

D3.3 REPORT ON THE VIGNETTE STUDY

WP3 – Exploring and evaluating strategies, methods and tools for increasing trust in science and addressing challenges of science-society co-creation and science communication.

T3.3 – Vignette study on the social mistrust and challenges of science-society co-creation

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Project summary

Although studies show that most people trust science, media coverage, political debates, and social media give the impression that public mistrust in science is widespread.

The VERITY project uses health and environment as case studies to examine varying levels of public trust in science and to seek solutions to the scepticism undermining public policy. It aims to strengthen the public's confidence in scientific findings, foster informed decision-making based on scientific evidence, and facilitate a more constructive and mutually beneficial relationship between science and society by enhancing trust in scientific research.

VERITY is centred around three questions: **What do people trust? Whom do people trust? How is trust built?** To find answers, the project moves through four stages, starting with surveys of existing research and citizen groups and finishing with the creation of a 'Protocol of Recommendations.' The aim of this Protocol is to provide guidelines and methods for traditional and non-traditional 'Stewards of Trust' to enhance trust in science and facilitate science-society co-creation.

The core aim of VERITY is to re-shape the '**Ecosystem of Trust in science**', a conceptual space where societal trust in science is formed, shaped, negotiated, and influenced. It encompasses the complex interactions, dynamics, and factors that contribute to the construction, negotiation, enhancement, or reduction of trust in science. The actors within this Ecosystem aim to enhance the public's confidence in scientific research and promote a more inclusive and accountable scientific enterprise.

Previous EU-funded projects have focused on particular actors within the Ecosystem of Trust (e.g., scientists, research funding organisations, research ethics committees) to explore the impact of particular 'machines of trust' (e.g., science communication, research ethics). VERITY goes beyond the state of the art by conceptualising '**Stewards of Trust**' as the actors within the Ecosystem that are responsible for upholding societal trust in science and facilitating science-society co-creation. These actors are organisations, groups, or individuals who possess extensive expertise and a strong commitment to trust in science, as evidenced by their official mandates, missions, or their influential positions in the field. As such, they play a crucial role in shaping the direction and outcomes of the initiative.

VERITY brings these actors together to strengthen societal trust in science. The project employs interdisciplinary expertise from research institutions and universities to develop tools and methods, including the Protocol of Recommendations, to increase societal trust in science, research, and innovation through original research and small-scale participatory activities. The VERITY tools and protocol will have open science and stakeholder participation at their core and consider society's needs, expectations, and values regarding science, research, and innovation.

VERITY findings will be widely disseminated to different 'Stewards of Trust', such as policymakers, research funding and performing organisations, higher education institutions and non-traditional stewards such as journalists or influencers, to enhance societal trust in science and facilitate science-society co-creation.

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	PANEPISTIMIO DYTIKIS ATTIKIS	UniWA	EL
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About D3.3 Report on the vignette study

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CONTENTS

Executive summary	7
List of figures	9
List of tables.....	9
List of acronyms/abbreviations.....	10
Glossary of terms	10
1. Introduction	11
2. Methodology.....	12
2.1 What is a vignette study?	12
2.2 Planning	13
2.3 Implementing.....	16
2.4 Reporting.....	18
3. Findings.....	20
3.1 Overall results	20
3.2 Science communication	26
3.3 Co-creation.....	28
3.4 Benefit sharing	29
3.5 Social media	31
4. Discussion & recommendations	33
5. Conclusion	37
Annexes.....	39
Annex 1. Limitations.....	39
Annex 2. Data collection methodology and data processing	40
References	43

EXECUTIVE SUMMARY

This deliverable reports the results of a vignette survey study carried out in four European countries (Austria, Cyprus, Greece and Spain) with 155 citizens. Our objective was to explore whether methods addressing societal mistrust in science that were identified in previous VERITY deliverable D3.2 (Focus groups with Stewards of Trust investigating and evaluating methods to guide trust in science) work differently for two citizen groups with varying levels of trust in science. Our main assumption was that four key methods identified in D3.2, namely science communication, co-creation, benefit sharing and social media, would work differently for Group 1, consisting of younger (18-30 old), more educated, urban citizens, and for Group 2, consisting of older (50+ old), less educated, rural citizens.

Given the limitation of our small-scale and non-randomised target group sample, vignettes were considered an appropriate tool to compare the reactions of our two different citizen groups assumedly divergent in their attitudes towards science. Vignettes are short descriptions of hypothetical situations representing specific methods addressing mistrust in science through the example of wind farms. Vignettes helped us assess whether the actual immediate reactions of citizens correspond to the previous VERITY project findings (especially but not limited to the result of D3.2).

Our results confirm our main hypothesis and indicate that Group 1 and Group 2 differ from each other both in terms of their initial position towards wind farms and how they respond to the different methods to enhance trust in science. Group 1, in general, perceives wind farms and all the related methods more positively than Group 2. Benefit sharing is the most important method with the highest impact, and it makes both groups more favourable towards wind farms. While science communication and co-creation are important methods to enhance Group 1's trust in science, they are not as effective in Group 2. We also found that social media had almost no overall impact on both groups.

While our results seem to be similar across different gender groups, women seem to be generally more positive, while benefit sharing had significantly greater impact on Group 1 men, compared to all other respondent groups. While science communication and co-creation are important methods with positive impact for Group 1, they are less relevant for Group 2. In addition to gender, social class and internet use tend to positively affect the perception of wind farms and the effectiveness of the related methods in Group 2. Being member of the working class, and using the internet less frequently had a positive effect on the attitude of elderly respondents.

Our findings have practical implications for all stakeholders involved in planning, designing and implementing methods addressing societal mistrust in science. We found that women might be reached out through a number of methods under various circumstances, while men should be more specifically targeted with a few key methods, in particular benefit sharing or co-creation. Men, especially in Group 2 are more likely to stick to their original

opinion (the specific methods tend to have a smaller effect) so it could prove harder to use appropriate strategies to raise their trust in scientific questions. We confirmed the D3.2 conclusions about the importance of tailored solutions according to the target group, and the usefulness of benefit sharing and co-creation (citizen engagement) as methods potentially effective for a wide variety of citizen groups. Our results indicate that relevant population characteristics, e.g., gender, social class or internet use might affect the substantially general attitude towards wind farms and the specific methods. Further study is warranted to understand the underlying reasons for distinct perceptions in homogenised groups to design appropriate methods addressing mistrust in science.

Our findings also validate some of the main conclusions of previous participatory project activities, e.g., T3.2 interviews and focus groups with the aim of supporting the forthcoming T4.2 VERITY Protocol. Our conclusions will inform the Protocol about the practical applicability of certain key methods prospectively raising trust in science of various citizen groups.

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LIST OF FIGURES

Figure 1: T 3.3 vignette study research design, adapted from Aguinis and Bradley (2014). Elaborated by F6S.	13
Figure 2: Radar chart distribution of perception rates by group (1 / 2) and gender (male/female). Values correspond to: V1 neutral, V2 science communication, V3 co-creation, V4 benefit sharing, V5 social media	23
Figure 3: Distribution of survey responses in Group 1 and Group 2 by gender for the neutral vignette.	24
Figure 4: Distribution of survey responses in Group 2 by social class for the neutral vignette.	25
Figure 5: Distribution of survey responses in Group 2 by internet use for the neutral vignette.	25
Figure 6: Distribution of survey responses in Group 1 and Group 2 by gender for the science communication vignette.	27
Figure 7: Distribution of survey responses in Group 1 and Group 2 by gender for the co-creation vignette.	29
Figure 8: Distribution of survey responses in Group 1 and Group 2 by gender for the benefit sharing vignette.	31
Figure 9: Distribution of survey responses in Group 1 and Group 2 by gender for the social media vignette.	33

LIST OF TABLES

Table 1. List of acronyms/abbreviations	10
Table 2. Glossary of terms.....	10
Table 3: T3.3 vignette structure.....	15
Table 4: T3.3 sample criteria	17
Table 5: Perception of wind farms in four country cases. Source: 'Special Eurobarometer 516 European citizens' knowledge and attitudes towards science and technology'	18
Table 6: Distribution of survey responses in Group 1 and Group 2 per country and gender	20
Table 7: Distribution of survey responses in Group 1 and Group 2 per social class and internet use.....	21
Table 8: Differences in attitudes towards wind farms in Group 1 and Group 2 for each vignette	22
Table 9: Differences in attitudes towards wind farms in Group 1 and 2 for each vignette per gender	22
Table 10: Differences in attitudes towards wind farms in Group 1 and 2 for science communication per gender	27
Table 11: Differences in attitudes towards wind farms in Group 1 and 2 for co-creation per gender	29
Table 12: Differences in attitudes towards wind farms in Group 1 and 2 for benefit sharing per gender.	30
Table 13: Differences in attitudes towards wind farms in Group 1 and 2 for social media per gender	32

LIST OF ACRONYMS/ABBREVIATIONS

Abbreviation	Explanation
AI	Artificial Intelligence
WP	Work Package

Table 1. List of acronyms/abbreviations

GLOSSARY OF TERMS

Term	Explanation
Benefit sharing	The fair distribution of benefits from scientific activities among the concerned stakeholders, whether or not they were directly involved in the research process.
Co-creation	The collaborative participation of citizens and other non-scientific stakeholders in various stages of a research and innovation process
External validity	A measure that indicates whether a study's findings can be generalized to other contexts.
Internal validity	A measure that indicates the studied causal relationship is not influenced by other factors.
Science communication	The practice of informing, educating and raising awareness of non-experts on science-related topics.
Steward of Trust	The organisations and persons that are responsible for guiding societal trust in science and facilitating science-society cocreation. Their responsibility emanates either from their official mandate and mission, or from their de facto power and influence.
Systematic Literature Review	A systematic review is a scholarly synthesis of the evidence on a clearly presented topic using critical methods to identify, define and assess research on the topic.
Vignette	'a short, carefully constructed description of a person, object, or situation, representing a systematic combination of characteristics.' (Atzmüller & Steiner, 2010, p. 128)

Table 2. Glossary of terms

1. INTRODUCTION

This deliverable assesses whether the actual reactions of citizens correspond to the findings stemming from the relevant previous project tasks, in particular the expert interviews and focus groups carried out in D3.2 to better understand the usability of potential different methods addressing trust in science. To this end, we designed a vignette survey study that explored whether different methods for enhancing trust in science work differently in various citizen groups that are known to have different attitudes towards science.

