



NEWSERA - Citizen Science as the
new paradigm for Science
Communication

Deliverable 3.7

Citizen Science as a communication tool in the Post-Factual Era

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STATEMENT OF ORIGINALITY

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SUMMARY

This deliverable aims at initiating a reflection on how citizen science (CS) can become a science communication tool with potential to tackle misinformation. For this we envisioned to open the discussion with the CS projects enrolled in NEWSERA as pilots, as well as, bring both research and practice experts to enrich the debate and open a new direction in this matter of timely global concern. The reflection process will have two main objectives: i) better understand the nature of misinformation; ii) identify the present and future role of citizen science in this important subject of ethics related to communication. Two workshops were organized and tested with the collaboration of the NEWSERA pilots and invited experts. The content and results are hereby described.

Citizens involved in CS projects become important data collectors and producers and can play a key role when it comes to science information and education. In this deliverable we analyze the way that CS projects can contribute to tackling one of the main problems we face nowadays in science communication: misinformation. After a comprehensive reflection on the matter, in a co-creation process with the NEWSERA pilots, partners and other stakeholders such as H2020 SwafS-19 sister projects (for instance, TRESKA and ENJOI) and communication experts, we provide as a main output a set of take-away ideas on how to use data and information in CS projects to help tackling misinformation.

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FOREWORD

“Systematic approaches to study the impacts of science communication and outreach are very timely. I find that, for some time, success was measured in terms of numbers people reached or in numbers of published articles, and less on what is effective in reaching specific communities, increasing science literacy, or decreasing misinformation.

The work of the NEWSERA’s community is extremely important in all these dimensions and my contribution, as an invited keynote speaker, at the Data4CitSciNews conference, focused more on how we can identify target groups. I tried to show some evidence that “a little knowledge is a dangerous thing” and that negative attitudes towards science are more frequent in groups that have some (albeit often poor) scientific knowledge but that strongly underestimate it.

We find that this has important consequences for science communication and outreach, as it divides possible audiences not only in terms of knowledge but especially in terms of confidence, or confidence gaps. For example, if our results hold, we expect that receptiveness to science will be stronger at the lowest and highest knowledge levels, where the confidence-to-knowledge ratios are also lowest.

Moreover, offering information that is incomplete, partial, or oversimplified, as science communicators often do, might backfire: it may offer a false sense of knowledge to the public, leading to overconfidence, and less support, further reinforcing the negative cycle.

Thus, it is important to share accurate information, while also conveying humility, both on the scientists’ and the lay public’s side, and without colliding with individuals’ values and ideology. Overall, more research is needed, and these efforts have to be increasingly multidisciplinary.”

Joana Gonçalves de Sá, Coordinator Social Physics and Complexity Lab, SPAC
ERC Proof of Concept FARE_AUDIT

“As part of my research into digital practices and social media platforms, it is clear that the problem of misinformation is not something that is predicated on a lack of information. We have lots of information readily accessible. We no longer need to wonder about questions about when the Mona Lisa was painted, who starred in the 1999 movie Office Space or about the connection between eels and the Bermuda triangle. Information like this is available practically anywhere, any time. The old deficit model of science communication has limited relevance in a society in which many of us – notably not all – have a direct connection to information at all times of the day.

Instead, our struggles with misinformation stems from the exploitation of certain normal biases that are innate to us as social beings. These biases are intended as shortcuts, and in normal situations they protect us from difficult situations, emotionally risky circumstances, or even engage us into something that piques our interest and motivates us. We are drawn to information that appeals to our emotions, reinforces our already existing prejudices, and echoes things we have often heard repeated. We are stimulated by information that makes us feel like we are in the know, aware of things that others are not and sets us apart. It appeals to both a sense of belonging and importance. And we tend to be reluctant to accept information that would upend or change our perspective because, for one thing, of the upheaval it would have on our worldviews, social relationships and understandings of ourselves. Misinformation and disinformation are made possible because our biases act against broader social interests and often our own personal interests without us realising this.

But new and unexpected information can be fulfilling and inspiring, opening people’s eyes to new experiences and connections. It can be transformative for each of us and our communities. This transformation is a critical purpose for citizen science approaches and effective collaborative science communication. We need to actively be about creating spaces for which we can be and become self critical and reflexive in a way that begins to shift conversations towards more open and trustworthy dialogues that disrupt problematic biases. We know that the only way to increase trust is in direct conversation at multiple levels.

Trust is always relational. Whether it be a researcher in the news, an influencer connecting with an audience, a collaborator on a community project, or a discussion with a neighbour, these relationships are critical components for overcoming some of the problematic scepticism that plagues our contemporary situation.

We are all working on answers and developing better responses to misinformation concerns which must simultaneously be immediate – we face immanent planetary concerns from climate to migration to pandemics – as well as incremental – we need to see scientific understanding and appreciation as a long term process. We cannot do this alone and need to continue collaborating and supporting our efforts at local, national, pan-European and global levels. It is in this vein that we begin to see increasing forms of cooperation which projects like NEWSERA have been effectively contributing to and from which new research and active collaboration stem. Collectively, these begin to reduce and reverse the tendencies of misinformation to spread unchecked and create a world in which people are more likely to gain both a sense of appropriate scepticism and warranted trust in science and scientific findings.

But even with this approach you are of course no doubt still left wondering about the relationship between eels and the Bermuda triangle. Thankfully a quick search on the internet can help you solve this.”

Jason Pridmore, Vice Dean of Education for the Erasmus School of History, Culture and Communication and Associate Professor in the Department of Media and Communication at Erasmus University Rotterdam
TRESKA SwafS-19 Coordinator

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1. Introduction

1.1 Mechanisms of Digital Misinformation

Disinformation is one of the major concerns of democratic countries. Behind false or fake news, strategies are often articulated to manipulate public opinion. During the last years that the world faced an unprecedented health crisis due to COVID-19, a concomitant massive infomedia arose¹. This has enormously contributed to the spread of fake news (fabricated information that mimics news media content in form but not in organizational process or intent), which overlaps with other information disorders, such as misinformation (false or misleading information) and disinformation (false information that is purposely spread to deceive people) (Lazer, *et al.*, 2018).

Misinformation in science communication refers to the dissemination of false or inaccurate information that misleads the public about scientific facts and concepts. This can include misinformation spread intentionally (e.g. through political propaganda or pseudoscience) or unintentionally (e.g. through errors in reporting or poor communication of scientific findings).

There is not a single definition for this current trend. Although at one time it might be appropriate to think of fake news as referring to the veracity of a news story, it is now believed that this idea has been irremediably polarized in the current political and media ecosystem (Vosoughi, *et al.*, 2018).

Using the term fake news is very reductive and doesn't help to understand the complexity of the phenomenon. Most of the content is not even fake, it is often genuine, but it is used out of context by people who know that falsehoods based on a germ of truth are more likely to be believed and shared².

The European Union (EU) defines disinformation as false or misleading content that is spread with an intention to deceive or secure economic or political gain, and which may cause public harm. Misinformation is false or misleading content shared without harmful intent though the effects can be still harmful³. In that sense, the spread of misinformation can have a range of damaging consequences,

¹ https://elpais.com/sociedad/2020/02/18/actualidad/1582053544_191857.html

² <https://firstdraftnews.org/long-form-article/understanding-information-disorder/>

³ <https://digital-strategy.ec.europa.eu/en/policies/online-disinformation>

such as threatening our democracies, polarizing debates, and putting the health, security and environment of EU citizens at risk.

Thus, beyond the concrete definition, we can talk about different types and categories of misinformation disorder. There are issues that have to do with falseness that are more related to misinformation, and there are issues that are built up by people with an intent to harm that are more related to disinformation. This is very common in the political communication context, but it can also happen in the scientific environment. In any of these fields, mismanaged content can be created by people who are simply interested in creating noise, and it can become viral easily and create harm. In that sense it can become extremely effective because it is easy to put it out of context.

