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Citizens' perspectives on science communication

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Abstract

The evolving landscape of science communication highlights a shift from traditional dissemination to participatory engagement. This study explores Dutch citizens' perspectives on science communication, focusing on science capital, public engagement, and communication goals. Using a mixed-methods approach, it combines survey data ($n = 376$) with focus group ($n = 66$) insights. Findings show increasing public interest in participating in science, though barriers like knowledge gaps persist. Trust-building, engaging adolescents, and integrating science into society were identified as key goals. These insights support the development of the Netherlands' National Centre of Expertise on Science and Society and provide guidance for inclusive, effective science communication practices.

Keywords

Public engagement with science and technology; Public perception of science and technology

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1 ▪ Introduction

The field of science communication is humming with the notion that science communication should be both more inclusive and focus more on participation [Giardullo et al., 2023]. Gradually the strategic goals and methods of science communication are shifting towards more engaging and participatory practices, stemming from the realisation that the science capital grows faster in active audiences than inactive ones. These discussions often take place among scholars or practitioners of science communication, rarely among citizens themselves. Do publics actually expect science and science communication to become more involving? And who are they expecting to take responsibility for science communication and with which goals?

These questions are of special relevance to the newly instated National Centre of Expertise on Science and Society (NEWS) of the Netherlands. In 2022 Robbert Dijkgraaf, the then Minister of Education, Culture and Science, announced that the Netherlands was to have a national centre focusing on the relationship between science and society. The centre, that aims to bridge the divide between science and society, is driven by a mission to involve a broader audience on the inner workings of science. It plans to do so by advising researchers and research institutions on how to shift the focus in science communication from results to the process and methods of scientific research, stimulating interaction and dialogue over dissemination, and increasing the overall learning capacity of the field by uniting practitioners and science communication researchers alike.

In order to answer these questions, we performed a mixed method study focused on the situation in the Netherlands. We posed our questions to both a representative sample of the Dutch population, as well as three focus groups with specific publics. In this query we combined science capital, involvement in research and perspectives on science communication, which is unique within the Dutch setting. Taken together it forms a baseline for the current state of the Dutch publics' science capital, as well as the public expectations of both science and science communication. However, these issues are not unique to the Dutch situation and have also been observed in international analyses [Gascoigne et al., 2020; Metcalfe, 2022]. Therefore, we expect our findings to be of interest to a broader community of science communication experts.

2 ▪ Theoretical framework

As documented by many scholars, a paradigm shift has taken place in science communication, moving from top-down, or deficit model thinking to more focus on public engagement with science, public participation in science and dialogue models [e.g. Bucchi, 2008; Giardullo et al., 2023]. Pushed by governments and the open science agenda, science communication and science initiatives are supposed to involve citizens in scientific practices. Although we do know something about how scientists and science institutes address this paradigm shift [Entradas et al., 2020; Nerghes et al., 2022], not much is known about citizens' perceptions, expectations, and opinions about engagement with science and science communication.

When considering the public's views on science and science communication we consider two overarching themes: citizens' views on the role of science in society, and their perspective on science communication. In the following sections we will outline these two themes.

2.1 ▪ *The role of science in society*

2.1.1 ▪ *Science capital*

Science capital, a term coined by Archer et al. [2015], encompasses all the ways that science is part of an individual's life, including knowledge, attitudes, experiences and resources. In line with earlier research by DeWitt et al. [2016], knowing something about the science capital of the public will help us understand whether science is something that they come across regularly or whether it is something they are not familiar with. DeWitt et al. [2016] defined four dimensions of science capital: what people know about science and the scientific process, what they think about it, how they engage with it, and whether they have access to it. In their survey study the authors found that science capital can serve as a predictor for future science aspirations. On the one hand, science capital can provide a baseline of a certain audience's engagement with science. On the other hand, increasing science capital can be considered a goal of science communication.

To our knowledge no previous measurement of the science capital of the Dutch population has been performed. However, from an existing survey, the Eurobarometer [European Commission, 2021], we do know that a majority of Dutch respondents watch or read about science on tv or in newspapers, magazines or books and that they talk about science with family or friends. A third of them visit science museums regularly or occasionally. Around three quarter of the respondents feel like they are moderately to very well informed about science and technology.

In addition, the Dutch Impactlab performed a study where they investigated the science capital of visitors to several science communication events. They used the concept of science capital from DeWitt et al. [2016] to develop a concise list of statements to measure science capital as part of a larger question bank for science communication projects. In their meta-analysis combining data of four science communication projects, including 217 children and 340 adults, they found that for the sample of the included projects the audience possessed a rather high science capital [Land-Zandstra et al., 2023]. The researchers therefore concluded that these science communication events seem to attract people that already have an interest in and knowledge about science and recommend the field to look for alternative/additional locations, activities and topics which can make science communication more accessible to a broader audience, lowering the threshold for those with lower science capital.

2.1.2 ▪ *Involvement with research*

In the field of science communication and in the context of open science there is a trend towards engaging citizens with all steps of the research process [Achiam et al., 2022; Giardullo et al., 2023]. As described by Strasser et al. [2019], the term citizen science spans many different practices and fields of research and has changed the discourse around science and the distinction between scientists and laypeople as the "consumers of science". One of its goals is to democratise science, making it more open to others outside of the ivory tower and to value other types of knowledge.

But how do citizens feel about that? In 2015 the Rathenau institute, a Dutch independent institute that conducts research and organizes debates on science, innovation, and new

technology, asked how people wished to be involved in scientific research [de Jonge, 2015]. This was at the time that the Dutch government launched the Dutch National Research Agenda, a research funding scheme with the specific aim to involve citizens more strongly in the decision making process by consulting them on the choice of research questions [Gunning-Schepers, 2017].

At the time, a small majority of the respondents (58%) answered that they did "not need to decide about topics that scientists deal with, as long as they do their job well". More than a quarter of the respondents (27%) deemed it important that the general public is involved in decisions about scientific research, but they did not feel the need to be involved themselves. Thirteen percent wanted to be more included in decisions about topics that should be researched by scientists and two percent indicated that they already were involved with these decisions. These results closely match this for the Dutch public in the 2021 Eurobarometer which posed similar questions, indicating a willingness to leave decisions to research professionals whilst informing the general public.

