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Science communication audiences in Lithuania: science motivation, attitudes toward media, and nature–friendly behavior

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Based on prior engagement-based segmentation of science communication audiences, to fill the gap on knowledge about audience segments in a Lithuanian context, this study aimed to explore the groups within society having different levels of trust and interest in science, and to compare them on science motivation, attitudes toward media and nature-friendly behaviors. A representative sample of 1,005 adults, aged 18 and above, with a mean age of 45.1 years (SD = 14.8) participated in the study carried out in 2024. Based on prior research, it was expected that four distinct profiles would emerge, but the LPA revealed just two distinct latent classes within the Lithuanian sample. Higher engagement group, 60.1% of the sample, scored higher on all interest and trust in science indicators, whereas lower engagement group, 39.9% of the sample, showed minor engagement with science. T-test analysis revealed additional differences between the profiles. Firstly, individuals in the higher engagement group were more motivated to learn about science "simply because they find it interesting." Second, the higher engagement group had more trust in the media's ability to inform them accurately about science and research. Finally, the findings showed that individuals who are more engaged with science are also more inclined to take environmentally friendly actions.

KEYWORDS

media, science, audiences, attitudes, behavior, nature, motivation, Lithuania

Introduction

Science communication plays a significant role in disseminating scientific knowledge to diverse audiences, and its efficacy generally depends on understanding its audiences and adapting the communication strategies accordingly (Lewenstein, 2022). However, science communication is increasingly moving beyond a one-way "deficit model" of knowledge, which assumes audiences are passive recipients of information: effective science communication now emphasizes engaging with audiences as active partners and building on the strengths they already possess—for example, their knowledge, values, motivations, lived experiences, and existing engagement with science or environmental issues—rather than focusing on what they lack (Marsh et al., 2023; Lewenstein, 2024). Adopting this asset-based approach means valuing these audience assets and fostering inclusive, two-way dialogues where knowledge is co-created (Kinchy, 2017). This shift toward participatory, dialogic communication is significant as the world confronts challenges like climate change: by engaging communities through dialogue and co-creation, science communication can better align with audience values and empower

collective action toward environmental sustainability (Schmid-Petri and Bürger, 2022; Vasquez, 2022). Accordingly, the present work examines science communication audiences—specifically their science motivation, attitudes toward media, and nature–friendly behavior.

Prior research revealed that effective science communication can contribute to public opinion and encourage individual behavioral change (Scheufele and Krause, 2019). However, the public is not homogeneous: individuals vary in their trust in science, their perception of scientific relevance, and their readiness to act on new information (Fischhoff, 2019), and these differences underscore the need for audience segmentation, which tailors communication strategies to the interests, needs, and concerns of distinct groups (Koch et al., 2020; Metag and Schäfer, 2018). Rising skepticism and political polarization regarding some scientific topics, including climate change, underscore current communication challenges, and many existing practices exhibit gaps to be addressed to reach diverse audiences (Mede et al., 2022; Klinger et al., 2022) and improve science communication (Fischhoff, 2019).

Although scientific communication encompasses a wide variety of scientific topics, understanding audience motivations, attitudes, and behaviors toward specific science domains can enhance the efficacy of communication strategies. One such domain is nature and environmental sustainability, which uniquely intersects with everyday life and personal experiences. Despite the numerous benefits derived from natural resources, in many regions, nature can present substantial threats, such as hurricanes or earthquakes. These threats can foster ambivalent or even negative attitudes toward nature (Prokosch et al., 2022). Such attitudinal ambivalence is critical for science communicators to consider, as it can directly impact whether individuals adopt nature-friendly behaviors or become indifferent or avoidant toward environmental issues. Prior research has consistently highlighted that nature-friendly behaviors are linked not only to environmental knowledge but also to personal connectedness to nature (Whitburn et al., 2020). Yet, there remains a significant gap in understanding how general science communication audiences differ in their environmental behaviors based on their broader attitudes toward science and their engagement with media. Just some studies analyzed how media representations of nature-related issues can shape cognitive schemas about the environment, prompting behavioral responses across diverse audiences (Trivedi et al., 2018; Awan et al., 2022). Therefore, while this article primarily explores general aspects of science communication audiences, the inclusion of environmental sustainability and nature-related attitudes and behaviors offers a context for examining how media attitudes and science motivation are linked to specific behaviors.

