Afonso Pais, Renata Ramalho, and Ana Sanchez

Assessing the Assessment of European Researchers' Night: Findings from a Nationwide European Researchers' Night

Introduction

Science communication initiatives are becoming more and more widespread across the world (Trench & Bucchi, 2021). They are accompanied by national and international policies designed to support these efforts and continue to bring science and the rest of society closer together (Weingart & Joubert, 2019). However, little attention has been paid to the assessment and reporting on the real impacts of these initiatives and policies (Weingart & Joubert, 2019; Ziegler et al., 2021).

The European Researchers' Night (ERN) is a long-standing initiative (started in 2005) funded by the European Commission through the Marie Skłodowska-Curie Actions. It comprises a series of events that take place annually on the last Friday of September across Europe and beyond, and which are designed to promote science and research. In addition, ERN aims to "increase awareness amongst the general public of the importance and benefits of research and innovation and showcase its concrete impact on citizen's daily life" and to "heighten young people's interest in science and research careers" (European Commission, n.d.(a)). In 2019, ERN reached 1.6 million visitors in four hundred different cities (European Commission, 2020a). In 2020, the number of visitors increased to two million (European Commission, n.d.(b)). Most ERN events are organised by institutions or consortiums that have been awarded competitive grants for the purpose by the European Commission. "Main events can last up to two full days", and build-up events "can also be organised prior" to the main events with activities that include "hands-on experiments, science shows, simulations, debates, games, competitions, quizzes, etc." in order to promote "the European dimension, gender balance, and inclusion in research and innovation" (European Commission, 2020b). In 2021, ERN events took place on September 24th with the European Green Deal as the main topic. The budget for the events was eight million euros (European Commission, 2020c).

Despite its wide timeframe and the growing number of participants, published empirical research on the impact of ERN remains scarce (Roche et al., 2017). As a result, ERN and other similar events have long been criticised for their lax approach to assessment and evaluation (Bultitude et al., 2011; Kennedy et al., 2018; Weingart & Joubert, 2019).

The European Commission funding requires the impact assessment of ERN activities but, as there are no specific assessment guidelines, each consortium develops and implements its own strategy. Moreover, results and strategies emerging from this process are rarely shared. Thus, it is very difficult for the science communication community to build on each other's experience with previous ERN events.

In 2021, we were involved in a Horizon 2020 project for ERN in Portugal. Under the project REGGAE (Researchers for European Green Growth and Education), we assessed the opinions and perceptions of three different stakeholders in the event: participants, scientists involved in the planning and implementation of activities, and organising institutions. In this way, we managed to collect valuable data and feedback regarding the initiative.

Here we present our findings regarding the participants' experience of ERN 2021, and from there reflect on the overall impact of the ERN assessment strategy. We believe the approach to ERN assessments needs to be reshaped. In order to work towards this goal, we reflect on the insights and drawbacks of our own experience assessing a nationwide ERN initiative and on what could make assessing ERN more valuable to organising institutions, science communication scholars and practitioners, as well as to the European Commission. With these reflections, we hope to contribute to a wider discussion about why we are assessing ERN and what we expect to achieve from our assessments. Only then will it be possible to devise a strategy for how to make these assessments. We believe that by exploring the purposes of ERN assessments, it will be possible to set useful guidelines for future ERN assessments (and science communication initiatives, in general). By defining tangible objectives, it will be possible to produce comparable results, which over time will also contribute to the effective assessment of the initiative's goals. At this point, it is important to note that for the purposes of this chapter "objectives" are defined as short-term, tangible, and more easily-assessed, and defined in relation to each science communication initiative. "Goals" are defined as the long-term objectives of initiatives, such as ERN, and reflect continuous efforts aimed to produce significant changes in participants (attitudes, knowledge, etc.).

Above all, we argue that data regarding events as well as their assessment and their results must be shared amongst practitioners, scholars, and funders in order to enable the transparent overall evaluation of the longest-lasting science communication initiative in Europe, fostering evidence-based science communication practice, and contributing to the science of science communication. Although our reflections here are mostly focused on the perspective of ERN participants, we believe it is necessary to consider all relevant stakeholders when designing common guidelines for a robust assessment of ERN.

The REGGAE consortium

The REGGAE Project was proposed and implemented by a consortium of three institutions with extensive experience in public engagement activities, ranging from structured formats of public debate to mobilisation and mutual learning activities and co-creation. The REGGAE consortium had been involved in previous ERN projects, specifically Futuro 2020 (in 2013) and Foresight 2030 (in 2016 and 2017).

The leader of the consortium was Ciência Viva, the Portuguese agency for scientific and technological culture. Created in 1996 to promote public awareness of the importance of science and technology at a national level with a particular emphasis on young people, Ciência Viva coordinates a national network of science centres spread across Portugal. In 2021, nineteen Ciência Viva centres organised ERN events and pre-events.

