel quite responsible for the research part, let's say the technical end. I would feel partly responsible as well, if rules were broken. It's hard to read everything, it's hard to read every line, there's trust relationship with the students(P15)</i>
Supervisors' practices in relation to RI	<i>It's a kind of informal training, often these kinds of questions are all. I have team meetings every week and I also have a select environment where we're all together (P9)</i> <i>I think this responsibility of the supervisor and really lowered their stress level because I think that kind of mistakes that happens in a reset, it's not the responsibility of the student (P21)</i>
Supervision style	<i>Mentoring is also how to learn to respond to students' different needs (P 7)</i> <i>It is very much dependent on the level of established trust between the supervisor and the student (P 17)</i>
Explicit practices	<i>I do not consider regular meeting as a special practice, it is more a standard way to supervise student (P 19)</i>
Implicit practices	<i>It is much more difficult because they are all kind of equally important (P 12)</i>
Virtues expressed in role modelling	<i>I think the first one is respectfulness. Because without respectfulness, you cannot provide a trustworthy environment and a peaceful learning and research environment (P5)</i>
Institutional training for supervisors	<i>Institutions have to take responsibility for training their supervisors (P 1)</i> <i>Courses are often led by someone without experience in guiding PhD candidates (P 14)</i>
Institutional support	<i>It would be helpful to have a kind of contract, a formal written agreement between the supervisor and the PhD candidate (P 12)</i> <i>Because if we put in a lot of funds and can get people for doing the administrative work, this helps the researcher to focus only on the research and on the methodology (P19)</i>
Supervision practices as extra criteria for assessment and promotion	<i>Good mentorship. Yeah, absolutely, because I think, you are guiding the new generation into academia for that. That should definitely be. I mean, teaching is the criteria for promotion. This is teaching as well.</i>
Relation between being a good researcher and a good supervisor	<i>It's important to be a good researcher, which means that you have good research practice and you know the topic you are working on. This is, of course, an important aspect of being a good supervisor as well. But there is so much more in being a supervisor than only being a good researcher (P 14)</i>

Concerning RI

Supervisors discussed specifically their role about RI. Some described their role as RI trainers as something intrinsic to their duty as supervisors. For them, transmitting RI competencies and attitude toward responsible research practices is part of guiding PhD candidates to becoming scientists and understanding their responsibilities.

Without integrity, there is no possible way to solve our scientific problem. I think this is associated with the idea of doing science (P1).

Some supervisors – working in countries where the topic of RI is more established – emphasised their role in providing direct and explicit instructions to their PhD candidates.

The supervisor should communicate effectively as regards the standards, rules and procedures, including the legal ones and some customary rules of academy integrity and academic honesty (P5).

Other participants emphasised their role in acting as a “good and responsible role model” (P5), in doing science but also in respecting colleagues. Some others also discussed their responsibility to provide PhD candidates with a responsible learning environment.

Some supervisors – within the life sciences and engineering - emphasised their responsibility to make sure that all team members have a “common understanding of what the whole research process is” (P 1) in terms of responsible research practices. Moreover, a few reported also feeling responsible “to lower the stress and to take responsibility for their (PhD candidates) mistakes” (P 21).

In relation to RI, supervisors discussed also their role when acting as co-supervisors. In terms of role modelling, they reported no differences in their behaviour. As highlighted by one participant, “it is about being professional” (P 2). In terms of providing explicit practices, their role depends on the level of RI skills and expertise of the main supervisor or other co-supervisors. Some participants – especially those working within the life sciences and engineering - emphasised the role of the supervisory team, where tasks, also related to RI, can be allocated to different supervisors depending on their level of experience and expertise.

Supervisors also discussed their role as RI trainers when supervising post-doctoral researchers. Similarly, supervisors reported no differences in terms of role modelling. In terms of explicit practices, post-doctoral researchers are expected to be more independent in dealing with all ethical and integrity issues; therefore there is no need for supervisors to provide explicit training. However, a few supervisors expressed some concerns about having higher expectations from post-doctoral researchers. Post-doctoral researchers might fail in showing the same RI standards, especially when coming from other institutions or research groups.

Supervisors’ Responsibility Level

In responding to the question “how much do you think supervisors are responsible for your PhD candidates?”, supervisors reported different points of view. First, a few junior supervisors think that they are 100% responsible for the work, behaviour and research outcomes of their PhD candidates. They highlighted their responsibility “for reviewing everything” (P 14), since the research outcomes are the result of a “true collaboration with the PhD candidate” (P 14). Second, many supervisors – mainly seniors from the life sciences and engineering - reported feeling responsible for the technical-scientific part. However, since checking everything has been reported as an impossible task, “it is also a matter of trust” (P 15). Finally, a few supervisors – from the humanities and social sciences - reported feeling responsible only as a role model and for providing feedback if requested by the PhD candidate.

Supervisors' Practices in Relation to RI

The main activity described by most supervisors is the organisation of regular meetings, both within the research team and alone with the PhD candidate. However, there was no consensus about the frequency of the meetings. For some supervisors, regular team and one-on-one meetings must be organised weekly (e.g. life sciences, engineering and physics), for some bi-weekly, and for some others monthly or if needed under the request of the PhD candidate (e.g. social sciences and humanities). These meetings are usually focusing on the scientific-experimental part of the research, discussing RI-related issues only if needed. Some supervisors described these meetings as “informal training moments” (P 9) and as an opportunity to transform “possible mistakes into a learning moment” (P 21).

Depending on the academic fields, discussions during the meetings focus on research-related issues, checking that the research is done properly (also from the technical/equipment point of view), reviewing data, data management, data analysis and how to report and properly communicate a study.

Supervision Style

All supervisors agreed that there is no a standardized way to supervise PhD candidates, but it depends on different variables related to experience, maturity, background and personal character traits of both, the supervisor and the supervisee. The supervision style is very much dependent on the period and on a specific situation during the PhD trajectory. However, one supervisor reported to have a common strategy for all PhD candidates concerning putting them “under the right level of pressure and stress” (P 17).

According to the supervisors, the supervision style is depending on the learning curve of PhD candidates, but also on the learning curve of supervisors themselves.