Previous studies demonstrated that lack of trust in communication on climate science can undermine motivation to engage in sustainability efforts (Hornsey and Fielding, 2020), whereas effective science communication can still prompt pro-environmental decisions (Hart and Nisbet, 2012), as heightened awareness and understanding of environmental science may correlate with pro-environmental actions (Clayton et al., 2015). Research also revealed that high trust in science does not necessarily translate into behavioral outcomes, as individuals may adopt nature-friendly practices due to moral, cultural, or social norms rather than scientific evidence alone (Hornsey and Fielding, 2020). Presumably, examining populations' nature-friendly behavior, which encompasses actions such as waste sorting, energy conservation, and eco-conscious consumer choices, can clarify how nature-friendly behavior variates in different science communication audiences.

Past research identified different typologies of the distinct and multifaceted audiences of science communication, grounded on demographic and socio-cultural factors, scientific knowledge, trust in science, levels of engagement with scientific information (Besley, 2018). This had practical relevance, as an effective science communication requires understanding diverse audiences, and addressing differences to ensure a balanced impact (Humm and Schrögel, 2020) and contribution to science engagement.

Science engagement itself is multifaceted, encompassing cognitive (e.g., knowledge, attention), affective (e.g., interest, trust, emotion), and behavioral (e.g., information seeking) dimensions (Scheufele and Krause, 2019; Scheufele, 2018). Initially, it was presumed that merely supplying factual information would encourage positive attitudes toward science, but contemporary scholarship underscores the role of motivation, emotion, and broader sociocultural influences (Hu et al., 2022).

While extrinsic science motivation is considered to be driving short-term or utilitarian engagement, intrinsic motivation was identified as fostering sustained interest and deeper exploration, shaping how individuals seek, process, and act upon scientific information (Bathgate and Schunn, 2017). Research revealed that individuals with low motivation rely more on peripheral cues, such as visual appeal, whereas highly motivated individuals critically evaluate evidence and arguments, consequently, effective science communication necessitates an integrated approach, accounting for every motivational profile (Kantar et al., 2023; Kappel and Holmen, 2019; Kessler et al., 2022; Wilkinson et al., 2022).

Furthermore, prior studies revealed that attitudes toward media also contribute to public engagement with scientific information: the growing range of media outlets through which individuals encounter scientific content yield sources of varying credibility, so trust in media emerges as a key determinant of whether audiences scrutinize or dismiss scientific findings (Scheufele and Krause, 2019). More to this, overly complex, unclear reporting can deter individuals from engaging with science-related topics as well as doubting media credibility, so trust in media, underpinned by perceptions of clarity, competence, honesty, and goodwill, is thus integral to effective science communication (Lupia, 2013). When media is perceived as transparent and ethical, public confidence in science may grow, and, conversely, perceived bias undermines confidence and might lead to disengagement, even regarding health or environmental concerns (Awan et al., 2022; Dan et al., 2021; Yeung et al., 2022).

Media environment is increasingly fragmented, spanning traditional platforms (television, newspapers) and diverse digital channels (social networks, podcasts, streaming services), which require strategies to address varying levels of interest, trust, and motivation among different segments of the public. Thus, audience segmentation, or profiling heterogeneous groups based on shared attributes, is important to create strategies for targeted messaging, improved scientific literacy and science engagement (Metag and Schäfer, 2018).