The **main research question** of this deliverable is: **do identified methods for enhancing trust in science work differently for citizen groups with varying levels of trust in science?**

Drawing on the main conclusions of D3.2., we identified four main methods used by different stakeholders to enhance trust in science, namely (1) science communication, (2) co-creation, (3) benefit sharing, (4) the use of social media. Following the main theme in T3.2, we use trust in renewable wind energy as a case to study trust in science. Through a vignette survey study, we explored whether each method makes a difference in people's attitudes towards wind farms.

To maximise the statistical leverage, we created two sub-group samples, namely Group 1 and Group 2, that are expected to have contrasting levels of trust in science. Drawing on the existing studies and our knowledge from the previous VERITY tasks, we chose to focus on age, education, and residence as our main sampling criteria to define these two sub-group samples (Antoniou & Iordanou, 2023; European Commission, 2021a; European Commission, 2021b; Krause et al., 2019; Mousoulidou et al., 2022). Group 1 included university students and graduates, aged between 18 and 30 years old, and living in urban areas. Group 2 consisted of people without a university degree, aged above 50 years old, and living in rural areas. We conducted the vignette survey in Austria, Cyprus, Greece, and Spain via online LimeSurvey with Group 1 and via printed paper copy survey (face-to-face or over the telephone) with Group 2. In total, we received **155 eligible responses**, of which 86 were Group 1 and 69 were Group 2.

In the next sections, we will first explain our methodological design, which will be continued with the sections of findings, discussion and recommendations, limitations, and conclusions.

2. METHODOLOGY

2.1 WHAT IS A VIGNETTE STUDY?

A vignette is 'a short, carefully constructed description of a person, object, or situation, representing a systematic combination of characteristics.' (Atzmüller & Steiner, 2010, p. 128). In vignette studies, respondents are given short descriptions of situations to elicit their perception of these scenarios. There are different types of vignette studies. Vignettes can take the form of texts, images, videos, or other media. They can be used as research instruments both in qualitative (Barter & Renold, 1999) and quantitative research (Atzmüller & Steiner, 2010). While in qualitative studies, vignettes are used in interviews and focus groups to elicit reflexive and rich responses from participants, in quantitative studies they are often integrated into survey designs to systematically measure and study participants' judgement of different scenarios.

Vignette studies in surveys combine the methodology of classical experiments and surveys to counter-balance their weaknesses (Atzmüller & Steiner, 2010; Aguinis & Bradley, 2014). Classical experiments are well-known for their strong internal validity (i.e. the confidence that the causal relationship that is being tested is trustworthy and is not influenced by unaccounted external factors) but demonstrate weaker external validity (i.e. generalisation of the findings to broader populations). On the contrary, survey studies perform well in terms of their external validity due to their representative sampling techniques but go low in terms of internal validity because of the lack of experimental interventions that could explore the nature and the direction of causal relations. **Vignette studies in surveys are designed to maximise both internal and external validity by systematically controlling the explanatory variables as in experiments and by studying diverse groups in their natural environment.**

Vignettes are well-known for studying potentially **sensitive topics**. Participants can find commenting on a hypothetical scenario less threatening than sharing their direct experience (Barter & Renold, 1999). Vignettes are also used to **compare different groups' interpretations of a 'uniform' situation**. In this way, researchers can study how similar vignettes provoke different evaluations and perceptions by different groups.

Despite these solid methodological advantages, vignette studies are still scarce in numbers. One reason for this scarcity is the fact that vignette studies require more time and effort, considering the complexity of designing, preparing, piloting, and administrating the experimental treatments. In T3.3, we follow best practice recommendations (Aguinis & Bradley, 2014) for planning, implementing and reporting experimental vignette studies. Below, we will discuss our vignette study design in three stages (i.e. planning, implementing, and reporting), which include seven steps reflected in Figure 1.



Figure 1: T 3.3 vignette study research design, adapted from Aguinis and Bradley (2014).
Elaborated by F6S.

2.2 PLANNING

Step 1: Deciding whether a vignette study is a suitable approach to study T3.3 research questions.

Trust in science questions have been studied through a wide range of methodological approaches including *large-N surveys* (Bak, 2001; Hamilton et al., 2015; Hayes & Tariq, 2000; Motta, 2018; O'Brien & Noy, 2018; Timmermann, 2020), *experiments* (Agle, 2020; Huang & Green, 2023; Zhang, 2023), and *qualitative studies* (Carlson, 2006; Nelson et al., 2024; Urkens & Houtman, 2023). As explained in the previous section, **vignette survey studies are suitable for exploring general public perceptions while also accounting for the nature and the direction of causality, i.e. what causes certain types of perception.** The objective of T3.3 is to assess the applicability of potential methods for enhancing trust in science. Along these lines, D3.3 explores whether the main methods for enhancing trust in science affect the public's perception of certain scientific controversies, in this case, renewable energy and wind farms.

Considering the **sensitivity of trust in science topics**, vignette studies are suitable tools since they ask respondents to evaluate hypothetical scenarios but not their direct personal

experiences. Last but not least, vignette studies are good for comparing the reactions of different groups to the same scenario. Therefore, vignette studies are valuable tools for **comparing different reactions of citizen groups who tend to diverge in terms of their attitudes towards science.**

Step 2: Choosing the study topic, the number of vignettes and specifying the explored factors

Wind farms were chosen as a topic for the vignette study because a similar topic had already been extensively discussed in multi-stakeholder focus groups organised in the framework of the preceding T3.2 project task. The selection of this topic for T3.2 was the result of a series of discussions between the involved partners. The aim was to pick a controversial topical scientific issue within the broad VERITY themes of health and environment (e.g., wind farms might be associated with scientific misinformation and pseudoscience on both environmental and health issues). The T3.2 focus groups discussed the most relevant potential methods to be used for **addressing mistrust** in science related to renewable energy and wind farms. Thus, we could directly use the results of these focus groups when designing our vignettes.

In T3.3, we eventually designed **five short vignettes** that explored participants' perceptions of wind farms under different conditions. We considered the relevant literature when determining this number of vignettes. The literature points out the trade-off between the size/number of vignettes and the response rate (Hughes & Huby, 2004). While a higher number of vignettes enables researchers to explore a variety of variables, repeated vignettes can cause respondents' fatigue and increase dropout rates. Longer vignettes can help researchers build complex and detailed scenarios but can come at the cost of respondents' attention. Therefore, economical vignette designs (i.e. shorter and limited numbers) are found valuable, enhancing participants' interest and achieving higher response rates.

The **first vignette was designed to be neutral** and did not include any prompt. The wording of this vignette was adapted from the Special Eurobarometer 516 European Citizens' Knowledge and Attitudes towards Science and Technology (2021b). The first vignette aimed to measure the general attitudes towards wind farms before the respondents were asked about different methods for enhancing trust in science. Therefore, we could collect information on respondents' initial reactions to wind farms before they are asked to evaluate different scenarios. **Each of the next four vignettes explored the effects of one of the main methods identified by Stewards of Trust during the T3.2 focus groups as methods with the most potential to enhance trust in science, namely (1) science communication, (2) co-creation, (3) benefit sharing, and (4) the use of social media.** As shown in Table 3, each of these four vignettes was designed to assess only one method. The last section of the vignette study was dedicated to collecting demographic information of the respondents.

Vignette number	Explored factor	Vignette text
Vignette 1	No prompt	<p>Imagine that there is a new wind farm planned where you live.</p> <p>How do you think this new wind farm will affect your life in the next years?</p>
Vignette 2	Science communication	<p>Imagine that there is a new wind farm planned where you live.</p> <p>The wind farm project has been long studied by environmental scientists. Scientific reports are shared with citizens. City hall meetings are held by scientists to explain why this wind farm is needed.</p> <p>How do you think this new wind farm will affect your life in the next years?</p>
Vignette 3	Co-creation	<p>Imagine there is a new wind farm planned where you live.</p> <p>The wind farm has been discussed with the residents for a long time. Citizen initiatives have been involved in the planning and development of the project. Regular feedback from the citizens is collected and incorporated into the wind farm project.</p> <p>How do you think this new wind farm will affect your life in the next years?</p>
Vignette 4	Benefit sharing	<p>Imagine that there is a new wind farm planned where you live.</p> <p>The wind farm will take the form of an energy cooperative. Local residents will be able to become a member of this cooperative and be the co-owners of the wind farm. The benefits generated by the wind farm will be distributed locally to the members of the cooperative. There will be annual dividends (distribution of the profits) to the cooperative members.</p> <p>How do you think this new wind farm will affect your life in the next years?</p>
Vignette 5	Social media	<p>Imagine that there is a new wind farm planned where you live.</p> <p>The wind farm project is positively welcomed by influential people on social media. It has become a highly mentioned topic in different social media platforms. Influential people on social media talk about its positive aspects in detail.</p> <p>How do you think this new wind farm will affect your life in the next years?</p>

Table 3: T3.3 vignette structure

Step 3: Choosing the type and design of a vignette study

Vignettes are found to be more effective when they are relevant to people's lives and appear real (Hughes & Huby, 2004). Therefore, while designing our hypothetical scenarios, we tried to keep the **description of situations as realistic (i.e. likely to happen) as possible** to elicit reactions that would correspond to actual behaviour. Responses were collected through **closed-ended questions**, where participants were given a **5-point Likert scale**. Closed-ended answers helped with the quantification of results. We adopted the first-person perspective when we invited participants to respond to the vignettes. In other words, participants responded to the vignettes from their point of view. While the first neutral vignette was always asked as the first vignette, **vignettes with prompts were randomised to control the recency effect**, that is, recalling an earlier vignette and answering the later vignette accordingly. The prompt text that assesses the impact of each method was written in a precise and accessible manner that could be understood by people of different backgrounds.

2.3 IMPLEMENTING

Step 4: Piloting the vignette study

Vignette studies are often piloted before their application to ensure their internal validity, which indicates the extent to which they capture the research question under study (Hughes & Huby, 2004). Piloting also helps refine the language of vignettes and supports their accessibility by different groups. **We piloted our vignette study with five individuals from different age, education, gender groups.** The piloting phase took place in a qualitative and open-ended format, which included discussion on individual vignettes and questions and getting the comments of the respondents. At this stage, the vignette survey was revised according to these comments before it was fully launched.

Step 5: Specifying the sample and choosing the settings

As detailed above, Group 1 and Group 2 **were expected to have contrasting levels of trust in science.** In this way, as advised by the literature, we could decrease the population variance, reduce uncontrolled and theoretically less relevant heterogeneity and focus on the variance with more explanatory power (Hopkin et al., 2015). Therefore, we collected a non-random sample in which individuals with high and low values of the independent variable were selected. This approach increased 'the chance of detecting a significant effect of variation in the independent variable on variation in the dependent variable' (Hopkin et al., 2015, p. 5).

