Mission impossible?

A cultural change to support scientific integrity

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Actively changing the culture of an organization is a considerable task since culture is rarely defined by written rules and established structures. Rather, it is an unwritten consensus, a mutual understanding of how people behave and interact with each other. This informal nature becomes a challenge whenever the need arises to actively change things, for instance, an institution's research culture in order to foster responsible conduct of research (https://wellcome.org/reports/what-researchers-think-about-research-culture).

"Scientific integrity forms the basis for trustworthy research". The first sentence of the Guidelines for Safeguarding Good Research Practice—Code of Conduct of the German Research Foundation (DFG, 2019) is both a claim and an appeal. The appeal is a voluntary commitment to adhere to the general principles of good research practice. The claim is reflected, among other things, by the measures to be taken in case scientific misconduct did happen. More generally, academic institutions can support and foster scientific integrity via two strategies with different implications. Institutions may either focus on education to enhance researcher's competence and sense of responsibility to conduct trustworthy research. Or they may favour control mechanisms such as pre-emptive manuscript and thesis screening by external companies as a prevention and deterrence (Abbott, 2019). Although the latter is likely to directly reduce the risk of certain forms of scientific misconduct, such as figure manipulation, it also means delegating researchers' responsibility for institutional rules to technical services instead of actively pursuing good scientific practices (GSP). As another factor, external manuscript screening or other technical measures are largely independent of the usual turnover rate owing to temporary contracts in an academic research institute, whereas educational and mentoring programmes have to take this into account for achieving a sustainable effect on GSP.

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Development of the Borstel model

The Research Center Borstel took up the challenge of instigating cultural change after a worst-case scenario of research misconduct (Schiermeier, 2010). The thorough investigation by internal and external boards did not only reveal dark spots of data manipulation that were not discovered and addressed before in the research routine. The realization of the extent of data manipulations that occurred over many years also initiated a strong desire to deal with the problem in a constructive way and to improve scientific integrity. There are a range of programmes available to educate scientific staff, such as the one offered by the German *Ombudsman für die Wissenschaft* (Sponholz, 2019), but we decided to go beyond education and to instil real cultural change. "When scientific misconduct at our own institute was uncovered approx. 10 years ago, we decided against what we felt was a technocratic or purely technological approach (such as software to detect manipulations, duplications or plagiarism). Instead, in a relatively small place such as ours, we started to put more and more emphasis on communication, transparency and participation as part of the day-to-day scientific culture. Therefore, a person-centered approach with frequent direct interactions of scientists and research integrity scouts has now become part of our center's culture, much in the same way as regular feedback interviews with employees, measures to improve diversity and work-life-balance have in recent years become part of daily practise. In other words: since 'culture eats strategy for breakfast' we now focus on culture at a very personal level to learn from our mistakes, both socially and scientifically", described Stefan Ehlers, the then CEO of the Research Center Borstel, our strategy.

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But how can cultural change be achieved? The two challenges were deciding on a meaningful strategy for a cultural change; and accepting that there are no hard measures for success. We developed a novel training programme with a special focus on psychological concepts and communication, subsequently called the *Borstel Model*

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(Möller-Hahlbrock *et al*, 2015; Fig 1A). From 2012 to 2014, our centre ran a workshop programme on GSP. Participation was obligatory for all research units and all employees since everyone—from the heads of the divisions to postdocs, to students and to technical assistants—could be involved in scientific misconduct (Rhoades, 2004). However, a typical drawback of most educational programmes is that, once they are finished, most of the acquired competencies are lost when everyone falls back into established behavioural patterns. To ensure that our workshop programme will have sustainable effects, we implemented an important additional step: each research group had to define one member as a "research integrity scout". We originally called them *GWP-Impulsgeber* in German, which would translate into good scientific practice impulse generator; to avoid confusion, we then changed it to research integrity scout.

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Research integrity scouts

The main rationale was to maintain awareness of GSP independent of training programmes and to actively involve staff into GSP training and development instead of delegating responsibility to the ombudspersons whose main tasks are counselling and investigating potential misconduct. It is the research integrity scouts who keep their research group sensitized to GSP: they remind co-workers of and address GSP topics and provide advice and information about many aspects of research integrity. The main channel through which they achieve this is laboratory meetings, retreats or seminars with their research groups where they reiterate and discuss the principles of GSP and their implications for daily work and address any problems that may arise. Further measures are an annual GSP day when the scouts report on their work and external speakers give talks on GSP. The overall idea behind the scouts is

to build up cultural change and GSP from within a research group with at least one member actively and constantly bringing up the topic rather than implementing GSP via "external" occasional education or training. It has the additional advantage of being flexible: unlike a one-size-fits-all solution, the research scouts can actively address and discuss the specific needs and problems of their own research group.

