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Measuring the effectiveness of communication of a podcast on food sustainability

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In this study, the effectiveness of communication of a podcast was assessed regarding the variables knowledge retention and interest. Two podcast episodes were produced about Portuguese research in sustainable food, and two news pieces with similar information and reading times were written to be used as a control for this experiment. Initially, 115 students from two universities in Lisbon filled in an online pre-test questionnaire. One week later, 102 students from those 115 students initially assessed listened to one podcast or read one news piece and completed an online post-test questionnaire. Statistical analysis showed a significant increase in the knowledge retention in both media and no significant differences in what concerns interest on food sustainability or science. Moreover, it was found that there were no significant differences between the two tested media in both the knowledge retention and interest. Nevertheless, the recent popularity of podcasts may justify its production as a new and flexible way to communicate science.

KEYWORDS

science and popular culture, media and science, food research, science communication, new media

1 Introduction

Podcasts have been growing in popularity in the last few years as media that can be used to communicate science (MacKenzie, 2019; Tobin and Guadagno, 2022). Podcasts can be defined as audio recordings found on the internet that are played on-demand or downloaded directly to a smartphone or computer (adapted from Harris and Park, 2008; Tobin and Guadagno, 2022). This form of communication, which began to take shape in the early 2000s, is cheap and easy to produce, does not require expensive equipment or specific technical expertise, and can be heard in flexible ways, such as when commuting to work, doing sports and household chores, etc. (e.g., Smith and Morris, 2014). According to a global analysis of science podcasts in English, these have been growing linearly between 2004 and 2010, and exponentially at least between 2010 and 2018 (MacKenzie, 2019). According to a U.S. survey (Edison Research, 2021), as of 2020, 55% of Americans (around 155 million) aged 12 and older had listened to podcasts, testifying to its popularity. In 2023, 38% of interviewees in Portugal said to have heard, at least, one podcast in the previous month (Cardoso et al., 2023) a similar value to the percentage of 34% of podcast consumers found for a selection of 20 developed countries (Newman et al., 2023).

As the podcasts themselves, particularly about science, studies about science podcasts are recent and limited. Nevertheless, some research has been done about the objectives of science podcasts and their advantages for learning. In a survey with 147 science podcasters from different regions, [Yuan et al. \(2022\)](#) found that excitement, interest, and recognition of the value of science are the most mentioned objectives for creating their podcasts. In a survey of European science-based radio broadcasters, it was concluded that their main goal was to be informative ([Merzagora, 2006](#)). Research has also shown that podcasts are useful tools in educational settings (e.g., [Evans, 2008](#); [Johnson et al., 2012](#)). For example, it was found that podcasts were an effective way to increase knowledge retention about diabetes in a group of 30 African Americans ([Johnson et al., 2012](#)).

When thinking about what are the most effective ways to communicate a particular message, comparative studies can be more convenient to make informed decisions on what medium to choose and how to communicate ([Jensen, 2014](#); [Jensen and Gerber, 2019](#)). Despite its limited number, such comparative research that includes science podcasts can be found in the literature. For example, business students at a University in London (UK, $n = 192$), were significantly more receptive to podcasts than the traditional lectures or textbooks ([Evans, 2008](#)). Also, in a study comparing a comic book, newspaper-illustrated chronicles, radio interviews and animated videos about stem cells ([Amaral et al., 2015](#)) found that radio interviews were the least favorite media by the audience (high school students, university students, adults, and retired). The newspaper-illustrated chronicles were the third preference, with a score close to the animated videos. Although a radio program and a podcast are not equivalent, their similarities can provide clues into how a podcast could be compared to written media. Research on the characteristics and effectiveness of various forms of science communication can help practitioners make more suitable decisions for their activities such as the form and content of this communication (e.g., [Thoma et al., 2018](#)). Indeed, the reflection using evidence-based research about how science outreach is done is thought to be important to improve the practice of science communication ([Jensen, 2014](#); [Jensen and Gerber, 2019](#)). More recently, a study compared the effectiveness of communication about nutrition between a video, a podcast, and an online article and found they were similar in terms of knowledge and behavior change intentions ([Weib and Konig, 2022](#)).

