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Framing Sustainable Mobility: Testing Message Effectiveness Through University Living Labs

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Abstract

Promoting sustainable mobility is a critical component of advancing sustainable development in higher education. This study explores how different communication strategies influence the perceived effectiveness of messages promoting sustainable mobility among university communities. Using focus groups, we examined the responses of students and staff at the University of Navarra (Pamplona, Spain) to messages emphasizing personal benefits, community engagement, and immediate action ("here and now"). Nine messages were evaluated, varying in tone (youthful vs. adult) and inclusion of data. Results reveal that message effectiveness differs significantly between students and professionals, highlighting the importance of tailoring communications to their audience's motivations, social context, and structural barriers. Students responded most positively to direct, actionable messages emphasizing the present, while professionals valued messages highlighting personal and collective benefits. Findings underscore the need for segmented, context-aware strategies in promoting sustainable mobility, contributing to broader sustainability goals in higher education.

Keywords: sustainable mobility; sustainability communication; higher education

1. Introduction

Sustainable mobility refers to transport systems and practices that minimise environmental impacts, promote economic efficiency, and ensure social equity and accessibility. It involves a transition from conventional fossil-fuel-based paradigms towards integrated, multimodal, and low-emission solutions, including electric vehicles, public transport, active modes (walking, cycling), and shared mobility services. It encompasses the movement of both people and goods, aiming to reduce negative impacts such as pollution, resource depletion, and social inequalities [1]. Its core principles include ecological sustainability, social justice, accessibility, and the reduction of resource use and emissions, while enhancing quality of life [2,3]. Promoting sustainable mobility is an urgent task in the current context of rapid urbanisation, climate change, and the need for resilient and inclusive societies [4].

Changing the behaviour of the public and key stakeholders, particularly moving away from car-centric norms, remains a considerable challenge. To achieve such behavioural change, communication is crucial: it not only raises awareness but also shapes attitudes, builds trust, and catalyses collective action [5,6].

However, effective communication to promote sustainable mobility is not straightforward, due to several reasons, including its multidisciplinary nature and inherent complexity. Effective communication requires a multifaceted approach that delivers relevant information [7], leverages appropriate technological resources, and engages key actors [8]. It is therefore necessary to employ communication strategies that deliver an accurate, comprehensible, and appealing representation to the public, fostering the engagement of all stakeholders in addressing this challenge.

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Communication strategies are essential for promoting sustainability and sustainable mobility. They play a critical role in raising awareness, influencing behaviour, overcoming policy barriers, enhancing learning, and promoting sustainable consumption. By effectively communicating the benefits and necessity of sustainability, these strategies can drive significant positive societal change [9–11].

Previous studies have identified various strategies employed by institutions across different countries to design environmental content messages, as detailed in the following section. However, to date, no studies have examined how citizens perceive messages based on these different strategies. We consider that the results of this new study can provide a foundation for guiding communication by environmental organisations, including research centres, social actors, and public entities.

This study was conducted on a university campus, functioning as a living lab. Living labs are collaborative platforms designed for user-centred innovation, where real-world environments are used to test, develop, and validate new products, services, and technologies. They involve multiple stakeholders, including researchers, companies, public authorities, and citizens, working together in a co-creation process [12]. Innovations are tested and validated in real environments, such as cities, university campuses, rural areas, and homes, rather than controlled laboratory settings [13].

2. Strategies for Communicating Environmental Issues and Sustainable Mobility

The term "strategy" has become a catch-all phrase used in various ways. Generally, it is understood as a plan, a guide, or a set of actions consciously designed to achieve a goal [14]. In the field of environmental communication, strategies establish general principles or specific recommendations for crafting messages.

Researchers have identified numerous strategies employed to communicate environmental issues in general, and sustainable mobility in particular. Thompson and Schweizer [15] propose a catalogue of ten common strategies in environmental communication, emphasising the importance of knowing the audience and connecting with their cultural values. Skula [16] adds that it is crucial to appeal to the co-benefits of action (such as health or financial savings) and to tailor messages to the audience's geographical location.

Studies also highlight structural, cultural, and psychological barriers that hinder effective communication on sustainable mobility. Scerri et al. [17] identified institutional and perceptual obstacles that hinder the implementation of active mobility interventions. Overcoming these barriers requires inclusive, credible strategies that are adapted to the sociocultural context. Rode et al. [18] explored car-use assumptions in London, emphasising the value of citizen deliberation in designing equitable policies, while Bardal et al. [19] identified barriers and effective strategies in three Norwegian cities, highlighting the importance of combining restrictive and incentive measures to achieve sustainable urban mobility. Furthermore, Van Lierop and Bahamonde-Birke [20] demonstrated that personal attitudes and the use of technologies influence transport mode choice, suggesting that campaigns must consider both individual and structural factors.