Although these results hint at an expectation to be involved in science, there are also possible barriers that prevent people from participating in research. Respondents of the Eurobarometer [European Commission, 2021] indicated that there are various barriers that prevent them from being involved with science and technology. Almost half of the sample (48%) identified lack of time as one of the main barriers, followed by lack of knowledge about science and technology (44%), lack of interest (30%), and lack of information about activities or events related to science and technology (27%). This was in line with the results in other European countries.

2.2 ▪ *Perspectives on science communication*

2.2.1 ▪ *Who is responsible?*

Scientists often feel that science communication is part of their responsibility towards society [Loroño-Leturiondo & Davies, 2018]. In their notion of science communication scientists include more traditional top-down approaches such as public lectures and contact with the media, as well as more participatory examples such as joining the public debate and citizen science. Besides scientists, there are many other actors involved in science communication, such as science journalists, governmental agencies and communication experts at research institutes and universities. Which actors the public expects to 'pick up the baton' of science communication isn't a straightforward matter and tends to vary depending on multiple variables, including the country.

The participants of the Eurobarometer were asked to appoint a maximum of three organisations or people who would be most suitable to explain the impact of scientific and technological advancements on society [European Commission, 2021]. A large part of the Dutch respondents (64%) found it most fitting if researchers working at universities or research institutes funded by the government would explain this, which is in line with the EU average. Journalists ended up in second place (40%), which is double the EU average, and scientists working for privately funded research institutes came in a close third (30%).

Specifically related to scientists, 41% of the respondents felt that scientists do not invest enough time in explaining their work to laypeople, as opposed to 20% who believed

scientists do spend enough time on that, a further 36% who remained neutral and 3% answered “Don’t know” [European Commission, 2021].

2.2.2 ▪ *Goals*

For science communication to be effective, it is important to have clear strategic goals. When the intentions of science communication efforts are known from the outset, it becomes much more feasible to assess whether the science communication goals have been achieved. Often these are categorised in goals related to knowledge and understanding; goals related to attitudes, opinions and feelings; and goals related to behaviour change [Besley & Dudo, 2022].

In Germany, the Impact Unit of Wissenschaft im Dialog performed a survey among organisers of science communication efforts, asking them to rate the different goals on their importance [Impact Unit, 2019]. Increasing public understanding in science, creating public acceptance and making sure science is part of public conversation were the most important goals. In a recent study among Dutch scientists, Nerghes, Mulder and Lee [2022] found that scientists rated goals related to knowledge transfer the highest, followed by goals related to making connections and making science more accessible.

What good science communication is in respect to the described goals is a question that should not be answered from an academic perspective only. Especially since the underlying goal is predominantly to ensure the scientific endeavour is of use to non-academic audiences. Comprehensive frameworks for this type of audience evaluation of quality are currently being developed [Taddicken et al., 2024] and these become even more relevant when combined with the audiences’ view on the most important goals of science communication.

3 ▪ Research questions

Together the research interests mentioned above led us to aim for a comprehensive query of the current state of the attitudes towards science and science communication. Are there (subtle) changes in the perceptions of science and do we find indications of shifting expectations of the way in which society should be involved?

Within this broader framework the primary research question for this study was: What are the perspectives of Dutch adult and young citizens on science communication?

The following subquestions guided both the survey and the focus groups:

- What is the current science capital of the Dutch public?
- How do citizens feel about being engaged with all steps of the research process?
- Who do citizens expect to be involved in science communication?
- Which science communication goals are most important to citizens?

4 ▪ Methods

We used a mixed-methods approach to gather citizens' perspectives on their involvement and engagement with science and science communication. This approach allowed us to gather data among a large, representative sample of the Dutch population ($n = 376$), but at the same time provide a more qualitative, in-depth perspective of smaller specific subgroups ($n = 66$). Quantitative (survey) and qualitative (focus group) data were gathered in parallel, each covering similar themes. Afterwards, the data were combined and analysed together.

In both the survey and the focus groups we gave respondents definitions of the concepts science and science communication to make sure everyone was interpreting them in the same way. The Dutch word for science is "wetenschap" and this includes the social sciences and humanities. We used the following descriptions, based on van Dam et al. [2020], Land-Zandstra et al. [2023] and Peeters et al. [2022]:

- **Science** is about asking questions, being curious, searching for solutions, experimenting, and discovering new things. Hence, science is everywhere. Science can for instance relate to nature, space, mathematics, society, humans, language, media, law, etcetera.
- **Science communication** encompasses all the ways in which people outside of the scientific world could be engaged with scientific research. This could be listening to and looking at results of research, formulating research questions together or discussing the possible consequences of science. One can think of popular scientific lectures, TV shows, discussion panels or audience research.

4.1 ▪ *Survey*

The survey included two main themes: *The role of science in society* and *Perspectives on science communication*. We used questions from existing surveys to be able to compare our results with existing data as well as to increase reliability and validity of the survey. In particular we looked at the survey of the Dutch Rathenau Institute regarding the Dutch populations' trust in science. This survey is held with an interval of three years [van den Broek-Honingh & de Jonge, 2018; de Jonge, 2015; van den Broek-Honingh et al., 2021; Tiemeijer & de Jonge, 2013]. Each time at least 800 respondents completed the survey, of which the themes and questions varied per year. In addition, we used some questions from the *Special Eurobarometer 516: European citizens' knowledge and attitudes towards science and technology* organised by the European Commission [European Commission, 2021]. The survey was conducted in Dutch and we translated the questions and results for this article. The complete (translation of the) survey can be found in Supplementary material A.

The survey started with the open question *What do you think of when you hear the word science?* to activate participants to think about science. After that we gave them the above-mentioned definition of science and asked five Likert scale questions about their science capital taken from the work of IMPACTLAB [Land-Zandstra et al., 2023; Peeters et al., 2022]. For instance: *I regularly speak with others about science in my daily life* (on a 5-point scale: from totally disagree to totally agree).

Next, we asked what barriers people experienced when engaging with science, where people could select a maximum of three options. For this, we used the same categories as the

special Eurobarometer [European Commission, 2021]. Categories included amongst others: *I do not find it interesting*, *I know too little about science*, *there are few good activities about science in my neighbourhood*, and *there are no obstacles for me*.

Then, we asked how they would like to be involved with scientific research, based on a question used by the Rathenau institute in 2015 [de Jonge, 2015] with options: *I don't need to be involved with decisions about science*; *I think citizens should be involved in research choices, but personally don't want to be part of this process*; *I would be interested to be involved in research design*; and *I am currently involved in research design*.