Drawing on the existing studies and our knowledge from the previous VERITY tasks, **we chose to focus on age, education, and residence as our main sampling criteria.**

This sampling decision was guided by two main factors. First, it was **more practical** to have control over the age, education, and residence of participants during the sample selection. We acknowledge that there are other crucial factors such as the level of

religiosity or political orientation that affect individuals' level of trust in science. However, these factors are less practical to account for while building a controlled sample.

Second, our **previous work on the relevant literature** and on 'Special Eurobarometer 516: European citizens' knowledge and attitudes towards science and technology' (2021b) have shown us that age, education, and urban/rural residence are important factors that determine individuals' level of trust in science. For instance, the impact of education on trust in science has long been studied and is perceived as a predictive factor of trust in science (Mousoulidou et al., 2022). As more educated people are arguably more knowledgeable about scientific information and have more access to scientific studies, it is expected that people with higher education have higher levels of trust in science compared to their less educated counterparts.¹ In terms of age, the Special Eurobarometer 516 (European Commission, 2021a, p. 37) reports that younger people find science less complicated than older people and are more willing to learn about science and scientific developments. Moreover, as also mentioned in the previous VERITY deliverable 1.2 (Antoniou & Iordanou, 2023), the work of Krause et. al. (2019) found that rural residents exhibit comparatively low trust in science. These existing findings paved the way for our assumption that younger, educated people living in urban areas tend to have higher levels of trust in science compared to older, less educated people living in rural areas.

	Age	Education	Residency ²	Gender
Group 1	18-30	University students/graduates	Urban	Female (50%) Male (50%)
Group 2	50+	No university degree	Rural	Female (50%) Male (50%)

Table 4: T3.3 sample criteria

In addition to the data on our main sampling criteria (age, education and residency) that defined our two sub-group samples, we also collected additional **demographic information** that might have further explanatory power. The most important such data related to gender where we purposefully aimed for an even distribution between men and women. We also collected data on self-identified social class (as a proxy for socio-economic status) and the frequency of internet use (as a proxy for exposure to news media and use of social media).

In terms of geographical area, we conducted our vignette survey study in four country cases including Austria, Spain, Greece, and Cyprus. An important reason for the country selection was the logistical factor, as the VERITY consortium had members

¹ We must also acknowledge some mixed evidence regarding the relationship between the level of education and trust in science, as also discussed by D1.2 (Antoniou & Iordanou, 2023).

² For the urban/rural definition, see Eurostat's classification: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Archive:Urban-rural_typology

in these countries who could conduct the vignette survey in person in remote rural areas. Second, these countries shared rather similar tendencies towards wind energy, which was the main topic of our vignette study. According to the 'Special Eurobarometer 516: European citizens' knowledge and attitudes towards science and technology' (2021b, p. 21), all four country cases perceived wind energy positively at a similar rate to the EU27 average. As a limitation of our case selection, we must also note that Austria had a higher score for negative perception of wind energy compared to the other three cases.

Country	Perception of wind farms	
	Total positive	Total negative
Greece	91	4
Spain	92	3
Cyprus	93	4
Austria	85	13
EU-27	87	9

Table 5: Perception of wind farms in four country cases. Source: 'Special Eurobarometer 516 European citizens' knowledge and attitudes towards science and technology' (2021b, p. 21)

Step 6: Administering the study

The T3.3 vignette survey was disseminated in two ways. **The online version of the survey was circulated within Group 1 (young, educated, urban), while the survey was printed out and conducted in person or via phone with Group 2 (older, less educated, rural).** The content of the two versions of the survey was identical, while the randomisation of the print-out version was ensured by the relevant VERITY researchers.

The online survey with Group 1 was available between 25 March and 15 April 2024 through a LimeSurvey link established by ZSI. Each partner made thorough efforts to disseminate the survey within its academic networks in four country cases. Group 2 members (older, less educated, rural) are considered a "hard-to-reach group" with lower accessibility through online survey links. Therefore, this group was reached in-person or via phone calls and a print-out version of the survey was used.

More details about the different data collection methods used by individual partners for both Group 1 and 2 are provided in the Methodological Annex 2.

2.4 REPORTING

Step 7: Choosing the method for analysing and reporting the data

To analyse the data, we first **re-coded** the responses to a **numerical scale**. Given that the answers can be mapped onto a 5-point Likert scale, we mapped the responses on a

numerical scale from -2 for very negative to +2 for very positive, with 0 being neutral. We then **divided** the responses **into two cohorts** corresponding to the two groups and compared the means of their responses to the different vignette prompts. We also **calculated the margin of error** on the mean at the 95% confidence interval, assuming a normal distribution of responses. That is, the errors given in our tables are the upper and lower limits around the mean, within which 95% of the respondents fall. Owing to the small sample size and the low resolution of the Likert scale, it is not feasible to make robust statements about the true distribution of responses, or whether it differs significantly from our assumption of a normal distribution.

Finally, we also **calculated the mean difference** from the neutral vignette for each prompt, that is, we subtracted the response to the neutral vignette from the response to the vignettes with different prompts, and then calculated the mean of these differences, as well as the margin of error as above.

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3. FINDINGS

3.1 OVERALL RESULTS

In total, we collected **155 eligible responses**, of which 86 were Group 1 and 69 were Group 2. Since we had strict sampling criteria based on age, education and residence to ensure internal homogeneity of each sub-group, we eliminated the responses not falling into our pre-defined categories in one of these criteria (for further details please check Annex 2).

As mentioned in sub-section 2.3., we aimed to achieve **gender balance** in our sample, which was almost fully achieved for Group 2 where we collected 33 answers from men and 36 from women. Interestingly, there is a larger disparity in the case of Group 1 where 60% of our responses came from women, showcasing a potentially higher interest and engagement from women students in our survey and research topic. Nevertheless, this distribution was deemed appropriate for our further analysis.

	Group 1*	Group 2°	Total
TOTAL received	103	79	182
TOTAL eligible	86	69	155
Country⁵			
Austria	28	23	51
Cyprus	9	10	19
Greece	24	15	39
Spain	25	21	46
Gender			
Man	33	33	66
Woman	52	36	88
Other	1	0	1

Table 6: Distribution of survey responses in Group 1 and Group 2 per country and gender

* Group 1: under 30, studying at a university or having at least a Bachelor's degree, living in an urban setting

° Group 2: above 65, not holding a tertiary degree, living in a rural environment

In terms of social class, **the distribution of responses was skewed towards 'middle class' in the Group 1 sub-sample**, therefore further analysis was not possible for such a small sample size. This means that almost 70% of all 18-30-year-old respondents answering the question on social class, identified him/herself as belonging to the 'middle class' (with the other two options being 'working class' and 'high class' of society).

In case of the question on the **frequency of internet use**, the responses of Group 1 are even more uniform: with the exception of one person, each Group 1 respondent uses the internet on a daily basis, with 78% using it more than 4 hours per day.

In contrast, the **responses to demographic questions were much more balanced in the Group 2 sub-sample**. We almost reached an even gender ratio (52% women and 48% men), and there were two distinguishable sub-groups both in terms of social class and internet usage. Interestingly, no respondents above 50 years old identified themselves as belonging to the 'high class' of society, while 54% categorised him/herself as the 'middle class' and 46% as the 'working class'. As regards the frequency of internet use, 55% of the respondents use it on a daily basis and 45% less often than daily. Consequently, we also checked whether there were some differences in the perception of certain vignettes based on the 'social class' and 'internet usage' variables – any significant finding will be indicated in the relevant sub-section below.

	Group 1	Group 2
TOTAL	86	69
Social class		
High class	3	0
Middle class	55	37
Working class	22	32
Internet use		
Daily use (4 hours+)	67	14
Daily use (4 hours less)	18	23
Less than daily	1	30

Table 7: Distribution of survey responses in Group 1 and Group 2 per social class and internet use

As mentioned in Section 2, we aimed to gain data from two distinct and unique target group sub-samples that were assumed to diverge in terms of their attitudes towards science. The hypothesis was that, due to its established sample characteristics, Group 1 (young, educated, urban) would have a more positive attitude towards a controversial scientific issue topical in each sample country (wind farms) than Group 2 (older, less educated, rural). **Our results confirmed our initial hypothesis** since when the answers were re-coded into a numerical Likert scale from -2 to +2 (see Sub-section 2.4 for more details) then, **the mean of Group 1 responses was 0.49, while the mean for Group 2 answers was slightly negative, -0.01**.³ When looking at the other vignettes, we note that such a difference in mean responses between the two groups is quite persistent for all methods (see Table 8).

³ With a margin of error of 0.2 for Group 1, and 0.25 for Group 2, meaning that 95% of all responses fell within the range of plus/minus 0.2 and 0.25 from the mean.

Mean \pm error of mean for vignette	Group 1	Group 2
Neutral	0.49 \pm 0.20	-0.01 \pm 0.25
Science communication	0.90 \pm 0.20	0.13 \pm 0.27
Co-creation	0.99 \pm 0.20	0.22 \pm 0.27
Benefit sharing	1.07 \pm 0.20	0.43 \pm 0.31
Social media	0.52 \pm 0.20	-0.06 \pm 0.30

Table 8: Differences in attitudes towards wind farms in Group 1 and Group 2 for each vignette

This means that, on average, Group 2 perceived the prospect of a new wind farm being built **as neutral** (and did not become much more favourable due to any of the subsequent vignette methods), while Group 1 had a more **positive attitude**. To sum up, in Group 2 there were a similar number of persons (22) perceiving the prospect of a wind farm being built near their place of residence as (very or slightly negative), neutral or slightly positive. In contrast, only 13 respondents in Group 1 had a negative opinion of our baseline scenario, while 24 people remained neutral, and 48 had a (fairly or very) positive stance towards wind farms.

If we look closer at the data and distribute the answers by the only demographic variable that could be used for both Group 1 and Group 2 (gender identity) then we observe that **women in general are more positive towards wind farms in both groups**. The mean of responses from men in Group 1 was 0.42, while it was 0.56 for women; in Group 2, the mean for responses from women was 0.17 and it was negative for men, with -0.21 (with a slightly higher margin of error in Group 2). This means that **men above 50 were the only sample group with a negative attitude towards wind farms**. There is a higher overall difference in the opinion of men and women in Group 2 than in Group 1: above-50 men tend to perceive wind farms more negatively than women, which is a pattern that repeats for all the analysed methods too (see Table 9).