Advanced audience segmentation is essential for designing effective messages in sustainability initiatives and campaigns, as it allows communication to be tailored to diverse audiences such as scientists, policymakers, activists, and the general public [21]. In the field of sustainable transport, the use of attitude-based segmentation techniques has grown significantly. These techniques allow the identification of groups with similar preferences and the design of customised campaigns, even using technologies such as mobile phones and machine learning algorithms, with success rates exceeding 98% in profile identification [22]. However, public policy frameworks promoting sustainable mobility technologies still face equity challenges. The exclusion of certain social groups from networks of influence can limit the adoption of new mobility habits. Consequently, it has been proposed to incorporate the concept of "epistemic justice" into diffusion models, integrating technical tools and theoretical analyses to reduce inequalities in the transition to sustainability [23].

Several studies have examined strategies employed to promote sustainable mobility, focusing on the characteristics of the messages disseminated. Huang and Guo [24] showed that eco-brand

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stories using rhetorical resources such as inversion and symbolism increase perceived authenticity and trust in the brand.

Other researchers have emphasised that images can play an important role in communicating environmental challenges [25]. Among the recommendations for creating effective images that foster engagement are ensuring that they include the basic elements of a story, maintain a sense of proximity, and convey an impression of spontaneity [26].

León et al. [27] identified several communication strategies used on social media through semi-structured interviews with communication officers and community managers from various environmental organisations across multiple countries. Among the general strategies for guiding communication, they highlight: developing a community, promoting education and awareness, disseminating scientific knowledge, and informing opinion leaders and policymakers. Furthermore, the study identified four strategies to connect with the public: finding common ground, emphasising the here and now, highlighting the benefits of involvement, and creatively empowering citizens. In the present study, three of these strategies were selected, as detailed in the methodology section.

3. Theoretical Framework

The theoretical framework employed in this study encompasses two theories, whose main points are summarised below.

3.1. Framing Theory

Framing Theory has become a key conceptual framework in environmental communication, providing a conceptual framework to understand how the way messages are presented influences the public's perception, interpretation, and action in relation to environmental challenges. Initially developed by Goffman [28] and later expanded by Entman [29], this theory posits that communicators select certain aspects of reality and emphasise them to define problems, diagnose causes, make moral judgments, and propose solutions.

In the context of sustainability, framing allows messages to be tailored to the characteristics of the target audience, enhancing their effectiveness. Lakhan [30] identifies four key dimensions in environmental communication: gain vs. loss, individual vs. collective action, present vs. future, and local vs. global, each with distinct implications for emotional impact, motivation, and behaviour. For instance, gain frames highlight the benefits of adopting sustainable practices, such as improvements in health or finances, whereas loss frames emphasise the negative consequences of inaction, such as natural disasters or biodiversity loss. Spence and Pidgeon [31] showed that gain frames are more effective in promoting climate change mitigation strategies, while loss frames are more effective in adaptation contexts.

Regarding the individual vs. collective dimension, Rickard et al. [32] found that collective frames are more effective among people with strong environmental values, fostering a sense of community and shared purpose. Temporal framing is also crucial: messages focused on the present generate greater urgency and emotional connection, while future-oriented messages can inspire long-term transformative visions [33]. Similarly, geographic framing affects perceived relevance: local messages tend to be more motivating than global ones, as they connect directly with the audience's everyday experience [34]. In this vein, Markowitz and Guckian [35] highlight the need to use frames that align with the audience's needs and beliefs, emphasising that framing should be not only strategic but also empathetic and contextualised.

The application of these frames enables environmental communicators to design more persuasive messages, adapted to the cultural, social, and psychological characteristics of their audiences. However, there is also a risk of message fatigue or eco-anxiety if certain frames, especially negative ones, are overused, underscoring the importance of balancing emotional content with constructive and feasible proposals. Overall, framing provides a solid foundation for creating effective environmental messages, provided it is applied with sensitivity to context and audience.

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3.2. Social Identity Theory

In social psychology, Social Identity Theory [36] proposes that individuals construct their self-definition based on the groups to which they belong. This theoretical framework helps to understand how group membership influences both individual and collective behaviours, as well as attitudes towards other groups. According to the authors, people tend to categorise others to organise their social environment, distinguishing between in-groups and out-groups. Affiliation with a group provides individuals with a sense of identity and belonging, which strengthens self-esteem, whereas external groups are often associated with prejudice and discriminatory attitudes. Through this categorisation process, individuals seek to maintain a positive social identity, which is reflected in favourable evaluations of their own group.