The second part of the survey was on science communication and we activated participants to think about this with the open question: *What do you think of when you hear the term science communication?* We gave the definition of science communication afterwards and asked which actors are the most suitable for doing science communication. We used similar categories as the special Eurobarometer [European Commission, 2021], such as researchers, communication officers or journalists and left space for an open answer. Participants could choose up to three answers.

For the goals of science communication we asked them to rate each of the following generally accepted goals on a 5-point Likert scale from not important at all to very important: *making sure that everyone in society is well-informed about science*, *sharing beautiful and interesting stories about science*, *promoting the use of science by society*, *promoting trust in science*, *making sure that society can make decisions about important societal challenges in which science is involved*, and *enthusing adolescents about science*.

The survey was distributed online among a sample of the Dutch adult population (18 years or older) by Market Research Agency MWM2. The demographics of our sample ($n = 376$) were representative for the adult Dutch population with regards to gender, age and educational background. Participants gave informed consent before answering the survey questions. We use descriptive statistics for our analysis of the survey results.

4.2 ▪ *Focus groups*

To complement our survey data with more in-depth explanations of people's opinions about science and science communication, we organised eight focus groups sessions with three different subgroups of the Dutch population:

- Adults with an existing interest in science: visitors of Science Cafe Deventer; a group of visitors joint a session before the event; *one session with 14 participants*.
- Adults who are less likely to be in contact with science: visitors of the Participatie Keuken ("Participation Kitchen") — an organisation that aims to increase the resilience of vulnerable groups in society by getting people to actively participate in its cultural and culinary activities; the guided conversation took place while they were joining the meal; *three sessions with a total of 31 participants*.
- Secondary school students of various grades and education levels, at schools in Amersfoort and Amsterdam; small groups of 5–6 students were joining in a session; *four sessions with a total of 21 students*.

We performed focus groups for several reasons: 1) in focus groups, people would be able to inspire each other; 2) we could easily check consensus among the group; and 3) especially for the second and third groups, it would be less intimidating to speak to researchers in a group instead of one-on-one. For each focus group we used an appropriate protocol (see Supplementary material B for an example). We started with a brief introduction about the set-up and then discussed the themes *The role of science in society* and *Perspectives on science communication*.

At the beginning of each session, we asked for oral informed consent. Legal guardians of the secondary school students who were under the age of 16 years received a letter two weeks prior to the meeting to inform them and their child about the research, and to obtain their consent.

Each focus group was moderated by one of the authors and notes were taken by another author or a student assistant. After the focus groups the notes were transcribed. For this article quotes are translated from Dutch. We used the focus group data to illustrate and interpret the perspectives that emerged from the quantitative results of the survey.

5 ▪ Results

In order to combine the survey data with focus group insights, we present them together for each of the discussed themes. When using quotes, we indicate if they came from a high school student [HS], a visitor of the science cafe [SC] or Participation Kitchen [PK].

5.1 ▪ *The role of science in society*

5.1.1 ▪ *Science capital*

In both the survey and the focus group we examined how people get in touch with science in their daily lives. In the survey 63.3% of the participants (fully) agreed with the statement "I am interested in science" and also 63.3% of the participants (fully) agreed with the statement "In my spare time, I participate in activities that allow me to learn something about science, such as visiting museums, looking up information online or watching science-related tv shows or videos" (see Figure 1).

During the focus groups many participants indicated that they are interested in science and that they feel they are dealing with science on a daily basis. One visitor of the Science Café illustrated this by saying: "I'm dealing with science because of the non-stop surprise and wonderment; by looking at the world with an inquisitive look [SC]." A student said something similar: "I want to gain more in-depth knowledge, but also learn about new things [HS]." There were however also some participants with an opposing view: "I am not involved in science and I do not want to be involved, since we as citizens are not taken seriously anyway [PK]."

Many participants in all three subgroups mentioned museums and hospitals as places where they get in touch with science. And in the focus group with a prior interest in science (Science Café visitors) participants also mentioned an inquisitive mindset as a way to use science in their daily lives.

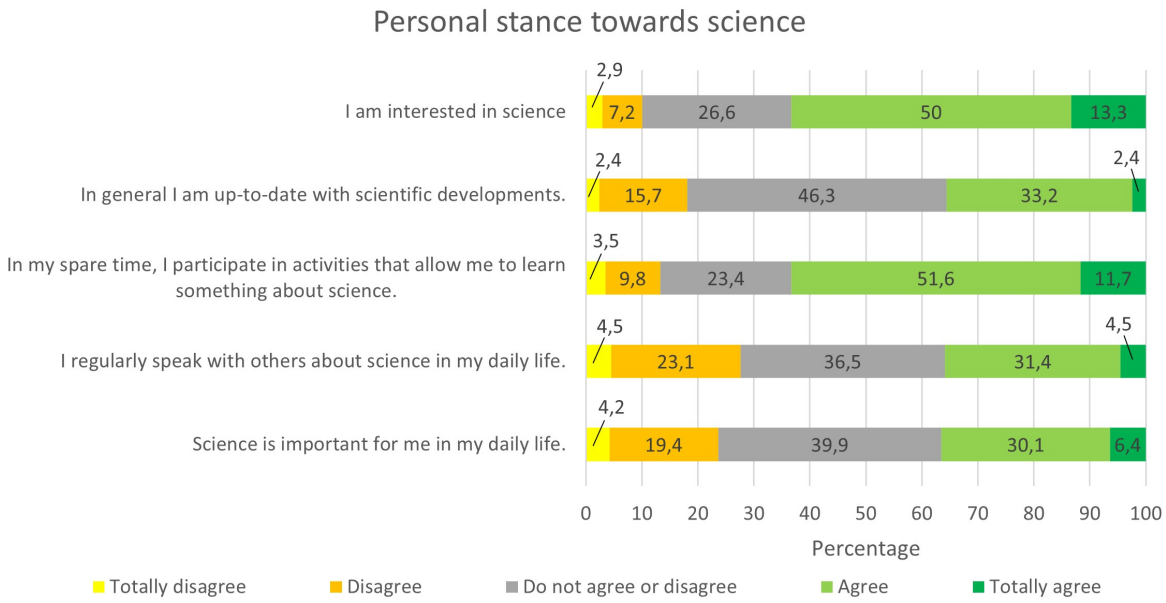

Figure 1. The science capital of survey participants ($n = 376$).