The other consortium partners are the following two research institutes operating in the field of the life sciences both with a high profile in science outreach: the Instituto de Investigação e Inovação em Saúde (i3S), an association of three institutes engaged in health and life sciences research of the University of Porto, and; the Instituto de Tecnologia Química e Biológica António Xavier (ITQB NOVA), a research institute of NOVA University Lisbon, dedicated to life sciences, chemistry, and associated technologies. Within the REGGAE Project, i3S coordinated the communication work package and ITQB NOVA coordinated the assessment package. Both institutions also organised their own ERN events and pre-events.

Activities

In total, REGGAE involved twenty-one institutions organising science outreach events across Portugal. All of the participating institutions organised a main event on Friday, September 24, 2021 (twenty-one main ERN events) as well as a total of eighty-eight build-up events in the preceding months. Overall, the 109 ERN events attracted over 12,500 participants and involved around eight hundred scientists.

The planners of ERN activities in 2021 faced the additional challenge of the uncertainty of the COVID-19 pandemic. From the start, it was planned that REGGAE included both face-to-face and remote events. Face-to-face events would also include a remote component, and there was an alternative plan to go fully remote if further COVID restrictions were implemented. Fortunately, this was not the case, and the only restrictions were the required use of masks and limitations on the number of people in closed spaces.

All events were disseminated through a dedicated website (https://nei.cienciaviva.pt/2021/), and social media accounts, and through the media outlets of the consortium's institutions and local partners.

Build-up events explored different formats, such as talks, hands-on activities, demonstrations, guided visits, or workshops. However, most of the REGGAE main events resembled science festivals as do many ERN initiatives (Jensen et al., 2021). According to Bultitude et al. (2011) a science festival is a "time-limited and recurring" event that focuses on "science, technology, engineering, and related aspects", and seeks to "engage non-specialists with the scientific content" through activities with a "common theme and/or branding". All REGGAE main events used the same graphic design in disseminated content and other onsite promotion materials. The Green Deal topic proposed by the European Commission was the main focus of all events. Events took place inside or in the vicinity of the science centres, the research institution (i3S), and in a marina (the event organised by ITQB NOVA).

Assessment strategy

The assessment strategy had two main dimensions: the participants and the researchers involved in the activities. A third focal point were the event organisers, here referred to as the institutions.

In this chapter, we will focus specifically on the results generated from the feedback of participants. First of all, we wanted to know who the participants were, what made them come to an ERN event, and what their experience was once there. The analysis of participants included the views they expressed about science and scientists.

The methodology of the REGGAE events assessment involved gathering data from over a hundred events at twenty-one different institutions. In terms of impact assessment, build-up events were mainly testing grounds for the main events. These tests allowed us to improve both the assessment instruments and the instructions for institutions implementing them, and also to define feasible targets for survey response rates at the main events.

Data collection instruments comprised questionnaires (for participants, researchers, institutions), interviews (for researchers), and other methods (for participants). We prepared both online and paper versions of the questionnaires to accommodate all possible situations.

The full data collection protocol was submitted to and approved by an Ethics Committee. Organising institutions received an instruction manual detailing how to apply the different instruments. All assessment documents (questionnaires,[1] guidelines,[2] results,[3] and Ethics Committee approval[4] are available in the respective links).

1 https://www.itqb.unl.pt/ern-2021-participants-questionnaire
2 https://www.itqb.unl.pt/instructions-manual
3 https://docs.google.com/spreadsheets/d/1mtYguGH6l7AgdchgH6wmTP3RzkZ5MSzC/edit?rtpof=true&sd=true
4 https://www.itqb.unl.pt/ethics-committee-approval

Questionnaires

Participants

We consider a participant anyone sixteen years old or older attending the event as a visitor. Participant questionnaires were made available to organising institutions in three formats: through the Mentimeter app (www.mentimeter.com), as a Google Form link, or as a PDF file to be printed and distributed. All formats had the same questions presented in the same order. Institutions could choose which formats were most adequate for their event, resources, and target audiences. We encouraged the use of Mentimeter because it is a user-friendly platform and allows for live-display of the results at the venues, which we hoped would encourage participation. The questionnaires were designed with the aim that participants would fill them out themselves (although some institutions had staff to help perform that task). To encourage participation, respondents could leave their email in a separate form and enter a raffle to win a Family Ticket to enter any Ciência Viva Centre in the country.

The items chosen for the participants' questionnaire aimed at assessing the general success of the events and the attainment of ERN's goals, including those related to the European Green Deal. We sought to understand whether people enjoyed their experience and how it contributed to improving their attitudes toward science and scientists, promoting scientific and research projects or institutions, and encouraging younger people to pursue scientific careers.

Researchers

In this study, we defined researchers as those invited by the organising institutions to design activities or interact with participants during an ERN event (researchers who were there only as visitors were considered participants). In compliance with GDPR, no email contacts were shared with the assessment team. Instead, we asked organising institutions to forward a Google Forms questionnaire to the researchers involved in their own events. In contrast, institutions had no access to individual responses. The questionnaires were anonymous but identified the venue. At the end of the questionnaire, researchers available for a follow-up interview were directed to a second unlinked Google

Form where they could leave their email address. As mentioned above, we will not discuss the researchers' responses in this chapter.