One of the most comprehensive segmentations in environmental and science communication proposes profiling audiences into four segments: "the engaged," having a high level of interest in science and actively seeking out information; "the interested," having a moderate

level of interest in science but more likely to engage when science communication is accessible and relevant to everyday life; "the disengaged," having little interest or knowledge of science; and "the skeptical," distrusting of science or holding negative attitudes toward scientific topics (Metag and Schäfer, 2018; Schäfer et al., 2018). Profiling of audiences is essential to reach different individuals, especially in segments when just using narratives, emotional stories, and practical examples can help to engage them.

Present study aims to explore science communication audiences in Lithuania—the groups within society having different levels of trust and interest in science, and the primary question is how science communication audiences' profiles, based on their science-related attitudes, differ together in science motivation, attitudes toward media and nature-friendly behaviors in a Baltic state's context. Based on prior engagement-based segmentation of science communication audiences (Metag and Schäfer, 2018; Schäfer et al., 2018), in this study, it was presumed that (H1) in the Lithuanian context, four segments of audiences will also be identified with distinct interest and trust in science profiles. Next, prior research revealed that different science communication segments might have distinct needs, attitudes, and behaviors (Humm et al., 2020; Humm and Schrögel, 2020; Burns and Medvecky, 2018; Wilkinson et al., 2022; Klinger et al., 2022), therefore, it was also hypothesized (H2) that science communication audiences will significantly differ in their science motivation, attitudes toward media and nature-friendly behavior. So, it was presumed that a multi-class solution would emerge, revealing meaningful differences among subsets of participants, and that individuals in a higher engagement with science profile would exhibit more positive attitudes toward media and stronger nature-friendly behavior. This study also intended to fill an empirical gap by advancing knowledge about latent audience segments in a Lithuanian context. The focus on Lithuania can provide additional insights: disparities in scientific literacy of population persist, and research on Lithuanian science communication audiences remains relatively sparse compared to Western Europe or North America (Valinciute, 2017).

Method

This research utilized quantitative cross-sectional survey design. The sampling approach employed multi-stage stratified random sampling, and was carried out between 21st of June and 7th of July, 2024, by the Lithuanian-British public opinion research company "Baltijos tyrimai". Professional interviewers conducted face-to-face surveys using a standardized questionnaire. The total of 1,005 adults (aged 18 and above) participated in the study. The participants were drawn from various regions to ensure geographic representativeness, and demographic quotas were set to approximate national distributions by age, gender, and settlement type (urban vs. rural). These procedures were designed to yield a balanced and representative sample, and the final dataset consisted of 459 men (46%) and 546 women (54%), with a mean age of 45.1 years (SD = 14.8). 15% of participants (149) were 18–29 years old, 34% (340)—30-49 years old, and the rest 51% (516) were aged 50 years and over. Family income for the 27% (265) were up to 1,200 Eur, for the 28% (283)—1,201 Eur, for the 21% (213)—over 2000 Eur, and the rest did not answer. The majority of participants had a higher education (university or similar), 18% had just secondary education, and 6%—incomplete secondary education. 43% (429) of participants were from major Lithuanian cities. The study adhered to national regulations and ethical guidelines for social research: participants were informed about the purpose of the study, the voluntary nature of participation, and their right to withdraw at any time, but there was no collection of any personal information about participants, all answers were treated as confidential and were only be considered in aggregate with the answers of all the other people taking part in the survey.

The structured questionnaire comprised several sections, but in this study the following was included: demographics (gender, age, educational attainment, income level, and county of residence), and 15 items taken from previous research (Metag and Schäfer, 2018; Schäfer et al., 2018). Participants rated themselves on a 5-point Likert scale on science engagement indicators (seven items, Cronbach alpha = 0.885, "Interested in science and scientific research," "Science and scientific research play an important role in life," "Interested in information about science news presented in the media," "Purposely seek information about science and scientific research," "Would like to participate in scientific research," "Trust science in general," "Important to be informed about scientific news and scientific research"), science motivation (four items, Cronbach alpha = 0.887, "Because I want to obtain information for studies or work," "Because I simply find it interesting," "Because I want to better understand science and scientific research," "Because I want to participate when others talk about it"), attitudes toward media (three items, Cronbach alpha = 0.904, "The media provides reliable information about science and scientific research," "The media provides understandable information about science and scientific research," "The media provides comprehensive information about science and scientific research"), and nature-friendly behavior (one item, "I sort my waste or otherwise protect the environment").