Some of the students that were interviewed noted that they regularly talk about science: "I'm discussing science a lot at home. I'm interested in space, NASA, SpaceX, etc. I'm looking into those topics [HS]." Other students indicated that they are thinking of science on a daily basis: "If my cat jumps from the roof, I'm reminded of physics [HS]." Talking and thinking about science were often related to current events: "We usually discuss a lot of things during dinner at home. We sometimes talk about science, but more often we discuss the news [HS]."

For some, science is clearly an important part of their daily lives: "One is dealing with science every moment of every day. For instance, while driving the car; someone has once thought to actually invent this car and I'm now driving that invention. I am very aware of that fact [SC]." Or: "You are confronted with science everywhere all the time. In the supermarket, on your phone: it is everywhere [HS]."

For others, science is more limited to situations that involve problem-solving: "For instance when I try to figure out how a certain machine works and what the underlying reason could be when it isn't functioning [SC]."

5.1.2 ▪ *Barriers*

After discussing their science capital, we also investigated the barriers that our participants experienced. Here multiple answers were possible. About a quarter of the survey respondents (27.4%) indicated that they do not encounter any obstacles that would prevent them from engaging with science, see Figure 2.

The barrier that was selected most often in the survey is the lack of knowledge about science (26.6%). A few focus group participants of the science cafe agreed: "Research is sometimes too complex to explain and when one tries to simplify the matter, there is the risk of oversimplification. To add nuance remains very important [SC]". Someone else added in that discussion: "For some topics I'd say my life would have been easier if I hadn't known so

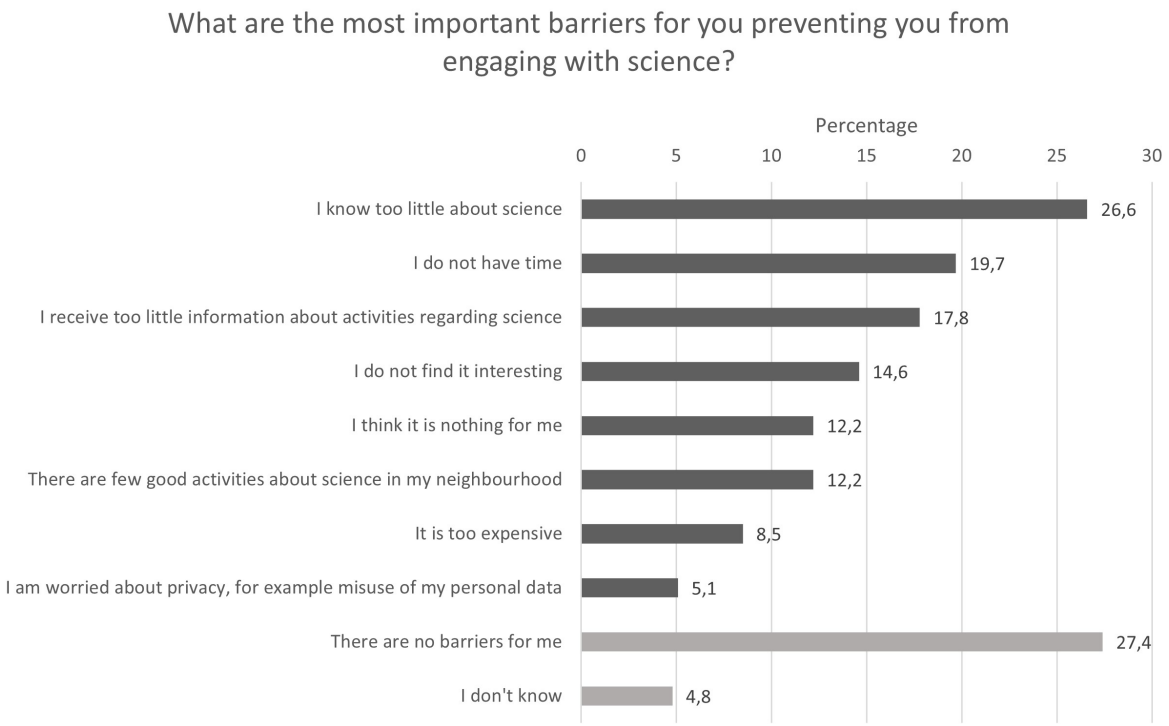

Figure 2. Barriers for engaging with science among survey participants ($n = 376$). Participants could select more than one answer.

much about it. The more you know, the more you realise how much you actually do not know. I'm not getting any closer to the answer. Or I should simply know even more about it, but I don't have the time or the intellect to fully understand the matter at hand [SC]." In the other focus groups, barriers were not mentioned specifically, only a few participants did not see the need for getting involved or engaged in science.

In the survey 19.7% of the respondents indicated that they do not have enough time to get involved with science. This also came up in the focus groups: "We have so little time because of school [HS]" and "I would really like to focus on one topic and zoom in, but we have too little time to thoroughly think about it and to explore ideas [HS]." Scientific jargon can also be a barrier, as was illustrated by an added comment from the survey: "People have to learn to communicate in a language that is easy to understand, so that it remains fun and accessible for everyone."

5.1.3 ▪ *Involvement with science*

Participants had mixed opinions on involving citizens in scientific research. In our survey only 1.9% of respondents were currently involved in research design and 21.0% would be interested to do so. Another 40.4% thought citizens should be involved in designing research but personally do not want to be part of this process. A final 36.7% did not need to be involved with decisions about science.

In the focus groups, some participants identified a lack of knowledge as the underlying reason for not wanting to think along when new research is set up: "Science and setting up

research should be a distinctive job that doesn't involve society, because you need a certain kind of knowledge for that, which I simply do not have [PK]." Or: "I'm not sure whether we have enough understanding of science to actively engage in and be involved with science. In 80% of the cases, the topic that we would suggest to research will probably already have been explored, or it could simply be impossible [HS]." Other reasons were also given: "I think that people rather want to hear about the solutions, such as the birth control pill [PK]" and "With these kinds of things, I'm suspicious that people only want to make a profit out of it, by submitting research proposals that will only be to their own benefit. I'd be afraid that fundamental research will disappear [SC]."