Mean \pm error of mean for vignette	Group 1		Group 2	
Gender	Male	Female	Male	Female
Neutral	0.42 \pm 0.27	0.56 \pm 0.27	-0.21 \pm 0.33	0.17 \pm 0.37
Science communication	0.85 \pm 0.27	0.92 \pm 0.30	-0.09 \pm 0.37	0.33 \pm 0.40
Co-creation	1.00 \pm 0.24	0.96 \pm 0.30	0.06 \pm 0.40	0.36 \pm 0.40
Benefit sharing	1.21 \pm 0.20	0.98 \pm 0.30	0.24 \pm 0.22	0.61 \pm 0.45
Social media	0.30 \pm 0.27	0.69 \pm 0.27	-0.12 \pm 0.22	0.00 \pm 0.41

Table 9: Differences in attitudes towards wind farms in Group 1 and 2 for each vignette per gender

Figure 2 shows the above-mentioned differences in Group 1 and 2 for both genders in a more transparent form. Using a **radar chart**, we can easily observe the significant difference **between younger and older respondents** in terms of the overall perception on wind farms, as well as see the slightly higher larger divergence between **men and women in case of Group 2** (i.e., elderly women being more positive than men). The values at 'V1' indicate the baseline (perception for the neutral vignette), compared to which we can observe a similar trend for both groups where attitudes are getting more positive through the different methods used: albeit at a different scale, an increasingly positive shift is visible from 'V1' to 'V4' (benefit sharing) through 'V2' (science communication) and 'V3' (co-creation), with 'V5' being an outlier (as explained in sub-section 3.5).

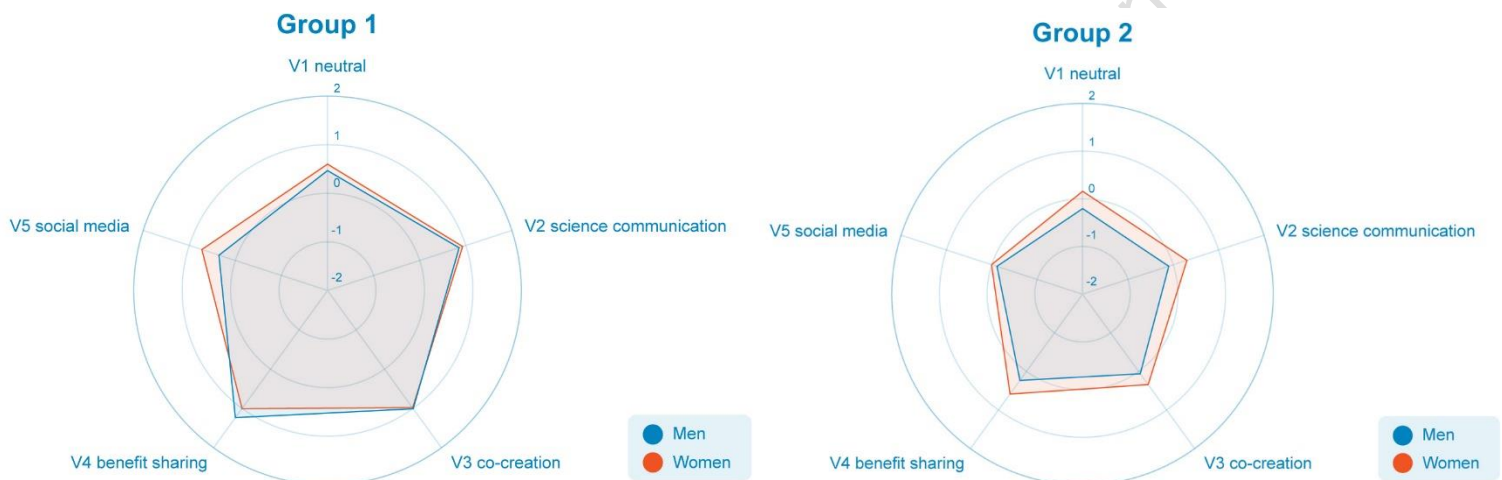


Figure 2: Radar chart distribution of perception rates by group (1 / 2) and gender (male/ female). Values correspond to: V1 neutral, V2 science communication, V3 co-creation, V4 benefit sharing, V5 social media

Looking at the individual responses, the more **negative attitude of men** can also be observed in Fig. 3. where there are much more positive answers visible for women than men in both groups. This finding is not in line with the findings of the most recent scientific literature, which indicates that women tend to have lower levels of trust in science than men, as VERITY deliverable 1.2 (Antoniou & Iordanou, 2023) summarises. Nevertheless, consensus on this finding is not high.

Nisbet et al. (2002) hypothesise that women's reservations about science might stem from their lower levels of scientific knowledge (education) in general. This explanation could, however, not be confirmed for the present data set where two homogenous groups were established in terms of education, meaning that there is no significant difference in educational level within groups. This implies that other **intersectional social or cultural factors**, or the gender differences in scientific news consumption, should be examined to better understand this phenomenon.

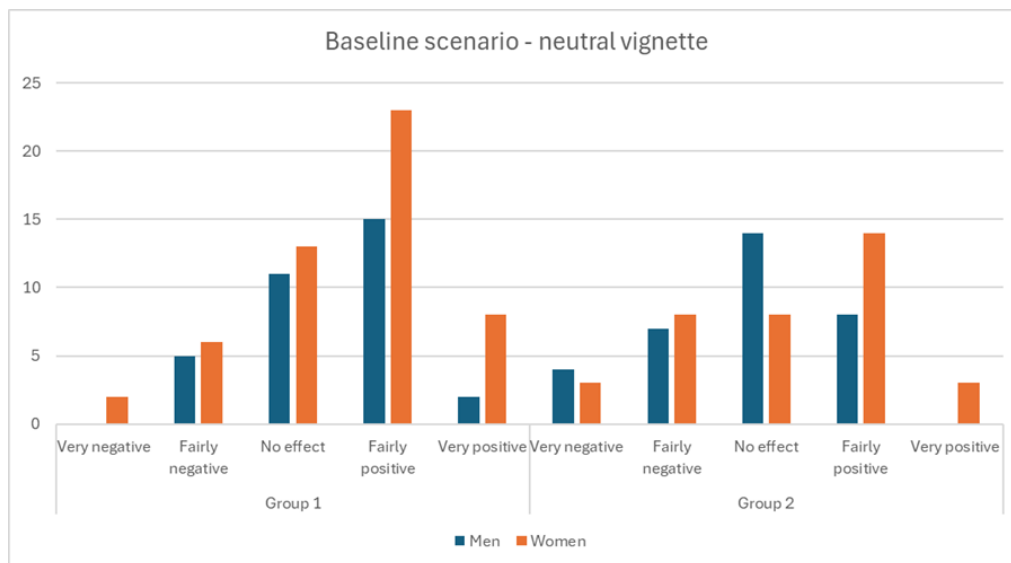


Figure 3: Distribution of survey responses in Group 1 and Group 2 by gender for the neutral vignette.

Moreover, we checked the effect of the variables of social class and internet use frequency on the perception of wind farms in Group 2 (as mentioned, the responses in Group 1 were too uniform for both demographic questions and hence an analysis was not feasible). We found that both variables seem to have an effect on the perception of wind farms.

Respondents belonging to the middle class (by self-classification) **had a much more negative attitude** towards wind farms than people belonging to the working class. If we quantify this on the 5-point Likert scale (-2 to +2) we get a mean of 0.34 for working-class persons and a mean of -0.32 for middle-class persons. In fact, each subsequent vignette method has a negative perception within the middle class. These results might indicate that respondents self-identifying themselves as 'working class' might have such intrinsic core values and norms that make them more receptive towards wind farms. This might not be generalisable to an a priori more positive attitude towards science but may support the view that 'working class' people have more trust and support for science that identifies environmental and public health impacts of economic production (i.e., impact science, such as renewable energy) than 'middle class' people.

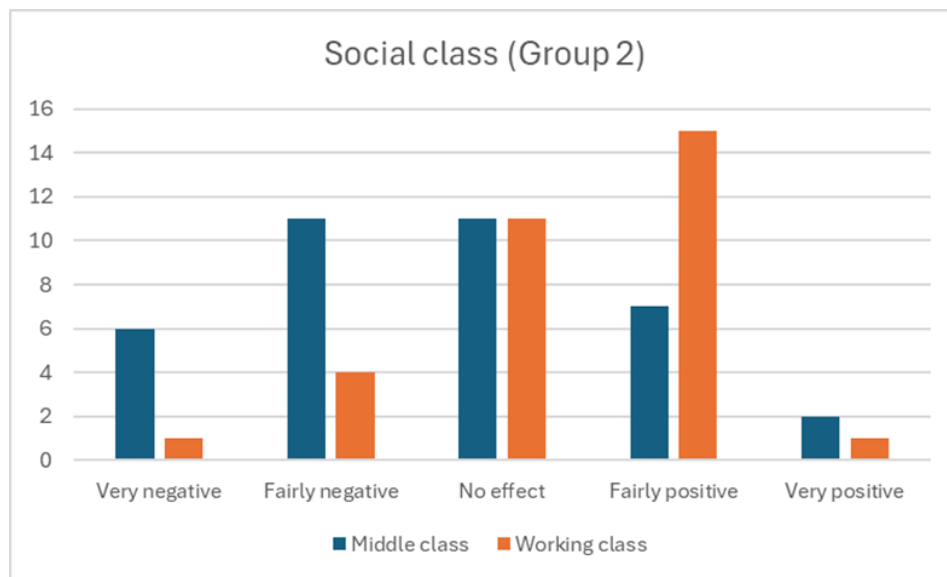


Figure 4: Distribution of survey responses in Group 2 by social class for the neutral vignette.

Regarding the effect of the frequency of internet use on the perception of wind farms among Group 2 respondents, we found that **people who surfed online every day were far more likely to have a negative perception of them** than respondents who used the internet less than daily. This adds nuances to the literature finding in VERITY deliverable 1.2 (Antoniou & Iordanou, 2023) that exposure of individuals to (scientific) news on the internet and in social media has been found to be positively correlated with higher levels of trust in science. Conversely, our finding shows that trust in science might decrease for elderly people (with no tertiary degrees) when exposed to more and more diverse news online, which underlines the need for (formal or informal) training on fact-checking and online source verification, as identified in Deliverable 3.2 (Szüdi et al., 2024).