Statistical analysis of the data was performed applying statistical package JAMOVI v.2.6.13. Latent Profile Analysis (LPA) served for the identification of unobserved subpopulations characterized by distinct patterns of science-related attitudes and engagement, and, following the LPA, independent samples t-Tests were performed to compare the latent classes on science motivation, attitudes toward media and nature-friendly behaviors.

Results

Initially, to test H1, a Latent Profile Analysis (LPA) was conducted using seven continuous indicators: (1) interest in science and scientific research, (2) the perceived importance of science and scientific research in life, (3) interest in science news in the media, (4) purposeful seeking of scientific information, (5) desire to participate in scientific research, (6) trust in science in general, and (7) the perceived importance of being informed about scientific news and research.

The LPA analysis compared several models with varying numbers of classes, and the best-fitting solution, based on Bayesian Information Criterion (BIC), was a two-class model. An analytic hierarchy process, utilizing multiple fit indices (AIC, AWE, BIC, CLC, and KIC), also supported this two-class solution as the optimal fit. The model fit indices for the best-fitting solution showed the following: a log-likelihood of −7,206, an AIC of 14,499, and a BIC of 14,701, and these values were lower compared to other models tested, confirming

that the two-class model was the most parsimonious fit. The significant Bootstrapped Likelihood Ratio Test (BLRT) ($p = 0.0099$) also supported the appropriateness of the two-class model. The entropy value for this model was 0.778, indicating a moderate level of classification accuracy, which suggests a reasonable separation between the classes. The means and standard deviations (SD) for each item within each class, along with their standard errors (SE) and variances, are presented in Table 1.

Class 1 showed higher mean scores across all items, suggesting higher levels of interest, trust, and engagement with scientific information, and Class 2 had lower mean scores, indicating a comparatively lower level of these attributes. For all indicators, the differences between the means of the two classes were statistically significant ($p < 0.001$), indicating that the two latent classes differ meaningfully. These classes, identified across the seven indicators, can be described as follows:

"Higher Engagement Group" (Class 1): This class comprised approximately 60.1% of the sample. Individuals in this class reported consistently high scores on all indicators, suggesting that they are highly interested in and engaged with scientific information and activities. This group perceives science as important, actively seeks information about scientific research, expresses a desire to participate in research, and demonstrates a high level of trust in scientific information. The means for this class across the indicators ranged from 2.746 to 3.976.

"Lower Engagement Group" (Class 2): This class accounted for approximately 39.9% of the sample. Participants in this class had comparatively lower scores across all indicators, indicating a lower level of interest, trust, and engagement with science and scientific research. This group, while still demonstrating some level of engagement, was less proactive in seeking scientific information or participating in research compared to Class 1. The means for this class ranged from 1.541 to 3.023.

The line plot demonstrating the LPA results is presented in Figure 1.

The results of the LPA partially confirmed H1 and showed that all indicators significantly differentiated between the two classes. The findings provide insight into the variability in public engagement with science and suggest the need for targeted communication strategies to increase scientific literacy and engagement in lower-engaged groups. However, within both profiles, certain similar patterns emerged: both profiles scored the highest on general trust in science (Item 6), then interest in science news (Item 3), but the lowest was willingness to participate in research (Item 5), and the second lowest was seeking information about science (Item 4).

Furthermore, to test H2 and reveal the differences in science motivation, attitudes toward media, and nature–friendly behavior across the classes, the independent samples T-test was conducted. The results are displayed in Table 2.