However, others deemed it important that people can be involved in the decision-making process: "You have to take citizens into account, otherwise it won't have a connection with society [PK]." For some it is dependent on the type of research: "It makes sense that scientists autonomously decide on their plan of action for fundamental research, but in the case of applied research it should be possible to explain what problem is being solved [SC]."

The students also valued the possibility to join the decision-making phase: "I think the younger generation should have a say in what is researched. It should not be obligatory, but if we want to, we should be given the opportunity to chip in. The school and the government do not automatically know what a young person wants. Otherwise you run the risk that they'll be making choices based on a limited view and understanding [HS]." Another student said: "We are, after all, the future. If we were asked, we would focus more on sustainability and supporting the planet, as we are the ones who will suffer the consequences [HS]."

Some focus group participants voiced the need for more involvement during the entire research process, not only during the research design phase: "I think it would be valuable if more information is shared while scientists are still working on their research, instead of only sharing the findings once the research has finished [PK]."

5.2 ▪ *Perspectives on science communication*

5.2.1 ▪ *Responsibility*

After discussing the role of science in society, we moved specifically to the topic of science communication, including who is responsible for it. When asked to pick (at most) three categories of actors who are most suitable for organising science communication, a majority of survey respondents (67.8%) chose researchers at universities or research institutions (see Figure 3).

Focus group participants also placed the responsibility of science communication mostly on the scientists: "The government should facilitate in terms of money, but scientists know better what they want to research and what they need. And they can explain it better too [PK]."

Communication officers of universities and research institutions were the second most selected group (38.6%) and journalists (23.1%) were picked less than researchers in companies (30.6%) and societal organisations (25.3%). In the focus groups, the government, communication officers and the media were mentioned a few times as well when asked about the responsibility for science communication. For example, one participant said: "Because companies hire scientists for research, I think it's better if it [science communication] happens through the government to make it more neutral". Interestingly,

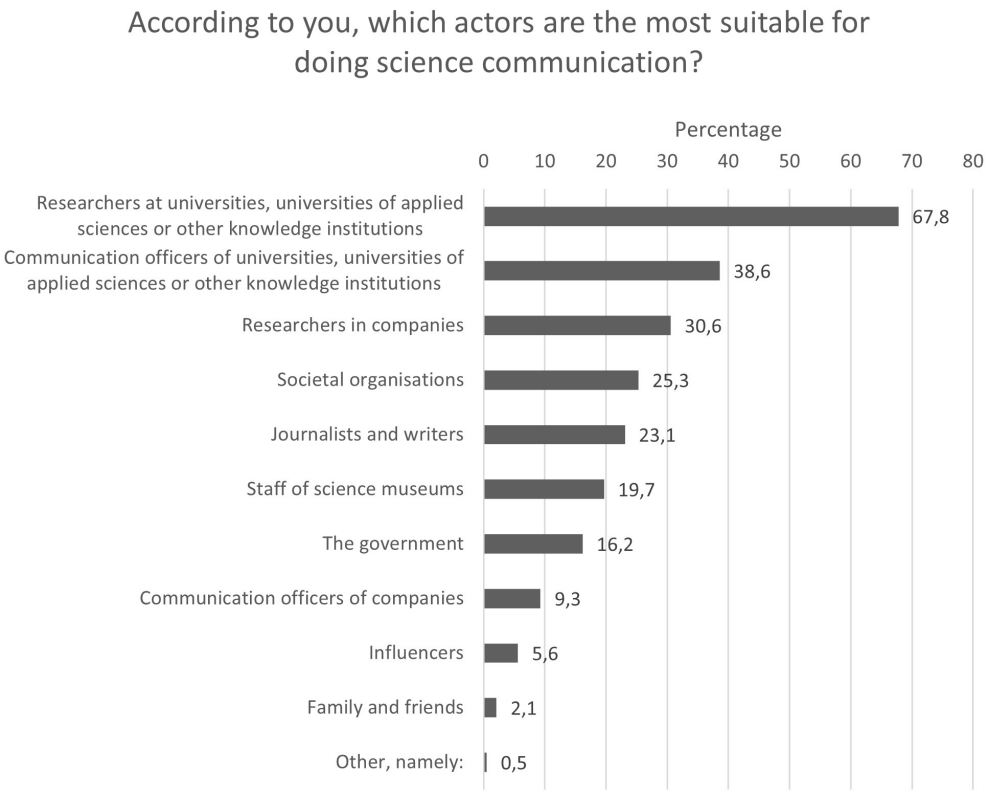

Figure 3. Suitable actors for science communication according to survey participants ($n = 376$). People could mention at most three actors.

one focus group participant remarked that the receiver is also partially responsible for the quality of the communication: "I think the entire chain that is involved in the communication process is responsible, even the receiver. People are inclined to read clickbait, which results in more clickbait being written, which is a reinforcing interaction. Everyone has the responsibility to ask themselves the question: is everything in balance? [SC]".

5.2.2 ▪ *Goals of science communication*

We also examined the goals that participants envision for science communication. The vast majority of survey participants (83.5%) believed it is (very) important that science communication aims to promote trust in science (see Figure 4). And multiple focus group participants agreed: "I think the lack of trust is one of the biggest issues regarding science communication [SC]." Focus group members also discussed that the strong conviction that some scientists show in their communication might hamper trust: "It would be much better if scientists would say: 'I do not know for sure, but what I have found, seems to point in this particular direction' [SC]."

Some participants believed more strategic communication would also help: "You first need a lot of research, and only if scientists know something for sure, it can be shared with the world. You want to avoid fake news, because that is very inconvenient [HS]." The topic of fake news came up several times in different focus groups as something that science communication could help avoid.