This is especially dangerous in social media because falsehood diffuses faster and farther than the truth in all categories of information (Vosoughi, *et al.*, 2018). For instance, false news stories are 70 percent more likely to be retweeted than true stories are. And this is essentially due to bots that are programmed to disseminate inaccurate stories. Instead, false news speeds faster around Twitter due to people retweeting inaccurate news items.

Solutions to tackle this problem are necessary and there is also a need to improve the use of traditional tools, for instance checklists or online protocols. For example, during the Global Media Literacy Summit held in London, in 2020, Professor Sam Wineburg, from the Stanford History Education Group, stated that “we cannot use a 20th century solution to fight a 21st century problem”⁴. In another high level event “[Fight Misinformation Google Initiative 2022](#)” one of the roundtables was focused on solutions that consider the involvement of citizens, placing media literacy as an important component in people’s lives (Valeria Kovtun, founder and head, Filter) or on people that can be “micro-influencers” with their peers and within their local area (Bejay Mulenga, Creative Entrepreneur, The Student View). Thus, different initiatives such as CS can be of help in this matter since it is a different way of citizen participation in science and helps improve scientific literacy.

⁴<https://www.euroscientist.com/media-literacy-to-counteract-misinformation-and-disinformation-a-c-hallenge-we-should-be-taking-on/>

1.2 Can Citizen Science be a tool to tackle misinformation?

As we have seen, the fight against misinformation is enormous, it affects different aspects of public communication, and it is a problem of today's society that is still being analyzed. The solutions so far generally start from a collaborative basis, between citizens and the media, citizens and public authorities, and the ultimate goal is to train citizens to be able to determine whether information is truthful, and to foster a critical spirit.

Citizen science is developing as a mechanism for engaging society and encouraging the population's interest in science and promoting their scientific literacy (López-Iñesta, *et al.*, 2022). By applying digital tools in the present innovative infosphere, citizen scientists can become the prime source of information on specific issues that they might have investigated in depth. Besides, CS projects involve members of the public in the scientific research process, often by gathering data or providing information for analysis. As such, these projects could help to deliver accurate and consistent information.

Therefore, we want to explore if CS can be a useful tool in tackling misinformation by involving the public in the knowledge generation process. By engaging citizens in data collection, analysis, and interpretation, they can become more informed and better equipped to evaluate claims and understand scientific evidence. Additionally, CS can also help to increase public trust in science by providing a transparent and collaborative process. However, it's important to note that CS alone is not sufficient at any extent to fully address the complex problem of misinformation and it should be explored in alliance with other strategies such as fact-checking, media literacy education, and critical thinking skills development.

1.3 How the EU is contributing to fight misinformation?

Large-scale misinformation campaigns are a major challenge for Europe and require a coordinated response from EU institutions and EU citizens. The European Commission has developed [several initiatives to tackle misinformation](https://digital-strategy.ec.europa.eu/en/library/communication-tackling-online-disinformation-europe-an-approach)⁵, such as the 2018 Code of Practice on disinformation, in which, for the first time worldwide, the industry agreed, on a voluntary basis, to self-regulatory standards to fight

⁵<https://digital-strategy.ec.europa.eu/en/library/communication-tackling-online-disinformation-europe-an-approach>

disinformation. Another important example are the Hubs launched by the European Commission to contribute to the fight against misinformation. Within the European Digital Media Observatory (EDMO), [fourteen national and regional hubs](#) have been set up to provide specific knowledge of local information environments, in order to strengthen the detection and analysis of disinformation campaigns, improve public awareness, and design effective responses for national audiences.

Specifically in European Science Communication initiatives, in the last years, the European Commission has funded several research projects, within its funding call “Science with and for Society - SwafS”. Together these projects have contributed to evidence-based science communication in the COVID-19 era (Roche, *et al.*, 2021) and are making significant contributions to empowering citizens in the public discussion of science.⁶ Within these projects, five of them refers specifically to misinformation and they try to contribute to tackling this phenomenon:



TRESCA focuses primarily on **social science** by exploring concerns about the effects of **misinformation, disinformation, and over-information in relation to public trust** in (social) **science communication**, having employed a large scale experimental survey research with emphasis on addressing misinformation and digital safety.

Find out more in trescaproject.eu



QUEST investigates **quality science communication dynamics** in the strands of journalism, social media, and museums, through three focus areas, - **climate change, vaccines and artificial intelligence** proposing tools to build **capacities, sound policy and incentives** for quality science communication.

Find out more in questproject.eu



ENJOI centres on **standards, principles, and indicators (SPIs)** in science communication in order to address the prevalence of misinformation, which will constitute the basis of the ‘**Observatory for outstanding open science communication**’ that aspires to become a **reference point for innovations** in science journalism and science communication, and their diffusion.

Find out more in enjoiscicomm.eu



CONCISE aims at providing **qualitative knowledge** –through public consultation– on the means/channels by which **EU citizens acquire their science-related knowledge, and how this knowledge influences their opinions.**

Find out more in concise-h2020.eu

Figure 1. Adapted from a poster presented by NEWSERA team members, at ESOF 2022.⁷

⁶<https://cordis.europa.eu/article/id/442429-science-communication-empowering-citizens-in-the-public-discussion-of-science>

⁷Magalhaes J, Tola E, Pridmore J, Fornetti A, Arias R. Public engagement and science communication for tackling misinformation and promoting trust in science. ESOF 2022 “Crossing Borders, Engaged Science, Resilient Societies”.

Along with these projects, NEWSERA has been working with 39 citizen science projects, from Italy, Spain and Portugal, as the NEWSERA Pilots, to co-design, implement and validate innovative communication strategies towards quadruple helix stakeholders (citizens, academic scientists, public sector and policymakers, and industry and SMEs) and science and data journalists, contributing to promote the role of CS in tackling misinformation.

This trend will continue in the new Horizon Europe program, in funded projects that include the participation and/or leadership of NEWSERA partners, such as the [IMPETUS](#), where 125 CS projects will receive financial, mentoring, and training support during a six-months accelerator program (in three yearly open calls scheme), and where there will be space for proposals that continue the fight against misinformation as well as specific training on journalism and relation with the media. Another project is COALESCE, a consortium formed by all SwafS-19 project coordinators together with other partners, starting April 2023, to establish the [European Competence Centre for Science Communication](#), which will specifically address mechanisms for rapid mobilization of science communication in times of crisis, while tackling misinformation and engendering trust in science. Others include the IANUS project “Inspiring and ANchoring trUst in Science, research and innovation”⁸ and [IBERIFIER](#) - The Iberian Media Research and Fact-Checking Network.

1.4 Citizen science communication in a nutshell

Understanding CS as a communication strategy means promoting a bottom-up approach that, from the first step, involves all stakeholders of potential interest and/or who are involved in the project.

An effective communication strategy engages new audiences, motivates participation in scientific projects, and makes each phase of the scientific research accessible, leading to collaborative and sustainable programs and actions (Rüfenacht, *et al.*, 2021).

CS as a mode of science communication has a number of potential positive impacts: it can help to promote empowerment, engagement, and trust among the public. By using inclusive communication methods, it is not only possible to

⁸ <https://www.eur.nl/en/events/strengthening-trust-science-conference-2022-06-13>

involve non-experts in scientific research, but more importantly to make the whole process democratic and participatory without excluding any target group.

Citizen science communication involves the exchange of information and knowledge between scientists and members of the public. This can include both the sharing of data and research results and the involvement of citizens in the scientific process through participation in research projects and data collection. This will foster the public's understanding of science and to involve citizens in the scientific process in order to improve the quality and impact of scientific research.

Another important advantage of CS communication is the possibility to investigate topics that might be undervalued or under investigated, particularly when relevant at a local level. We should also highlight that citizen scientists collaboration can be pivotal to the scale-up, collection and data classification that scientists may find difficult to do on their own due to limited resources..

In that sense, the overall aim of NEWSERA is to unveil the potential of CS projects as a communication mechanism for science and technology. These initiatives can be highly engaging, raise awareness and educate in science, they can promote critical thinking and increase trust in science and science communication.