An independent samples T-test evaluated the differences in means between the classes across eight variables, and only three statistically significant differences between the two groups ($p < 0.05$) were observed, so H2 was partially confirmed. Science motivation variable ("Interested in science because it's simply interesting") demonstrated a significant difference, with Class 1, "Higher Engagement Group," ($M = 3.20$, SD = 1.31) scoring higher than Class 2, "Lower Engagement Group" ($M = 3.00$, SD = 1.27), although the effect size was relatively small. Furthermore, attitudes toward media variable ("Media trustfully informs about science and research") also showed a significant difference: "Higher Engagement Group" ($M = 3.43$, SD = 0.94) scored higher than "Lower Engagement Group" ($M = 3.27$, SD = 0.86), but the effect size was also slight. Finally, behavioral variable ("I sort garbage/waste or save/protect nature in other ways") indicated a significant difference, with "Higher Engagement Group," ($M = 4.10$, SD = 1.05) having a higher mean than "Lower Engagement Group," ($M = 3.94$, SD = 1.19), with a small effect size. For the remaining variables, the mean differences did not reach statistical significance.

Discussion

The study aimed to identify latent classes within the Lithuanian population based on attitudes toward science and scientific engagement and to determine whether differences existed between these classes concerning science motivation, attitudes toward media, and nature-friendly behaviors.

Based on prior research, it was expected that four distinct profiles would emerge (Metag and Schäfer, 2018; Schäfer et al., 2018), reflecting typical patterns of public engagement with science: highly engaged audiences characterized by strong scientific motivation and frequent media consumption; moderately engaged audiences with selective interests in science topics; passively engaged audiences who have limited interaction

TABLE 1 Means and standard deviations for each item across latent classes.

Indicators	Class 1 (n = 488; 60.1%)				Class 2 (n = 324; 39.9%)			
	Mean	SE	SD	Variance	Mean	SE	SD	Variance
Item 1: Interested in science	3.426	0.0735	0.799	0.639	1.764	0.0792	0.799	0.639
Item 2: Science plays an important role	3.613	0.0628	0.872	0.761	2.194	0.0996	0.872	0.761
Item 3: Interested in science news	3.852	0.0654	0.803	0.645	2.227	0.0916	0.803	0.645
Item 4: Seeks information about science	3.024	0.0831	1.038	1.077	1.666	0.0829	1.038	1.077
Item 5: Wants to participate in research	2.746	0.0896	1.032	1.066	1.541	0.0637	1.032	1.066
Item 6: Trusts in science	3.976	0.0513	0.818	0.669	3.023	0.0700	0.818	0.669
Item 7: Importance of scientific news	3.827	0.0575	0.799	0.649	2.405	0.0881	0.806	0.649

SE, Standard Error; SD, Standard Deviation.