> *"The overall idea behind the scouts is to build up cultural change and GSP from within a research group…"*

Of note, the scouts do not act as "eyes and ears" of the ombudspersons. They are actively engaged in shaping the institute's research culture and thus represent an independent pillar to support good scientific practice in everyday work. Clear communication of the research integrity scouts' tasks and responsibilities—and the limits thereof—is therefore important both for them and for their research group. Eventually, GSP is the responsibility of everyone and cannot be delegated to a scout; neither should a scout become the person of choice to handle conflicts or disputes within the team. Since the research integrity scouts are active team members from all levels—student to postdoc to staff scientist to technician—they also have to learn how to lead and moderate discussions with their team. Such skills are being trained at a communication workshop and the peer group meetings of the research integrity scouts where they learn, for instance, to start a group meeting with a team game to open the scene for GSP topics.

Many scientists in medicine and the natural sciences are first put off by novel forms of communication and social interaction; they are well acquainted to specific formats of presenting and discussing their data with an overall strong emphasis on objectivity, neutrality and rationality. Thus "the chair circle challenge" for open discussion of social interactions and their effects on GSP during the initial training workshop induced some discomfort and dismissal among the participants; like a red flag, it seemed to signal that something is going to happen outside the professional scientific environment. Our initial training therefore first familiarized team members and their PIs
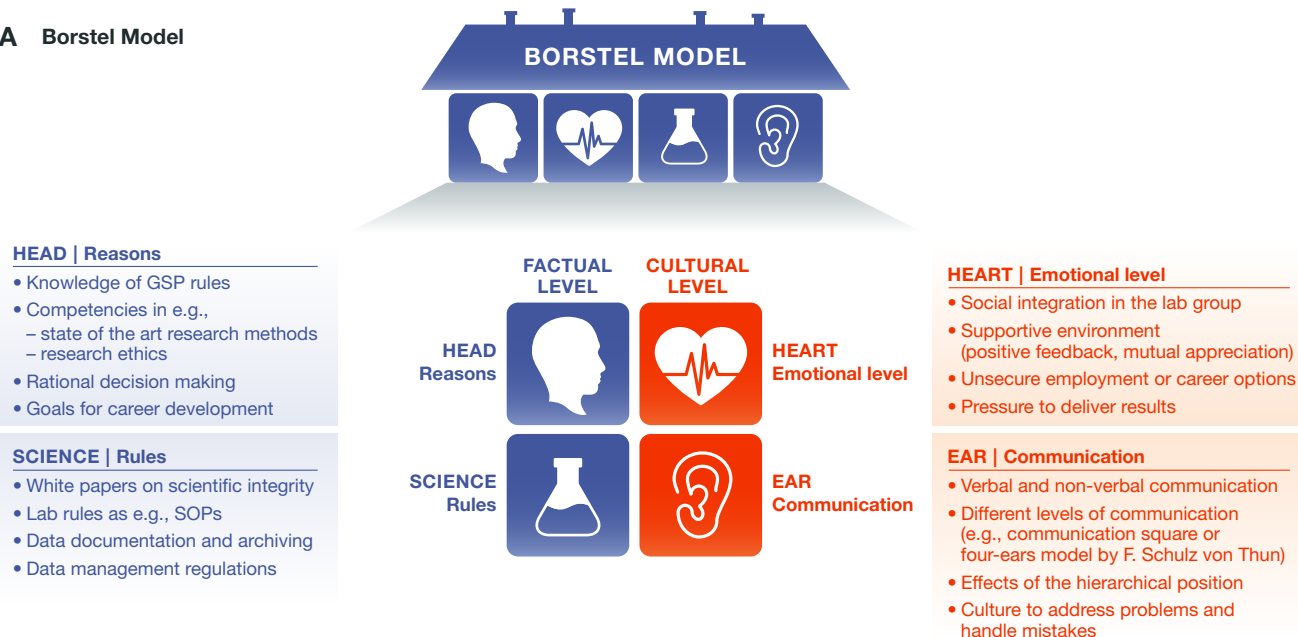
with this and other formats of communication that are necessary to maintain awareness of GSP among all group members (Fig 1B). New employees are introduced to the objectives and culture of GSP. Further information is provided by a flyer or the comprehensive report on "Das Borsteler Modell," which is also available on the institute's intranet. Our institute hosts many students and guest scientists from all over the world, and we have to address cultural aspects and discuss research integrity issues also in English, which can be quite challenging sometimes for non-native speakers and because of inter-cultural differences.