The NEWSERA approach of building a dialogue, through co-creation activities, with its target audiences, will allow rethinking science communication strategies (Magalhães et al., 2022). The aim of NEWSERA is to show the virtues of CS as an inclusive, broad and powerful science communication mechanism that can increase trust in science communication and, in turn, in science at large, while opening up science and innovation to society, raising awareness and educating in science, and reducing the chances of incurring in fake news by means of promoting critical thinking.

This approach focuses on the research and innovation stakeholders that represent key local actors from government, associations, research and scientific institutions, companies and civil society/citizens, which engage in bottom-up collaborative processes in policy and research, and challenge the traditional top-down policymaking processes (Volpe, *et al.*, 2016). As aforementioned, NEWSERA target audiences are represented by the quadruple helix stakeholders and data journalists.

1.5 CitSciComm Labs - the NEWSERA approach

In order to co-design, implement and validate citizen science communication strategies, NEWSERA enrolled 39 citizen science projects (selected via a dedicated survey⁹ and individual interviews), the NEWSERA pilots, in what we called the CitSciComm Labs, organized in three different rounds, spread over three years. This was complemented with mentoring and other formal and informal training activities.

In each Lab, Citizen Science pilots interacted with representatives from each of the quadruple helix stakeholders, together with science communicators (the NEWSERA Sounding Board) to co-design communication strategies that improve their impact, as well as the engagement of their projects in relation to each of these stakeholders. Moreover, a cross-cutting Lab was organized specifically targeting science and data journalists.

Briefly, the first round of Labs, had as its main goal to co-design communication strategies towards each of the aforementioned stakeholders. The methodology has been described elsewhere (Magalhães, *et al.*, 2022). Another important output of first round workshops was the NEWSERA Policy Brief 1, identifying specific barriers CS projects face when interacting with each of the stakeholders groups as well as specific recommendations (Elorza, *et al.*, 2021).

The second round of Labs consisted of four different sessions, each of them devoted to cross-cutting topics of general interest to all CS pilots. We proceeded towards a common approach, more focused on mutual learning and training in order to respond to the detected needs and priorities addressed by the NEWSERA pilots, making use of the co-creation and participatory methodologies that had already produced positive results in the first round¹⁰. These topics include critical elements that need to be considered when designing a communication strategy for the projects, especially when addressing different stakeholders. The cross-cutting issues that were discussed in the four sessions were:

- “Data Journalism lab: Unleashing the power of CS generated data”: how to use data visualization tools and different communication formats.

⁹ <https://zenodo.org/record/4836948>

¹⁰ “Creating new pathways for increased dialogue between science and society through citizen science”, Science & You, Metz 2021.

- “Indicators lab: Measuring the impact of CS communication strategies”: co-designing a set of indicators to measure the impact as well as the engagement of the projects.
- “Policy Lab: Contributing to evidence-informed policies”: how to generate innovative strategies to engage public sector agents.
- “Ethics and Misinformation Lab: Addressing ethical issues and countering misinformation”: identification of ethical issues and the co-creation of guidelines on ethical aspects in science communication, as well as recommendations for CS projects to tackle misinformation.

After several consultations with the projects involved, as well as with different stakeholders, the NEWSERA consortium considered that misinformation was a cross-cutting issue to be specifically addressed in one of the workshops of this second round, along with the ethical aspects that needed to be addressed. It is a paramount concern for CS projects due to the fact that a mistreatment in the transmission of information can generate misinformation problems for the general public and entails an ethical reflection on the ways of preparing and spreading information that every citizen science project must take into account.

Additionally, research on the mechanisms of misinformation is a relatively recent field of study, and in the case of citizen science it is not yet resolved, therefore the contribution that NEWSERA can make to this field by analyzing it together with the projects involved and the different stakeholders could be considered an innovative approach.

The third round of Labs, similarly to round 1 distribution, consisted in individual workshops dedicated to each of the quadruple helix stakeholders as well as science and data journalists. As part of the last lab, a public event, Data4CitSciNews and an exhibition complemented the workshop activities. By gathering research and practice experts we took this opportunity to validate and discuss key take away ideas obtained at the Misinformation workshop from round 2.

In the following sections 2 and 3 we will describe the methodology and results obtained in the different activities specifically addressed to misinformation, which

constitute the basis of several recommendations to the CS and science communication communities in order to contribute to tackling misinformation.

2. #CitSciComm Labs Round 2: Ethics and Misinformation Lab

2.1 Methodology

The Ethics and Misinformation Lab: “Addressing ethical issues and countering misinformation” had as main goals the identification of ethical issues and the co-creation of guidelines on ethical aspects in science communication, as well as recommendations for CS projects to tackle misinformation.

For that we divided the Lab in different workshops, first a session on Ethics that took place online and independently with the CS projects from Portugal, Spain and Italy. Thereafter, we organized an online session, held jointly for all the pilots from the three countries to delve into the topic of mechanisms against misinformation with the main objective to analyze how CS can contribute to improving the mechanisms that prevent the spread of misinformation.

In this workshop we first addressed theoretically the topic of misinformation, disinformation and fake news with talks from two invited speakers, representing both the research and practice fields on the topic: Jason Pridmore, Vice Dean of Education for the Erasmus School of History, Culture and Communication and Associate Professor in the Department of Media and Communication at Erasmus University Rotterdam. Jason is also the lead on several projects with his research team, including TRESKA, SPATIAL, REINCARNATE, and he co-leads the Inspiring and Anchoring Trust in Science project; and Elisabetta Tola, an Italian journalist and science communicator. She lectures AI and data journalism, science communication and multimedia at the Master in Science Communication at Sissa, Trieste, and other journalism schools, co-founder of the science communication agency Formicablu, radio presenter of the daily science programme Radio3Scienza on RAI Radio 3 and chief editor of the digital magazine Il Bo Live, edited by the University of Padova, Elisabetta is also a partner of the NEWSERA project, involved in the science and data journalism Labs. She is the coordinator of the ENJOI project.

The second part of the workshop was dedicated to explore a fictional case-study inspired by real CS projects in order to co-identify misinformation issues.

After an intense work session, we were able to extract several preliminary take-away ideas so that CS projects can apply them when generating their work and results and thus contribute to transmitting truthful and trustworthy information.

CS Projects involved in the workshop:

The participants in the Misinformation Workshop ensured maximum representativity and diversity of participants, with CS projects from the three countries and different domains of research. Those who took part in the workshop were:

NEWSERA CS Pilots participants

[Rios Potáveis](#) is part of the international CS project Drinkable Rivers. It aims to understand the impact of tourism on the water quality of the Douro River, involving the local community in monitoring actions to investigate several parameters (e.g. nitrate and phosphate content, water hardness, amount of minerals, number of bacteria, surrounding landscape). The project aims to inform and influence public policies in order to improve the conservation status of the region's water bodies.

[MosquitoWEB](#) invites all participants to report the presence of mosquitoes. Mainland Portugal is in the path of invasive mosquitoes, which, besides being very aggressive and annoying, transmit pathogens such as the Dengue and yellow fever viruses. The aim is to characterize the dispersion and activity of these mosquitoes, as well as the movements of native species.

[Cities at Night](#) locates and geo-references night photos taken from the International Space Station and has been coordinated with the European Space Agency (ESA) and the National Aeronautics and Space Administration (NASA).

[The Citizen Observatory of Drought](#) promotes a better understanding of drought risk. It relies on geographic information technologies and artificial intelligence to disseminate spatial information related to water status and uses, climate variables, water resources and drought management and planning, and it is accessible to all citizens. Citizen input feeds the research process and specifically contributes to calculate indicators of social perception and public opinion to build a more robust Drought Vulnerability Index and to

facilitate deliberation on the most appropriate and most accepted management measures by citizens.

[Mammalnet](#) aims to gain insight on the benefits and limitations of using CS to monitor mammals across Europe, and to learn how we can collect better data and encourage participation.

[D-NOSES](#)/OdourCollect addresses odour pollution. In the project, different communities affected by bad odours point out and assess odour points through the OdourCollect app, which maps them and traces their backward trajectory in order to identify possible sources of bad odours.