For the current study, the chosen topic is food sustainability. This is a pressing issue due to an expected rise to 9.7 billion people in the world by the year 2050 ([Ritchie et al., 2023](#)), along with an increase in animal protein in the diets of citizens in developing countries. Moreover, approximately 14% of the world's food is lost between harvest and the retail market, and 17% at the retail and consumer levels [[Food and Agriculture Organization of the United Nations \(FAO\), 2019](#)]. The global food system (including production, distribution, and consumption) also contributes to the emissions of greenhouse gases, one of the main causes of climate change [[Food and Agriculture Organization of the United Nations \(FAO\), 2019](#)]. Hence, there are many challenges to food sustainability such as the increase of efficiency in food production, waste reduction, use of less water in agriculture, adoption of more vegetable-based diets, etc. Public communication is key to increasing awareness about these issues ([Diaconeasa et al., 2022](#)).

After producing short podcast audio episodes/radio broadcasts about food sustainability for the information channel of the

Portuguese national public radio Antena 1, the main objectives of the research were to:

1. Assess the impact of short podcast episodes on knowledge retention about food sustainability in comparison to press news in higher education students.
2. Assess the impact of these podcast episodes on the interest in food sustainability in comparison to press news in higher education students.

2 Materials and methods

2.1 The podcast/radio program

A podcast with ten short audio episodes was produced in Portuguese concerning national research on sustainable food production. The option for the duration of 9–10 min per episode was that this would approach the reading time of written news (i.e., since the duration is similar, the comparison between formats is considered appropriate). Nevertheless, it is acknowledged that this is a partial representation of the types of podcasts in terms of duration, content, and format. In partnership with Antena 1, the researchers provided the ten defined themes, did the initial contacts to assess the viability of each episode, and financed the costs associated to the recording of the programs. Each episode had as host a radio journalist of Antena 1 who presented the topic, interviewed researchers and commented on the visits to research laboratories or fields. This journalist had full autonomy of authorship. The content was always similar: the chosen theme was introduced and reported on-site where the podcast was made, interviewing one or more of the researchers involved.

Different issues related to food sustainability were covered, especially concerning the stages of production and consumption (see [Supplementary Material S1](#)). The podcast was aimed to achieve a diversity of themes, institutions, scientists, and regions, including the recording of an episode in the Azores archipelago. The Portuguese national radio channel (Antena 1) is one of the three radio channels of the Portuguese public broadcasting entity. The radio episodes were broadcast on weekdays between the 6th and 17th of February 2023 at 2:40 pm. After broadcasting, all episodes were made available online on the RTP (Rádio Televisão Portuguesa) play podcast platform.

The target audience was adults who listened to podcasts on the RTP Play platform and/or live radio on Antena 1. The Portuguese audience that listens to podcasts is diffused and unspecific, still not well characterized in Portuguese media studies ([Cardoso et al., 2023](#)). The produced episodes were heard in the live radio broadcast of Antena 1 potentially by about 100,000 listeners, according to broadcasting data of RTP on December 2022. At the time of writing, there was no available data about the number of times these episodes were heard as podcasts.

2.2 The experiment

Two podcast episodes were chosen for this research: one about the reduction of waste in broccoli consumption (Title: “Reduce waste in broccoli”; Episode 4; [Supplementary Material S1](#)) as an example of

a land resource and another about the sustainability of aquaculture with mussels (Title: “Sustainable aquaculture,” Episode 6) as an example of an aquatic resource. A former journalist and science journalism lecturer wrote two news pieces with similar information to these episodes. Each news piece was written in Portuguese, had about 1,050 words, and was illustrated with one picture ([Supplementary Material S2](#)).

To assess participants’ preferences between hearing the podcast and read the news piece on both knowledge retention (cognitive dimension) and interest (emotional dimension), a pre-test and post-test were developed ([Supplementary Material S3](#)). In both media, there was a section for the characterization of participants, a second section about interest in sustainable food and scientific research, and a third section to test knowledge retention on food waste. In the post-test, there was a fourth section to assess if participants liked to hear the podcast or read the news. The questions concerning knowledge retention were multiple choice, whereas all others were seven-point Likert scales. In the preliminary testing, eight volunteers were involved: two read each one of the two news and two listened to each one of the two podcast episodes. Volunteers filled in the first version of the pre-testing and post-testing questionnaires to assess clarity, time of response, link access, etc.