Institutions

We also developed a questionnaire for the institutions organising the events to assess their view on the initiative and the assessment strategy itself. Although we do not explore those results in detail here, we do mention some important insights drawn from them.

Follow-up interviews (researchers)

To complement the information collected in the researchers' questionnaires, we invited ERN researchers to a follow-up interview. One week after ERN, we invited willing researchers to a Zoom interview. We adopted a semi-structured interview format with a script to guide the conversation. Two people conducted the interviews and took notes. The individual sessions were recorded with the explicit consent of the interviewees and later transcribed and anonymised. As mentioned above, we do not discuss the researchers' dimension here.

Other data collection methods

Aware of the difficulties of collecting data via questionnaires in this type of events, we wanted to test other assessment methods that might be more interactive and entertaining for participants. We opted to focus on collecting participants' opinions about specific topics and proposed two additional data collection instruments: dotmocracy and post-it walls (explained below). Organising institutions were free to decide whether to use these formats during their events. We provided possible questions in the instruction manual for institutions.

Dotmocracy is a method where participants answer different questions by placing a sticker (or token) indicating their desired answer for a single or multiple-choice question or by using colours to give different answers to a particular question (e.g. red – no; yellow – maybe; green – yes). The outcome is a board in which the place (or colour) of the tokens represents the participants' perceptions.

The post-it wall is a similar method but for open-ended questions. In this case, participants answer the questions by writing their answer on a post-it and placing it under the question. The result is a colourful wall presenting participants' thoughts and opinions.

In both cases, participants are asked to collaborate in the construction of an aesthetically pleasing board that contains information regarding their opinions, perceptions, or attitudes.

Summary of results

The first conclusion we drew from our assessment was that that REGGAE events were a success as measured by stakeholders' satisfaction. We received very positive feedback from institutions, participants, and researchers, and found no significant differences in data collected at different venues.

Here, we focus on the results obtained for the participants at the main ERN events organised by REGGAE on September 24. We collected 666 participant questionnaires during the twenty-one main events. Overall, these events attracted approximately 6,500 participants of which we estimated 4,200 were sixteen years old or older (and thus were eligible to answer the questionnaire). This corresponded to a 16% response rate. With a few exceptions, the number of responses was proportional to the number of participants at each event.

Participants rated their experience at ERN very positively (median of 9 out of 10) and most were willing to participate in future editions of the event. Participants responded that they had fun, and had the opportunity to interact with scientists and learn more about science and technology (Figure 1). Furthermore, they became more aware of how science works, its importance, and its role in their daily lives.

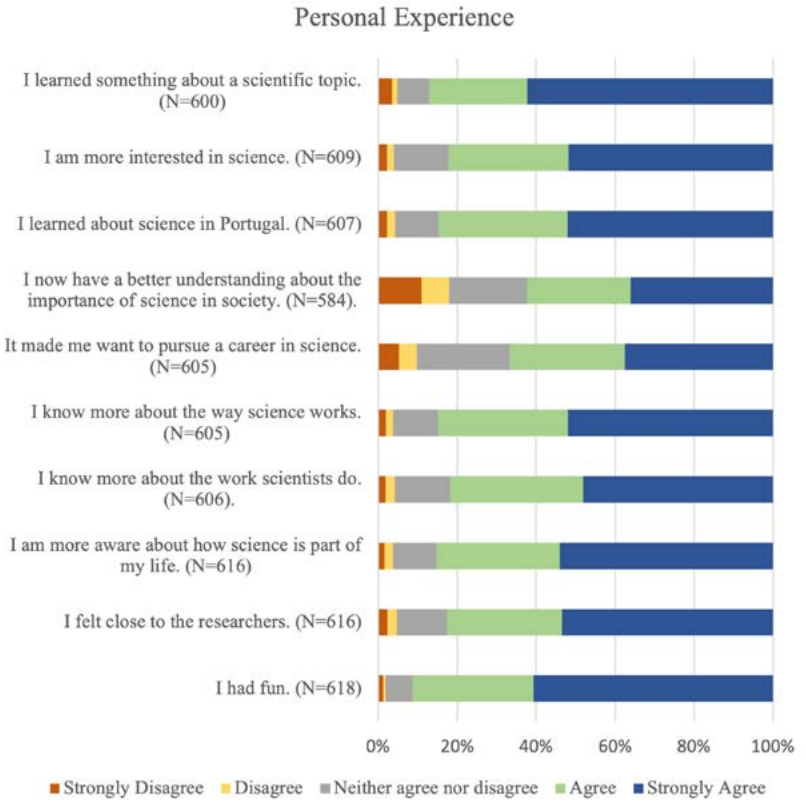

Figure 1: Distribution of respondents by level of agreement with each statement concerning their personal experience at ERN2021

Most respondents were female (62%), which is an overrepresentation of the female proportion of the national population (according to the Institute of National Statistics, in 2021, 52.4% of Portugal residents were female). This is not surprising as women are more likely to attend such events, usually with their children (Mazzitelli et al., 2019). In some cases, women have also been found to be less likely than men to refuse to answer questionnaires (Groves & Couper, 1996).