[Genigma](#) is a smartphone app based on real data obtained in the lab. During a game, volunteers analyze fragments of cancer cell DNA, for which there is no better identifier than the human eye. The objective is to build a genome map of cancer cells that would allow us to understand which parts of the genome of these cells play a fundamental role in the development of cancer.

[COMPASS](#) aims to support teachers to develop lessons that connect science and mathematics with each other and, most crucially, with the lives of their students.

[DENIS](#) has been created to help researchers to compute very large groups of cardiac electrophysiological model variations. It connects volunteers with researchers to help them in their projects. All the results obtained using DENIS must be published, and all the models used in DENIS must be shared once the project has ended.

[Aliens in the Sea](#) aims to collect data on plant and animal alien species in the waters surrounding Sicily and its smaller islands, in order to create a database on their distribution and threat levels. The project also aims to raise public awareness of the problem of biological invasions through correct information, specifically among fishermen, beach goers, boaters, and others involved in sea-related activities.

[Sea Cleaner](#) focuses on the problem of anthropogenic waste in the marine environment. Citizens are an active part in monitoring and data collection processes, together with professional researchers or trainers. Its aim is to raise awareness among young people on the environmental issues, and to bring them closer to science in an active and exciting way. Through education and training, students who participate in these science activities learn how to apply the scientific method in the field.

[GERT](#) involves citizens into surveys for studying and monitoring local biodiversity. Data submitted by the citizens converge into the National Network on Biodiversity (NNB) of the Ministry of Environment. The project aims to educate and train participants on

environmental issues through the scientific method, and empower them to influence the decision-making process on environmental issues.

2.2 Understanding misinformation issues: a theoretical approach

In the first part of the workshop, the two guests gave lectures on the basic concepts of misinformation so that all attendees could become familiar with the conceptualization of this ethical problem.

Elisabetta Tola began by explaining how she has seen the misinformation issue grow over the past 20 years, and shared with the audience some results from research that has been done in the past fifteen years on the digital ecosystem, focusing on how this is multiplying the effect and the impact of misinformation.

The first red flag on the risk of misinformation came from the World Economic Forum in 2013, when it defined Misinformation as one of the main risks for modern society. In 2020, the World Health Organization declared an intertwine between the pandemic and the infodemics (overabundance of information): like pathogens in epidemics, misinformation spreads fast and adds complexity to health emergencies. Therefore, even though there are examples of misinformation already in the second half of the twentieth century, a lot of things have changed in the era of digital information because we now have access to a massive amount of information without filters. That has implied an amplification effect because everything is accelerated through more channels and our ability to filter that information is lower.

The first conclusion was that it is not simple to fight misinformation because it is not simple to define it. And the narratives created around the scientific data, sometimes reduce the complexity of reality. In this regard, having communities of people, active citizens in society and making science in a more communicative way can make a very active solution.

Is fake info new?



Figure 2. Slide used on Elisabetta Tola's presentation.

Jason Pridmore shared some fundamental ideas to understand the social process we are experiencing with misinformation, such as the idea that the more we repeat something, the more we believe it's true. Having more information does not mean that we have more knowledge. And it is also very important to understand that there is no general audience, people come from different backgrounds and experiences and get the information in very different ways. Moreover, people have a lot of human biases and misinformation connects with emotions and reduces logical thinking. It also reinforces pre-existing prejudices and creates an illusory truth effect: repeated information tends to be perceived as truthful.

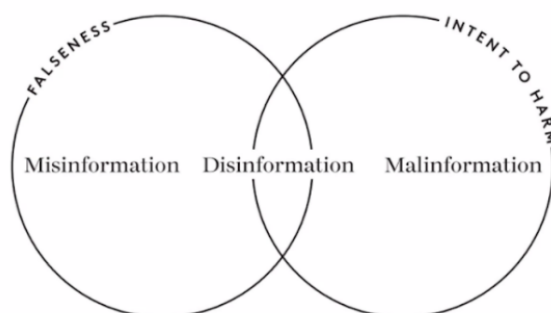


Figure 3. Slide used on Jason Pridmore's presentation.

Some of the conclusions discussed by the two speakers were the need to have a greater audience awareness: to understand how the audience works, how they process the information. This must necessarily be complemented with the promotion of critical thinking of the audience itself. Having a greater degree of knowledge and understanding one's own biases will help to analyze the information received with a critical spirit. And verification and fact-checking tools are very useful in this task, to reinforce the conclusions that have been obtained and to be able to verify their veracity.

Following the presentations, an interesting discussion was held with the representatives of the NEWSERA pilots. One of the questions raised was what kind of techniques can be used to overcome the confirmation bias; and one of the solutions discussed was to work more on dialogue and conversation. In that sense, the CS approach can be interesting to emphasize citizens with the scientific community, citizens being a key part of this bottom-up conversation.

Another issue of interest to the audience was to understand how to make the Public Sector, and more specifically governments, use and deliver reliable and scientific information. This topic was discussed with much attention and one of the conclusions was the need to engage the public sector on being more transparent, on making society more aware of the decision-making processes. It was also found necessary for the Public sector to have evidence-based information as one of the different sources of information they get, but also to explain how decisions are made, since decisions are taken as the result of a combination of scientific evidence and political, economic and social considerations and evaluations. We cannot expect to explain decisions based only on evidence, data and source, but we should be aware that we also need to contemplate sociological and political perspectives in the discourse. As a consequence of this, there is a need to include social sciences in the scientific side, to have multidisciplinary approaches.

The final topic discussed was whether there was any misinformation research being done in conjunction with psychologists. Jason Pridmore provided access to a recent article in *Nature Reviews Psychology* on psychology and misinformation (Ecker *et al.*, 2022). While this suggestion was offered during the session, we need to note that much more research and many publications have been published in




the past couple of years on the subject, a sign that this field of investigation has been growing in correlation with the growth of the problem.

2.3 Co-identifying misinformation issues in CS using a case study model

The second part of the workshop consisted of a participatory dynamic with all the projects involved. To carry out this exercise, we used the MIRO tool to work together and get common reflections and ideas from all the participants.

NEWSERA facilitators presented a case-study “Lago Pulito”, representing a fictional CS project story (Fig. 4) that showed both an ethical problem and a misinformation issue. The story was framed in a way to stimulate discussion within participants on their role and promote a common constructive solution during the dynamic, having common discussion on countermeasures and eventually tools and approaches to solve the problem. The case study was written by Elisabetta Tola, and the participatory methodology was designed by Blanca Guasch with the collaboration of Joana Magalhães, Leire Leguina and Elisabetta Tola.

Case study

Lago Pulito is a Citizen Science project. It involves citizens from two towns that face each other from the two sides of a lake, surrounded by hills and plains, in the Northern region of Lombardia, Italy. The lake is home to an important number of valuable native species of birds, fish and plants. There are also two protected areas along its banks, where fishing and bathing is forbidden.

The participants of the CS project have spent months sampling the waters and the sand of the small beaches, to evaluate the cleanliness, the chemical and organic quality and the state of local biodiversity.

The data demonstrates that near the urban areas there is more pollution and wildlife is less present, whilst the protected areas show a higher degree of biodiversity and also better chemical and organic quality parameters.

Now, Lago Pulito is ready to share its data with the local administrations. However, they face a puzzling problem.

The two towns are administered by opposite political governments: one is a centre-left coalition and the other one is a far-right movement. They have very different ideas with regard to environmental protection.

To make things more complicated, during the last winter, an informal settlement of refugees, which includes a number of families with small children, recently arrived, running from the war, has self-organized on a small stretch of sand, on one of the banks, not far from the protected area.

The data collected by Lago Pulito show clearly that the informal settlement is having an impact in terms of the cleanliness of the water and of the sand in the small beach. There is garbage left on the bank, there are no proper toilets, the sanitary condition of the settlement is very difficult. People use the water from the lake for all their needs.

Figure 4. Case study - Lago Pulito.

After reading the case, a series of questions were displayed in the MIRO board so that participants could write their answers as well as any doubts or concerns that may arise. These were divided in four steps.