Students were asked to participate during one of their regular university classes, in which their teachers were also present. After a brief explanation of the study, the first questionnaire was completed on March 6, 2023 by 115 students. On 13 March 2023, one week later, participants were exposed to the science communication contents. They were randomly divided into four groups: two groups listened to podcast episodes, and the other two groups read the two news pieces with similar information to the podcast (51 heard the podcast and 51 read the news). After listening/reading, the participants filled out a post-test questionnaire about what they had read/listened to. All the pre-test and post-test questionnaires were filled out online, except for two cases in which participants could not access the links and used a paper form. Additionally, and complementary to the experiment, participants were asked if they listened to podcasts and read news and, if so, they were asked to quantify an average time per day ([Supplementary Material S3](#)). This study was approved by the Ethical Committee of the Faculty of Sciences of the University of Lisbon (Portugal).

2.3 The sample

The audience of generalist podcasts and newspapers is diffused and unspecific, therefore difficult to select and sample. Thus, we chose a sample of higher education students to serve as volunteer participants in the current study. As mentioned above, this choice is also justified because podcasts are potential educational tools including for higher education (e.g., [Harris and Park, 2008](#); [Lin and Huang, 2024](#)).

Before the experiment, participants received information detailing its scope and were encouraged to pose any queries they had. All participants who provided informed consented were considered for the study. Undergraduate students from a course in natural sciences at the University of Lisbon and a course in social sciences at the Nova University of Lisbon were included, to achieve a more diverse group in terms of fields of study. The sample has 102

individuals, 50 are natural science students and 52 are social science students. Fifty-three individuals identified as females (52%), 45 identified as males (44%), one individual identified as non-binary, and three preferred not to say. Students in natural sciences were mostly male (60%), while students in social sciences were mostly female (70%). The average age was 19.9 ± 3.5 years, which is expected given that they are mostly first-year and second-year undergraduate students.

2.4 Data analysis

All the analyses were done using SPSS version 28 (IBM, 2023). For each question, a pre and post-experiment frequency distribution was calculated. The analysis was divided into four items: (1) knowledge retention about food sustainability, (2) interest in sustainable food and science, (3) overall appreciation of the podcast/news product, and (4) habits of listening to podcasts/reading news ([Supplementary Material S3](#)).