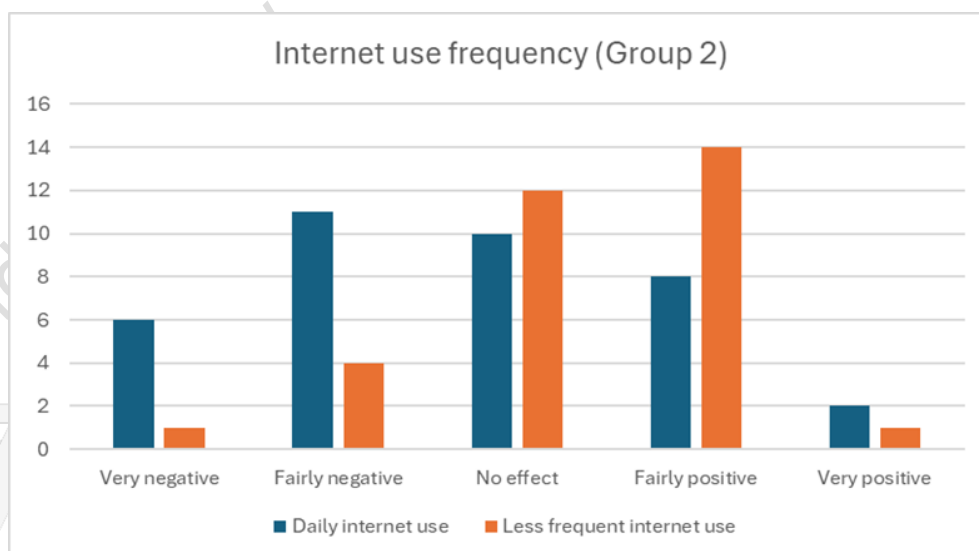


Figure 5: Distribution of survey responses in Group 2 by internet use for the neutral vignette.

In the next four sub-sections, we briefly introduce our findings for each of the vignettes (science communication, co-creation, benefit sharing and social media). Each sub-section will start with a concise overview of how each method might enhance trust in science, as indicated by the current scientific consensus and our previous findings in the VERITY project, followed by a summary of the most important findings from the vignette study.

3.2 SCIENCE COMMUNICATION

Based on state-of-the-art literature, **science communication's role** in addressing misinformation and mitigating societal mistrust in science is better recognised than before, due to the recent COVID-19 pandemic (Matta, 2020), climate change and the emergence of new technologies (Kupper et al., 2021). However, for scientific communication to be effective, it should abandon the traditional one-way communication methods, and rely more on dialogue and collaboration between scientists and citizens (Reincke et al., 2020).

However, there is **no broad consensus** on key aspects of such bi-directional science communication, e.g., who (which actors) should make the communication, how the communication should be made (including topics, channels and formats), and who should be the main target groups. VERITY sought to shed more light on these debated aspects to find out more about how to make science communication effective in tackling mistrust in science.

The VERITY literature review (Antoniou & Iordanou, 2023) found that scientific messages should be ideally delivered by **scientific agents**, preferably experts involved in the research. These experts should engage with citizens in a compelling way tailored to target group needs and interests. To make science communication effective, they should be able to tell an engaging narrative raising people's interest in science and understanding of scientific logic and processes. Not only expertise but also the integrity, benevolence and openness of science communicators should be at the forefront.

Our first vignette focused on science communication, and it was formulated in a way which considers previous findings of the VERITY project. The wording indicates that respectable scientists are engaged in scientific communication with the citizens which is achieved in a bi-directional way at the local level, resorting to the participatory method of city hall meetings.

Table 8 shows that science communication was – after benefit sharing and co-creation – the third most effective method in both Groups. Its mean scores are slightly below that of co-creation in both Groups. Nevertheless, older people seem to have a much less positive attitude towards science communication than younger people (an average score of 0.13 in Group 2 vs. 0.90 in Group 1). The overall effect of science communication was also lower in Group 2 for an already lower initial score (a positive move of 0.14 in Group 2 vs. 0.41 in Group 1). Notwithstanding social media which – as detailed in sub-section 3.5 – has an overall zero effect in both Groups, this is the lowest effect from any methods in both Groups and might only be considered significant for Group 1 (0.41 increase).

Mean \pm error of mean for vignette	Group 1		Group 2	
Gender	Male	Female	Male	Female
Neutral	0.42 \pm 0.27	0.56 \pm 0.27	-0.21 \pm 0.33	0.17 \pm 0.37
Science communication	0.85 \pm 0.27	0.92 \pm 0.30	-0.09 \pm 0.37	0.33 \pm 0.40

Table 10: Differences in attitudes towards wind farms in Group 1 and 2 for science communication per gender

Science communication is **the only method where women had a more favourable opinion** than men **in both groups**. In both groups, women tend to give more very positive scores for science communication, however also being more critical (the rates of women are more dispersed in Group 1, as visible in Fig. 6). Starting from an overall higher mean response level in Group 1 (0.90 compared to the mean of 0.13 in Group 2), science communication had a positive effect increasing respondents' attitudes towards wind farms among younger persons. However, no such significant positive effect could be observed in Group 2 (the mean of responses was raised to 0.41 in Group 1, compared with 0.14 in Group 2). There was no substantial difference between men and women in this regard in either group: the attitude of both genders increased similarly towards wind farms through science communication.

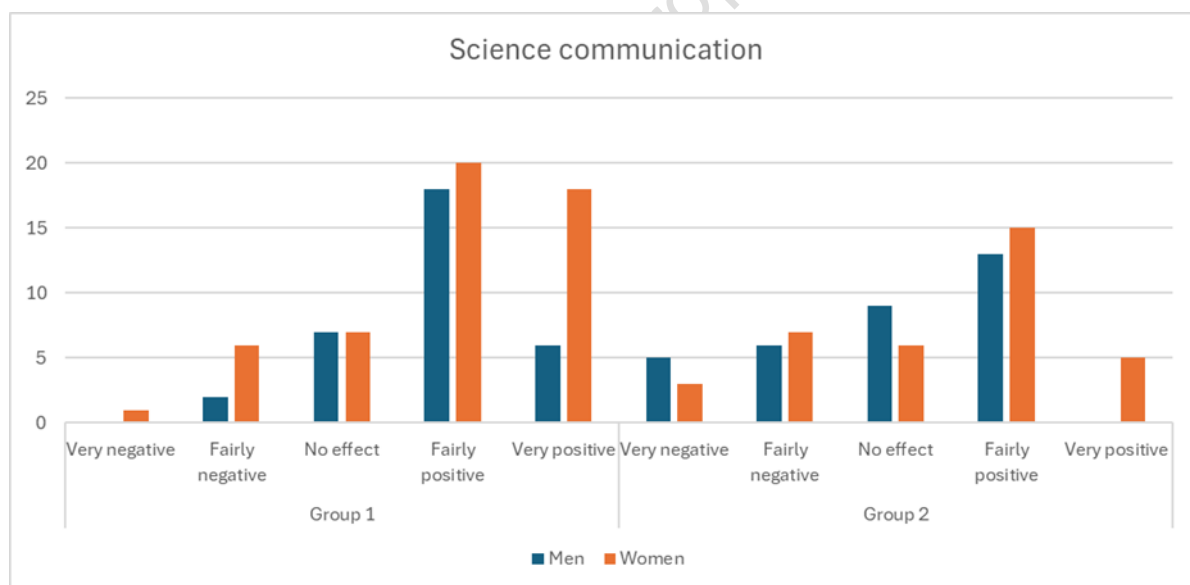


Figure 6: Distribution of survey responses in Group 1 and Group 2 by gender for the science communication vignette.

3.3 CO-CREATION

Co-creation can play a crucial role in bringing the world of science **closer to citizens**, developing relationships of mutual trust between societal and scientific actors, democratising research, and thus ultimately tackling societal mistrust in science (Heinisch, 2021; Gírbés-Peco et al., 2022). Co-creation is a key element of citizen engagement (Gurzawska et al., 2023), which means any collaborative way of coming together between science and society for mutually beneficial outcomes (Eckhardt et al., 2021).

The VERITY findings **confirm a consensus** of previous EU projects that enhancing trust in science necessitates granting the public greater involvement and agency in co-leading or co-designing research activities (Antonioni & Antonioni, 2023). However, there was no agreement on whether, in all cases, a higher level of citizen engagement is preferred. Similarly, the opinion on preferred ways of citizen engagement varied among stakeholders, for instance, science shops, science cafés, science stores or citizen assemblies were brought up as best practices in the VERITY interviews and focus groups. The beneficial effects of new technology, such as gamification, were also highlighted for effective citizen engagement and co-creation (Szüdi et al., 2024).

Science-society co-creation is particularly powerful when science is focused on applied knowledge production (Gunnell et al., 2021), such as in our case of 'wind energy'. Therefore, one of the vignettes focused on co-creation. Since VERITY did not confirm the most preferred co-creation methods, the wording did not specify any concrete methods but underlined that citizen initiatives were involved in the respective phases of wind farm deployment. In addition, the vignette highlighted that feedback was not only collected but also taken into consideration in the planning, design and implementation stages, ensuring an interactive, advanced form of co-creation between scientists and the public. This ensured that one of our key findings was taken into consideration, namely that any successful co-creation process requires that relevant stakeholders have in-depth knowledge of the local contextual factors and demographics involved.

Table 8 shows that **co-creation** was the **second most effective method** in both Groups after benefit sharing. Its mean scores are only slightly below that of benefit sharing in Group 1, but more below the score of benefit sharing in Group 2. Older people seem to have a less positive attitude towards co-creation than younger people (an average score of 0.22 in Group 2 vs. 0.99 in Group 1). The overall effect of co-creation was half as strong in Group 2 for an already lower initial score (an increase of 0.23 in Group 2 vs. 0.50 in Group 1). This effect is higher in both Groups than for science communication and social media but stays below the effect of benefit sharing.

Mean \pm error of mean for vignette	Group 1		Group 2	
Gender	Male	Female	Male	Female
Neutral	0.42 \pm 0.27	0.56 \pm 0.27	-0.21 \pm 0.33	0.17 \pm 0.37
Co-creation	1.00 \pm 0.24	0.96 \pm 0.30	0.06 \pm 0.40	0.36 \pm 0.40

Table 11: Differences in attitudes towards wind farms in Group 1 and 2 for co-creation per gender

As shown in Table 11 above, the means of the responses suggest that co-creation is deemed a more important method among women in Group 2 (more very positive responses), and an equally relevant method for women and men in Group 1. While the means of responses are almost the same for younger men and women, Fig. 7 indicates that Group 1 women tend to rate co-creation at a more varying rate, dispersing their scores across the whole scale. In contrast, the majority of younger men were quite positive towards co-creation. This finding, as well as the fact that we observe the greatest beneficial increase in the attitudes towards wind farms for younger men (the mean of responses increases with 0.58 for men in Group 1 which is significantly better than for women in Group 1) indicates that **co-creation has fundamental positive connotations and positive effect for younger men**. By comparison, Group 2 responses do not show any such patterns: co-creation has a similar – slightly favourable – effect for both, men and women (see Fig. 7).