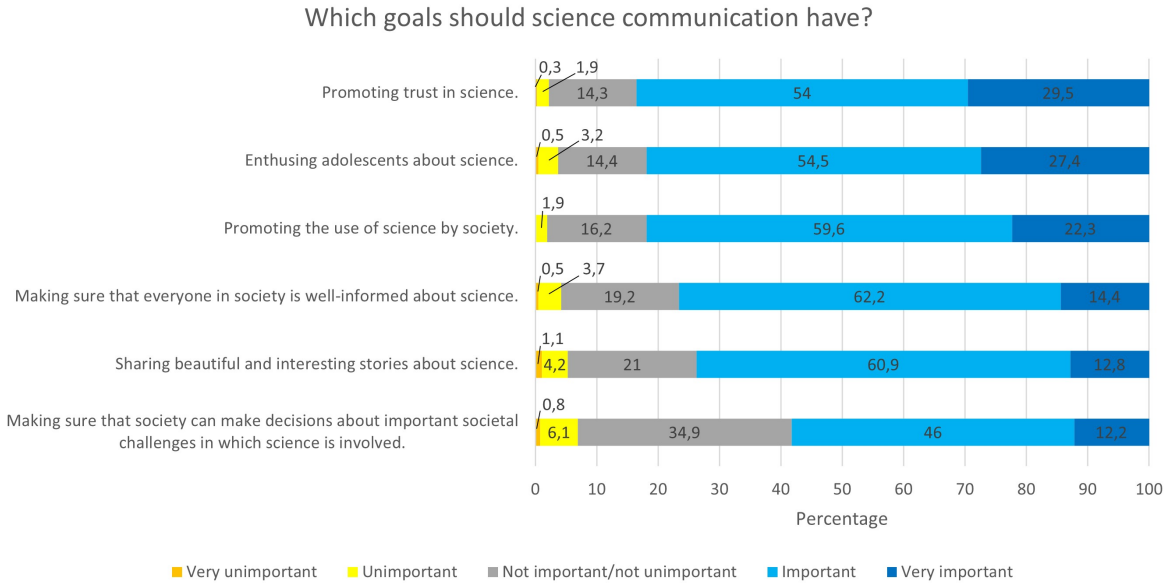

Figure 4. Citizens opinions on possible goals for science communication in our survey ($n = 376$).

Moreover, enthusing adolescents was considered (very) important. A total of 81.9% of the participants of the survey indicated this and it also came up multiple times in the focus groups: “To bridge the gap between science and society it is necessary to make science accessible to adolescents who do not necessarily interact with science within their own environment. Students are usually eager to learn more, but this eagerness is slowly lost during their time in formal education [SC].” A student phrased it like this: “I greatly value science communication. You might not remember everything that you are told or discover, but it makes you curious, especially when you visit museums. [HS].”

Science communication should also promote the use of science by society according to many survey participants (81.9%). To illustrate this point, one of the focus group participants stated: “Perhaps it can help to predict what kind of things you need to do in order to achieve certain goals [SC].” Two students made a very practical point: “Otherwise it will become very chaotic” and “A long time ago, people thought that smoking was good for you, but now we know this isn’t true [HS].”

Many survey participants (76.6%) also agreed that informing the public should be another main goal of science communication. From the focus groups we understood that this is partly as a justification for transparency: “I have a feeling that much remains untold. It needs to be more transparent [PK]”, but also to ensure that people are better equipped to make their own choices: “We should not completely rely on a specialist. Rather, we should educate people about their own body, reading labels of medicine etc., so that they are able to make their own decisions [PK].” A student noted: “Science as a concept is often misunderstood, not necessarily the subject matter. I would thus spend more attention on explaining science as a concept [HS].”

Lastly, 73.7% of the survey participants value interesting stories. Or as a focus group participant phrased it: “If you ask me, science communication exists because it should invite people to explore the truth: how does the world around us work? [SC]”

6 ▪ Discussion and conclusions

First and foremost, it is worth addressing the added value of taking the time to talk to people from different backgrounds about science communication, especially during the focus group interviews. Often, decisions about science communication are made without involving the audience, limiting both the perceived possibilities in scope, as well as the effectiveness of public interactions about science.

We learnt a great deal during the focus groups, and we incorporated the views of citizens in every aspect of the design of the national centre. We also used citizen quotes throughout our policy report [Verkade & Smeets, 2023a, 2023b] to show the people behind the theory and numbers and this was greatly appreciated by various readers. Below we discuss our findings on the two themes: *The role of science in society* and *Perspectives on science communication*. For each topic, we discuss our findings, compare them to the Dutch population in previous surveys and relate the findings to the broader field of science communication. We also give recommendations for future practice and research.

6.1 ▪ *The role of science in society*

6.1.1 ▪ *Science capital*

Our study provided us with a representative baseline of the science capital of the Dutch population. To put this into perspective we compared the science capital in our representative sample with that of the science capital measured in other studies, e.g. from IMPACTLAB [Land-Zandstra et al., 2023; Peeters et al., 2022].

As expected, an open science family day at a university had considerably higher science capital scores than our baseline. However, even a science festival specifically aimed at children from areas with less experience with science-related activities or institutions still attracted an audience with rather high science capital as compared to that in our representative sample.

This comparison not only shows the need to look beyond science communication events and their conventional locations (such as universities or libraries) and think about ways to make these activities more accessible. At the same time, it also helps organizers of science communication initiatives to determine if they have reached the desired audience in terms of science capital.

6.1.2 ▪ *Involvement with science*

When it comes to being involved in all steps of the research process, we see a clear difference between the outcomes of the Rathenau Institute from 2015 and our results from 2023 towards a wish to be more involved. Our survey showed that over 40% think that the general audience should be involved in the decision-making process, whilst in the 2015 sample from the Rathenau Institute only 27% thought so [de Jonge, 2015].

The percentage of people who would like to be involved in research decisions themselves also seems to have grown from 13% to 23%, whilst the percentage of people who are actually involved in research design remained stable at only 2%. There is a growing group of citizens

who would like to be engaged in research, but who are currently not connected. Possibly, the pandemic period could have shown people the role of science in certain societal issues and the importance of democratic decision making.

The Eurobarometer of 2021 also found a lower percentage (31%) of the Dutch population who thought citizens should be consulted on decisions about science and technology [European Commission, 2021]. Here, part of the lower percentage might be explained by the focus on science and technology, which people might associate more with fundamental research. In our focus groups, citizens were very outspoken about the distinction between different types of research, where they felt citizen engagement was much more important in applied research.

Why this increased interest in participating in science hasn't translated into more direct involvement remains an open question. From our survey it is impossible to determine forthright whether the low direct involvement is an issue on the side of the supply (opportunities created by researchers for citizens to participate) or the demand side (the willingness and interest of citizens to be involved). Moreover, it is important to consider the barriers that people encounter that hinder their participation in science communication activities.