Social Identity Theory has been widely applied to the analysis of interactions in digital environments and the study of intergroup dynamics, such as in-group favouritism and biases against out-groups. Identification with one's own group reinforces internal cohesion and can influence members' opinions and behaviours.

Research has shown that users of online communities exhibit clear in-group favouritism while tending to exclude or marginalise out-groups [37]. On social media, this phenomenon manifests in polarised behaviours such as "likes", retweets, or comments. These practices, which support the in-group and oppose the out-group, contribute to intensifying divisions between communities [38].

This theory is also useful for understanding phenomena such as "echo chambers" and "filter bubbles" in digital environments. In-group favouritism is often accompanied by confirmation bias, whereby individuals seek and interpret information in a way that supports their pre-existing beliefs while disregarding contradictory data. On social media, this process is amplified by algorithms that personalise content for each user, creating environments dominated by like-minded opinions and reinforcing existing convictions. In this way, echo chambers or information bubbles are formed, limiting exposure to diverse perspectives and promoting misinformation [39].

Furthermore, social identification helps to understand online engagement and participation. Studies indicate that social media can facilitate the emergence of social movements and digital activism by connecting individuals with similar values and beliefs. This interaction promotes active participation, strengthens the sense of belonging, and enhances the group's collective power [40].

4. Research Objectives

The general objective of this study is to enhance understanding of the effectiveness of different strategies commonly used to communicate sustainable mobility to society as a whole.

This general objective was specified through two particular objectives focused on local audiences, namely students and professionals at the University of Navarra. In the 2024–25 academic year, the University of Navarra (UNAV) had 9,838 undergraduate students, 3,217 master's students, and 1,103 doctoral students, according to the academic report for that year. The vast majority attended the Pamplona campus, a spacious, landscaped site housing the buildings of the various schools and faculties. Additionally, 7,365 staff members were employed across UNAV's campuses in Pamplona, San Sebastián, Barcelona, and Madrid. Among them, 2,759 worked in academic and research centres (the majority—2,178—in Pamplona), and over 3,800 professionals were part of the Clínica Universidad de Navarra [41].

Regarding sustainable mobility, a survey on the travel habits of the university community indicates that slightly more than 42% of respondents travelled to campus on foot and almost 14% by bicycle. These figures are consistent with an environment where most students live on or very close to campus. However, 31% of teaching staff and 44% of non-teaching staff commuted by car [42].

The specific objectives of this study are defined as follows:

1. To analyse how messages based on different communication strategies are perceived by individuals from various groups who regularly commute to the University of Navarra campus in Pamplona (Spain).

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2. To explore which types of messages about sustainable mobility (benefits of sustainable mobility; sense of community; importance of the here and now) are perceived as more or less effective by participants, and to understand the personal, social, or cultural factors influencing that perception.

The research design is both propositional and focused on practical enhancement. The results will be communicated as constructive recommendations to strengthen sustainability on campus.

5. Methodology

Taking into account differences in age, profession, and mobility habits within the University of Navarra campus, two focus groups were conducted: one comprising students and the other consisting of academic staff and administrative and service personnel.

5.1. Ethical considerations

Prior to the study, approval was obtained from the University of Navarra Ethics Committee, submitting a protocol detailing the objectives, methodology, informed consent, and data management.

The study followed these criteria:

-Informed consent: Participants voluntarily agreed to take part after receiving clear information on the study's objectives, methodology, and data usage.

-Confidentiality: The participants' identities were not disclosed at any stage.

5.2. Participant selection

To ensure adequate representation of diverse perspectives, broad inclusion criteria were applied, respecting the internal diversity of the university community. Efforts were made to achieve gender parity, represent a variety of habitual transport modes (walking, cycling, car, bus, etc.), and involve participants from different faculties.

As a recruitment strategy, the research team invited students and staff to participate voluntarily. Invitations were communicated informally, through announcements during classes or emails sent to individuals known to the team. While this approach was sufficient to recruit participants for the staff focus group, student participation required an incentive payment.

Interested participants provided information via online forms (Google Forms), with anonymised data including:

-Basic information: gender, age, role at the university

-Faculty/service

-Usual mode of transport

-Available dates

The student form was completed by 30 individuals. From these, 12 were selected based on the inclusion criteria and invited to attend on Thursday, 9 October, at 1:00 p.m. in a room at the Faculty of Communication. For staff, 12 individuals with availability were registered and invited to a session on Friday, 10 October, at 1:00 p.m., in the same room. Ultimately, 9 students and 8 staff members confirmed their attendance and participated in the focus groups. Their profiles are presented in Appendix 1.