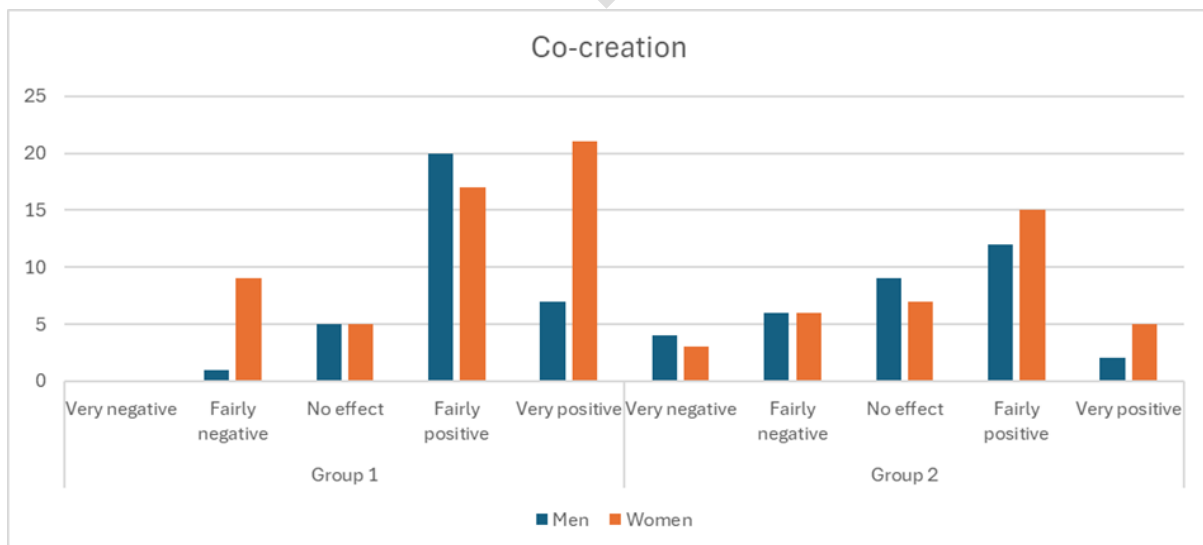


Figure 7: Distribution of survey responses in Group 1 and Group 2 by gender for the co-creation vignette.

3.4 BENEFIT SHARING

Benefit sharing relates to the distribution of benefits and burdens arising from research activities. It is primarily concerned with the question of what is owed to individuals and

communities participating in research (Simm, 2021). It aims to ensure that the benefits from scientific progress are shared fairly among potential recipients, whether or not they were involved in the research process (Schroeder, 2019).

Individual or community experiences of inequitable research practices and unequal distribution of research outcomes are often the basis for mistrust in science (Bedeker et al., 2022). Scientists should therefore engage in advance with the local community, in particular with underrepresented groups in research activities in a transparent and reciprocal way, acknowledging their research contribution and aligning research with local needs (San Code of Research Ethics, 2017; Bernabe et al., 2023).

Our previous VERITY findings focused on **open science**, **science education** and **network-building** as key benefit sharing mechanisms with the highest potential for a positive impact on trust in science. In respect of all three mechanisms, the need for inclusive community involvement, i.e., the active participation of underserved population segments was underlined.

In this context, the most relevant VERITY focus group suggestion concerning the benefit sharing method was the idea of establishing and maintaining local networks with an inclusive involvement of relevant actors around research activities where scientific information and benefits can also be shared with disadvantaged members of the public. The vignette on benefit sharing was worded in this sense where we asked the opinion of respondents on an energy cooperative which is co-owned by local people who share the benefits and burdens with the other cooperative members.

Table 8 shows that benefit sharing was the **most positively perceived** method in both Groups. The overall mean score in Group 2 is still only half of that of Group 1 (1.07 in Group 1 vs 0.43 in Group 2), but this is the only method where the overall effect is comparable between the two homogenised sample groups (an increase of 0.58 in Group 1 vs an increase of 0.45 in Group 2). The effect of benefit sharing is substantially higher than any other methods for older people, while its overall effect is only comparable with co-creation for younger people.

Mean \pm error of mean for vignette	Group 1		Group 2	
Gender	Male	Female	Male	Female
Neutral	0.42 \pm 0.27	0.56 \pm 0.27	-0.21 \pm 0.33	0.17 \pm 0.37
Benefit sharing	1.21 \pm 0.20	0.98 \pm 0.30	0.24 \pm 0.22	0.61 \pm 0.45

Table 12: Differences in attitudes towards wind farms in Group 1 and 2 for benefit sharing per gender.

Our results indicate that **benefit sharing is the most important method with the highest impact**, which makes both groups more favourable towards wind farms. It increases the perception of both, men and women in Group 2 at the same rate (the mean

of responses is raised by 0.44) and has a particularly significant favourable effect on younger men (Table 12). The mean number of responses of men in Group 1 is raised by 0.79 (almost double as much as for women in Group 1) and this is the only method by which younger men are more positive overall than younger women (with 0.23). As visible in Fig. 8, almost all men in Group 1 gave a favourable score for the idea of an energy cooperative, with the only negative scores coming from women in Group 1. The negative scores are more evenly balanced in Group 2 between men and women, and here women tend to give more (very) positive responses.

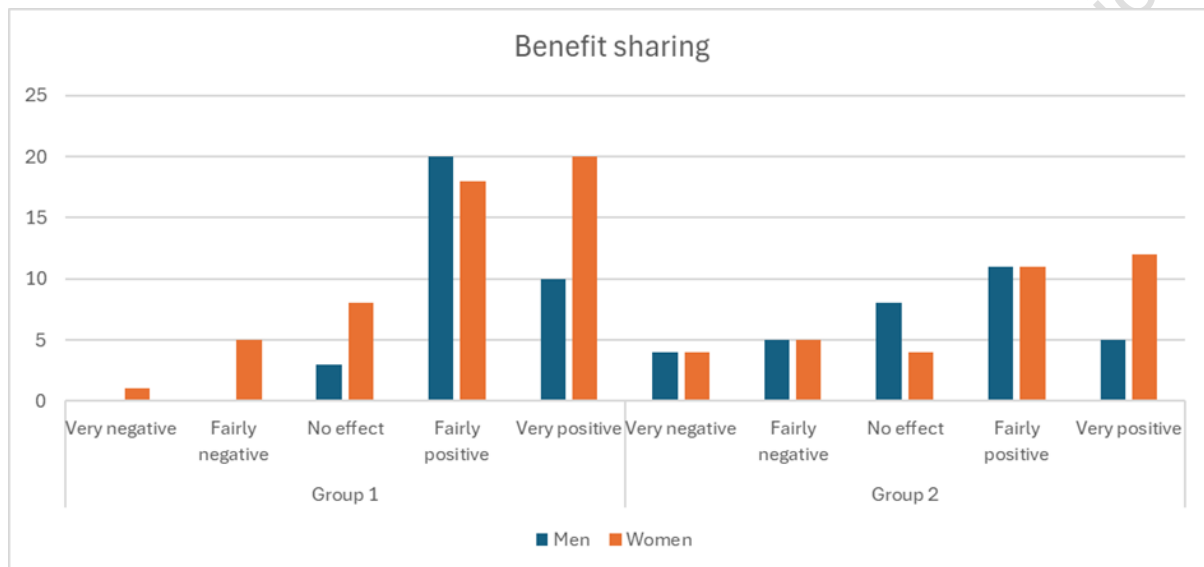


Figure 8: Distribution of survey responses in Group 1 and Group 2 by gender for the benefit sharing vignette.

3.5 SOCIAL MEDIA

VERITY literature review found that, while there is a large body of literature investigating the effect of media exposure on trust in science (Anderson et al., 2021), studies focusing on such an effect of social media are relatively few. Such research would be increasingly relevant since social media (online social networks and blogs) has already become the second most frequently used source for receiving scientific information in almost all European countries – with television being the first choice (European Commission, 2021b).

Current literature seems to agree that **social media** can act both as an **enabler and as a hinderer** of societal trust in science: on a positive note, social media makes science more readily available to the public, but on the other hand people tend to become more susceptible to misinformation, fake news spread widely and continually through social media platforms (Allcott & Gentzkow, 2017; Mousoulidou et al., 2022). VERITY's analysis of 2021-23 tweets in the CoVaxxy data set shows that in average people share news from

trustworthy and untrustworthy sources (web sites) in a 3:1 ratio.⁴ This means that, despite a high percentage of trustworthy sources being shared, people online are often exposed to untrustworthy messages (Monachelis et al., 2024).

VERITY's findings on social media and its potential relationship to societal trust in science are aligned with this scientific consensus on the ambivalent overall impact of social media on trust in science. Our systematic literature review found that the exposure of individuals to news related to science and scientific news in social media is positively correlated with higher levels of trust in science (Phylactou. & Iordanou, 2023).

VERITY focus group discussions accordingly underlined the importance for science communicators of maintaining a social media presence and building up a digital identity, which helps set up trustworthy sources for scientific information among the several social media platforms (Szüdi et al., 2024). To test these findings, the last vignette asked the opinion of respondents on influential people sharing positive aspects of wind farms on various social media platforms. Our results seem to confirm the current scientific consensus on the ambiguous effect of social media exposure on trust in science in an interesting way. Overall, influencers on **social media had almost no impact on either group compared to the baseline scenario** (there was a negligible 0.03 increase for the mean of responses in Group 1, while a minor -0.04 decrease for the mean in Group 2 – see Table 8).

Mean \pm error of mean for vignette	Group 1		Group 2	
Gender	Male	Female	Male	Female
Neutral	0.42 \pm 0.27	0.56 \pm 0.27	-0.21 \pm 0.33	0.17 \pm 0.37
Social media	0.30 \pm 0.27	0.69 \pm 0.27	-0.12 \pm 0.22	0.00 \pm 0.41

Table 13: Differences in attitudes towards wind farms in Group 1 and 2 for social media per gender

However, when we look into the data from a **gender perspective**, we can observe that there are two sub-groups where a social media campaign had a negative effect on the original (baseline) perception of wind farms: younger (Group 1) men and older (Group 2) women (Table 13). One potential explanation is that these respondents are likely to find 'influential people' promoting the wind farm so suspicious to begin with that their trust decreases from its initial level. As Fig. 9 showcases, this vignette is the most divisive for both men and women in both groups, and responses are getting more scattered around the whole scale as for the other vignettes. It is noteworthy that men seem to have a stronger opinion on social media than women: the share of 'no effect' ratings increased

⁴ The categorisation of trustworthiness is based on the Iffy Index of Unreliable Sources – <https://iffy.news/news>

for women in both Group 1 and 2, while men tend to navigate towards a more negative or positive attitude (less 'no effect' responses).