6.1.3 ▪ *Barriers*

The main barrier to getting involved with science was given to be too little prior knowledge, both in the survey as well as during the focus groups. Our findings are mainly in line with those of the Eurobarometer [European Commission, 2021]. Citizens seem to assume that you need a lot of scientific knowledge in order to participate in the research process, underestimating their potential contribution based on other types of knowledge they might possess. The conversations in the focus groups further highlighted the underlying assumptions of what science is, and who is *able* to contribute might be an important barrier to the publics' involvement in the research process.

With this seeming to be a commonly held assumption it begs the question what the underlying cause of this perceived distance towards the scientific process is. Have scientists perhaps given off the wrong impression of the potential value of the 'outsiders perspective'? Whatever the cause, scientists and science communicators should recognize these barriers, by actively addressing these assumptions and by reaching out to audiences rather than waiting for them to engage.

Concluding, these observations highlight the value of including other voices than only those of scientists. Science communicators can increase public awareness about the possibilities to get involved. Hecker et al. [2018] have pointed out that people are willing to participate when their involvement in science has clear demonstrable benefits. From suggesting research gaps to collecting data, citizens can be involved in a multitude of ways. In promoting this, we can show how science and society can benefit from active networking and new formats of collaboration, including true co-design with participants.

6.2 ▪ *Perspectives on science communication*

6.2.1 ▪ *Responsibility*

Another surprising result of our survey was that communication officers from (applied) universities and research institutions were named as the second most suitable actor for organising science communication efforts. When we were designing the survey, we had some discussions with communication officers who thought that citizens might not think of them as important. But citizens do see their role as important and some focus group spontaneously described that science communication should be done by people who are specialized in it.

In contrast, journalists scored much lower than we expected. These results differ quite a bit from those of the Eurobarometer [European Commission, 2021] where journalists ended behind scientists and medical doctors (their survey did not include communication officers). One explanation for this is that the Eurobarometer focused on *explaining implications of science and technology*, whilst we used a broader definition of *engaging with science*, suggesting a subtly but importantly different role expectation.

In the literature the role of institutional communication officers is often discussed in relation to getting news into the mass media [Scanu, 2006]. However, some scholars also discuss the changing landscape of science communication and the related changing roles of communication officers [Volk et al., 2023]: communication officers are increasingly involved in more engagement with citizens such as in citizen science projects. In addition, communication officers could be more involved in science communication research projects.

6.2.2 ▪ *Goals*

When it comes to the goals of science communication, there are differences in what citizens, scientists and organisers of science communication deem to be important. The citizens in our survey chose promoting trust in science, enthusing adolescents and promoting the use of science by society as the most important goals.

In recent surveys, scientists prioritised knowledge transfer, making connections and making science more accessible [Nerghes et al., 2022]. Organisers of science communication picked increasing public understanding in science, creating public acceptance and making sure science is part of public conversation as the most important goals [Impact Unit, 2019].

Enthusing adolescents was not prioritised by scientists nor by science communication organisers, possibly because they see this activity more as a part of (informal) science education rather than that of science communication. However, it is good to realize that the boundary between science education and science communication is blurry — and that citizens might not be aware of the subtle differences.

Overall, whilst citizens' science communication goals are not completely disjunct from those of scientists and organisers, it will be good to make sure these goals are better aligned in the future. If we are serious about public engagement, we should also engage citizens in setting up goals for science communication projects and involve them in all steps of communicating science.

6.3 ▪ *Limitations*

A few limitations should be taken into account when interpreting the findings of this study. First of all, this study focused on the Dutch context. Not all results will be transferable to other cultures, but we hope that by sharing this work we inspire others to conduct similar studies. We are happy to share materials and further details with people who are interested in setting up something similar in their own country.

Another limitation is that there is some self-selection of participants in both the focus groups and the survey. Although our survey sample was representative regarding gender, age and educational background, the most vehement anti-science people will likely have opted-out.

A final limitation is that nomenclature is subtle, there are many different interpretations of terms like science and science communication [Illingworth et al., 2015]. We tried to battle this by giving all participants the same explanations, but pre-existing ideas might have influenced interpretations.

6.4 ▪ *Conclusion*

Modern science communication aims to engage citizens in all steps of research. We have some knowledge on how researchers and science communication organisers view science communication but lack knowledge about the views and perceptions of citizens themselves. In this study that included a survey and focus groups among Dutch adults we focused on two themes: the role of science in society and perspectives on science communication. We found that many participants want to be involved in science communication but feel that they lack the prior knowledge. This is also reflected in the fact that the science capital of this representative Dutch sample is lower than the science capital measured at some science communication events.

Participants view researchers and communication officers as the most suitable actors for doing science communication and believe the most important goals for science communication are trust in science, enthusing adolescents and promoting the use of science by society. Taking these findings into account when designing science communication initiatives will hopefully increase the success of such endeavours that aim to bridge science and society.

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References

Achiam, M., Kupper, J. F. H., & Roche, J. (2022). Inclusion, reflection and co-creation: responsible science communication across the globe. *JCOM*, *21*(04), E. https://doi.org/10.22323/2.21040501

Archer, L., Dawson, E., DeWitt, J., Seakins, A., & Wong, B. (2015). "Science capital": a conceptual, methodological, and empirical argument for extending bourdieusian notions of capital beyond the arts. *Journal of Research in Science Teaching*, *52*(7), 922–948. https://doi.org/10.1002/tea.21227

Besley, J. C., & Dudo, A. (2022). *Strategic science communication: a guide to setting the right objectives for more effective public engagement*. Johns Hopkins University Press. https://doi.org/10.56021/9781421444215

Bucchi, M. (2008). Of deficits, deviations and dialogues: theories of public communication of science. In M. Bucchi & B. Trench (Eds.), *Handbook of public communication of science and technology* (1st ed., pp. 57–76). Routledge. https://doi.org/10.4324/9780203928240

de Jonge, J. (2015). *Vertrouwen in de wetenschap 2015. Feiten en cijfers*. Rathenau Instituut. Den Haag, The Netherlands. https://www.rathenau.nl/nl/werking-van-het-wetenschapssysteem/vertrouwen-de-wetenschap-2015

DeWitt, J., Archer, L., & Mau, A. (2016). Dimensions of science capital: exploring its potential for understanding students' science participation. *International Journal of Science Education*, *38*(16), 2431–2449. https://doi.org/10.1080/09500693.2016.1248520