*Mentoring is also how to learn to respond to students' different needs (P 7)
...after 30 years of mentoring, I feel I am learning every day. (P 1)*

The supervision style also depends on PhD candidates' motivation and level of confidence. However, for a few supervisors being overconfident might be problematic, and that “students too keen to self-promote themselves have to be flagged” (P 15).

A few senior supervisors highlighted that their style of supervising is also based and “dependent on the level of established trust” (P 17) and “common motivation” (P 5).

Explicit Practices

Supervisors were asked to rank the three most important explicit practices among the five pre-selected (Fig. 2 – Explicit practices). Most supervisors defined the five practices – or some of them depending on the academic field - as equally and extremely important. One participant reported not being involved in any of these practices, defining him/herself as “not a kindergarten teacher or a cop trying to bring candidates into lines” (P 2).

Organising regular meetings has been ranked as the most important explicit practice, as a “standard way of mentoring” (P 19). This practice, together with reviewing data, is extremely valuable for supervisors working in the life sciences and, physics and engineering.

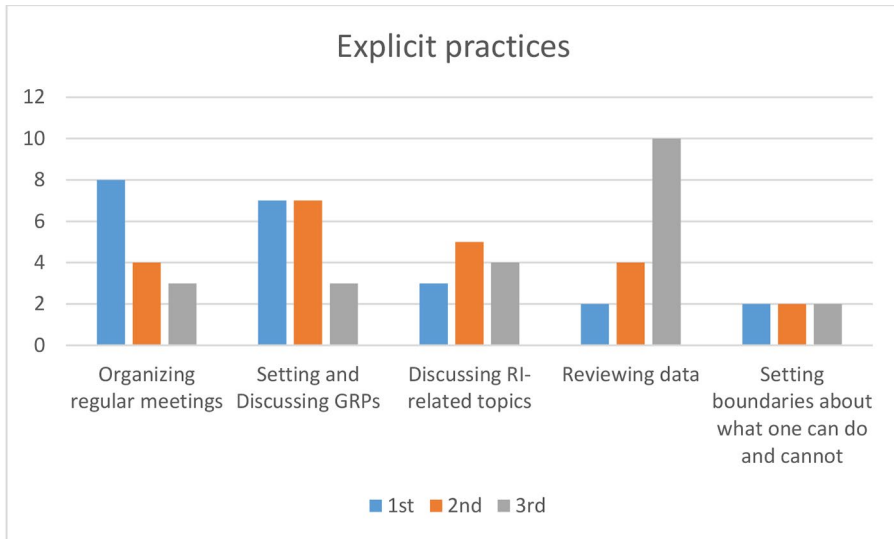


Fig. 2 – Explicit practices (The figure shows how supervisors ranked the explicit practices. For example, organizing regular meeting was ranked at the first place by 8 supervisors, at the second place by 4 supervisors and at the third place by 3.)

Implicit Practices

Supervisors were asked to rank also the three most important implicit practices among the six reported in Fig. 3.

It is much more difficult because they are all kind of equally important (P 12)

Supervisors ranked role modelling as the most important implicit practice to foster RI. The involvement of PhD candidates within the decision-making process has been reported to be also important since supervisors can explain better to PhD candidates why some decisions are taken and others not. According to some junior supervisors, also redefining the concept of failure and monitoring the level of stress of their PhD candidates are important to foster RI practices.

In discussing these practices, one junior supervisor (physics and engineering) added to the proposed list one extra implicit practice. This practice is related to being as eco-friendly as possible in doing research and in transmitting this value to PhD candidates (e.g. do not print if not needed, lab-procedure on how to dispose of specific substances). Another junior female supervisor discussed the importance of paying attention to diversity-related issues (e.g. gender, religion and ethnicity).

Virtues Expressed in Role Modelling

Supervisors were asked to choose among 27 different virtues (Supplement 1-interview guideline), what they think are the 10 most important ones (without ranking them) that they have to express and show when acting as good role models. Honesty, respectfulness and

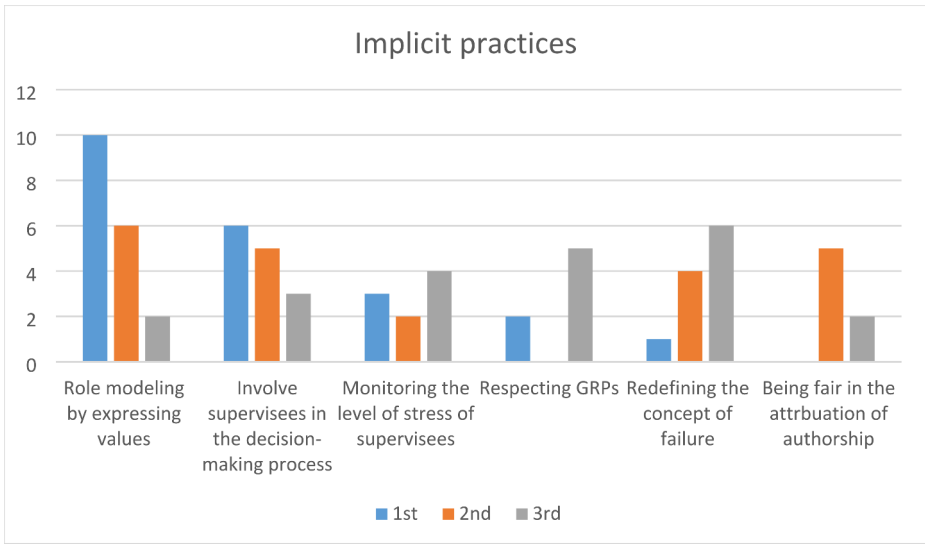


Fig. 3 – Implicit practices (The figure shows how supervisors ranked the implicit practices. For example, role modelling was ranked at the first place by 10 supervisors, at the second place by 6 supervisors and at the third place by 2.)