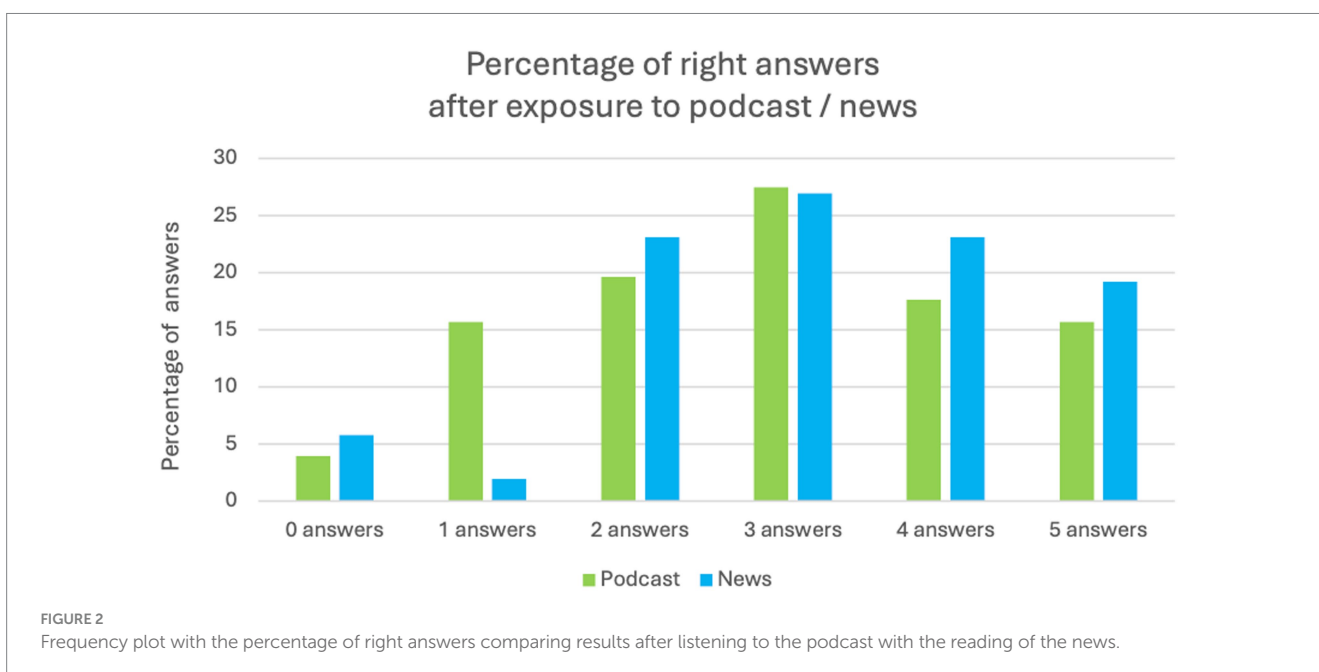
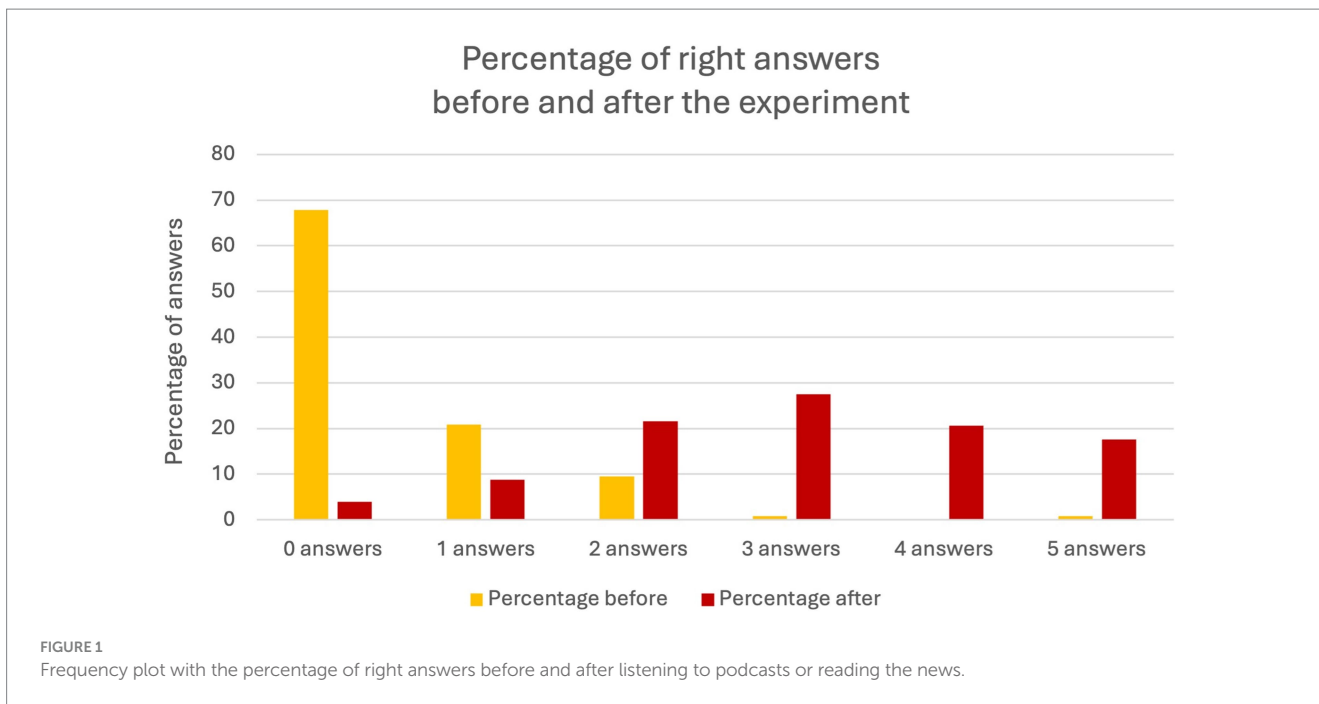
The five questions regarding knowledge retention about food sustainability were analyzed together. The composite rate was obtained by adding the number of correct answers, before and after the experience, but also in the groups after the podcast and after the news. For all questions where statistical tests were used, a Shapiro-Wilkinson test was made in advance to test normality. Considering that the tested variables were not normal, non-parametric statistical analysis was done using the Wilcoxon Signed Rank Test to compare knowledge before and after the experience, and the Kruskal Wallis Test to compare knowledge retention after the experience of listening to the podcast and reading the news. In questions concerning interest ([Supplementary Material S3](#)), and after checking there were no statistically significant differences between curiosity (Q9) and the desire to know more (Q10) about sustainable food, results of mean values were calculated and analyzed. The same procedure was done to the questions about interest in research (Q11) and willingness to learn about science (Q12). Percentages of respondents that listened to podcasts and read news, as well as the average time per day, were also calculated.