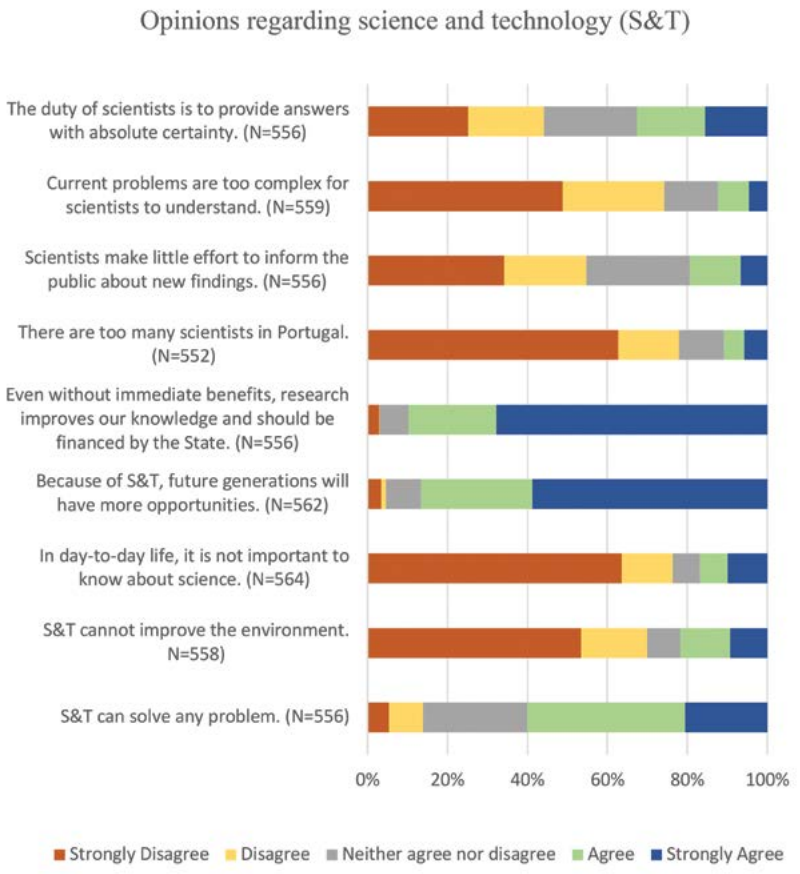

Figure 2: Distribution of respondents by level of agreement with each statement

In terms of age, age groups 16-24 (24%) and 35-54 (49%) are overrepresented compared to their proportion of the national population (10.6% and 28.4% respectively). It is likely that many respondents were young people interested in science and technology and exploring a career within the scientific field (21% of respondents were students of scientific fields), or parents accompanying their children to the event (71% of the respondents were attending the event with friends or family or accompanying children).

The participants' profiles tended to match those reported at other science festivals (Kennedy, Jensen, & Verbeke, 2018). Namely, they were highly educated (68% had at least a bachelor's degree compared to 21% nationwide), and/or had a professional (23% of respondents) or personal connection to science (61%). More than half had visited the hosting institution before, indicating previous experience with similar events, which is characteristic of attendees of science communication events.

In general, participants had a very positive image of science and scientists (Figure 2). They recognised the importance of research and scientific knowledge and showed great confidence in the ability of scientists to understand and tackle current problems. This positive perspective of science is perhaps even exaggerated as many participants expressed the belief that science can solve any problem (60%), and that scientists should always provide answers with absolute certainty (33%). These overly confident views or wishful thinking could be understood in the context of the COVID-19 situation in Portugal in September 2021, and the fact Portugal had a very successful vaccination campaign with 95% of the population voluntarily vaccinated against SARS-Cov2.

ERN participants tended to regard themselves as being very interested in scientific topics related to the environment (average self-rating of 8.8 out of 10) and moderately knowledgeable (average of 6.9 out of 10) with the self-rating of knowledge beingly slightly more widespread.

The data collected through other methods confirmed and complemented these results. For example, the dotmocracy board used at the event in the Oeiras marina (Figure 3) showed that respondents believed that "science will find solutions for the environmental crisis" (75% answered yes, no one answered no) or that the "investment in science should be higher" (100%). These results are not surprising given the generally positive opinions about science expressed by respondents, and the personal or professional links to science and technology identified above. Moreover, an additional question highlighted that most participants had met at least one scientist before. Nevertheless, meeting a scientist was a first-time experience for 14% of the respondents. A fourth question addressed how the COVID-19 pandemic affected respondents' confidence in science: 45% stated that it had increased, and

55% that it did not change (we assume because it was already high, given the results described above).