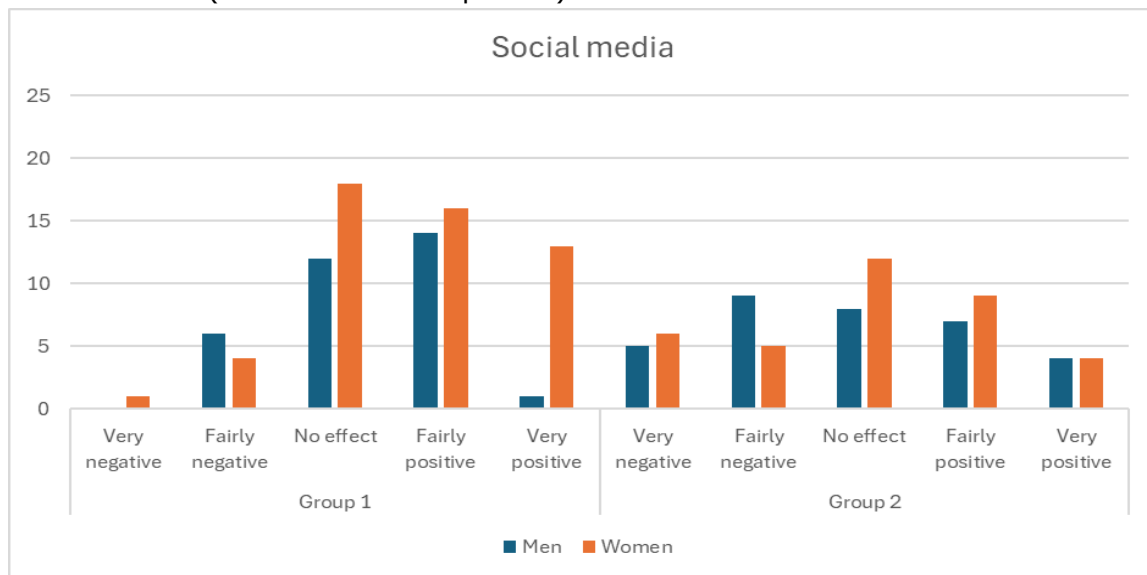


Figure 9: Distribution of survey responses in Group 1 and Group 2 by gender for the social media vignette.

4. DISCUSSION & RECOMMENDATIONS

The objective of T3.3 was to explore whether the actual reactions of citizens correspond to the previous findings of the VERITY project on the most relevant methods addressing societal mistrust in science. We designed a vignette survey for this purpose where – around the example of wind farms, also used in the preceding T3.2 activity – five vignettes were used to explore whether and for which target groups the selected methods, i.e., science communication, co-creation, benefit sharing, and social media could work.

Based on our findings stemming from the 155 eligible responses to our vignette survey, the following discussion points can be drawn to foster the selection, design and implementation of methods addressing societal mistrust in science that are relevant for certain population segments. Each discussion point below starts with a **specific finding** of the vignette study, followed by **related recommendations** or potential **future actions** in blue boxes. Points 1-2 deal with group-level findings, points 3-5 concern findings related to specific methods, while the further points relate to findings connected to demographic variables: points 6-8 with gender, point 9 with social class, and point 10 with internet use.

1. The main **hypothesis** of the vignette study **was confirmed**. Our two main target groups were set up to possess opposing characteristics that put them on the other side of the 'trust in science' spectrum. While Group 1 – consisting of younger and more educated people living in an urban environment – should have an inherently more positive attitude, Group 2 – consisting of older and less educated people living

in rural settings – should be more negative towards wind farms and related scientific issues. Our survey results indicate that the two groups clearly differ in terms of their initial position, and **Group 1 perceives wind farms more positively (0.49) than Group 2 (-0.01)**.

This conveys that if we plan to tackle mistrust in science among older people, we should further investigate the grounds for this fundamentally lower perception on wind farms in Group 2. One potential way forward is that the actual methods used might need to ‘take a step back’ and – instead of addressing concrete scientific areas – should aim to **raise the interest and engagement of Group 2 in science** itself, as suggested in D3.2.

2. The two groups also differ in terms of how they respond to the different methods to enhance trust in science. In general, **it is more difficult to achieve a positive effect through any methods in Group 2**. Accordingly, it is less likely to influence the initial position of the older respondent group (with an average increase of 0.2 in the mean responses across all vignettes, compared to an average raise of 0.38 in Group 1).

This implies that it could take more time and efforts to address the scientific trust issues of older and less educated people with any of the chosen methods. In case of Group 2, **methods might need to consider a long-term perspective**. The concrete methods are also of importance; for instance, while science communication and co-creation are important methods with positive impact in Group 1, they are less relevant in Group 2. Anyway, benefit sharing seems to efficiently influence the initial attitude of both Groups (see next point).

3. **Benefit sharing is the most important method with the highest impact** that makes both groups more favourable towards wind farms. While our results seem to be similar across different gender groups, benefit sharing had the greatest effect on the perception of men in Group 1 (0.79 higher mean of responses in comparison to the neutral vignette), while all the other groups had a positive change in perception in the magnitude of 0.42 – 0.44.

The positive evaluation of the energy cooperative by each target group might confirm the finding of D3.2, according to which the **build-up of sustainable long-term relationships** between citizens and other local stakeholders (Stewards of Trust) is a crucial step to address societal mistrust in science, intertwined with local environmental, socio-economic and political considerations.

4. As opposed to benefit sharing, our results showed that **social media had almost no overall impact on both groups**. Interestingly, the communication of influential people on social media platforms slightly lowered the initial attitude of men in Group 1 and women in Group 2 (scores given to the neutral vignette). These two sub-groups can be deemed the most sceptical towards social media. We should better understand the reasons why these two very different groups mistrust social media in the first place to be able to use social media as a tool for positively affecting trust in science. It is possible that older women tend to regard all social media platforms as unreliable information sources. By comparison, young men are

more likely to be overwhelmed by the abundance of online (scientific) information and thus become more resistant to social media influences.

In order to effectively reach both groups, science communicators should aim to establish a **digital identity** which might help them to stand out as a verified source, bringing science closer to citizens with target group specific strategies, as mentioned in D3.2.

5. Unlike in case of the 'social media' and 'benefit sharing' methods, we found a gender-related difference for science communication: **women have a slightly more positive attitude towards science communication**. In particular, women in Group 1 have a favourable opinion. Science communication is rated almost as positively as co-creation by women in both groups, while men tend to rate co-creation and benefit sharing higher than science communication.

This suggests that **women can be more positively influenced by scientists** showcasing the benefits and added values stemming from wind farms at a local level. At least for our wind farm example, women seem to have more inherent trust in scientists and experts as science communicators, while men are more distrustful.

6. In general, **women have a more positive stance towards wind farms than men**. Our results are not consistent with previous studies which found that women tend to have lower trust in science. This is generally explained by their generally lower level of education, which cannot be true for our homogenised groups (where in total men and women have a similar level of education).

Our **finding might be topic-specific** or might be caused by some other socio-cultural factors – other than age, residence and education – that makes women more positive towards science within such a homogenous sample. Future research should focus on identifying these factors and test them through similar experimental studies, using a different example than wind farms for measuring trust in science.

7. **Women give more dispersed scores for each method**, meaning that they tend to use all five scores when evaluating the vignettes. In contrast, men in Group 2 are less likely to give 'very positive' scores for the vignettes, and men in Group 1 usually have a much more moderate scoring where they predominantly apply only three scores from five in each vignette. In practice, they used the 'fairly negative' – 'no effect' – 'fairly positive' scores for science communication and social media, and the 'no effect' – 'fairly positive' – 'very positive' scores in case of benefit sharing and co-creation.

This suggests that **younger men** tend to have a more uniform perception on each method, but they **might also be more resistant to changing their attitude**. It is important to understand the underlying grounds for mistrust in science for all population segments, but our finding implies that this could be even more decisive in the case of younger men.

8. **Older men have the least favourable attitude towards wind farms**. This is the only sub-group which has an initial negative perception of the neutral vignette

(baseline scenario). They are less likely to give 'very positive' scores for any of the methods investigated. **Their perception only increases** in a significant way when they are directly involved in the planning or development process of wind farms **through co-creation or benefit-sharing** methods (with benefit sharing being the most important method).

Depending on the scientific topic, it is therefore recommended to **specifically address (older) men** with methods aimed at involving them in the scientific process or research activities at hand.

9. If we divide respondents in Group 2 by their social class (middle class and working class of society), we observe that **people belonging to the middle class are much more sceptical towards wind farms**. They have an overall negative stance for each method, starting from a mean of -0.32 for the baseline scenario (no prompt). Only benefit sharing reaches a mean value of around 0 for all responses in the middle class, while the means within the working class start from 0.34 and reach 0.97 with benefit sharing.

One potential explanation can be that **people self-identifying** themselves as 'working class' have such prior attitudes and core values that make them more receptive specifically towards wind farms, and presumably more generally towards impact science. Future research can be envisaged that will aim to better understand the dynamics between social class (political affiliation) and the general attitude towards and trust in impact sciences.

10. If we divide respondents **in Group 2** by the frequency of their internet use (daily users and less frequent users), we observe that **higher internet use is associated with a more negative perception of wind farms**. This seemingly contradictory finding can be explained by the fact that elderly people are more likely to find it more difficult to distinguish between untrustworthy and trustworthy online news sources than younger people. Therefore, more frequent internet users in Group 2 are more likely to consume more fake news, misinformation, pseudoscience, or out-of-context facts than people relying on more traditional news sources.

Training courses **tailor-made for elderly people** on fact-checking and source verification might be an effective first step to contribute to their more confident internet use, involving better recognition of reliable sources and ultimately leading to a higher level of trust in scientific issues found online.

5. CONCLUSION

This report shortly describes the main findings of a small-scale vignette survey experiment ($n = 155$) carried out in four European countries comparable in terms of trust in science (based on relevant Eurobarometer data), focusing on two target groups with distinct key characteristics (younger, more educated, urban people vs older, less educated, urban people) determining varying levels of trust. We aimed to enrich our qualitative data stemming from earlier expert interviews and multi-stakeholder focus groups with more quantitative data from citizens. This data serves to assess the validity of our D3.2 findings about the most relevant conditions under which the identified methods tackling societal mistrust in science might work effectively.