5.3. Focus Group Dynamics

Participants entered the room and sat around a rectangular table on which folders were placed containing the following: an information sheet explaining the objectives, focus group dynamics, and data handling (Appendix 2); the informed consent form (Appendix 3); and a template with sustainable mobility messages (Appendix 4).

After the facilitator explained that participants should read the information sheet and, if they agreed, sign the consent form, the session was recorded. It began with a brief self-introduction by each participant. The exercise then proceeded with a preliminary activity to assess the perceived

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effectiveness of messages corresponding to three types of strategies: personal and social benefits of sustainable mobility; sense of community; and the importance of the here and now. Additional variables were also introduced, such as messages with or without data and in a youthful or adult tone.

Specifically, nine messages were presented (Table 1), formulated with the assistance of Artificial Intelligence, combining the following characteristics:

-Three messages on personal or social benefits, three on community, and three on the here-and-now approach

-Four messages in an adult tone and five in a youthful tone

-Three messages with data (figures) and six without data

The questioning began by asking participants which message they considered most effective (ranked 1), followed by which they considered least effective (ranked 9). Participants explained their choices, and discussions arose on various aspects, as reported in the results section. Explicit attention was paid to the effectiveness of messages with youthful language, with data, and highlighting different benefits of sustainable mobility. The focus groups concluded upon reaching saturation, when responses began to repeat—after 40 minutes for the students and 60 minutes for the staff group.

Table 1. Sustainable mobility messages and English translations.

Message	Spanish	English
A	”Si cada día vienes en bici, no solo ahorras pasta: te sube el flow y bajas el estrés."	“Bike daily and not only save money: boost your flow and reduce stress."
B	"El 56% ya elige opciones sostenibles para venir al campus. ¿Y tú?"	"56% already choose sustainable ways to get to campus. What about you?"
C	"Cuando eliges moverte de forma sostenible, sumas al esfuerzo colectivo."	"Choosing sustainable travel contributes to the collective effort."
D	"¿Te flipa el plan low cost? Camina o pedalea al campus y súmate al flow verde."	"Love a low-cost plan? Walk or bike and join the green flow."
E	"Cada vez somos más los que venimos andando, en bici o compartiendo coche."	"More of us walk, bike, or carpool to campus."
F	"El transporte privado genera el 30% de las emisiones urbanas. Caminar o usar bici es una acción real."	"Private transport causes 30% of urban emissions. Walking or biking is real action."
G	"Ir en modo sostenible lo dice todo: me importa mi salud, mi planeta y mi gente."	"Going sustainable says it all: I care for my health, planet, and people."
H	"¿Cómo vienes al campus mañana? Menos emisiones, más intención. Empieza ya."	"How will you get to campus tomorrow? Less emissions, more intention. Start now."
I	"Ser parte del cambio también va de cómo llegas a clase. Más del 60% ya elige opciones sostenibles."	"Being part of change also depends on how you get to class. Over 60% choose sustainable options."

Source: Authors presentation.

5.4. Subsequent Analysis

For quantitative analysis, the completed templates were collected, and messages with the greatest positive or negative impact in each group were identified. Positions for each message (M1 to M9) were summed across all forms to calculate an average score per message. Messages with the lowest scores were identified as the most effective, and those with the highest scores as the least effective. Comparisons were also made between the two focus groups (Table 1).

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Qualitative analysis, based on the transcription of recorded sessions, aimed to understand why a message resonated (or did not) with participants, classifying the most common reasons. This analysis provided the following insights:

-Identification of the most and least effective communication strategies according to participants' interpretations (e.g., messages focused on individual benefits, appeals to community, or immediate action calls).

-Differences in message reception according to participant profiles, such as their role within the university (student, academic staff, administrative staff).

-Understanding of personal, social, and cultural factors influencing message perception, including prior beliefs, environmental norms, or practical barriers.

-Spontaneous proposals or concrete suggestions on improving sustainable mobility communication from the perspective of the message recipients.

6. Results

The results for each of the two focus groups and a comparative analysis between them are presented below. Participants ranked nine messages from 1 to 9, where 1 represented the most effective and 9 the least effective. The positions of each message across all forms were summed to calculate an average score per message (Table 2).

Table 2. Messages for Sustainable Mobility: Strategy, Tone, and Scores.