1. What are the risks associated with making this data public in terms of misinformation or misinterpretation?
2. How do you think these framing alternatives could have an impact on local politics? How could they be used by the two coalitions to bend them to their political agenda?
3. Formulate an interpretation of the data that, while remaining true to the results, can help people understand them and offer an ethical and constructive solution.
4. Is there a way for Lago Pulito CS pilot to make the data available in a way that it prevents misinterpretation?

Box 1. Prompt questions to address the case study.

We then asked the participating pilots to first, analyze the risks in terms of misinformation/disinformation/fake news; and secondly to give solutions to each of the detected risks. In both situations we asked them to consider the quadruple helix stakeholders as well as media, and different communication formats (data, objective reports, press releases, policy briefs) (Fig. 5).

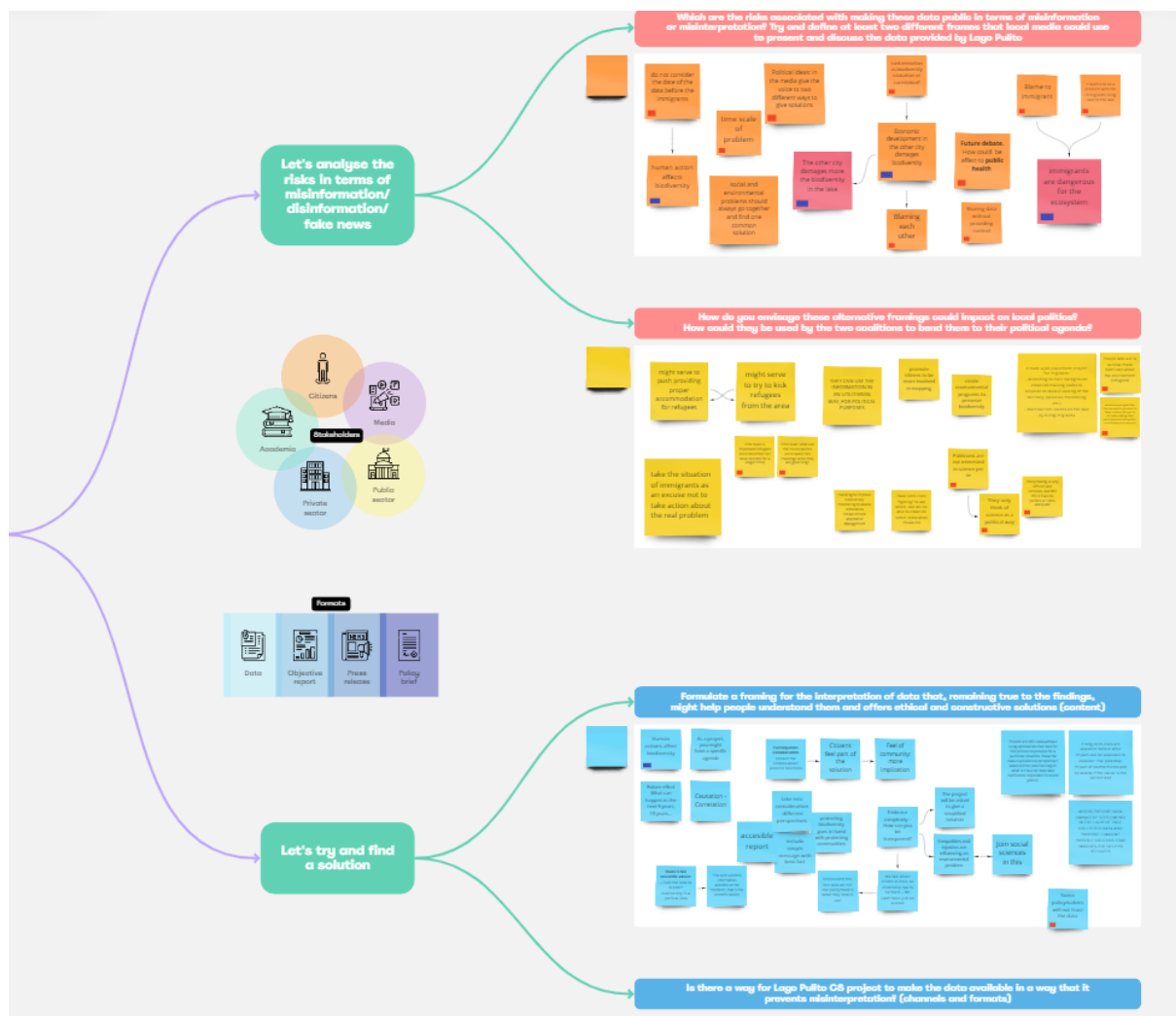


Figure 5. Approaches to analyze the case study “Lago Pulito”.

First of all, the risks associated with making the data public in terms of misinformation were considered. There was a high risk to blame the immigrants for the biodiversity problems when the scientific data are shared without providing context. It also allowed the confrontation between both cities, blaming each other for damages in the biodiversity of the lake.



Figure 6. MIRO practice on Misinformation.

These alternative framings could impact on local politics in both cities, since it could be used in a negative way through a political campaign against immigrants, leading to misinformation actions. Nevertheless, it can also be used to establish restoration measures to improve biodiversity in the area. That could be done by formulating a framing for the interpretation of data that, remaining true to the findings, might help people understand the problem and offer ethical and constructive solutions.

Finally, the question on what kind of formats could be used to present data information that prevents misinterpretation was aroused. The participants debated on this matter and brought some ideas on different ways of presentation such as infographics or talking in a direct way with citizens from both cities. But overall it highlighted the importance of open and accessible data to audit the information for any involved stakeholder and avoid skew in the interpretation of the data, as well as explaining the risks that can be derived from the analysis of data.

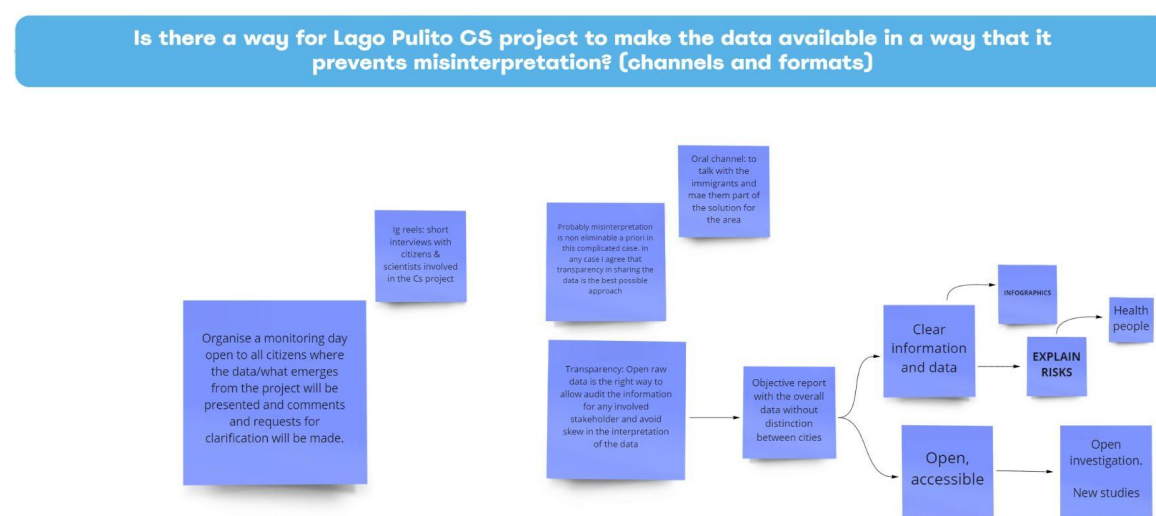


Figure 7. MIRO practice on Misinformation.

Overall, the pilots examined the case by highlighting the ambiguities of interpretations in relation to different ways of packaging the news and reading it. The political ambiguities made it possible to reflect on the relationship between politics and science on the one hand, which is at the forefront today, and on the ability of individual science projects to equip themselves with a communication plan that can cope with ordinary and emergency situations on the other.