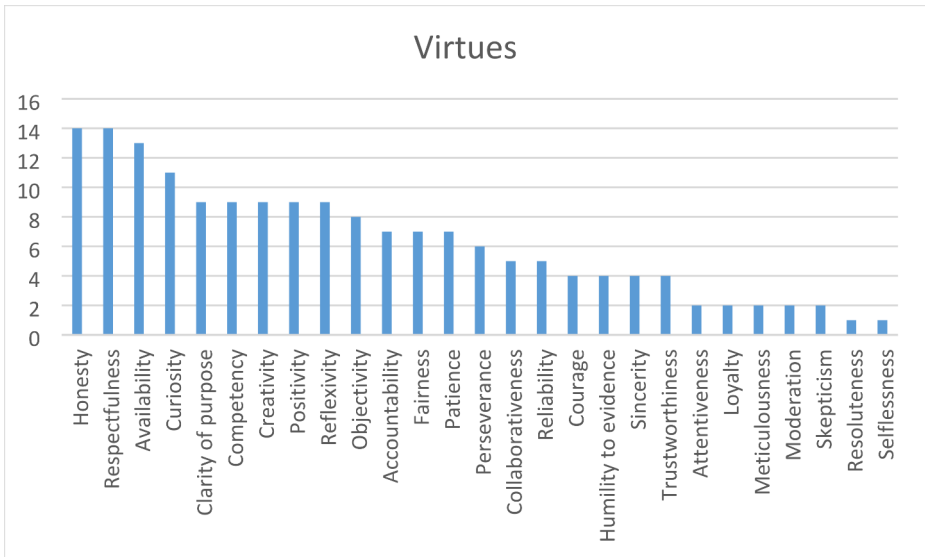


Fig. 4 – Virtues expressed in role modelling

availability are the virtues mentioned more often by supervisors (Fig. 4- Virtues expressed in role modelling).

Institutional Training for Supervisors

In the second half of the interview, supervisors were asked their opinions on the role of institutions in providing training on supervision practices and on RI. Supervisors expressed general appreciation for these institutional trainings and emphasised the need for institutions to take responsibility about this important subject.

Institutions have to take responsibility for training their supervisors (P 1)

The importance for research institutions to offer RI training for supervisors was clarified by one of the interviewees, by explicitly say that there are not enough supervisors trained in terms of RI.

What I got in terms of research integrity, I got it from my students (P 11)

Regarding the mandatory nature of both trainings, most of the supervisors were in favour to make them mandatory, for some also as “a contractual obligation” (P 8). Although considering mandatory trainings important, one participant expressed his/her perplexity about their implementation. In his/her opinion, “the people that make these decisions are professors as well and usually do not want mandatory things” (P 9). A few supervisors expressed some concerns about imposing mandatory training, seeing them more as an administrative tick-box exercise.

The main concern regarding providing training sessions about their organisation.

Courses are often led by someone without experience in guiding PhD candidates (P 14).

According to supervisors, trainings on supervision practices should focus on communication skills, leadership practices, and how to deal with PhD candidates’ stress and psychological well-being. According to them, rather than being only based on theory, supervisors should engage into discussions with peers about their experiences. Training focuses on RI should be more discipline-specific rather than addressing general topics.

Institutional Support

All the supervisors agreed on institutions being responsible to support supervisors and supervision practices. They suggested different ways in which institutions can support supervision. First, by promoting informal exchange of experiences among supervisors, by organising regular group discussions. Second, by requiring at least two supervisors for each PhD candidate and by organising PhD supervisory committees at least once a year. Third, by having regular monitoring of the supervision practices or by having senior supervisors mentor juniors. Forth, by requiring a “formal written agreement between the supervisor and the PhD candidate” (P 12). Fifth, by “providing more funding and administrative support” (P 19). Finally, by supporting “candidates’ well-being and not leaving everything on the shoulder of the supervisors” (P 5).

Supervision Practices as Extra Criteria for Assessment and Promotion

All supervisors reacted positively about the inclusion of supervision practices among the criteria for assessment and promotion. For some, like teaching, also supervision should be considered, since supervisors “are guiding the new generation into academia” (P 2).

Although being in favour of including good supervision as a criterion, almost all supervisors were concerned about how to make this as measurable and objective as possible. Differently from the H-index, number of publications and grants received, supervision practices are hardly measurable in an objective way. However, some supervisors agreed that even if a qualitative and subjective assessment of poor practices cannot be used to accuse someone, repeated concerns might be an indication of a problem.

Relation Between Being a good Researcher and a good Supervisor

Most supervisors agreed that being a good supervisor is related to be a good researcher, although it is not a direct consequence of it.

It's important to be a good researcher, which means that you have good research practice and you know the topic you are working on. This is, of course, an important aspect of being a good supervisor as well. But there is so much more in being a supervisor than only being a good researcher (P 14).

For most supervisors, being a good supervisor entails also having “some social and relational skills” (P 19) and being able to transfer different skills and knowledge to their PhD candidates.

Discussion

During the interviews, participants were asked to discuss issues concerning their role and responsibilities as supervisors, RI trainers, responsible role models and their supervision practices. In addition, they were asked to discuss the role of institutions in supporting, promoting and rewarding responsible supervision.

Supervisors described four different main activities. The first activity refers to supervising PhD candidates' development in terms of knowledge, expertise and skills and providing them with information concerning the topic of research and RI (e.g. discipline-specific, RI-related). The second activity refers to promoting good, responsible practices and high standards of RI. It also involves supervisors engaging in explicit RI practices and acting as responsible role models. The third activity refers to building a trust-based relationship with supervisees and helping them to enlarge their professional network. The last activity refers to supervising all the issues related to the management of the PhD trajectory (e.g. administrative formalities, PhD milestones and deadlines). These four specific types of activity, namely intellectual, behavioural managerial, relational and managerial supervision have been described as fundamental in embodying the role of the supervisor. These types of mentoring activities have been already highlighted in the literature as important practices that supervisors have to carry out in embodying the role of responsible mentors (Antes,