Entradas, M., Bauer, M. W., O'Muircheartaigh, C., Marcinkowski, F., Okamura, A., Pellegrini, G., Besley, J., Massarani, L., Russo, P., Dudo, A., Saracino, B., Silva, C., Kano, K., Amorim, L., Bucchi, M., Suerdem, A., Oyama, T., & Li, Y.-Y. (2020). Correction: Public communication by research institutes compared across countries and sciences: building capacity for engagement or competing for visibility? *PLoS ONE*, *15*(11), e0242950. https://doi.org/10.1371/journal.pone.0242950

European Commission. (2021). *Special Eurobarometer 516: European citizens' knowledge and attitudes towards science and technology (v1.00)* [Data set]. Directorate-General for Communication. Brussels, Belgium. http://data.europa.eu/euodp/en/data/dataset/S2237_95_2_516_ENG

Gascoigne, T., Schiele, B., Leach, J., Riedlinger, M., Lewenstein, B. V., Massarani, L., & Broks, P. (Eds.). (2020). *Communicating science: a global perspective*. ANU Press. https://doi.org/10.22459/cs.2020

Giardullo, P., Neresini, F., Marín-González, E., Luís, C., Magalhães, J., & Arias, R. (2023). Citizen science and participatory science communication: an empirically informed discussion connecting research and theory. *JCOM*, *22*(02), A01. https://doi.org/10.22323/2.22020201

Gunning-Schepers, L. (2017). Inspiration. A national research agenda. In B. de Graaf, A. R. Kan & H. Molenaar (Eds.), *The Dutch National Research Agenda in perspective: a reflection on research and science policy in practice* (pp. 221–222). Amsterdam University Press.

Hecker, S., Bonney, R., Haklay, M., Hölker, F., Hofer, H., Goebel, C., Gold, M., Makuch, Z., Ponti, M., Richter, A., Robinson, L., Iglesias, J. R., Owen, R., Peltola, T., Sforzi, A., Shirk, J., Vogel, J., Vohland, K., Witt, T., & Bonn, A. (2018). Innovation in citizen science — perspectives on science-policy advances. *Citizen Science: Theory and Practice*, *3*(1), 4. https://doi.org/10.5334/cstp.114

Illingworth, S., Redfern, J., Millington, S., & Gray, S. (2015). What's in a name? Exploring the nomenclature of science communication in the UK. *F1000Research*, *4*, 409. https://doi.org/10.12688/f1000research.6858.2

Impact Unit. (2019). *Evaluation and impact in science communication. Results of a community survey November/December 2019*. Wissenschaft im Dialog. Berlin, Germany. https://impactunit.de/wp-content/uploads/2021/08/Summary_Community_Survey.pdf

Land-Zandstra, A., Strick, M., Peeters, W., & de Jong, P. (2023). *Het meten van impact van wetenschapscommunicatie: eindrapport IMPACTLAB*. https://doi.org/10.5281/zenodo.7884384

Loroño-Leturiondo, M., & Davies, S. R. (2018). Responsibility and science communication: scientists' experiences of and perspectives on public communication activities. *Journal of Responsible Innovation*, *5*(2), 170–185. https://doi.org/10.1080/23299460.2018.1434739

Metcalfe, J. (2022). Science communication: a messy conundrum of practice, research and theory. *JCOM*, *21*(07), C07. https://doi.org/10.22323/2.21070307

Nerghes, A., Mulder, B., & Lee, J.-S. (2022). Dissemination or participation? Exploring scientists' definitions and science communication goals in the Netherlands. *PLoS ONE*, *17*(12), e0277677. https://doi.org/10.1371/journal.pone.0277677

Peeters, W., Land-Zandstra, A., & Strick, M. (2022). Een nieuwe aanpak voor het meten van impact in de wetenschapscommunicatie: theoretisch kader en praktische uitwerking. *Tijdschrift voor Communicatiewetenschap*, *50*(3), 231–250. https://doi.org/10.5117/TCW2022.3.006.PEET

Scanu, M. (2006). The role of institutional science communication. *JCOM*, *05*(03), C05. https://doi.org/10.22323/2.05030305

Strasser, B. J., Baudry, J., Mahr, D., Sanchez, G., & Tancoigne, E. (2019). "Citizen science"? Rethinking science and public participation. *Science & Technology Studies*, *32*(2), 52–76. https://doi.org/10.23987/sts.60425

Taddicken, M., Fick, J., & Wicke, N. (2024). Is this good science communication? Construction and validation of a multi-dimensional quality assessment scale from the audience's perspective. *Frontiers in Communication*, *9*, 1384403. https://doi.org/10.3389/fcomm.2024.1384403

Tiemeijer, W., & de Jonge, J. (2013). *Vertrouwen in de wetenschap 2012: hoeveel vertrouwen hebben Nederlanders in de wetenschap?* Rathenau Instituut. Den Haag, The Netherlands. https://www.rathenau.nl/nl/werking-van-het-wetenschapssysteem/vertrouwen-de-wetenschap-2012

van Dam, F., de Bakker, L., Dijkstra, A. M., & Jensen, E. A. (Eds.). (2020). *Science communication: an introduction*. World Scientific. https://doi.org/10.1142/11541

van den Broek-Honingh, N., & de Jonge, J. (2018). *Vertrouwen in de wetenschap: monitor 2018*. Rathenau Instituut. Den Haag, The Netherlands. https://www.rathenau.nl/nl/werking-van-het-wetenschapssysteem/vertrouwen-de-wetenschap-2018

van den Broek-Honingh, N., Glas, I., & Vennekens, A. (2021). *Vertrouwen van Nederlanders in wetenschap (enquête 2021)*. Rathenau Instituut. Den Haag, The Netherlands. https://www.rathenau.nl/nl/kennis-voor-transities/vertrouwen-van-nederlanders-wetenschap-enquete-2021

Verkade, A., & Smeets, I. (2023a). *Nationaal Expertisecentrum Wetenschap & Samenleving: plan van aanpak*. https://doi.org/10.5281/zenodo.7763918

Verkade, A., & Smeets, I. (2023b). *National Centre of Expertise on Science & Society — The Netherlands: action plan (summary)*. https://doi.org/10.5281/zenodo.7808844

Volk, S. C., Vogler, D., Fürst, S., Schäfer, M. S., & Sörensen, I. (2023). Role conceptions of university communicators: a segmentation analysis of communication practitioners in higher education institutions. *Public Relations Review*, *49*(4), 102339. https://doi.org/10.1016/j.pubrev.2023.102339

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