Figure 3: Dotmocracy used at ERN2021 at the Oeiras marina. Eighty-two visitors gave opinions. The questions were: "Will science find solutions for the environmental crisis? Yes/Maybe/No" (top, left); "Investment in science should be: higher/ the same/lower" (top, right); "Did COVID-19 affect your trust in science? Yes, it increased. / It did not affect it. / Yes, it decreased." (bottom, left); "Had you ever interacted with scientists before ERN2021? Yes/No" (bottom, right)

A post-it wall at the Ciência Viva Centre in Vila do Conde (Figure 4) revealed what people enjoyed most about the event: ("I enjoyed hearing the bats." "I enjoyed seeing the bats.") and that they learned something new (such as how big bats are or how they communicate). It corroborated the positive views on science with respondents choosing positive adjectives to describe the event (e.g. "fantastic", "interesting", "fun" …). In terms of what participants enjoyed the least, only eight gave input, four of whom reported there was nothing they disliked. These results are similar to what the questionnaires revealed.

Figure 4: Post-it Wall used in Vila do Conde. The questions were: "What did you enjoy the most?" (top, left); "Three words you associate with science." (top, right); "Something you did not know before your visit." (bottom, left); "What did you enjoy the least?" (bottom, right)

Challenges of the assessment strategy

Implementing an assessment strategy for so many events with the involvement of so many institutions posed many challenges. Each institution is different, having different conditions, staff, and resources, which makes it difficult to ensure a harmonious data collection process. We tried to minimise discrepancies by providing assessment protocols while also allowing some flexibility for local adjustments.

Data collection during events such as science festivals is difficult. Participants are there to have fun, meet researchers, learn about new projects, ask questions or give comments; they do not want to fill out extensive questionnaires. In our questionnaires, we tried to limit the questions to those that would contribute to our two main aims: assess the success of ERN as an event, and tackle some of ERN's more general impact

dimensions as defined by the European Commission (promotion of scientists and research, raising awareness of their importance, attract young people to careers in science). All the same, as pointed out by a few participants and by the organizing institutions, the questionnaires were too long.

Data collection decisions were also constrained by legal and ethical issues. We opted for a conservative approach and avoided posing sensitive questions, such as economic status or ethnicity, to participants (asking about ethnicity is illegal in Portugal). Judging by the educational and professional status we observed, the economic status data would probably have further confirmed the participant profile found at similar events – specifically, middle and upper class (Kennedy et al., 2018). As for ethnicity, in Portugal, there are no official national statistics and, although it was much debated, the official census in 2021 did not include that information. Instead, we opted to ask respondents if they considered themselves to be a member of a minority (12% answered in the affirmative). This response may account for different situations as respondents will use their own definition of minority in their particular context (nationality, ethnicity, sexual orientation, etc.).

We also decided not to collect data from children. The General Data Protection Regulations (GDPR) requires parental consent for the collection of personal data from children under sixteen years old, which would have been difficult to obtain in the ERN event settings. While we could have found strategies to circumvent this limitation, we believed it was more important to assess older teenagers (sixteen and older) who would soon have to make choices about their studies and future careers rather than introducing additional instruments. We did collect data on how many children participated in the activities (a conservative estimate of 2,275) and have plenty of observational evidence on how much they enjoyed the events.

Finally, there is an intrinsic limitation to assessing the impact of ERN in terms of the goals set by the European Commission. It is unlikely that a single event, such as ERN, changes a person's career choice or views on science and technology. It is even more difficult to measure such changes with any on-site assessment instruments. To gain insight into those issues, we propose, instead, an effort to define stable data gath-

ering strategies that would assess the evolution of ERN audiences (and ERN researchers) over time.

How can we move forward?

Our knowledge of science communication has been evolving as the field has been growing both as a practice and as a discipline (Bucchi & Trench, 2021). However, according to Gerber et al (2020), there seems to be a clear gap between practitioners and scholars created by the failure to recognise each other's needs, aims, and priorities. There is also a third variable in this equation – the funders (in this case, the European Commission).

Simultaneously, there seems to be a disconnect between the motives and goals of science communication and its practical impacts (Weingart & Joubert, 2019). Despite aiming to bring together science and the rest of society, most science communication activities seem to be reaching always the same people (Kennedy et al., 2018). Our results confirm this phenomenon, with ERN participants being highly educated and having an existing interest or connection to science. This means other segments of society are excluded from these initiatives, perpetuating the overall social exclusion of underprivileged groups (Dawson, 2014). Participants in science communication initiatives usually demonstrate previously existing positive attitudes toward science and researchers, and are more likely to take full advantage of the products and knowledge that science generates. However, if we, as science communication practitioners, believe that all citizens should have access to science in its many forms, we must strive to reach those who feel they are not welcomed by these initiatives. Improving assessment will help us gain better insights about who is missing and why, learn from initiatives that attract the non-converted, and develop new strategies to engage other target groups with science.

We are fully aware that it is not possible to introduce significant changes in knowledge, much less in attitudes, regarding science (and most topics) with single activities or events such as ERN. Still, each science communication activity or initiative contributes to the definition of the participants' relation to science and scientists. Assessing, documenting, and sharing knowledge about the impact of such activities helps us

understand what works and what does not, what we can change and what we cannot (or should not). To be fair, the European Commission does request the documented assessment of funded ERN initiatives, but there are no general guidelines for how this assessment should be done nor are impact reports are available.