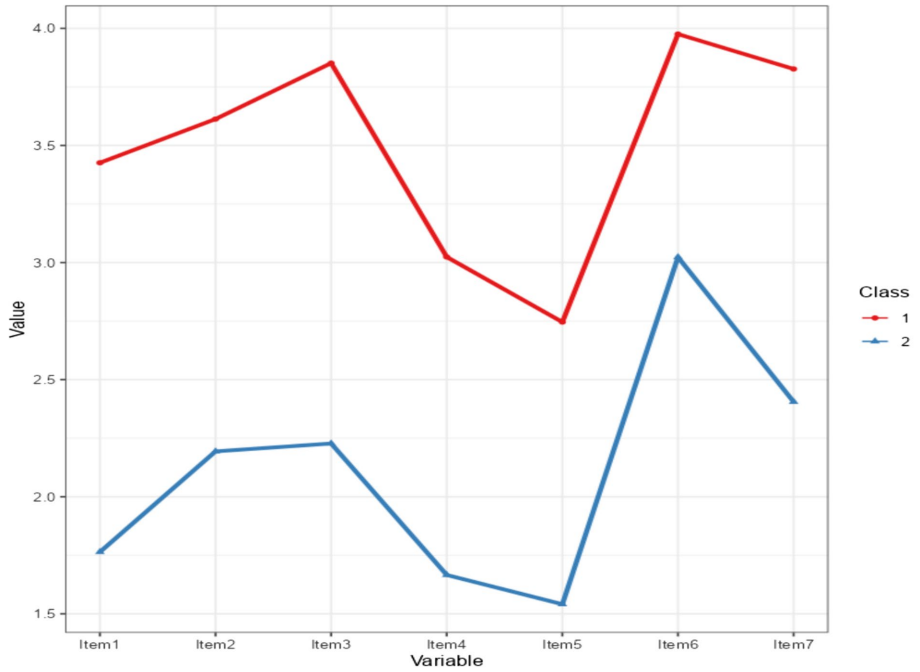

FIGURE 1
Latent profile analysis: line plot across seven indicators.

with science media; and disengaged audiences who demonstrate minimal interest or involvement in science communication. However, the LPA revealed just two distinct latent classes within the Lithuanian sample based on seven indicators, namely, interest in science and scientific research, the perceived importance of science and scientific research in life, interest in science news in the media, purposeful seeking of scientific information, willingness to participate in scientific research, trust in science in general, and the perceived importance of being informed about scientific news and research. So, this study revealed different segmentation than was previously established in the European context (Metag and Schäfer, 2018; Schäfer et al., 2018), but the reason could be different methodology applied, as previous research clustered audiences based on much more indicators than this study.

The findings of this study revealed that members of Class 1 (Higher Engagement Group, 60.1% of the sample) scored higher on all indicators, suggesting a strong interest in science and trust in scientific information. Members of Class 2 (Lower Engagement Group, 39.9% of the sample) showed lower engagement with science compared to Class 1, as reflected by consistently lower mean scores on all indicators. These findings align with previous research, suggesting that there are distinct segments within the population that vary in their attitudes toward and engagement with science (Metag and Schäfer, 2018). In the Lithuanian context, such segmentation underscores the need for targeted communication approaches to cater to different levels of scientific literacy and interest: Class 1 members are likely to be receptive to scientific messages, exhibit curiosity, and actively seek out scientific knowledge, and Class 2 members exhibit lower engagement and may be more skeptical or less interested in scientific topics, which could make them harder to reach with traditional science communication strategies. Interestingly, similar patterns in both classes were observed: groups scored higher on general trust in science and interest in science news, but the willingness to participate in research and purposeful seeking information about science was lower. These results reminds that communication segments might have distinct needs, attitudes, and behaviors, and effective science communication responds to a variety of audiences (Longnecker, 2023; Humm et al., 2020; Burns and Medvecky, 2018; Tong et al., 2019).

To better understand the differences between the two science engagement segments, independent samples T-test was conducted on eight variables related to science motivation, attitudes toward media, and nature-friendly behaviors. The analysis revealed significant differences between the two classes for several variables. Regarding science motivation, "higher engagement group" showed a significantly higher score compared to "lower engagement group," indicating greater motivation driven by genuine interest in science. It means that individuals in the higher engagement group are more motivated to learn about science "simply because they find it interesting," which might evidence intrinsic driver of engagement (Bathgate and Schunn, 2017).

Regarding Attitudes Toward Media, the "higher engagement group" tends to have more trust in the media's ability to inform them accurately about science and research. This aligns with previous research which demonstrated that trust in media is critical for fostering positive attitudes toward scientific information and increasing public engagement (Yeung et al., 2022; Bajwa et al., 2022; Ramaiah and Rao, 2021; Shabani and Keshavarz, 2022).

Regarding nature-friendly behavior, the findings showed that individuals who are more engaged with science are also more inclined to take environmentally friendly actions, highlighting a positive

TABLE 2 Differences in science motivation, attitudes toward media, and nature-friendly behavior across "higher" and "lower" science engagement groups.