> *"We thus did not develop a one-size-fits-all mandatory practice to address GSP, but research groups developed their own solutions to improve their workflow and communication…"*
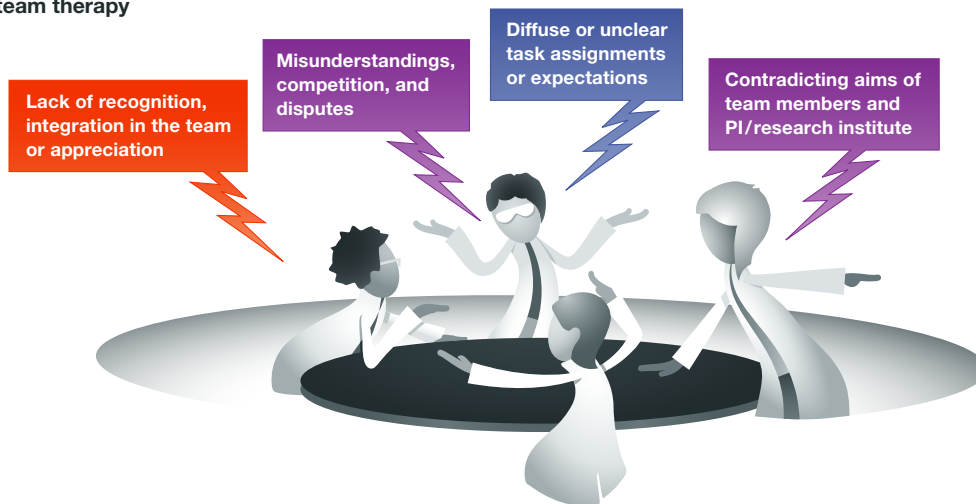
Research integrity scouts meet regularly for peer coaching sessions with the institute's two coordinators for research integrity to further debate their experiences and any issues from their groups. These meetings are specifically designed to introduce new topics and developments, to train moderation formats in the friendly atmosphere of a peer group, exchange ideas and experiences, and to receive support to manage challenging situations. Quite early, we also established an annual meeting of the research integrity scouts with the centre's CEO for internal reflection on the process and on the institute's culture. This annual meeting gives the scouts more visibility and a direct channel for communicating their needs and challenges. It is also important for continuous development of our GSP strategy at the institute and for discussion of other structural measures to support GSP directly with the CEO. Furthermore, we established formats and techniques to be used in group meetings and retreats, for example analysing the research group's situation or a systematic assessment of the life cycle of research data from data acquisition, storage, analysis and processing to deposition (Dirnagl *et al*, 2018).

As new research groups joined the institute after the initial workshop programme, it became necessary to maintain the overall

A Borstel Model

BORSTEL MODEL

FACTUAL LEVEL

CULTURAL LEVEL

HEAD Reasons

HEART Emotional level

SCIENCE Rules

EAR Communication

HEAD | Reasons
- Knowledge of GSP rules
- Competencies in e.g.,
  – state of the art research methods
  – research ethics
- Rational decision making
- Goals for career development

SCIENCE | Rules
- White papers on scientific integrity
- Lab rules as e.g., SOPs
- Data documentation and archiving
- Data management regulations

HEART | Emotional level
- Social integration in the lab group
- Supportive environment (positive feedback, mutual appreciation)
- Unsecure employment or career options
- Pressure to deliver results

EAR | Communication
- Verbal and non-verbal communication
- Different levels of communication (e.g., communication square or four-ears model by F. Schulz von Thun)
- Effects of the hierarchical position
- Culture to address problems and handle mistakes

B Research team therapy

Lack of recognition, integration in the team or appreciation

Misunderstandings, competition, and disputes

Diffuse or unclear task assignments or expectations

Contradicting aims of team members and PI/research institute

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Figure 1. The Borstel Model.

(A) Integration of research integrity guidelines and laboratory rules with emotional and psychological aspects of communication and behaviour. The boxes list factors and circumstances that can affect scientific integrity. (B) Factors that can distract laboratory members from the main scientific goals or from scientific integrity. Knowledge about these connections helps to find solutions.

high level of GSP despite regular turnovers. Partnering new research integrity scouts with experienced scouts was an important step to achieve this and ensure the necessary transfer of knowledge and experience. Noteworthy, experienced scouts—postdocs, students and technical assistants—quickly adapted the concept of the team in order to improve the GSP measures on all levels of the research work (Fig 2A). The integration of new scouts is now well established, and the GSP team does not suffer from a loss of active members, as we anticipated in the beginning, but has grown over the years despite the typical turnover of students and postdocs who leave the institute after a couple of years. Of note, many of the team members who engage as research integrity scouts would not have been included in a typical scientific integrity education, which usually addresses students and scientific staff. The constructive engagement of laboratory technicians in the research integrity scout team reflects the high intrinsic interest in quality management and scientific integrity among all employees who work in science.