Mart & DuBois, 2016). Intellectual and behavioural supervision are directly related to RI and can directly influence supervisees' behaviour and research attitudes towards responsible research. Managerial and relational supervision are indirectly related to RI and can indirectly influence supervisees' research practices in terms of QRPs and misconduct. Failing to facilitate managerial issues related to the PhD trajectory and to promote a healthy supervisor/PhD candidate relationship might put the PhD candidate under pressure and in search of shortcuts or more willing to engage in QRPs. This has been also discussed extensively in the literature, where it has been highlighted that reducing the PhD candidates' stress and pressure, and increasing their mental well-being is beneficial to reducing QRPs (Moncur, 2013; Redman et al., 2006; Roberts, Kavussanu & Sprangue, 2001). However, it is unlikely that a single supervisor can have enough competencies, skills and time to deal with all the different activities that have been described. As reported in the literature, having multiple supervisors would allow PhD candidates to benefit from different approaches, skills and competencies, also in terms of filling possible gaps in promoting responsible research practices (Abedin et al., 2012; DeCastro et al., 2013; Haven et al., 2020; Pennanen, Heikkinen & Tynjälä, 2020). Moreover, supervisors can benefit from a sharing activity-related responsibility. In the interviews, it was made clear by the participants that even if not all supervisors can carry out all the related activities, the role model function must be a core element, also in co-supervision of students. Group mentoring would be also beneficial to PhD candidates in case one of the supervisors is not willing to engage with explicit activities aiming to foster RI (as reported by one of the interviewees). In a classic one-on-one supervision relationship, this inadequate supervision approach might be harmful to the PhD candidates' well-being, their perception of RI practices and responsible supervision, and it can lead them to engage in research-related misbehaviour.

While conducting the interviews, it became clear how supervision practices are not standard and depend on different variables. Although these variables are often related to the supervisee and its learning curve, attitudes, competencies, maturity and motivation, supervision practices depend also on supervisors' characteristics, experience and willingness to engage in supervisory activities. Supervisors' practices in relation to their role of promoting and facilitating good research practices and fostering RI standards have been described differently depending on seniority, country, academic discipline and academic disciplines. During the interviews, it was interesting to note that the EC grant record of the supervisors has no impact on the supervisors' view of general supervision and RI practises. The only difference is in relation to open science practises. Supervisors who have an EU grant seem to be more willing to engage in open science and open publications than other colleagues. This may be a consequence of the fact that the EU requires mandatory open access publications for its grantees. In relation to role modelling, supervisors consider it crucial and fundamental in order to show supervisees a model they can imitate and be inspired by.

Senior supervisors see themselves as RI trainers as something implicit to their role. The development of the scientific competencies of the PhD candidates can not be separated from the development of RI competencies and the internalization of professional values and RI high standards. This is also emphasised in the literature. "Professional supervision" benefits PhD candidates in becoming responsible researchers and future responsible supervisors (Abedin et al., 2012; Huybers, Greene & Rohr, 2020; Ripley et al., 2012; Straus, Chatur & Taylor, 2009). Senior supervisors do not feel the need to be in control of every step taken by the PhD candidates. Their control decrease depending on the learning curve of the super-

visees. Senior supervisors value the creation and the continuation of a relationship based on trust and mutual respect. A relationship that Lee and colleagues described to be “for life” with a future well-supported colleague (Lee, Dennis & Campbell, 2007).

Juniors seem to be more willing to be involved in/in command of all the research phases and in all the steps of the research trajectory. Juniors seem to be more willing to pay attention to emerging issues such as the level of stress of their PhD candidates and address their fear of failing. As highlighted in literature, these practices might be useful to lower the pressure on PhD candidates and to avoid them to engage in QRPs or consider taking shortcuts (Redman et al., 2006; Roberts, Kavussanu & Sprangue, 2001). In addition, juniors seem to be more aware of their societal and environmental responsibilities. The importance of supervisors addressing these emerging RI topics has been already stressed in previous studies (Bouter et al., 2016; Pizzolato, Abdi & Dierickx, 2020; Watts et al., 2017). Moreover, as already stressed in literature, junior supervisors seem to feel more responsible for being exemplars concerning the work/life balance (Straus et al., 2013).

Supervisors working in countries where national regulatory documents, and apparently training, concerning RI are present for far longer (Desmond & Dierickx, 2021), seem to be more willing, inclined and prepared to discuss the topic. The major willingness to discuss RI, rules, guidelines and engage in explicit practices of supervisors working in specific countries (e.g., Scandinavian countries) seems to reflect the fact that the topic is nowadays well-rooted into the research system. In these countries, research practices and RI go hand-in-hand and are not taught separately. Moreover, it seems that supervisors working in countries where RI training, usually for PhD candidates, are more present seem to be more willing to address the topic (Abdi et al., 2021).

The majority of the supervisors value having regular meetings (in team or one-on-one) with their PhD candidates. However, frequent regular meetings seem to be a priority only within the life sciences and, physics and engineering. Explicit practices discussed during the interviews seems to be specific to the research team environment and academic field. As reported also by previous studies, the review, analysis and interpretation of raw data seem to be extremely important in lab-related environment (Antes et al., 2019; Rabatin et al., 2004; Titus & Ballou, 2014). Within the social sciences and humanities, supervisors appear less willing to engage in explicit practices and in socializing PhD candidates into RI. Differences in RI expectations among academic fields has been already reported in literature, where RI expectations regarding the social sciences and humanities were lower than for other academic fields (Haven et al., 2019; Wells et al., 2014).

Female supervisors seem to be more willing to be of emotional support to their PhD candidates than their male colleagues. In discussing their role, female supervisors seemed to be personally and emotionally attached to their supervisees, not just in relation to their PhD trajectory, but also in relation to personal issues. Taking care of them and being of emotional/psychological support is perceived as part of their role. The importance of being of emotional support has been also highlighted by previous studies (Abedin et al., 2012; Anderson et al., 2007). Being of emotional support might lower the stress and pressure of PhD candidates and the possibility to engage in QRPs (Redman et al., 2006; Roberts, Kavussanu & Sprangue, 2001). On the opposite, knowing what is going on in the personal life of the PhD candidates is also important for male supervisors, but it seems to have more a practical scope. Preventing possible unintentional questionable practices by knowing that the PhD candidate might lose focus on his/her work or engaging due to a personal situation.

Although there is a correlation between specific supervision practices and supervisors' characteristics (e.g. seniority, country, academic discipline, academic disciplines), the relationship that is created between the supervisor and the PhD candidate is unique and different from others. As any other relationship, it depends on uncountable variables. "Having the right chemistry" is important to foster a trust-based and healthy relationship (Jackson et al., 2003; Straus et al., 2013).