Sharing information

From our perspective, one major obstacle for the impact assessment of ERN is the lack of information from previous editions. With very few results published and no assessment protocols available, each consortium has to design its own activities and assessment strategy instead of building on previous tried and tested methods. This seems like a waste of valuable resources and data. With eighteen years of funded ERN initiatives so far and several countries involved accounting for several millions of participants and thousands of researchers, with minimal standards for the collection of data, the dataset would be enormous by now.

Sharing assessment protocols and results is a crucial step toward a better understanding of the overall impact of ERN. Like other projects funded by the European Commission, funded ERN initiatives should be required to have data management plans, describing how data will be collected, anonymised, and stored in accordance with FAIR principles (Findable, Accessible, Interoperable, and Reusable). We envisage a central database where results are uploaded, but until such a system is available, each consortium can make its own databases available, starting from a minimum set of standards to a more robust framework for science communication datasets. The value of having all of these results accessible would be enormous and would foster analysis by science communication scholars. However, in order to make this feasible and above all productive, it is necessary to define an assessment strategy that allows for the collection of data amongst all institutions in a standardised manner, which would facilitate comparisons between ERN initiatives and over time. The definition of this strategy requires the following steps: 1) setting objectives and goals to be assessed; 2) designing instruments to collect data; 3) understanding the type and nature of the data produced, and; 4) sharing the data and results of the assessment. Ideally, we should aim toward creating a centralised data centre that

contains the assessment strategies and all data generated from different ERN initiatives in a standardised, accessible, and comparable manner.

Of course, comparisons need to be sensible. Different initiatives in different countries, or even within the same country, will necessarily produce different results. To generate useable conclusions, it will be necessary for databases to include detailed descriptions of the conditions in which the data was collected, such as the type of event, the location, and other relevant information. Finally, as Ziegler et al. (2021) also believe, the evaluation of ERN or any science communication initiative must "not replace academic impact research" because it is not the place, nor the time for that kind of research.

Agreeing on goals and objectives

The most important and complex step is to agree on why (or what for) we are assessing ERN. The value and use of impact assessment data will necessarily vary according to its user. Practitioners will most likely focus on a more strategic view of assessment such as how the data can be used "to improve the visitor experience and increase the impact of the interaction" (Barriault & Pearson, 2010), to increase the number or diversify the profile of participants, or even to come up with more cost-effective methods for activities. In parallel, the European Commission, as funder, may wish to assess the return on their investment in terms of science policy goals. Finally, scholars would be able to gain insights into ongoing science communication activities, learn more about ERN audiences or scientists, and contribute to a grounded discussion with practitioners about new directions for assessment strategies and the initiatives themselves. Although some objectives and goals of the three parties coincide, others do not. It will be impossible for an assessment strategy to fully meet all these needs, and certainly compromises are necessary. We suggest defining minimum requirements for a robust impact assessment and designing modular assessment instruments, which may be combined, allowing for flexibility.

Through ERN, the European Commission aims to promote science in general and research projects, demonstrate their importance and benefits to society, and attract people to scientific careers. However, these long-term goals are influenced by many other factors, which

makes them complex, and thus difficult (if not impossible) to attain with one-off events and their success hard to measure. Aiming to make a direct assessment of ERN goals is therefore unrealistic. When answering questions about changes in attitudes and knowledge, for example, respondents may be infatuated by their presence at the event or give answers that they believe the institutions wants to hear (Jensen, 2014), which may lead to overly optimistic and inaccurate data. If we want to improve the assessment of ERN initiatives, we should start by reframing goals and designing realistic, tangible, and measurable objectives.

The assessment of a European-wide activity calls for the definition of a European-wide assessment strategy, which can only be obtained through collaborative reflection involving funders, practitioners, and researchers from different fields, in particular social scientists "whose expertise will remain relevant to measuring impact and developing strategies for effective science communication" (Ziegler et al., 2021). Rather than changing ERN's overall goals we need to accept that each ERN initiative is a step towards long-term goals and also a part of a broader spectrum of public policy measures and science communication activities. Each step should have more specific and measurable objectives. To get a better grasp of the true impact of these initiatives, we must learn to identify the "small steps" that move us toward long-term goals (Besley et al., 2017). Having realistic and tangible short-term objectives will also help science communicators (and researchers) design more targeted activities and later learn from the assessment results. For example, we may not be able to assess whether participation in one ERN event changes a respondent's perception of science and technology, but we can find out whether ERN was their first opportunity to talk to a scientist or the first time they were in contact with a specific field. We may not be able to assess if ERN changes a researcher's perception on the importance of listening to the public, but we can find out if they learned something from the audience during participation.

Agreeing on design and assessment methods

After agreeing on objectives and goals, the next step is to agree on assessment methods. Even if all past ERN results were shared now, com-

parisons over time and between countries will be very difficult if there are no common data collection instruments. Once we settle on the desired impact and on what are we aiming to assess, we can define suitable tools to assess how successful ERN initiatives have been from several points of view. Moreover, if we can agree on (at least some of) these tools, we can have standard and consistent guidelines for assessing ERN as suggested by many scholars (Roche et al., 2017). We are not proposing a one-size-fits-all survey, but rather a combination of instruments targeting distinct information needs so that following these guidelines would provide a better overall picture of "what" happens and "who" participates at ERN events, and how ERN contributes to continuing building a bridge between science and the rest of society.