Measures of success

The cardinal question not only raised by us but also brought up by our governance authorities when we started this process at the Research Center Borstel was: How do we determine the success of our strategy? The answer is: there is no single measure. But there is positive feedback from staff
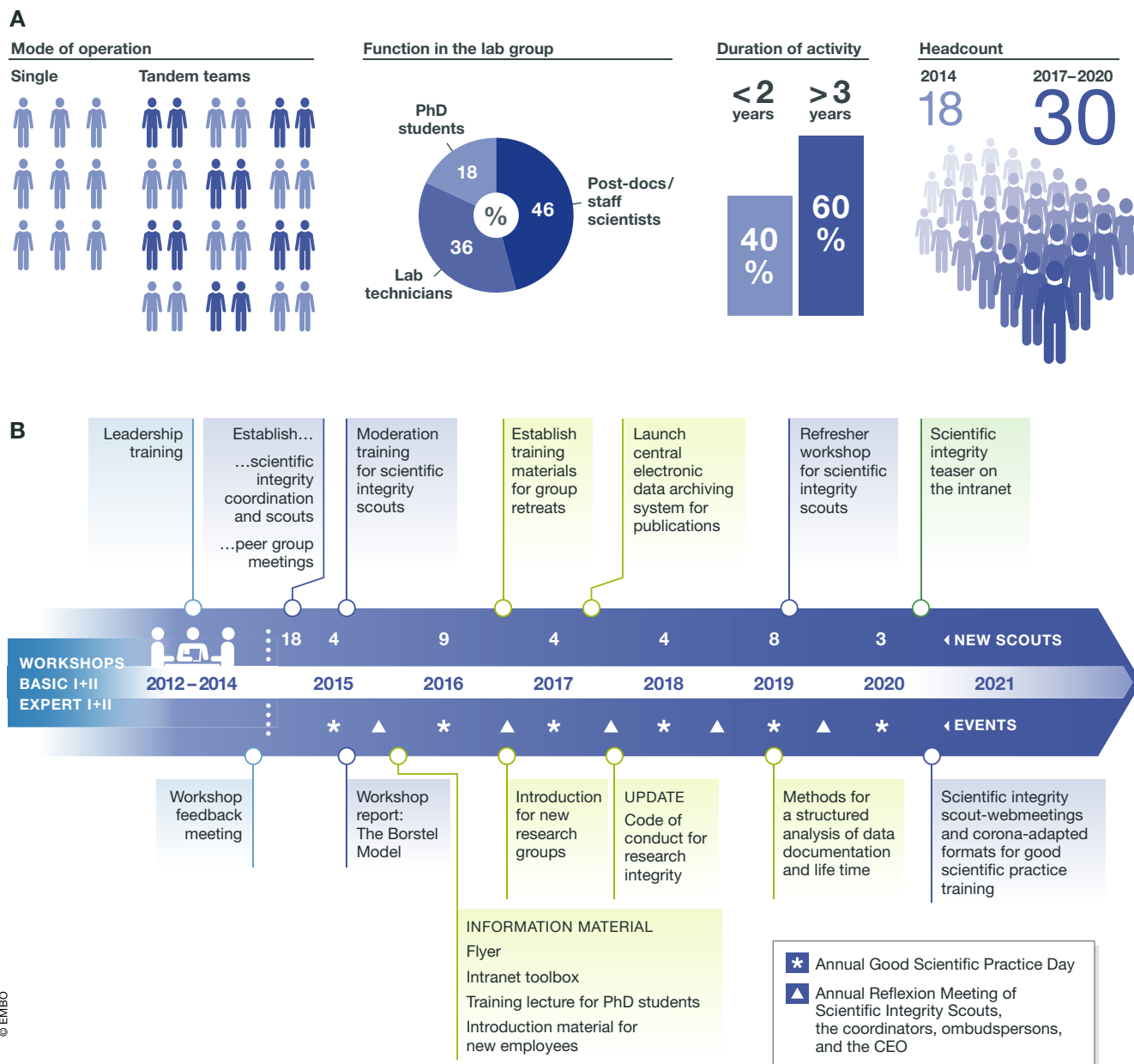
Figure 2. Scientific integrity scouts.