Communicating, in fact, scientific uncertainties supported by technical opinions is believed to bring citizens closer to science, which is not to be understood as an imposed superstructure, but as a source of continuous discoveries and updates that also thrives on doubts, conflicting opinions, and differing views. Important,

however, support the opinions by scientific data presented in a fusible and clear way to the public by adopting, where possible, the contribution of citizen scientists who, more than any other figure, are able to configure the spread of fake news. CS can be a lever in renewing the trust relationship between society and science. The use of lay scientists, through the promotion of bottom-up practices and participatory and expanded multi level communication, can be an antidote to the misinformation that often results in disillusionment and skepticism.

2.4 Conclusions of the case-study dynamic

After this collaborative brainstorming, a general summary of the main suggested ideas was made, which were once again contrasted by all the attendees. Among all the ideas, two stood out:

- It is paramount to be aware of the trade-off complexity, specially related to science topics, for something that can be misunderstood;
- There is a need for more research on human judgment, to understand why and how people act a certain way or the other when faced with a specific case of information.

There were also several challenges identified that CS projects must face when addressing ethical issues:

- It is crucial to include all stakeholders that can have interests in the research. Furthermore, it is a special challenge to include vulnerable stakeholders (i.e., refugees);
- Public sector representatives and politicians are not interested in science *per se*, they usually have an agenda and a purpose that needs to take into account the science advice but also advice from other fields (social, cultural, etc.);
- It is important to assess priorities: for instance, in the case discussed, is it more important to measure pollution rather than clean the environment?
- Sometimes research is moved by self-interest (participants want to produce research, or the legitimacy of being a scientist), rather than what would benefit the community the most.

To overcome these challenges and contribute to tackling misinformation in science communication, participants defined a series of preliminary ideas that can help promote trust in the scientific processes of citizen science.

2.4 Preliminary take-away ideas for CS to tackle misinformation

The final part of the co-creation workshop consisted on defining some preliminary take-away ideas that can help CS projects to generate trust in their procedures and results. Always using the MIRO dynamic, suggestions, concerns and ideas were discussed and developed among all the participants. Some of the main reflections were that the problem is not the data that we get in the research process, but the way to frame it, and to know the risk associated with that specific data. Besides, an important assumption was made: in misinformation, there is not a unique solution that applies for all cases, we have to design a specific communication plan for each citizen science project. After the discussion, ten main ideas were chosen among the participants, that are the preliminary take-away ideas on how CS projects can contribute to tackle misinformation.

Preliminary Take-away ideas

- 1- Act on the three phases of misinformation: production, dissemination, and consumption, with a holistic and transversal approach.
- 2- Discuss current existing gaps in knowledge and limitations of the scientific methods.
- 3- Publish your methodology and data following FAIR principles (Findable, Accessible, Interoperable, and Reusable).
- 4- Anticipate an emergency crisis and prepare specific communication plans to lead with trolls and the spread of misinformation.
- 5- Consider how you frame your data to avoid misinterpretation or misuse.
- 6- Differentiate between different target audiences, considering age, gender, social group, etc.
- 7- Present yourself as a primary and original source to allow verification.
- 8- Build trust relations with different stakeholders.
- 9- Be open and transparent about your motivations and potential conflicts of interests.
- 10- Include other systems of knowledge in the scientific process.

Box 2. Preliminary take away ideas for CS to tackle misinformation.

We thereafter planned to validate this preliminary take away ideas with a wider audience that also included science and data journalists experts during CitSciComm Labs - Round 3.

3. Rethinking misinformation

3.1 DATA4CitSciNews, interconnecting data journalism and citizen science

To ensure that the outcomes and recommendations generated in the #CitSciComm Lab of Ethics and Misinformation were consistent, an interactive exercise was organized within the DATA4CitSciNews, a hybrid event NEWSERA carried out in collaboration with NEWSERA SwafS-19 sister project, ENJOI, bringing together both communities of practice. There is a strong collaboration between the two projects, since both explore quality openscience communication involving multiple stakeholders. While NEWSERA is focused on citizen science and its potential for communication to different stakeholders, ENJOI looks at engagement as the key to improve the quality of science journalism.

DATA4CitSciNews was organized in Barcelona, on November 28th, with science communication experts and speakers who brought examples, case studies and contributions on the topics of data science journalism, citizen journalism and misinformation in science communication (Fig. 8).

To address specifically the research advances on the topic of misinformation/fake news, we invited Joana Gonçalves de Sá, leader of the Social Physics and Complexity (SPAC) research group at LIP and an Invited Associate Professor at Instituto Superior Técnico, Universidade de Lisboa.

Furthermore, to discuss and validate the preliminary take-away ideas with a wider and specialized audience, we organized an interactive session, using Slido graphical tool, so both onsite and virtual audience (the event was broadcasted live on [NEWSERA youtube channel](#), with more than 300 people) could rank them considering the highest priority in a communication strategy for CS projects.

The session was led by Marco Boscolo, from Formicablu with direct feedback from other invited speakers, Jacopo Ottaviani (award-winning computer scientist and data expert who works as Code for Africa's Chief Data Officer), Karma Peirò (journalist and co-director of the Visualization for Transparency Foundation), Matteo Moretti (co-founder of Sheldon Studio) and Christoph Raetzsch (Associate

Professor at the School of Communication and Culture-Media Studies at Aarhus University).

DATA4CitSciNews		28th November 2022
↘ Open event to the public		Auditorium Antoni Caparrós
9.30 - 10.00	Registration	
10.00 - 10.10	Welcome from NEWSERA and ENJOI Coordinators <i>Rosa Arias, Science for Change and Elisabetta Tola, formicablu</i>	
10.10 - 10.55	Key lecture: Data Journalism - what's new? <i>Matteo Moretti, Information experience designer</i>	
10.55 - 11.40	Key lecture: Misinformation/Fake News - what's new? <i>Joana Gonçalves, Coordinator Social Physics and Complexity Lab – SPAC</i>	
11.40 - 12.00	Session and Q&A <i>Moderated by Jesús Méndez, Science Media Center, Spain</i>	
12.00 - 12.30	Coffee Break	
12.30 - 13.30	Round table: Advancing on the concept of citizen science journalism <i>Jacopo Ottaviani - Code for Africa, Mapping Makoko</i> <i>Karma Peiró - Visualization for Transparency, Making data visible for social good</i> <i>Christoph Raetzsch - Aarhus University, Infrapublics</i> <i>Federica Arenare - Datatinja, Openthebox</i> <i>Moderated by Elisabetta Tola</i>	
13.30 - 13.50	Misinformation Recommendations for Citizen Science initiatives <i>Marco Boscolo, NEWSERA Data journalism expert</i>	
13.50 - 14.00	Visual Wrap Up and Closure <i>with Edgar Sanjuán, Visual & Design Thinker and Joana Magalhães, NEWSERA Project Manager</i>	

Figure 8. Morning Program from Data4CitSciNews event.

The full program and biographies of the speakers is available elsewhere¹¹.

3.2. Data Journalism - what's new?

The workshop started with a lecture by Matteo Moretti about some of the latest developments in Data Journalism and design. He explained the true meaning of open data: it's not just making data available, but democratizing it, spreading the culture of data and of critical thinking in the use of the internet and media in

¹¹ https://newsera2020.eu/wp-content/uploads/2022/11/DATA4CitSciNews_full-program.pdf

general. He also briefly explored the dangers and virtues of the internet and social media in the spread of false information.



After his speech, the topic of misinformation was introduced in order to get more information in this subject and to deepen the research done so far in NEWSERA.

3.3. Misinformation/fake news - what's new?

The key lecture on Misinformation was given by Joana Gonçalves de Sá, leader of the Social Physics and Complexity (SPAC) research group at LIP and an Invited Associate Professor at Instituto Superior Técnico, Universidade de Lisboa. Her current research uses experimental and computational methods (big data and complex systems) to study decision-making, mainly in policy and health. In 2019, she was the recipient of an ERC Starting Grant to study human behavior using the online spread of “fake news” as a model system and in 2022, a Proof of Concept grant to conduct the project Fake News Recommendations - an Auditing System of Differential Tracking and Search Engine Results (FARE_AUDIT).