As highlighted by the majority of the supervisors during the study, being a good researcher is just a prerequisite to being a good supervisor. Being a good and responsible researcher is crucial, but it differs from being able to transmit responsible practices and to follow the development of PhD candidates. Supervisors have to express a set of virtues that slightly differ from the ones important to being a good researcher. Honesty has been highlighted by many as the most important virtue. The same can be found in literature where honesty is defined crucial to be a good supervisor as well as a good researchers (Character traits: Scientific virtues. Nature, 2016; Pizzolato & Dierickx 2022a; Straus et al., 2013). Virtues identified as important to be a good researcher (e.g. perseverance, objectivity, humility of evidence and attentiveness) are replaced by virtues considered essential to be a good supervisor (e.g. respectfulness, availability, creativity and positivity) (Character traits: Scientific virtues. Nature, 2016). Respectfulness, availability, positivity were also highlighted by Lee and colleagues in their guide for mentors published on Nature (2007).

In addition to different virtues, good supervisors must have specific competencies and characteristics that differ from the ones that a good researcher must have. Possessing the right virtues is just the starting point to act as a supervisor. Good supervisors must possess a set of competencies that complement the ones for being a good researcher. These competencies can be innate in some researchers, but they can also be taught and trained. The supervisors participating in the study clearly valued the organisation of specific institutional training on RI and supervision practices targeting supervisors. According to the literature, these trainings play an important role in fostering supervisors RI practices and ability to transmit these practices (Löfström et al., 2014; Ripley et al., 2012; Straus et al., 2013). Recently, Dutch supervisors participating in a pilot study described this typology of training as highly recommended and reported to be more skilled than before participating in the training (Haven et al., 2022). Moreover, supervisors might be involved in dedicated sessions led by some junior colleagues, who might be more prepared in addressing RI issues (Pizzolato & Dierickx, 2022b).

Supervisors have made suggestions as to how institutions can support supervisory practices. Although this institutional support can only be seen in terms of promoting supervisory practices and supporting supervisors, it has a cascading effect on supervisees in terms of research practises and associated attitudes and behaviours. Creating informal group discussions would enable supervisors to exchange best practices but also tips and tricks on how to deal with specific situations (e.g., lowering supervisees' stress and addressing their fear of failure). The creation of these peer-discussion groups has been also previously advocated within the literature (Di Benedetto et al., 2021; Gruber et al., 2020). Requiring at least two supervisors would benefit the PhD candidate but also the supervisors involved. PhD candidates, and supervisees in general, would benefit from different perspectives, not to have one world view of RI practices and the academic environment (Haven et al., 2020). Supervisors would benefit from sharing commitment and time in training the PhD candidates. Moreover, having more than one supervisor would probably lower possible tensions that a one-on-one

relationship can create and that can lead to a stressful and unhealthy collaboration, and as a possible consequence, it can lead supervisees to engage in QRPs. Matching senior supervisors with junior supervisors might be beneficial to provide informal training sessions to complement institutional training on supervision practices. Besides what suggested, a few best practices are already reported within the literature (Lechner et al., 2020; Lerouge & Hol, 2020, Sawatzky & Enns, 2009).

The supervisors participating welcomed the inclusion of supervision practices within the pool of criteria for assessment and promotion. As institutions assess academic performance in teaching, also supervision practices must be evaluated and considered. As already stressed in literature, formally recognizing the role of supervisors in training “the next generation of researchers” is something that institutions have consider (Kafedjiska et al., 2022). In line with the San Francisco Declaration on Research Assessment (DORA) and the Hong Kong principles (Moher et al., 2020, principle 5), institutions should not merely focus on journal metrics but also consider the larger contribution that researchers, in acting as supervisors, can give to the research environment. The main concern of the supervisors involved in the study was how to make this criterion objective and measurable. A qualitative and subjective bottom-up assessment by doctoral students and supervisees can help to get an idea of certain supervision practises. Although this assessment can only give half a picture of the real situation, multiple concerns about a particular supervisor may prompt institutions to monitor the situation closely.

Strengths and Limitations

To our knowledge, this is one of the few qualitative studies involving focusing on supervisors’ role as RI trainers (Pizzolato & Dierickx, 2022a). The study investigates supervisors’ perceptions concerning their RI practices and responsibilities across country, gender, academic domain and seniority. This study can serve as a preliminary attempt to highlight differences in supervisors’ perceptions, approaches and real-life practices as RI trainers and role models. Moreover, this explorative study can serve as an outline to organise further research on the matter.

However, it is also fair to point out some limitations. The most important limitation of this study is the selection bias. At this stage, we are aware that it is not possible to generalise and consider these study results as universally valid. The sample size is probably too small to understand in depth all the possible nuances arising from the different inclusion criteria. Although we found differences between the three different academic domains, we are aware that there are also differences within each academic domain. The same reasoning can be applied to the differences between countries. Although we have included supervisors from 16 different European countries, not all countries are represented (e.g. Germany, Austria, the Baltic countries). Unlike the US, where RI is firmly rooted throughout the country, European countries have a different understanding, tradition, research system and policies/laws regarding responsible conduct. In most cases, while there are clear differences between countries, in some countries there are also differences between institutions or even faculties. As for junior supervisors, while there are some commonalities, their approach to RI may have been influenced by too many variables, and the sample size available is too small to understand all possible nuances in depth. More in-depth studies of supervisory practices

that focus on a specific criterion (e.g. gender, discipline, country and seniority) are needed to address these issues.

Conclusion

This study tries to give an overview on supervisors' perspective concerning their role as RI trainer and role models, and how supervision practices can influence supervisees' research practices. In addition, it tries to give voice to supervisors regarding what institutions can do to support them and supervision practices. Supervisors value their role as responsible exemplars, in fostering RI awareness and in transferring RI competencies. Although there are some commonalities concerning supervisors' understanding of their role concerning role modelling, approach and real-life supervision practices can differ largely across discipline, gender, seniority and country. Although it is possible to outline different best practices (e.g. having regular meetings, discussing good research practices, monitoring PhD candidates' stress), there is no a unique and standard way to be a good and responsible supervisor. A successful collaboration, transmission of professional values and RI competencies also depend on the presence of a human match between the supervisor and the PhD candidate.

All supervisors agreed on institutions being responsible in supporting supervisors and supervision practices. This can be done by providing dedicated training sessions on RI and supervision practices. They provided also a few examples on how institutions can assist supervisors and promote responsible supervision practices (e.g. peer discussion groups, coupling senior and junior supervisors, providing administrative support). Although supervisors valued the inclusion of supervision practices within the criteria for promotion and assessment, they expressed concerns regarding making this criterion as objective and measurable as possible.