Message	Strategic Focus	Tone / Data	Student Score	Professional Score
A	Personal benefits (health, savings, wellbeing)	Youthful, no data	65 – least effective	33
B	Here and now (urgency)	Adult, with data	50	40
C	Community sense (collective action)	Adult, no data	39	37
D	Personal benefits (economic savings)	Youthful, no data	58	51 – least effective
E	Community sense (belonging)	Youthful, no data	43	41
F	Here and now + direct environmental impact	Adult, with data	35	42
G	Personal benefits + collective values	Youthful, no data	36	30 – most effective
H	Here and now + meaningful personal action	Adult, no data	29 – most effective	46
I	Community sense (collective action)	Youthful, with data	41	40

Source: Authors presentation.

6.1. Student Focus Group

Nine students participated in this focus group, out of the twelve invited: five women and four men, aged 20–27 (Appendix 1). There was considerable agreement on which messages were least effective. Most considered messages A (4 of the 9 participants rated it 9, the lowest) and D (4 rated it 8) ineffective in communicating sustainable mobility. However, there was less consensus regarding the most effective message: three of nine considered H the best, and two chose C. Three others rated F as 2. Overall, message H ("How are you coming to campus tomorrow? Less emissions, more intention. Start now.") was the most effective, while message A ("If you cycle every day, not only do you save money, your flow rises and your stress drops…") was the least effective (Table 1).

Regarding the most effective messages, participants indicated that H was brief, direct, and included a clear call to action, making it persuasive for the university community. Message F ("Private transport generates 30% of urban emissions. Choosing to walk or cycle…") was appreciated

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for providing concrete data along with alternative transport options. Message G ("Going sustainable says it all: I care about my health, my planet, and my people") was not chosen as the top option, but scored highly in nearby rankings, emphasising multiple benefits of sustainable mobility. Message C (focusing on collective effort) was the best for some students, who highlighted that it directly addressed the individual while also promoting collective contribution.

As for the least convincing messages, message A was widely criticised. It was considered too long, with a forced attempt at youth slang that felt "old-fashioned," reducing credibility. The next least effective was D ("Love the low-cost plan? Walk or cycle to campus and join the green flow. More savings, more style"), which, although not liked by everyone, received the highest rating (1) from one student due to its informal language and emphasis on economic savings. Others ranked it poorly for precisely the same reasons: excessively informal language perceived as unconvincing or "forced." Message B ("56% already choose sustainable options to come to campus. And you?…") was disliked by some because starting with a percentage felt abrupt, making it less attractive to continue reading.

After sharing their scores, students pointed out some features they considered important for effective messages. They emphasised that messages should be direct and concise, with a call to action or a question that directly engages the reader or listener:

"I realised that the messages I voted as most effective were the ones that start with a question. It's like a direct appeal to the person to participate, so I respond." (Student 9)

"I guess messages that talk more about a community, for example, 'the campus moves wisely, join the movement', all those messages that engage you, you feel more reflected." (Student 4)

Regarding other elements, participants highlighted that a forced attempt at youth slang by an institution is counterproductive. However, they also noted that, as part of a campaign with illustrations, colours, and modern typography, a youthful tone could work:

"I think in these messages from an institution—since we assume it comes from the university—it works better to use language we all understand, not an attempt to get close [to young people], because it ends up like a Mr. Burns meme." (Student 4)

Students also valued the inclusion of data for credibility, provided it is well-integrated:

"If you start with a concrete number, it might make you reluctant to read on. But I do think it's important to give the numbers, because if you want me to do something, give me the figure for why I should do it." (Student 3)

"If you tell me it's more ecological but don't give me any data to believe it, it doesn't really engage me." (Student 7)

Regarding motivations for choosing sustainable mobility, health and savings (personal benefit) were most convincing for the majority. While some considered savings important for themselves, others noted that it might not deter peers from using cars:

"I have many friends who have cars, and even before they took the bus when they didn't have a car, now they don't care about fuel prices—they still prefer the car." (Student 9)

"Maybe they even paid for the bus before, and now they aren't paying for fuel because it's their father's car." (Student 4)

Messages appealing to the community generated mixed reactions. Some felt motivated to join a collective, while others were not influenced if others were already contributing:

"I'm not a self-centred or selfish person, but when they tell you everyone else is already doing it, I don't really care." (Student 9)

"I'm a bit contrary; they tell me everyone is doing it, and I feel FOMO [Fear Of Missing Out]. That's why I felt these [community] messages resonated more." (Student 1)

"There has to be a balance between personal effect, personal responsibility, and being part of the collective. (...) Saying 'you can join this community and be part of a bigger movement' involves you personally." (Student 2)

Appealing to the planet was less convincing as a main motivator:

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"It shouldn't be 'you're saving the planet'. While it's clear that the action matters, you're not going to save the world alone, but your change represents something bigger and important." (Student 4)

Another participant questioned message I, which includes "Over 60% already choose sustainable options," as it may not be clear to everyone which options are considered sustainable.