Parameters	*t*	df	*p*	Mean difference	SE difference	95% Confidence Interval		Cohen's *d*
						Lower	Upper	
Science motivation								
Because I want to obtain information for studies or work.	1.85	731	0.064	0.1776	0.0958	−0.01045	0.366	0.141
Because I simply find it interesting.	2.08	735	**0.038**	0.2039	0.0981	0.01134	0.397	0.158
Because I want to better understand science and scientific research.	1.41	728	0.158	0.1339	0.0947	−0.05207	0.320	0.108
Because I want to participate when others talk about it.	1.65	722	0.100	0.1517	0.0921	−0.02904	0.332	0.126
Attitudes toward media								
The media provides reliable information about science and scientific research.	2.22	704	**0.026**	0.1558	0.0701	0.01826	0.293	0.171
The media provides understandable information about science and scientific research.	1.74	717	0.082	0.1229	0.0706	−0.01575	0.262	0.133
The media provides comprehensive information about science and scientific research.	1.30	698	0.194	0.0952	0.0733	−0.04871	0.239	0.100
Nature-friendly behavior								
I sort my waste or otherwise protect the environment.	1.98	798	**0.048**	0.1583	0.0801	0.00115	0.316	0.143

Bold values are $p < 0.05$.

relationship between scientific engagement and pro-environmental behavior. These results complement previous contributions in the field (Wang and Lin, 2017; Trivedi et al., 2018; Awan et al., 2022).

The unique findings from this study include the demonstration that higher science engagement group are motivated to seek for scientific information because they "simply find it interesting"; moreover, they think that "the media provides reliable information about science and research," and they "sort waste or otherwise protect the environment." This finding underscores the need for science communicators to foster engagement with diverse media platforms to effectively inspire environmentally sustainable behaviors.

Taken together, the presence of two distinct science communication audiences in Lithuania suggests that tailored communication strategies are important: the highly engaged group may benefit from advanced opportunities for involvement, such as citizen science projects, whereas a lower engagement group requires more foundational outreach efforts that build trust and make science relevant to everyday experiences. Since some attitudes toward media significantly differ between the classes, efforts to improve trust in media, such as transparency initiatives, and providing accessible explanations of complex topics, could help engage those in the lower engagement group. The significant difference in nature-friendly behavior between the segments highlights the potential of scientific engagement to promote pro-environmental behaviors, so providing practical opportunities for individuals to take part in environmentally friendly activities, while connecting these actions to scientific reasoning, could enhance both nature-related responsibility and science engagement, and policymakers and educators ought to be aware of the varying levels of engagement within the population to take steps for closing the gap.

Despite insights, this study has several limitations, as it applies just cross-sectional design, explores just one specific cultural (Lithuanian) context, and applies somewhat limited self-report measures, thus, in the future, it is recommended to apply longitudinal design, explore different cultural contexts, and apply robustly validated measures.

Conclusion

While previous studies suggested that science communication audiences typically cluster into four distinct profiles—engaged, interested, disengaged, and skeptical, this study identified only two primary audience groups. This divergence is related to applied LPA specifics: the present study incorporated just 7 of the measurement items used in earlier studies, which may have contributed to identifying fewer profiles. Incorporating additional measurement items could reveal more audience segments.

The findings of this study revealed significant differences in science motivation, attitudes toward media, and nature-friendly behavior between two distinct latent classes within the Lithuanian population. Individuals who demonstrated higher science engagement, also demonstrated intrinsic science motivation ("simply find it interesting"), trust in media, and pro-environmental behaviors, while individuals who exhibited lower science engagement, scored also lower on trust in media and nature-friendly behaviors. The findings underscore the need for tailored communication approaches to foster a deeper connection to science among the less engaged groups, focusing on building trust, demonstrating relevance, and

providing opportunities for meaningful involvement. By addressing the characteristics of each audience, science communicators can presumably enhance the scientific literacy of individuals and drive positive behavioral changes in society.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors without undue reservation.

Ethics statement

The studies involving humans were approved by Protocol of Institute of Communication at Mykolas Romeris University for permission to conduct research based on agreement with Research Council of Lithuania No. P-VIS-23-57. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

AD: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

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Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The author declares that Gen AI was used in the creation of this manuscript. It was used to correct/edit language in some parts of the manuscript.

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