3 Results

3.1 Knowledge retention about food sustainability

Before hearing/reading the episode/news, the majority (67.83%) scored zero right answers in the questions concerning knowledge, 20.87% scored only one right answer and 9.57% scored two right answers ([Figure 1](#)). After the hearing/reading, the most common number of right answers was three (27.19%), with 21.36% of participants with two right answers and 20.39% of participants with four right answers. Considering both communication media being tested in the experiment, the mean number of right answers before hearing/reading was 0.5 per participant and 3.0 per participant after the experiment. According to the Wilcoxon Signed Rank test, the difference was statistically significant ($Z = -8.387$; $p < 0.001$), which means that there was an increase in knowledge retention after exposure to the podcast/news.

When analyzing the tested media separately, the most frequent result was three right answers (mean 2.9 for podcast and 3.2 for news),



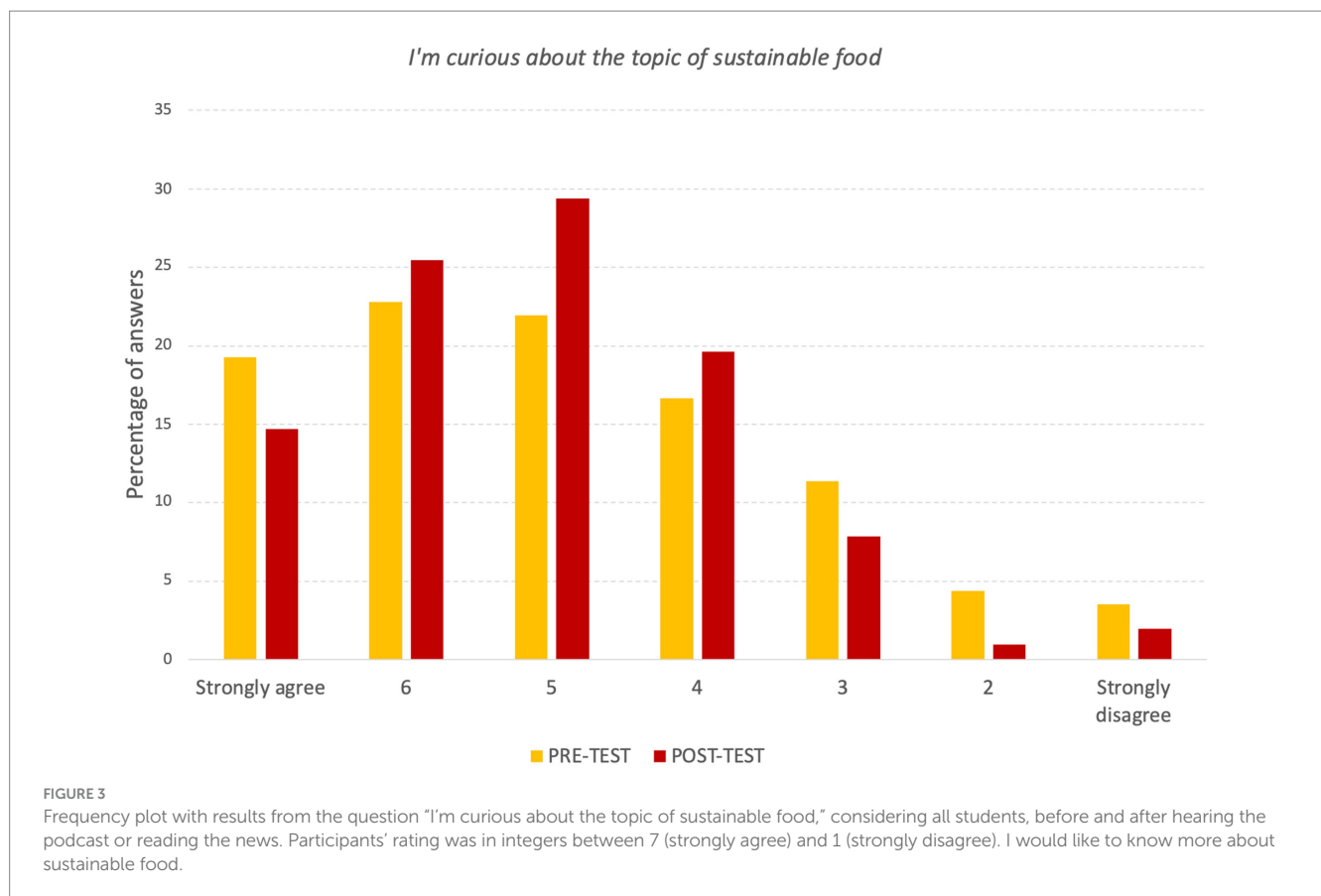
with similar percentages distribution (Figure 2). According to the Kruskal-Wallis test, the differences between the two media were not statistically significant ($H=1.831$; $p=0.176$). Therefore, both the podcast and the news promoted a similar level of knowledge retention despite a slightly higher value for the news piece.