This explorative study puts the basis to plan new and more specific studies. Further focused studies are needed to in-depth understand differences across gender, academic domain (also within the same domain), country and seniority. Moreover, studies focusing on making supervision practices measurable and objective are very much needed to start considering supervision on the same level of journal metrics.

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Authors' Contribution DP and KD contributed to the collection and analysis of the data and the manuscript writing. Further, both authors read and approved the final manuscript.

Statements and Declarations

Disclosure Statements The authors declare that there is no conflict of interest.

References

- Abdi, S., Pizzolato, D., Nemery, B., & Dierickx, K. (2021). Educating PhD students in Research Integrity in Europe. *Science and engineering ethics*, 27(1), 5. <https://doi.org/10.1007/s11948-021-00290-0>.
- Abedin, Z., Biskup, E., Silet, K., Garbutt, J. M., Kroenke, K., Feldman, M. D., & Pincus, H. A. (2012). Deriving competencies for mentors of clinical and translational scholars. *Clinical and Translational Science*, 5(3), 273–280. <https://doi.org/10.1111/j.1752-8062.2011.00366.x>.
- ALLEA (2017). *The European Code of Conduct for Research Integrity* (revised edition)
- Alfredo, K., & Hart, H. (2011). The university and the responsible conduct of research: who is responsible for what? *Science and Engineering Ethics*, 17(3), 447–457. <https://doi.org/10.1007/s11948-010-9217-3>.
- Anderson, M. S., Horn, A. S., Risbey, K. R., Ronning, E. A., De Vries, R., & Martinson, B. C. (2007). What do mentoring and training in the responsible conduct of research have to do with scientists' misbehaviour? Findings from a national survey of NIH-funded scientists. *Academic Medicine*, 82(9), 853–860. <https://doi.org/10.1097/ACM.0b013e31812f764c>.
- Antes, A. L., Kuykendall, A., & DuBois, J. M. (2019). (a). Leading for research excellence and integrity: A qualitative investigation of the relationship-building practices of exemplary principal investigators. *Accountability in Research* 26(3): 198–226. <https://doi.org/10.1080/08989621.2019.1611429>.
- Antes, A. L., Mart, A., & DuBois, J. M. (2016). Are leadership and management essential for good research? An interview study of genetic researchers. *Journal of Empirical Research on Human Research Ethics*, 11(5), 408–423. <https://doi.org/10.1177/1556264616668775>.
- Pizzolato, D., & Dierickx, K. (2022a). The mentor's role in fostering research integrity standards among new generations of researchers: A review of empirical studies. Under review.
- Bell, E. (2015). A room with a view of integrity and professionalism: personal reflections on teaching responsible conduct of research in the neurosciences. *Science and Engineering Ethics*, 21(2), 461–469. <https://doi.org/10.1007/s11948-014-9545-9>.
- Bird, S. J. (2001). Mentors, advisors and supervisors: their role in teaching responsible research conduct. *Science and Engineering Ethics*, 7(4), 455–468. <https://doi.org/10.1007/s11948-001-0002-1>.
- Bouter, L. M., Tjeldink, J., Axelsen, N., Martinson, B. C., ter, & Riet, G. (2016). Ranking major and minor research misbehaviours: results from a survey among participants of four World Conferences on Research Integrity. *Research Integrity and Peer Review*, 1(1), 17. <https://doi.org/10.1186/s41073-016-0024-5>
- Bouter, L. M. (2018). Fostering responsible research practices is a shared responsibility of multiple stakeholders. *Journal of clinical epidemiology*, 96, 143–146. <https://doi.org/10.1016/j.jclinepi.2017.12.016>.
- Boyatzis, R. E. (1998). *Transforming qualitative information: thematic analysis*. and code development: sage.
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101. <https://doi.org/10.1191/1478088706qp063oa>.
- Brown, M. E., & Treviño, L. K. (2014). Do role models matter? An investigation of role modeling as an antecedent of perceived ethical leadership. *Journal of Business Ethics*, 122(4), 587–598. <https://doi.org/10.1007/s10551-013-1769-0>.
- Bukusi, E. A., Manabe, Y. C., & Zunt, J. R. (2019). Mentorship and ethics in global health: fostering scientific integrity and responsible conduct of research. *American Journal of Tropical Medicine and Hygiene*, 100(Suppl 1), 42–47. <https://doi.org/10.4269/ajtmh.18-0562>.
- Character traits. (2016). Scientific virtue. *Nature*, 532, 139. <https://doi.org/10.1038/nj7597-139a>.
- Crabtree, B. F., & Miller, W. L. (Eds.). (1992). *Doing qualitative research*. Sage Publications, Inc.
- DeCastro, R., Sambuco, D., Ubel, P. A., Stewart, A., & Jagsi, R. (2013). Mentor networks in Academic Medicine. *Academic Medicine*, 88(4), 488–496. <https://doi.org/10.1097/acm.0b013e318285d302>.
- Declaration of San Francisco (DORA). <https://sfedora.org/read/>
- Desmond, H., & Dierickx, K. (2021). Research integrity codes of conduct in Europe. *Understanding the divergences Bioethics*, 35(5), 414–428. <https://doi.org/10.1111/bioe.12851>.
- Di Benedetto, C. A., Lindgreen, A., & Ringberg, T. (2021). Guiding PhD Students. In T. U. Thomsen, A. Lindgreen, A. Kjærgaard, E. Rosier, & A. Tuncdogan (Eds.), *Handbook of Teaching and Learning at Business Schools: A Practice-based Approach* (pp. 313–331). Edward Elgar Publishing. <https://doi.org/10.4337/9781789907476.00035>
- Embassy, Lechner, I., Paloš, A. P., & Haven, T. (2021). Responsible Supervision. (<https://embassy.science/wiki/Theme:Ab4200ca-c14d-413d-a9f6-aa5a93e1800e>). Last access 15/03/2022.
- Faden, R. R., Klag, M. J., Kass, N. E., & Krag, S. S. (2002). On the importance of research ethics and mentoring. *American Journal of Bioethics*, 2(4), 50–51. <https://doi.org/10.1162/152651602320957565>.
- Fanelli, D. (2009). How many scientists fabricate and falsify research? A systematic review and meta-analysis of survey data. *Plos One*, 4(5), <https://doi.org/10.1371/journal.pone.0005738>.