6.2. Staff Focus Group

Eight staff members participated in this focus group (four women and four men, aged 30–60; Appendix 1). Three considered message A the best, and two preferred message G. Overall, message G ("Going sustainable says it all: I care about my health, my planet, and my people") received the lowest cumulative score, making it the most effective, whereas message D ("Love the low-cost plan? Walk or cycle to campus and join the green flow. More savings, more style") was the least favoured.

There was considerable divergence regarding the target audience for sustainable mobility campaigns. One participant supported message A as being directed towards students:

"If we want to reach more people, and where there's most room for improvement, it's the students, because we know employees' lives are more complicated—they have to take their kids to school. We have more scope if we focus on students, who are the majority." (Professional 1)

Conversely, another participant avoided language clearly aimed at young people, preferring messages targeted at professionals:

"I avoided terms clearly aimed at young people because I think the message should be for professionals. If we convince professionals, even if fewer, they can set an example, and they might be more resistant than students to this more sustainable shift." (Professional 3)

Regarding messages using youth slang, one participant remarked:

"I think not only will it fail to reach non-students, even students might perceive it as an awkward attempt to seem 'cool'—I'm failing in the attempt." (Professional 8)

There was also debate about messages including data. One participant selected message B ("56% already choose sustainable options to come to campus. And you?…") as the best, believing the statistic supported the call to join the change (Professional 8). Another argued that messages should avoid figures, as they can quickly become outdated or manipulated (Professional 3). A third participant ranked message I ("Being part of the change also involves how you get to class. Over 60% already choose sustainable options. The campus moves wisely, join the movement") as the least effective, since what others do is not a sufficient reason to change personal behaviour (Professional 6).

Two participants noted that some messages were unrealistic. For example, message F ("Private transport generates 30% of urban emissions. Choosing to walk or cycle is a real action against climate change") did not reflect personal realities, as family obligations and existing infrastructure make sustainable travel impossible, leaving them reliant on cars (Professional 4).

In relation to this issue, one participant suggested that messages must be flexible to avoid excluding those who "have no choice but to drive." Another recommended including future scenarios—even if the word "future" does not appear in the text—and the concept of "sustainability" (Professional 3).

The suggestion of a forward-looking scenario was contested by another participant, who emphasised the need to act in the present and had ranked messages that included phrases such as "The campus moves wisely, join the movement" or "Join the change that is already underway" as effective (Professional 7). Additionally, the effectiveness of words like "join," "participate," and the idea of "change" was supported by another participant (Professional 5).

Other motivations were also mentioned. For example, the group highlighted the importance of conveying the feeling and enjoyment of experiencing "this wonderful campus," which reduces stress (Professional 6). In this context, they explored the meaning of the "campus experience," including enjoyment of extracurricular offerings and institutional values.

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For one participant, it was important that sustainability and the planet appear in the messages, particularly in a personal context of stronger climate change denial (Professional 2). To avoid fear-based messages that could be paralysing, another participant recommended positive communication that offers options for change without demonising anyone for their travel choices (Professional 8). This approach of providing options and empowering choice was well received by the group.

Finally, all participants agreed that campus mobility could be changed:

"There's a percentage of people who don't need a car and who can change, who can have options. Appealing to that experience, to well-being, to this campus we have, I think we all agree that change is possible, because I think we're currently in a stationary situation." (Professional 3)

6.3. Comparison of Results

In comparing the most and least effective messages between students and professionals, interestingly, two messages were rated almost inversely by the two groups (Table 3).

Table 3.

Students	Staff
H – Most effective (29 points)	H – Second least effective (46 points)
A – Least effective (65 points)	A – Second most effective (33 points)

Source: Authors presentation.

Message H, which begins with a question and calls for immediate action, was considered the most effective by students, but was ranked as the second least effective by university professionals. Conversely, message A, focused on cycling and using various youth slang terms, was rejected by students but rated highly by the professionals.

Other notable differences include:

-In general, students were less hostile to messages containing numerical data than professionals.

-Professionals highlighted the health of the planet as a key motivator, whereas students were more sceptical about what impact individual actions could achieve.

-Although professionals also supported the inclusion of the word "sustainability," in the student focus group, one participant noted that the phrase "choose sustainable options" might not be clear enough, as the specific options were not explained.

These differing perceptions are discussed in the following section.

7. Discussion

The results obtained in the discussion groups allow for a deeper understanding of the perceived effectiveness of different messages about sustainable mobility, revealing patterns that confirm, nuance, and expand upon previous studies. This research provides relevant findings on how different university groups interpret and evaluate communication strategies, which advances the understanding of segmentation and personalization of messages in real contexts.