Assessment instruments do not need to be restricted to questionnaires, and indeed should include other quantitative and qualitative methods. Above all, assessment should not overwhelm either participants or practitioners. By combining different methods, we would be able to avoid lengthy questionnaires even if sacrificing some information.

We propose dividing the participants' assessment into three dimensions: 1) the attendee's profile; 2) their satisfaction with the experience, and; 3) their perceptions and attitudes about science.

In an event such as a science festival, for example, dimensions 1) and 2) could be assessed by questionnaires directed at a random sample of the population. Short questionnaires that are easy to implement, quick to analyse, and ensure anonymity. Dimension 3) could be assessed with other data collection methods, such as dotmocracy or post-it walls, which could be conceived of as an additional activity in the festival and could potentially involve all participants.

Questionnaires would provide stratified information about the audience and their experience at the event while not taking up too much of their time. Simultaneously, audience members' opinions about science and scientists would reflect a more general view of the participants. This would also facilitate obtaining data from children without collecting personal information.

There are also disadvantages that come with this division, namely the inability to cross opinion and attitudes data with the profile of par-

ticipants. Moreover, the number of questions that may be posed using boards is limited. Otherwise, the whole venue would be filled with opinion boards that would ultimately interfere with the objective of promoting interaction with science and scientists.

Nevertheless, one must accept that ERN events are not the best setting for such social studies nor is that the point of impact assessment. Learning about the public perception of science is the aim of Eurobarometers and similar studies, which are designed with that purpose. For ERN assessment, just learning about "who" attends the event and how different audience segments experience the events can be extremely valuable. If we can obtain in addition a general view about the audience's opinions, we also gain insights on participants' opinions about specific science and technology topics, helping us to fine tune future initiatives.

Being able to collect quantitative and reliable data about the audience and comparing it to local statistics can help us to assess if we have reached the desired target audience, who is being left out, and what could be done to tackle that shortcoming in the future. Comparisons over the years will show how ERN audiences are evolving. Comparisons between venues or countries may identify new strategies and highlight blind spots in our overall efforts.

We believe that simpler, standardised assessment strategies will have many benefits: cost-effectiveness, feasibility, comparability, and representativeness. With simpler and easier data collection tools, we should be able to collect more (and more honest) responses and increase the response rate. Further qualitative data could be collected with on-the-spot interviews with participants and through systematic observation. In our experience, not all institutions have enough resources to devote to these tasks but could nevertheless benefit from the data collected at other places when designing their activities.

Conclusion

We are at an important crossroads in the relation between science and the rest of society. Climate change, the COVID-19 pandemic, nanotechnologies, and artificial intelligence represent challenges that require a public discussion involving all stakeholders in society (Trench & Bucchi, 2021). Science communication will be pivotal in this transition and,

if on one hand, the efforts and investment have never been greater, on the other we are not yet capable of properly assessing their true impact.

ERN is one of the biggest international science communication initiatives (if not the biggest), and yet, despite the millions of euros in investment, the thousands of researchers and hundreds of institutions involved every year, there is no access to the data collected, and we lack a clear perspective of what this data should entail. Failing to address these needs means we cannot build on years of experience gathered all over Europe, and that we will make preventable mistakes. Joining efforts will contribute to collective growth and the improvement of ERN in general and, as a consequence, increase its impact. And we do not need to reinvent the wheel because the foundations to define a suitable assessment strategy for these communication efforts have already been developed in other fields. All we need to do is take one step back, learn from what has already been done, transfer this knowledge to the growing field of science communication, and use this to take several significant steps forward.

Better assessment of ERN will provide valuable information. It will allow us to learn from ours and others' experiences to improve the quality of these initiatives. Moreover, it will produce sufficient and meaningful data that will allow the European Commission to justify annual investments in ERN and other initiatives. Finally, it will provide valuable insights allowing scholars to continue developing our knowledge of the field, and over time this will improve our ability to implement successful and meaningful activities.

Acknowledgements

This work was supported by the European funding programme Horizon 2020, through Marie Sklodowska-Curie project REGGAE (GA 101036079), FCT - Fundação para a Ciência e a Tecnologia, I.P., through MOSTMICRO-ITQB R&D Unit (UIDB/04612/2020, UIDP/04612/2020), and LS4FUTURE Associated Laboratory (LA/P/0087/2020).

We want to thank Maria Castanheira (ITQB NOVA) and Rita de Almeida Neves (ITQB NOVA) for valuable discussions and support in designing the assessment methods and mapping the results. We also thank our partners Sofia Lucas (Ciência Viva – Agência Nacional para a Cultura

Científica e Tecnológica) and Julio Borlido Santos (i3S), and all the coordinators of ERN events for implementing the assessment strategy and gathering results at their venues.