- Fisher, C. B., Fried, A. L., & Feldman, L. G. (2009). Graduate socialization in the responsible conduct of research: a national survey on the research ethics training experiences of psychology doctoral students. *Ethics & Behaviour*, 19(6), 496–518. <https://doi.org/10.1080/10508420903275283>.
- Forsberg, E. M., Anthon, F. O., Bailey, S., Birchley, G., Bout, H., Casonato, C., & Zoller, M. (2018). Working with research integrity-guidance for research performing organisations: the Bonn PRINTEGGER statement. *Science and Engineering Ethics*, 24(4), 1023–1034. <https://doi.org/10.1007/s11948-018-0034-4>.
- Gopalakrishna, G., Ter Riet, G., Vink, G., Stoop, L., Wicherts, J. M., & Bouter, L. M. (2022). Prevalence of questionable research practices, research misconduct and their potential explanatory factors: a survey among academic researchers in the Netherlands. *PLoS one*, 17(2), e0263023. <https://doi.org/10.1371/journal.pone.0263023>.
- Gray, P. W., & Jordan, S. R. (2012). Supervisors and academic integrity: Supervisors as exemplars and mentors. *Journal of Academic Ethics*, 10(4), 299–311. <https://doi.org/10.1007/s10805-012-9155-6>.
- Gruber, J., Prinstein, M. J., Abramowitz, J. S., Albano, A. M., Borelli, J., & Weinstock, L. (2020, May 13). Mental Health and Clinical Psychological Science in the Time of COVID-19: Challenges, Opportunities, and a Call to Action. <https://doi.org/10.31234/osf.io/desg9>
- Hauer, K. E., Teherani, A., Dechet, A., & Aagaard, E. M. (2005). Medical students' perceptions of mentoring: a focus-group analysis. *Medical Teacher*, 27(8), 732–734. <https://doi.org/10.1080/01421590500271316>.
- Haven, T. L., Tjldink, J. K., Martinson, B. C., & Bouter, L. M. (2019). Perceptions of research integrity climate differ between academic ranks and disciplinary fields: results from a survey among academic researchers in Amsterdam. *Plos One*, 14(1), 1–17. <https://doi.org/10.1371/journal.pone.0210599>.
- Haven, T., Pasman, H. R., Widdershoven, G., Bouter, L., & Tjldink, J. (2020). Researchers' perceptions of a responsible research climate: a multi focus group study. *Science and Engineering Ethics*, 26(6), 3017–3036. <https://doi.org/10.1007/s11948-020-00256-8>.
- Haven, T., Bouter, L., Mennen, L., & Tjldink, J. (2022). Superb supervision: a pilot study on training supervisors to convey responsible research practices onto their PhD candidates. *Accountability in Research*, 00(00), 1–18. <https://doi.org/10.1080/08989621.2022.2071153>.
- Huybers, T., Greene, B., & Rohr, D. H. (2020). Academic research integrity: exploring researchers' perceptions of responsibilities and enablers. *Accountability in Research*, 27(3), 146–177. <https://doi.org/10.1080/08989621.2020.1732824>.
- Jackson, V. A., Palepu, A., Szalacha, L., Caswell, C., Carr, P. L., & Inui, T. (2003). "Having the Right Chemistry": a qualitative study of mentoring in academic medicine. *Academic Medicine*, 78(3), 328–334. [https://doi.org/10.1016/s1359-6128\(17\)30424-x](https://doi.org/10.1016/s1359-6128(17)30424-x).
- Kafedjiska, I., Heckmann, L., Pires, V., Saxena, P., & Lasser, J. (2022). The Mental Health Crisis among Doctoral Researchers – Findings and Best Practices. *Zeitschrift für Beratung und Studium*, 17(1), 1–7.
- Kornfeld, D. S. (2012). Perspective: research misconduct: the search for a remedy. *Academic Medicine*, 87(7), 877–882. <https://doi.org/10.1097/ACM.0b013e318257ee6a>.
- Lechner, I., Tjldink, T., Sørensen, M. P., Ravn, T., Bendtsen, A. K., Labib, K., et al. (2020). D 4.3: Second version of SOPs and guidelines. <https://sops4ri.eu/deliverables/>
- Lerouge, I., & Hol, A. (2020). Towards a Research Integrity Culture at Universities: From Recommendations to Implementation. Advice paper No. 26.
- Lee, A., Dennis, C., & Campbell, P. (2007). Nature's guide for mentors. *Nature*, 447(7146), 791–797. <https://doi.org/10.1038/447791a>.
- Löfström, E., Trotman, T., Furnari, M., & Shephard, K. (2015). Who teaches academic integrity and how do they teach it? *Higher Education*, 69(3), 435–448. <https://doi.org/10.1007/s10734-014-9784-3>.
- Mejlgaard, N., Bouter, L. M., Gaskell, G., Kavouras, P., Allum, N., Bendtsen, A. K., & Veltri, G. (2020). Research integrity: nine ways to move from talk to walk. *Nature*, 586, 358–360.
- Moher, D., Bouter, L., Kleiner, S., Glasziou, P., Sham, M. H., Barbour, V., & Dirnagl, U. (2020). The Hong Kong Principles for assessing researchers: fostering research integrity. *Plos Biology*, 18(7), 1–14. <https://doi.org/10.1371/journal.pbio.3000737>.
- Moncur, W. (2013). The Emotional Wellbeing of Researchers: Considerations for Practice. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, 1883–1890.
- Muthanna, A., & Alduais, A. (2021). A thematic review on research integrity and research supervision: Relationships, crises and critical messages. *Journal of Academic Ethics*, 19, 95–113.
- Pennanen, M., Heikkinen, H. L. T., & Tynjälä, P. (2020). Virtues of mentors and mentees in the finnish model of teachers' peer-group mentoring. *Scandinavian Journal of Educational Research*, 64(3), 355–371. <https://doi.org/10.1080/00313831.2018.1554601>.
- Pizzolato, D., Abdi, S., & Dierickx, K. (2020). Collecting and characterizing existing and freely accessible research integrity educational resources. *Accountability in Research*, 27(4), 195–211. <https://doi.org/10.1080/08989621.2020.1736571>.
- Pizzolato, D., & Dierickx, K. (2022b). Reverse mentoring to enhance research integrity climate. *BMC Research Notes*, 10–13. <https://doi.org/10.1186/s13104-022-06098-w>.