The narrative strategies proposed worked differently for the various audiences within the university community. Even among more homogeneous audiences, such as students on the one hand and professionals on the other, differences emerged in the perception of message effectiveness.

For students, the narrative strategy linked to the "here and now" was the highest rated, as two messages (H and F) of the three responding to this strategy were highlighted for their effectiveness. The third (B), however, was not considered particularly effective, largely because it began with a percentage. Students identified the "here and now" narrative as a direct call-to-action message. In the case of professionals, this strategy was not particularly valued as effective.

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This result corroborates previous research carried out within the framework of Framing Theory [28,29], confirming that messages appealing to the present and immediate action, such as message H, generate greater impact among students. This finding aligns with McDonald et al. [33], who highlight that temporal frames focused on the present increase urgency and emotional engagement. However, the same message was considered less effective by professionals, revealing that temporal framing does not have a universal effect but depends on the profile of the recipient. This finding is significant because it shows that even strategies supported in the literature can have divergent effects depending on the target group.

For both students and professionals, the least effective messages (A and D, respectively) were those emphasizing personal benefits without providing data and with a youthful tone. However, this strategy of communicating benefits such as savings or health worked well for professionals in the case of messages G and A, which were considered the most effective. For students, message G appears as the second most effective. It should be noted that this message combines collective values with those individual benefits of sustainable mobility.

In general terms, these results reinforce what was stated by Spence and Pidgeon [31]. However, this research adds important nuances: although savings were considered relevant, some participants noted that it is not always a decisive factor, especially when the transportation cost does not fall directly on them, as is the case with students. This type of reasoning, linked to family economics or the use of shared vehicles, has not been widely addressed in previous studies and deserves attention in future research.

The third strategy, based on the sense of community, did not stand out either positively or negatively in either group. However, in the dialogue about the messages, some participants did highlight the importance of joining or becoming part of a change that was already underway within the university. This perception aligns with Social Identity Theory [36], which emphasizes how belonging to a group can strengthen individual engagement in collective actions. In this sense, messages appealing to the community can activate a shared identity feeling, especially if it is perceived that the group one belongs to — in this case, the university community — is already committed to sustainable mobility. Rickard et al. [32] also highlight that collective frames are more effective among people with strong environmental values, fostering a common purpose. Although not all participants in this study responded positively to this type of message, its potential to generate cohesion and collective motivation suggests that, if properly designed, it can be a powerful tool to promote sustainable behavioral change.

Another original finding is the identification of ambivalence toward certain community messages. While some students and professionals felt motivated by being part of a collective, others showed indifference or even rejection of the idea of following what "everyone else is already doing." This internal polarization within the same group reveals that collective frames do not always generate cohesion and that appeals to the group must be carefully designed to avoid adverse effects. In contrast, professionals valued messages offering options and future scenarios more, suggesting a greater orientation toward planning and long-term sustainability.

It appears that the professional focus group concentrated on students as the primary audience for the messages, since the options rated most effective (G and A) contain a youthful tone. In the case of students, their first choice matches an adult tone (H), and their second choice (G) uses the expression "modo sostenible," which has been considered youthful but with a more controlled level of slang than messages A or D.

Social Identity Theory [36] helps interpret the students' critical reaction to the use of youthful slang in institutional messages. The rejection of message A, for example, is related to a perceived lack of authenticity, which aligns with Huang and Guo [43], who state that rhetorical narratives must be consistent with the sender's identity to build trust. This study provides empirical evidence on how institutional "approach attempts" can be counterproductive if not perceived as genuine, especially among young audiences.

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Messages containing data (B, I) also did not particularly stand out for effectiveness or ineffectiveness. However, in the discussion groups, it was one of the elements that sparked divergent opinions. In the case of message F, it was well received by some students. Therefore, regarding the use of data in messages, this research confirms that its effectiveness depends on presentation. Students valued data when it was clearly and contextually integrated, while professionals showed greater skepticism, questioning its validity and usefulness. This finding reinforces the need to adapt message format and tone according to the recipient's profile, as suggested by Jurabek et al. [21] and Semanjski & Gautama [22] in their studies on advanced segmentation.

Finally, this research provides evidence on the importance of considering structural conditions in message reception. Some professionals noted that certain messages were unrealistic, given that their family dynamics, along with the lack of infrastructure, forced them to use cars. This type of practical barrier, also identified by Scerri et al. (2025)[6] and Bardal et al. [19], is confirmed in this study as a factor limiting message effectiveness, even when messages are well designed.