(A) Research integrity scouts are recruited among team members, excluding the PI. Their proportion are 36% laboratory technicians, 18% PhD students and 46% postdocs and staff scientists. (B) Milestones and development of the scientific integrity team. The numbers indicate the number of newly recruited scientific integrity scouts in that year.

members and from new employees when they receive the GSP introduction by the research integrity scout of their group or when they learn about communication theories like the *square of communication* and the *iceberg model*, and how this is related to their research project or data quality. The structured analysis of data documentation and reproducibility of experiments has initiated further changes in the workflow,

knowledge transfer, and communication within the individual groups, depending on their starting situation and their needs.

We thus did not develop a one-size-fits-all mandatory practice to address GSP, but research groups developed their own solutions to improve their workflow and communication within the frame of the institute's GSP culture. These improvements are shared by the research integrity scouts or

presented as best practice solutions at the annual GSP day. Most research groups have an annual group retreat including a session to discuss specific needs or the general group situation. As a conclusion, we can state that the changes initiated by this bottom-up approach are very successful, because they meet the requirements of the respective groups. Our approach of building up the competence for critical reflection has

furthermore the advantage of being flexible to react to new challenges or needs.

Is this a self-developing process? In the beginning, it required the concerted action of the initial workshops, the guidance and coaching by the scientific integrity coordinators and the ombudspersons, and the political and financial support by the institute's managing directors. Once we reached a certain threshold of GSP competence within the research teams, many processes and tools were naturally developed by the people engaged. Stepwise implementation of a framework of institutional structures now ensures sustainability (Fig 2B). The research integrity scout's function and the coordinators have now been included in the institute's code of conduct for research integrity (*Betriebsvereinbarung über die Selbstkontrolle in der Wissenschaft, Forschungszentrum Borstel, 2017*).

We also implemented technical measures. We introduced a central data archiving system for all primary data in publications that ensures protected data storage and allows data inspection by ombudsmen in case of an allegation. Archiving and documentation of data generation, processing and usage is now mandatory to receive credit for publications in the internal merit-based reward system. This incentive system ensures a high coverage of archiving manuscripts and the data therein. An interesting side effect we observed upon introduction of the archiving requirement was an improvement in the workflow for data documentation in many research groups. Introduction of electronic laboratory notebooks is next on the agenda.

Different solutions and strategies to improve GSP

Universities and research institutions have employed different solutions to support scientific integrity. The focus—more technical, more cultural or a mixture of both—usually depends on their specific needs. The Max Planck Society, for instance, has introduced a new code of conduct, mentoring and training for junior and senior scientists to improve communication and to reduce conflicts of interest after various allegations of misbehaviour at the group leader level. A recent report published by the League of European Research Universities highlights various approaches to develop research ethics at universities (https://

www.leru.org/publications/towards-a-research-integrity-culture-at-universities-from-recommendations-to-implementation). Training sessions for research integrity such as the Curriculum developed by Gerlinde Sponholz for the German Ombudsman or the one by the NIH's Office of Research Integrity (ORI) focus on education. The Leibniz Association supports various approaches including technical solutions, as chosen by the Leibniz Institute on Aging in Jena, and cultural changes, as initiated at the Leibniz Lung Center—Research Center Borstel and the Leibniz Institute for Neurobiology in Magdeburg. To our knowledge, the scientific integrity scout model is a unique approach to enable sustainability in improving research culture involving all levels of employees. Indeed, the German Research Council (DFG) cites the Borstel Model as a best practice example to support research integrity on a practical level (https://wissenschaftliche-integritaet.de/kommentare/weiterfuhrende-links-berufsethos-2/chapter/128/).

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In conclusion, we aimed to establish a culture of active participation and multiplication by the research integrity scouts. Awareness and competence are now prevalent on all levels of the research teams. The Research Center Borstel is well aware that there is no efficient way to prevent wilful misconduct. But we are convinced that we have achieved a successful transition of the institute's culture towards transparency, voluntary self-regulation and learning from mistakes. Sharing our experience hopefully encourages other institutes and universities to consider our strategy.

Author contributions

This manuscript is based on the experiences of ABS, head of the Division of Immunobiophysics, and FS, senior postdoc in the Division of Clinical and Molecular Allergology, as coordinators for research integrity and coaches of the team of RI scouts at the Research Center Borstel. HF and ABS initiated and conceived the pilot project "The Borstel Model" in their function as Ombudspersons of the Research Center Borstel. FS, HF and ABS wrote the manuscript.

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