References

Barriault, C., & Pearson, D. (2010). Assessing exhibits for learning in science centers: A practical tool. *Visitor Studies, 13*(1). https://doi.org/10.1080/10645571003618824

Besley, J. C., Dudo, A., & Yuan, S. (2017). Scientists' views about communication objectives. *Public Understanding of Science*, *27*(6), 708–730. https://doi.org/10.1177/0963662517728478

Bucchi, M., & Trench, B. (2021). Science communication as the social conversation around science. In M. Bucchi & B. Trench (Eds.), *Routledge handbook of public communication of science and technology* (pp. 1–13). Routledge.

Bultitude, K., McDonald, D., & Custead, S. (2011). The rise and rise of science festivals: An international review of organised events to celebrate science. *International Journal of Science Education*, *Part B*, *1*(2), 164–188. https://doi.org/10.1080/21548455.2011.588851

Curtin, R., Presser, S., & Singer, E. (2000). The effects of response rate changes on the index of consumer sentiment. *Public Opinion Quarterly, 64*(4), 413–428. https://doi.org/10.1086/318638

Davies, S. (2008). Constructing communication: Talking to scientists about talking to the public. *Science Communication, 29*(4), 413–434. https://doi.org/10.1177/1075547008316222

Dawson, E. (2014). Reframing social exclusion from science communication: Moving away from 'barriers' towards a more complex perspective. *Journal of Science Communication*, *13*(02), C02. https://doi.org/10.22323/2.13020302

Dawson, E. (2019). *Equity, exclusion and everyday science learning: The experiences of minoritised groups.* Routledge.

European Commission. (2020a). *European Researchers' Night 2020*. https://marie-sklodowska-curie-actions.ec.europa.eu/news/european-researchers-night-2020

European Commission. (2020b). *European Researchers' Night 2021*. https://marie-sklodowska-curie-actions.ec.europa.eu/funding/european-researchers-night-2021

European Commission. (2020c). *Apply for Funding 2021 European Researchers' Night*. https://marie-sklodowska-curie-actions.ec.europa.eu/news/apply-for-funding-2021-european-researchers-night

European Commission. (n.d.(a)). *MSCA & Citizens*. https://marie-sklodowska-curie-actions.ec.europa.eu/actions/msca-citizens

European Commission. (n.d.(b)). *2021 European Researchers' Night*. https://marie-sklodowska-curie-actions.ec.europa.eu/event/2021-european-researchers-night

Gerber, A., Broks, P., Gabriel, M., Lorenz, L., Lorke, J., Merten, W., Metcalfe, J., Müller, B., & Warthun, N. (2020). *Science communication research: An empirical field analysis.* Edition innovare.

Groves, R., & Couper, M. (1996). Contact-level influences on cooperation in face-to-face surveys. *Journal of Official Statistics, 12*(1), 63–83.

Jensen, A. M., Jensen, E. A., Duca, E., & Roche, J. (2021). Investigating diversity in European audiences for public engagement with research: Who for public engagement with research: Who Ireland, the UK and Malta? *PLoS ONE, 16*(7), e0252854. https://doi.org/10.1371/journal.pone.0252854

Jensen, E. A. (2014). The problems with science communication evaluation. *Journal of Science Communication, 13*(1), C04. https://doi.org/10.22323/2.13010304

Kennedy, E., Jensen, E., & Verbeke, M. (2018). Preaching to the scientifically converted: Evaluating inclusivity in science festival audiences. *International Journal of Science Education, Part B, 8*(1), 14–21. https://doi.org/10.1080/21548455.2017.1371356

Mazzitelli, G., Arnone, S., Bramato, M., Capra, I., Ciocca, G., Ceca, A. D., Giovanditti, R., Grasso, C., Maselli, D., Sanzone, G., Sereni, D., & Spagnoli, F. (2019). 12 years of data, results and experiences in the European Researchers' Night project. *INTED2018 Proceedings, International Academy of Technology, Education and Development*. https://doi.org/10.21125/inted.2018.0031

Roche, J., Davis, N., O'Boyle, S., Courtney, C., & O'Farrelly, C. (2017). Public perceptions of European research: an evaluation of European Researchers' Night in Ireland. *International Journal of Science Education, Part B, 7(4)*, 374–391. https://doi.org/10.1080/21548455.2017.1371354

Singer, E., van Hoewyk, J., & Maher, M. P. (2000). Experiments with incentives in telephone surveys. *The Public Opinion Quarterly*, *64*(2), 171–188. https://doi.org/10.1086/317761

Trench, B., & Bucchi, M. (2021). Global spread of science communication. In B. Trench & M. Bucchi (Eds.), *Routledge handbook of public communication of science and technology* (pp. 97–113). Routledge. https://doi.org/10.4324/9781003039242

Weingart, P., & Joubert, M. (2019). The conflation of motives of science communication - causes, consequences, remedies. *Journal of Science Communication, 18*(3), Y01. https://doi.org/10.22323/2.18030401

Ziegler, R., Hedder, I. R., & Fischer, L. (2021). Evalutaion of science communication: Current practices, challenges and future implications. *Frontiers in Communication*, *6*. https://doi.org/10.3389/fcomm.2021.669744