During her lecture, Gonçalves de Sá used the metaphor that misinformation spreads like infectious diseases: that's why we need to study the hosts (humans) and the environment in which it spreads (networks), to understand how to tackle the issue. Fighting misinformation, however, means also that we need to take some paradoxes into account: offering accurate information often does not help, and it might even make it worse. It is also necessary to take into account the environment of social media, its technical details and the psychological aspects that drive the spread of untrue information, being it intentional (fake) or unintentional (false).



Gonçalves's findings might help better explain the dynamics behind the public understanding of science, a comprehension truly needed to design and define more targeted and informed approaches to improve not only the understanding but also the engagement and therefore the trust and appreciation for science. Gonçalves and her team used a large dataset from the Science and Technology Eurobarometer surveys, over 25 years in 34 countries, to find evidence that a combination of confidence and knowledge is a good predictor of attitudes towards science. The findings show that negative attitudes towards science peak not at the lowest level of knowledge, as generally believed, but rather at the intermediate

one, where confidence is largest. The team has thus proposed a new model, based on the superposition of two previous well known models, and discuss how this can inform science communication. Gonçalves's results have interesting implications to current science communication strategies. The model indeed predicts that receptiveness to science will be stronger at the lowest and highest knowledge levels.

One important idea Gonçalves de Sá expressed - that was in accordance with the main conclusions of the first workshop on misinformation - was that it is important to put more science in CS projects and science communication. On one hand, citizens in CS projects should be in charge of complex tasks, not only simple ones, because they need to understand the complexity of the research methodology. On the other hand, offering incomplete, partial or simplified information – as science communicators often do – can be counterproductive, as it perhaps offers the public a false sense of knowledge that leads to overconfidence. The lecture thus allowed the audience to get familiar with the misinformation matter from a science communication perspective.

After the event, Science Media Centre journalist Jesús Méndez, who was a moderator of both keynotes, published a very interesting article focusing on the Dunning Kruger effect, explored during Gonçalves talk. The Dunning-Kruger effect became especially known during the pandemic, when overconfident voices and self-proclaimed experts were emerging from all corners. As aforementioned, a new study from Gonçalves' team added an important nuance to that effect: the greatest distortion occurs not amongst those who know the least, but at the intermediate levels, which is exactly where the majority of all of us fall,¹² which can have major implications to trust in science.

The main messages of Gonçalves de Sá talk are summarized hereby:

¹²<https://www.heraldo.es/noticias/sociedad/2022/12/21/luis-enrique-y-la-novedad-en-el-efecto-dunning-kruger-1619937.html>

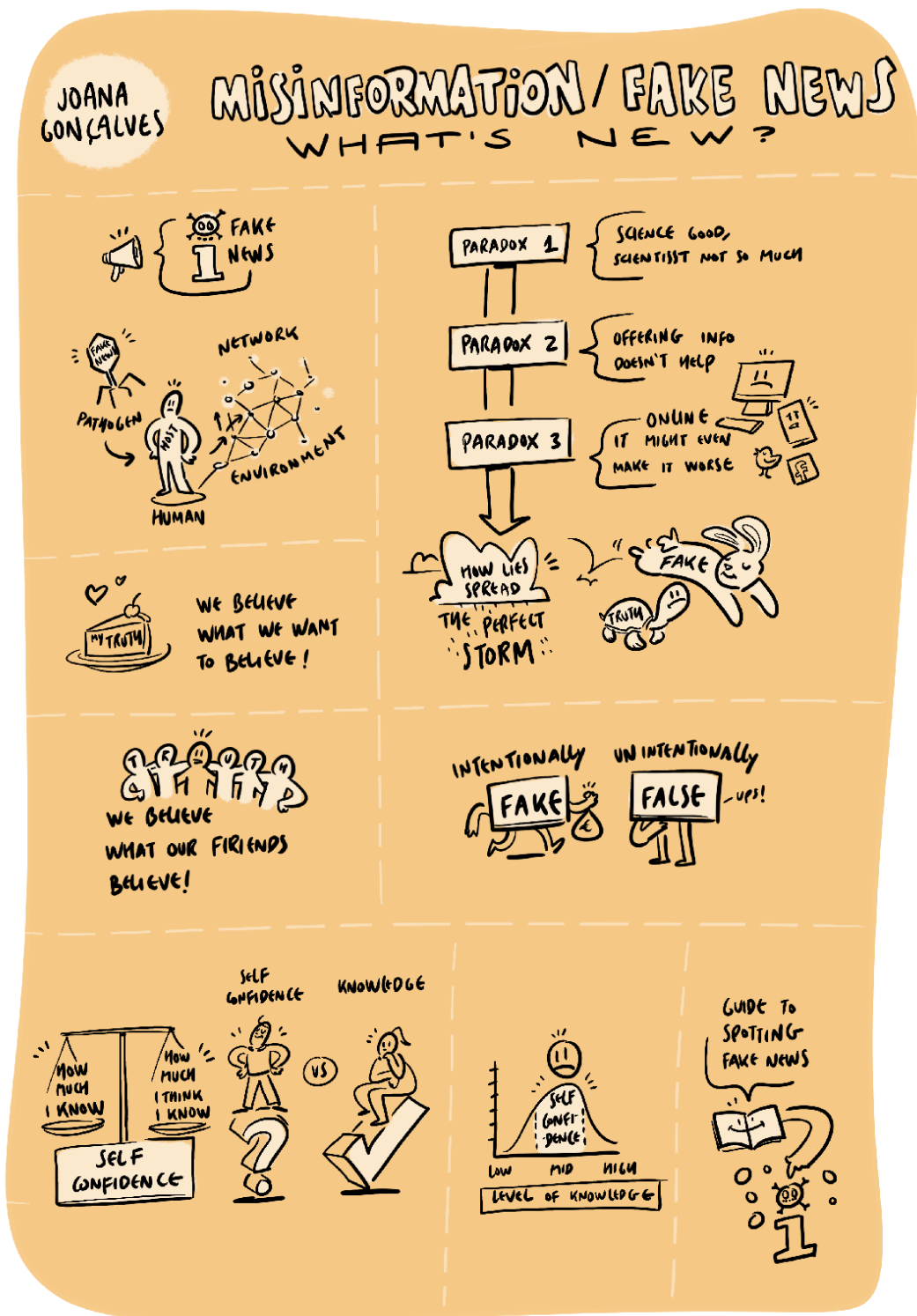


Figure 9. Visual graphic representation of Joana Gonçalves-Sá Talk, by Edgar Sanjuán.