3.2 Interest in sustainable food and science

The questionnaire had two questions aiming to assess the participants' interest in sustainable food issues (Q10 and Q11;

Figure 3). The most frequent answer to these questions was “somewhat agree” [5] or “agree” [6]. No statistically significant differences between answers to the two questions were found ($H=0.002$; $p=0.965$), therefore they were analyzed together. The mean value before the experience was 5.06 and after the experience was 5.09. According to the Wilcoxon signed-rank test, these differences before and after exposure were not statistically significant ($Z=-0.220$; $p=0.826$). Therefore, interest in the topic did not significantly change after hearing the podcast or reading the news.

By comparing the responses of the participants who listened to the podcast with those of the participants who read the news, some



differences can be noted (Figure 4). Most readers rated [5–6], while most listeners rated [4–5], on a scale where 7 corresponds to strongly agree. However, these differences are not statistically significant according to the Wilcoxon signed-rank test ($Z = -0.22$; $p = 0.826$), i.e., the degree of curiosity about sustainable food of individuals who heard the podcast and read the news is similar.

The second pair of questions aimed to assess the participants' interest in science and scientific research (Q12 and Q13; see Figure 4). The Kruskal-Wallis H test has shown no statistically significant differences between answers to the two questions ($H = 0.152$; $p = 0.697$), and they were once more analyzed together. The mean value before the experience was 5.06 and after the experience was 5.09. Differences pre/post for podcast/news are not statistically significant ($Z = -0.205$; $p = 0.838$). Thus, listening to the podcast or reading the news did not significantly change the participants' interest in both science and scientific research.