- Pupovac, V., & Fanelli, D. (2015). Scientists admitting to Plagiarism: a Meta-analysis of surveys. *Science and engineering ethics*, 21(5), 1331–1352. <https://doi.org/10.1007/s11948-014-9600-6>.
- Rabatin, J. S., Lipkin, M., Rubin, A. S., Schachter, A., Nathan, M., & Kalet, A. (2004). A year of mentoring in academic medicine. *Journal of General Internal Medicine*, 19(5), 569–573. <https://doi.org/10.1111/j.1525-1497.2004.30137.x>.
- Redman, B. K., Templin, T. N., & Merz, J. F. (2006). Research misconduct among clinical trial staff. *Science and engineering ethics* 12(3), 481–489.
- Resnik, D. B. (2012). Ethical virtues in scientific research. *Accountability in Research*, 19(6), 329–343. <https://doi.org/10.1080/08989621.2012.728908>.
- Ripley, E., Markowitz, M., Nichols-Casebolt, A., Williams, L., & Macrina, F. (2012). Guiding the next generation of NIH investigators in responsible conduct of research: the role of the mentor. *Accountability in Research*, 19(4), 209–219. <https://doi.org/10.1080/08989621.2012.700880>.
- Roberts, G. C., Kavussanu, M., & Sprague, R. L. (2001). Mentoring and the impact of the research climate. *Science and Engineering Ethics*, 7(4), 525–537. <https://doi.org/10.1007/s11948-001-0010-1>.
- Rose, G. L. (2003). Enhancement of mentor selection using the ideal mentor scale. *Research in Higher Education*, 44(4), 473–494. <https://doi.org/10.1023/A:10242890008491>.
- Sawatzky, J. A. V., & Enns, C. L. (2009). A mentoring needs assessment: validating mentorship in nursing education. *Journal of Professional Nursing*, 25(3), 145–150. <https://doi.org/10.1016/j.profnurs.2009.01.003>.
- Science Europe working group on research integrity (2016). Research integrity practices in Science Europe member organisations. Science Europe. https://www.scienceeurope.org/media/onrhl1tf/science_europe_integrity_survey_report_july_2016_final.pdf
- Straus, S. E., Chatur, F., & Taylor, M. (2009). Issues in the mentor-mentee relationship in academic medicine: a qualitative study. *Academic Medicine*, 84(1), 135–139. <https://doi.org/10.1097/ACM.0b013e31819301ab>.
- Straus, S. E., Johnson, M. O., Marquez, C., & Feldman, M. D. (2013). Characteristics of successful and failed mentoring relationships: a qualitative study across two academic health centers. *Academic Medicine*, 88(1), 82–89. <https://doi.org/10.1097/ACM.0b013e31827647a0>.
- Tijdink, J. K., Bouter, L. M., Veldkamp, C. L., van de Ven, P. M., Wicherts, J. M., & Smulders, Y. M. (2016). Personality traits are Associated with Research Misbehaviour in Dutch scientists: a cross-sectional study. *PloS one*, 11(9), e0163251. <https://doi.org/10.1371/journal.pone.0163251>.
- Titus, S. L., & Ballou, J. M. (2014). Ensuring PhD development of responsible Conduct of research behaviours: who's responsible? *Science and Engineering Ethics*, 20(1), 221–235. <https://doi.org/10.1007/s11948-013-9437-4>.
- Tomić, V., Buljan, I., & Marušić, A. (2022). Perspectives of key stakeholders on essential virtues for good scientific practice in research areas. *Accountability in research*, 29(2), 77–108. <https://doi.org/10.1080/08989621.2021.1900739>.
- Tong, A., Sainsbury, P., & Craig, J. (2007). Consolidated criteria for reporting qualitative research: a 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care*, 19(6), 349–357.
- Vandemeulebroucke, T., Dierckx de Casterlé, B., Welbergen, L., Massart, M., & Gastmans, C. (2019). The Ethics of Socially Assistive Robots in aged care. A Focus Group Study with older adults in Flanders, Belgium. *The Journals of Gerontology: Series B*, XX(Xx), 1–12. <https://doi.org/10.1093/geronb/gbz070>.
- Vears, D. F., & Gillam, L. (2022). Inductive content analysis: a guide for beginning qualitative researchers. *Focus on Health Professional Education*, 23(1), 111–127.
- Watts, L. L., Mulhearn, T. J., Medeiros, K. E., Steele, L. M., Connelly, S., & Mumford, M. D. (2017). Modeling the Instructional effectiveness of responsible Conduct of Research Education: a Meta-Analytic path-analysis. *Ethics and Behaviour*, 27(8), 632–650. <https://doi.org/10.1080/10508422.2016.1247354>.
- Weil, V. (2001). Mentoring: some ethical considerations. *Science and Engineering Ethics*, 7(4), 471–482. <https://doi.org/10.1007/s11948-001-0004-z>.
- Wells, J. A., Thrush, C. R., Martinson, B. C., May, T. A., Stickler, M., Callahan, E. C., & Klomparens, K. L. (2014). Survey of organisational research climates in three research intensive, doctoral granting universities. *Journal of Empirical Research on Human Research Ethics*, 9(5), 72–88. <https://doi.org/10.1177/1556264614552798>.
- Whitbeck, C. (2001). Group mentoring to foster the responsible conduct of research. *Science and Engineering Ethics*, 7(4), 541–558. <https://doi.org/10.1007/s11948-001-0012-z>.
- Wright, D. E., Titus, S. L., & Cornelison, J. B. (2008). Mentoring and research misconduct: analysis of research mentoring in closed ORI cases. *Science and Engineering Ethics*, 14, 323–336. <https://doi.org/10.1007/s11948-008-9074-5>.

Xie, Y., Wang, K., & Kong, Y. (2021). Prevalence of Research Misconduct and Questionable Research Practices: a systematic review and Meta-analysis. *Science and engineering ethics*, 27(4), 41. <https://doi.org/10.1007/s11948-021-00314-9>.

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