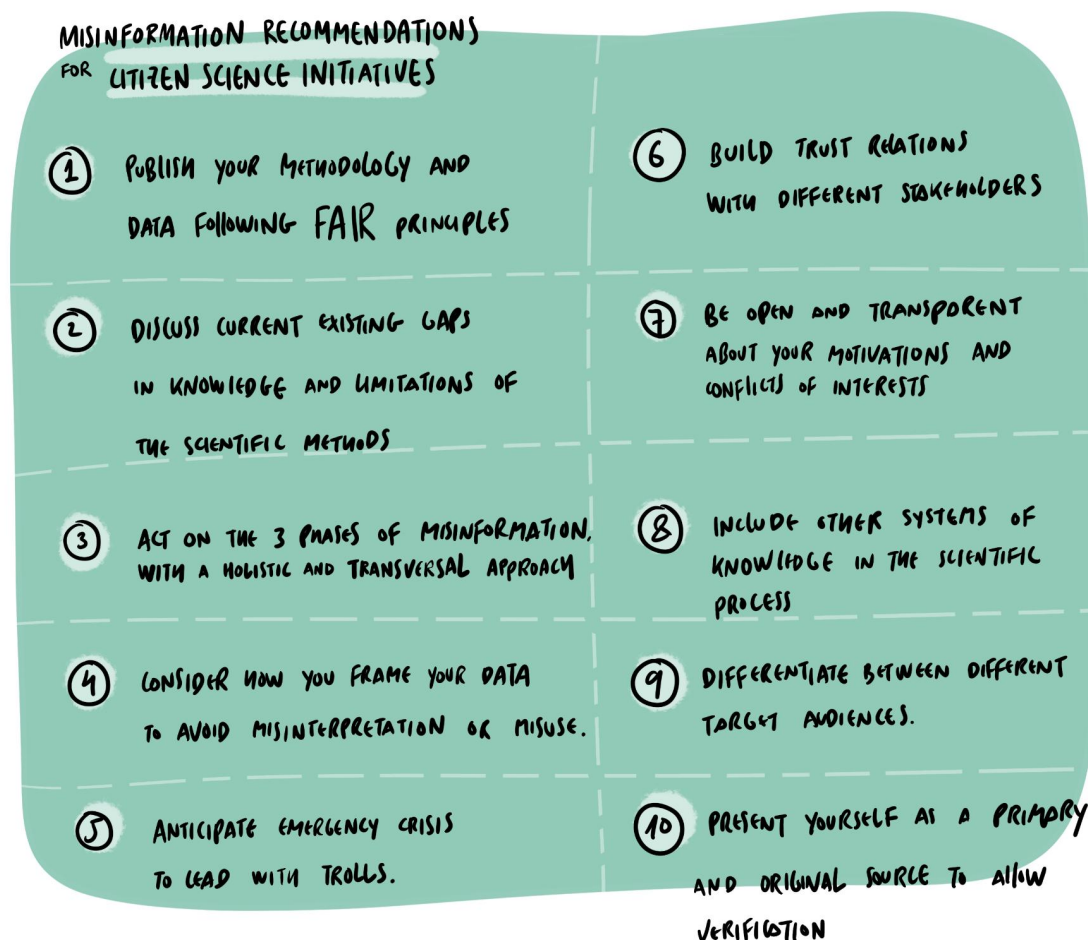
3.4 Validation of Misinformation Take-Away Ideas for Citizen Science initiatives

As aforementioned an interactive session format was used to validate the preliminary take-away ideas on misinformation that resulted from CitSciComm Labs round 2. Journalist Marco Boscolo guided the speakers and the general audience to the explored concepts during the previous keynotes and roundtable and discuss the recommendations to tackle misinformation when doing science journalism and citizen science communication. The audience contributed to the discussion ranking the importance of the take-away ideas. Overall, more than 50 people participated (speakers + audience - online and onsite). The slido tool was used to interact with the participants. The ten take-away ideas were displayed in the slido board, and everyone could rank them in the way they considered the best. “Publishing methodology and data following FAIR principles” was ranked first, followed by “Discussing existing gaps in knowledge and limitations of the scientific method”. Among a second round of tips, the most important was valued to be “Build trust relations with different stakeholders” and “Be open and transparent about your motivations and potential conflicts of interest”.



The take-away ideas were discussed one by one, and they were reviewed and validated by this second group of experts and general audience. The final validation of recommendations was as follows.

4. Take away ideas for CS initiatives: Role of Citizen Science on tackling misinformation



***FAIR principles (Findable, Accessible, Interoperable, and Reusable)**

**** 3 phases of misinformation: production, dissemination and consumption**

Figure 10. Visual graphic representation of the take away ideas for CS initiatives: Role of Citizen Science on tackling misinformation, by Edgar Sanjuán.

5. Concluding Remarks

Misinformation can have detrimental effects on individuals, communities, and society as a whole. It can lead to the spread of harmful or false information, which can cause confusion and mistrust. It can also be used to spread propaganda and influence public opinion, which can have significant political and societal consequences. Additionally, misinformation can undermine the effectiveness of public health efforts, such as during a pandemic, and decrease societal trust in science. Finding solutions to fight against misinformation and act rapidly in times of crisis is necessary to promote accurate information and protect individuals, communities, and society from its negative effects.

Misinformation is a topic that NEWSERA has been dealing with since the beginning, since it is one of the main problems that exist today in Science Communication. We were interested in learning more and exploring how citizen science could have an impact in tackling this phenomenon.

NEWSERA's methodology is innovative because of the co-creation process with CS projects and different stakeholders, and we envisioned applying this same methodology to this topic. That is why we organized two workshops held throughout the project, to better understand this phenomenon and to be able to put forward ideas to improve the quality of citizen science projects in this regard. As we have seen in this deliverable, the first workshop took place within the Round 2 Lab and was an internal workshop: we worked directly with misinformation, science and data journalism experts and the NEWSERA pilots to come up with some preliminary general recommendations. In the second workshop we opened the process to a wider audience and together with research and practice experts and a broader public interested in citizen science communication and journalism, we analyzed the recommendations we had obtained with the pilots. The main result is thus the “Take-Away Ideas for citizen science initiatives: Role of CS on tackling misinformation” that we believe can be applied by any project when verifying the ethical aspects of its research and when preparing its scientific communication strategy to address different stakeholders.

We hope that this NEWSERA contribution will be useful for the citizen science and science communication communities.

6. References

Ecker UKH, Lewandowsky S, Cook J, *et al.* (2022) The psychological drivers of misinformation belief and its resistance to correction. *Nat Rev Psychol* 1, 13–29. <https://doi.org/10.1038/s44159-021-00006-y>

Elorza A, Leguina Leire, Lacunza I, Arias R, Magalhaes J. (2021). Re-thinking Science Communication: Take-away Ideas for Citizen Science Initiatives. doi: [10.5281/zenodo.5533911](https://doi.org/10.5281/zenodo.5533911)

European Commission, 2018 Code of Practice on Disinformation, [2018 Code of Practice on Disinformation | Shaping Europe's digital future \(europa.eu\)](https://ec.europa.eu/digital-storytelling/en/2018-code-of-practice-on-disinformation)

European Committee of the Regions, Volpe, M., Friedl, J., Cavallini, S., *et al.* (2016) Using the quadruple helix approach to accelerate the transfer of research and innovation results to regional growth, Committee of the Regions. <https://data.europa.eu/doi/10.2863/408040>

Magalhães J, Guasch B, Arias R, Giardullo P, Elorza A, Navalhas I, Marín-González E, Mazzonetto M and Luís C. (2022) A methodological approach to co-design citizen science communication strategies directed to quadruple-helix stakeholders. *JCOM* 21 (04), A05. <https://doi.org/10.22323/2.21040205>

Lazer DMJ, *et al.* (2018) "The Science of Fake News," *Science* 359, 6380, 1094-1096.

López-Iñesta E, Queiruga-Dios M, García-Costa D, Grimaldo F (2022) Citizen science projects: An opportunity for education in scientific literacy and sustainability. *Metode Science Studies Journal*, 12, 33–39 <https://doi.org/10.7203/metode.12.17824>

Pennycook G, Epstein Z, Mosleh M, Arechar A, Eckles D and Rand D (2021) Shifting attention to accuracy can reduce misinformation online. *Nature*, 592, 590–595 <https://doi.org/10.1038/s41586-021-03344-2>

Roche J, Arias R, Bell L, Boscolo M, Fornetti A, Knutas A, Kupper F, Magalhães J, Mannino I, Mendoza I, Moreno-Castro C, Murphy K, Pridmore J, Smyth F, Tola E, Tulin M, Weitkamp E and Wolff A (2021) Taking Stock and Re-Examining the Role of

Science Communication. Front. Environ. Sci. 9:734081. doi:
[10.3389/fenvs.2021.734081](https://doi.org/10.3389/fenvs.2021.734081)

Rüfenacht, S. et al. (2021). Communication and Dissemination in Citizen Science. In: The Science of Citizen Science. Springer, Cham. https://doi.org/10.1007/978-3-030-58278-4_24

Tola, E. (2020) Media literacy to counteract misinformation and disinformation: a challenge we should be taking on. euroscience.com

Vosoughi S, Roy D, and Aral S. (2018) The spread of true and false news online. Science, 359, 6380, 1146-1151 [10.1126/science.aap9559](https://doi.org/10.1126/science.aap9559)

Williamson P. (2016) Take the time and effort to correct misinformation. Nature 540, 171 <https://doi.org/10.1038/540171a>

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