3.3 Overall appreciation of podcast/news

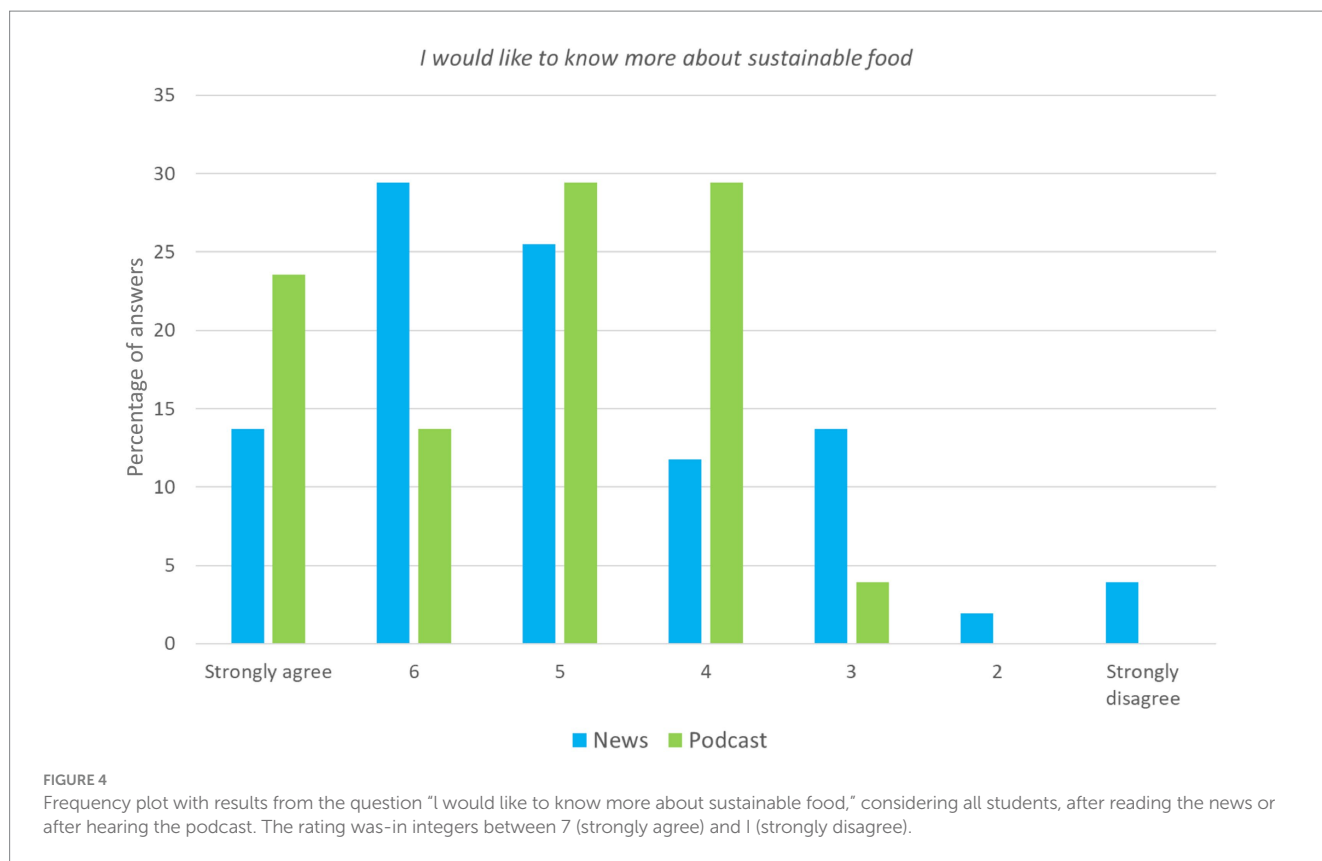
In the overall appreciation of the podcast/news (Q21), most readers (71%) considered the episode or news very good to above average [7–5]. The dispersion of listeners' opinions was greater than readers, with 67% rating between average [4] and good [6] and 20% rating it below average [3] to very poor [1]. The Kruskal-Wallis H test has shown no statistically significant differences in the overall appreciation between podcasts and news ($H = 3.633$; $p = 0.057$). The mean value for the podcast was 4.8 and for the news was 5.2.

3.4 Habits of listening to podcasts/reading news

In total, 71 participants replied to the questions about their use of podcasts and news. About half of the participants ($n = 35$; 49.3%) reported hearing podcasts, with an average duration of about 31 min per day, whereas most participants ($n = 59$; 83.1%) read the news for about 32 min per day, on average. Therefore, more participants reported reading news than heard podcasts and spent a similar amount of time per day using these two media.