Our vignette study results confirmed some of the main conclusions of D3.2 and the preceding project activities, such as T1.2, T1.4 or T3.1. First, **audience segmentation is key** to using methods that are the most effective for specific target groups. We observed that – in line with our preliminary assumption – the younger, more educated, urban respondents have a generally more positive attitude towards wind farms and the different methods to enhance trust in science than the older, less educated, rural people. Assuming that a more positive attitude also likely entails a higher susceptibility, this necessitates the design and implementation of different methods tailored to their needs and interests.

Second, there are some methods that seem to be more universally applicable to diverse target groups. In our case, **benefit sharing had the highest impact**, making both groups more favourable towards wind farms. This is a method that can be used in various forms to enhance trust in different controversial topical scientific issues such as renewable energies. This is aligned with our D3.2 outcomes that benefit sharing is the highest ranked method by multiple (expert) stakeholders, and that network-building should be used as a separate overarching method (strategy) supporting other methods tackling societal mistrust in science. In contrast, we did not find unequivocal evidence of the effectiveness of other methods, in particular social media. Our results were ambiguous with respect to certain sample sub-groups, but overall **social media had almost no impact on either groups**.

However, in terms of the perception of the effectiveness of validated methods, we can notice **differences** even **within the** homogenous **two vignette sample groups**. Women are in general more positive towards wind farms and most methods to enhance trust in science, but they showcase a higher diversity in their attitudes. By comparison, men are less positive, but their views on each method are less varied. Consequently, women might be reached with more methods under various circumstances, while men should be more specifically targeted with a few key methods, such as benefit sharing or co-creation. Men seem to have a stronger opinion on all the methods; therefore, it could be more difficult to persuade about scientific issues; this is especially true for older, less educated men.

Third, there are also some target group **characteristics requiring further attention and research**. Our results indicate that, among older, less educated, rural respondents,

the frequency of internet or social class belonging might also decidedly affect their attitude towards wind farms and the different methods of enhancing trust in science. We should study the underlying reasons for such distinct perceptions in homogenised target groups and accordingly design our methods to address these people's mistrust of specific scientific issues effectively.

These findings are the last one in the series of VERITY activities obtaining first-hand information from a **multitude of stakeholders** (citizens, journalists, researchers, practical experts and other relevant target group categories as mentioned in the VERITY stakeholder mapping and engagement strategy (Häberlein & Hövel, 2023) through diverse project activities (focus groups, interviews, vignette study survey). It complements our previous results by addressing the most effective and beneficial use of different methods to address societal mistrust in science and guide future VERITY project activities. This report was, in particular, intended to inform and support the upcoming VERITY protocol (T4.2). Its conclusions that validate previous lessons learnt from a citizen perspective will be translated into practical recommendations for the Stewards of Trust to raise societal trust in science and facilitate science-society co-creation.

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ANNEXES

ANNEX 1. LIMITATIONS

Like any other research, this study has also some limitations. First of all, a small and non-random sample limits our efforts of generalising our findings to the broader population. To deal with this problem, we have designed our sample into two symmetrically opposing groups to control theoretically less relevant heterogeneity and to focus on the variance which is expected to have more explanatory power. Therefore, while our sample size cannot allow a full set of hypothesis testing, our sample design permitted exploration of certain mechanisms of trust in science i.e. how the methods of science communication, co-creation, benefit sharing, and social media change initial attitudes towards wind farms.

Second, while the dataset is collected from 4 different countries (Austria, Cyprus, Greece, and Spain), due to the limited sample size, we could not conduct a cross-country analysis. Since we were aware of this limitation while designing the study, we intended to choose similar country cases in terms of their general attitudes towards renewable energies and wind farms. While all four country cases are similarly positive about wind farms, we must also acknowledge that Austria scores slightly higher in terms of the perceived negative effects of wind farms.

Third, we aimed to use one controversial scientific topic for the whole vignette study, through which we could assess how our selected methods affect the initial attitude of the two sample groups. We chose wind farms since this topic proved to be an effective facilitator for focus group discussion on trust in science in the preceding project activity, and thus we could directly link our previous discussion findings with the methods used in the vignettes. These discussions showed that perception on wind farms is profoundly influenced by knowledge about and attitudes towards technological and scientific advancements, along with other environmental, economic, societal and political considerations. However, as pointed out in D3.2, these factors are usually interrelated and jointly shape people's relation towards trust in science. Taking into consideration these details, we consider wind farms as an appropriate, albeit imperfect case study and interpret our findings in a cautious way.

Fourth, the considerations about the ideal number of vignettes and length of the overall survey resulted in certain methods identified in D3.2 not being included in the final vignette study. The four methods used were considered the most important and feasible from a citizen evaluation standpoint. In particular, research ethics and research integrity methods were deemed relevant by experts, but citizens would likely have found it demanding to evaluate them via vignettes. Likely, other demographic variables, e.g. religious affiliation or political position could have also been included in the survey but were eventually excluded due to their sensitive nature which could have increased dropout rates.

Fifth, the vignette survey was conducted via an online link with Group 1 and via printed online copies with Group 2. These different formats might have some unaccounted impact

on responses. We adapted the survey format in a way to reach out to hard-to-reach populations like Group 2 (older, less educated, rural) and maximise the number of responses we collect.

Sixth, although we tried to control for the 'recency effect' by randomising the order in which vignettes are introduced, we still need to acknowledge that the previous vignettes might have an unaccounted effect on the ways that the later vignettes are answered.

ANNEX 2. DATA COLLECTION METHODOLOGY AND DATA PROCESSING

The four partners followed different data collection methodologies in each country for both Group 1 and 2, relying on their existing networks, and considering the sampling criteria.

Summary of data collection methods for Group 1:

In Austria, ZSI distributed the link to internal junior colleagues fitting the description of Group 1, as well as sent out relevant news per e-mail to the research communication or public relations departments of 22 Austrian universities and 18 universities of applied sciences before the end of March 2024. Six of them confirmed per e-mail that they had disseminated the news on the online survey among their relevant students. The final number of responses collected from Austria in Group 1 confirms that the survey link was shared among students in at least these six higher education institutes belonging to different study fields, such as medical, technical or social sciences and humanities.

In Spain, the survey link was shared with various university networks including University of Pompeu Fabra, Autonomous University of Barcelona, Open University of Catalunya, and University of Barcelona.

In Greece, the link to the online questionnaire was sent to students at the University of West Attica (UniWA). It was not sent in bulk, but random students at the university were approached. As the project partners in UniWA belong to the Electrical and Electronic Engineering department, the questionnaire was first addressed to some of the students of this department. On the other hand, to avoid bias and get responses from students with different backgrounds and studies, students were approached in the university's restaurant where students from all departments gather. Also, the questionnaire was addressed to some students in Athens outside the UniWA with different fields of study through personal contacts.

In Cyprus, the link to the online questionnaire was sent to students at the University of UCLan and some graduate students. The students were studying for a BSc in Psychology. The sample consisted of students from Cyprus and international students who were studying at UCLan Cyprus.

Online respondents gave their consent to data processing by clicking on the "Submit" button at the end of the online survey at the dedicated LimeSurvey platform. Only those results were analysed that had been appropriately submitted in this way by the individual

respondent. In order to make respondents familiar with their rights, a Declaration on Data Processing document was attached through a hyperlink to the LimeSurvey platform before the first question. Thus, interested respondents could look into their rights in more detail before deciding whether to proceed with the survey.

Summary of data collection methods for Group 2:

ZSI organised two so-called mobile 'research salons' in a group setting with elderly people where, after an initial introduction of the VERITY project and a short discussion on the project and task aims, the surveys were individually filled out in reassuring surroundings. The first such research effort was organised in an elderly care facility in a small town in Lower Austria on 25 March, while the second event took place in a pensioners' club in a village in Burgenland on 4 April 2024. 10 and 11 responses were collected respectively, which was complemented by a few responses through individual endeavours.

In Spain, data collection for Group 2 took place in the rural site of Granada through a local contact person. Hard-copy surveys were carried out through home visits between April 5-10, 2024. Two responses were ineligible due to their higher education status. Additional two surveys were conducted over the phone on April 12th, 2024.

In Greece, VERITY colleagues from UniWA took advantage of personal acquaintances with a person involved in local government in a small village in northern Greece to gather data from Group 2. The printed-out questionnaires were handed out in the village to customers in a local bakery which is owned by the above-mentioned person. Because of this, there were also a few responses from people of a neighbouring village.

In Cyprus, half of the elderly people were approached by UCLan when visiting a senior activity centre and a village coffee shop in the district of Nicosia. We informed the seniors who happened to be there at the time of the research, and we invited them to complete the paper questionnaire. The other half of the sample was a convenient sample recruited from personal contacts from another village in the district of Larnaca.

Offline respondents gave their consent to data processing by answering with "Yes" to the statement "I hereby agree to participate in the VERITY survey". The statement was at the end of a Participant Information and Informed Consent Form document which summarized the relevant project details (purpose, procedure of research activity) and participant rights (participation and withdrawal, data security and anonymity) in a plain language. When the data collection was organised in a group form, for instance at ZSI's mobile research salons, the Participant Information and Informed Consent Form was read aloud to respondents to encourage them to ask any potential questions before the survey.

Exclusion of data:

All partners were successful in gathering relevant responses that fulfilled each pre-determined criteria (age, residence, and education) in both Groups. Nevertheless, not all responses could be used in the final data set. Altogether 263 responses were collected until the deadline, out of which 184 were collected online for Group 1, and 79 were received

via a paper survey for Group 2. 60 online responses were not full (meaning that the respondents did not finalise the online questionnaire or did not click the final 'Submit' button), which means that 124 total full responses were collected online.

Since we decided to establish two sample sub-groups that are homogenous with respect to our main sampling criteria, i.e., age, education, and residence, therefore we needed to exclude the responses not falling into our pre-defined categories in one of these criteria. As a result, out of the 124 full online answers, 38 responses had to be excluded from the analysis of the Group 1 results for non-eligibility reasons, i.e. the responses did not fulfil some case selection criteria. 20 persons were between the age group of 31-49, while 1 person did not provide his/her age at all.

This means that there were altogether 103 respondents from the age group of 18-30, out of whom 15 persons had to be excluded due to their place of residence (14 persons living in rural area or village, and 1 person providing no answer) and 2 more persons had to be excluded for educational reasons since 1 only completed primary education and 1 did not answer the question. Thus, 86 eligible responses could be analysed for Group 1.

Out of the 79 answers to printed-out Group 2 surveys, 10 responses had to be excluded for educational reasons: 9 persons finished a university degree education, and 1 person did not answer the question. This means that 69 eligible responses could be analysed for Group 2.

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