4 Discussion

This study aimed to assess the impact of a podcast compared to press news on knowledge retention and interest in science and scientific research. The topic food sustainability was chosen as it can arouse interest, both on a personal level and because of its implications for collective action. Results showed significant differences in the mean number of right answers before and after exposure to both tested media, which indicates a knowledge retention increase about the chosen themes. Although the mean number of right answers was slightly higher in the case of news pieces than in the podcast episodes, these differences were not significant. This is aligned with previous studies which have concluded that podcasts promote learning in educational settings (Johnson et al., 2012; Vainieri et al., 2023). Moreover, the current study confirms a previous study that concluded that the effectiveness of podcasts is similar to



online articles (Weib and König, 2022). Also, considering that the prime objective pointed by science-based broadcasters was to be informative (Merzagora, 2006), it can be stated that the tested science podcast fulfilled this role.

Interest in sustainable food and science was already high before the experiment and did not significantly change after exposure to both media. Also, the comparison between podcasts and news pieces did not show significant differences. Nevertheless, in a previous study, podcasts were preferred to traditional lectures or textbooks by higher education students (Evans, 2008). Therefore, this preference for podcasts as an educational tool may not apply when compared to other media and/or audiences. In this case, podcasts do not live up to the expectations of the reported main goal of science podcasters to increase interest in science (Yuan et al., 2022). On the other hand, it seems that an audience with little or no interest in science will be less likely to take the initiative of listening to a podcast or read news pieces on scientific issues. Hence, a significant increase in interest in scientific issues by either tested media may be difficult to achieve and more feasible with other communication formats. For example, Amaral et al. (2015) aimed to communicate about stem cells and concluded that a comic book and an animated video are more appealing to audiences than a radio interview or an illustrated news chronicle.

In terms of habits for both tested media, it was found a lower number of participants using podcasts in comparison to news but the average time per day is similar in both cases. Moreover, results obtained in the present study of about 49% of participants listening to podcasts are higher than the 38% that were recently registered for the Portuguese population. The explanation for this discrepancy may be that younger populations use podcasts more frequently than the general population (Cardoso et al., 2023). In this respect, this recent

media may be more appropriate to engage younger generations with science, even though news pieces presented similar values of use.

The current study presents several limitations that should be acknowledged. First, higher education students do not necessarily represent the Portuguese adult population, in particular older citizens and/or less educated audiences. Second, it is likely that the chosen theme of research is a widespread concern and is probably more engaging than other scientific themes. Another limitation is that there was a period of 7 days between the pre-test and the post-test. This option aimed to reduce participants remembering the questions of the testing before exposure to the two media, but participants can also be influenced by other sources of information during this period. Nevertheless, the method used was designed to minimize this influence by comparing the effectiveness of communication with a control group and to have a reasonable number of participants (more than 100 in total). Moreover, the approach in the study was to produce short podcasts with the duration of 9 to 10 min that mix interviews with on-site visits. This is a relative representation of podcasts in terms of duration and content that was considered closer to the written news, even though podcasts can assume many different forms. In light of these limitations, it is recommended that the effectiveness of science podcasts can be assessed with other audiences, using other science-related themes, and with different ways to tell audio stories that cover a wider range of podcast types.

Finally, the equivalent results obtained for both media and the possibility of similar costs suggest that it is indifferent to produce news pieces or podcast. Nevertheless, considering the relative growth of the popularity of science-related podcasts in the last few years (MacKenzie, 2019), this may justify its existence as an alternative to more usual media such as news pieces. Moreover, podcasts can attract audiences with different profiles, age groups, and interests including education

and entertainment (Lin and Huang, 2024). Additionally, they can be used flexibly on diverse occasions such as educational settings, public transport, house chores, sports, etc. In conclusion, despite the similar results in terms of knowledge retention and interest between podcast episodes and news, producing podcasts can be an alternative and flexible way to communicate science with younger audiences.

Data availability statement

The original contributions presented in the study are included in the article/[Supplementary material](#), further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving humans were approved by Ethics Committee of the Faculty of Sciences of the University of Lisbon. 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. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

Author contributions

BP: Conceptualization, Investigation, Formal analysis, Writing – review & editing, Writing – original draft. AM: Conceptualization, Investigation, Formal analysis, Writing – review & editing, Writing – original draft. AG: Conceptualization, Investigation, Writing – review & editing.

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Conflict of interest

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

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Supplementary material

The Supplementary material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fcomm.2024.1421692/full#supplementary-material>

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