Overall, the results of this research not only confirm previous findings but also provide new elements for designing more effective communication strategies. The comparison between students and professionals reveals that segmentation cannot rely solely on age or institutional role but must consider motivations, barriers, and lifestyles. Additionally, the value of living labs is highlighted as spaces for experimentation and message validation in real contexts, allowing for the collection of direct and spontaneous perceptions that enrich the design of environmental communication campaigns.

8. Conclusions

This study has advanced the understanding of how different university groups perceive the effectiveness of messages about sustainable mobility, depending on the communication strategies employed. Through the qualitative methodology of discussion groups, it has been evidenced that there is no universally effective strategy; rather, message reception varies significantly according to the recipient's profile, motivations, context, and structural barriers. Therefore, it seems necessary to segment sustainable mobility communication campaigns to target the motivations of diverse audiences. A single campaign message may not be effective for the entire university community. Even when segmenting between students and professionals, it would be advisable to consider different mobility narratives to reach the largest possible audience.

Among students, the "here and now" narrative is especially effective, as they interpret it as a call to action that generates a sense of urgency. In this regard, expressions such as "join in" or "get involved" support a community narrative, while also fitting within the "here and now" narrative. Both students and professionals positively valued this direct appeal, so community and present-action narratives can converge and prove effective.

Narratives emphasizing personal benefits, such as health or savings, may also prove effective for some audiences, although their efficacy was ambivalent. While some participants valued them positively, others rejected them when perceived as inauthentic or excessively informal. This finding highlights the importance of carefully managing the tone and coherence of the message with the institutional identity, especially when addressing young audiences. The tone and words used to present the benefits of sustainable mobility are important, as they can provoke mixed reactions. For example, the way planetary benefits are presented, the use of the word "sustainability," or the choice of a more youthful tone are all relevant. The use of youthful slang and data requires meticulous work in composing the campaign message, as its effectiveness depends on choosing the right words and placing them appropriately within the text.

Overall, the results of this research reinforce the need to design segmented, empathetic, and contextually grounded environmental communication campaigns. Additionally, the use of living lab–type environments is highlighted as ideal spaces for experimenting, validating, and adjusting messages in real contexts, with the active participation of the target audience. An effective message should combine elements of personal benefit (health, well-being) with care for the planet and the

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community, using positive, natural, and inclusive language that promotes choice and the unique experience of the campus.

These results will enrich the communication strategies used in institutional or public campaigns, tailoring them more precisely to the motivations and sensitivities of the target audience, thereby contributing to more sustainable mobility in the university environment and potentially in other similar contexts.

Future research should consider expanding the sample to other universities or urban contexts, incorporating mixed methodologies that combine qualitative and quantitative analysis, and exploring the impact of messages on actual habit change in the medium and long term. It would also be valuable to analyze how variables such as environmental identity, institutional trust, or prior exposure to sustainability campaigns influence message reception.

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Institutional Review Board Statement: "The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Review Board (or Ethics Committee) of University of Navarre (protocol 2025.169, Pamplona, 27 August 2025)."

Informed Consent Statement: "Informed consent was obtained from all subjects involved in the study."

Data Availability Statement: We encourage all authors of articles published in MDPI journals to share their research data. In this section, please provide details regarding where data supporting reported results can be found, including links to publicly archived datasets analyzed or generated during the study. Where no new data were created, or where data is unavailable due to privacy or ethical restrictions, a statement is still required. Suggested Data Availability Statements are available in section "MDPI Research Data Policies" at https://www.mdpi.com/ethics.

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Abbreviations

The following abbreviations are used in this manuscript:

MDPI	Multidisciplinary Digital Publishing Institute
DOAJ	Directory of open access journals
TLA	Three letter acronym

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LD Linear dichroism

Appendix A – PARTICIPANT PROFILE

Participant Profile	Campus Commute	Age/Sex/Program/Position
Student Profile		
1	Bus	Female, 21 years old, Bachelor in Journalism
2	Bus	Female, 24 years old, Bachelor in Psychology
3	Walking	Female, 20 years old, Bachelor in Applied Management
4	Walking	Male, 23 years old, Bachelor in Journalism
5	Bicycle	Female, 27 years old, Master's in Faculty of Pharmacy and Nutrition
6	Bus	Male, 25 years old, Master's in Faculty of Pharmacy and Nutrition
7	Walking	Male, 20 years old, Bachelor in Primary Education
8	Walking	Male, 21 years old, Bachelor in Journalism
9	Walking	Female, 21 years old, Bachelor in Audiovisual Communication
Professional Profile		
1	Walking	Male, 35 years old, Administrative and Services Staff
2	Car	Female, 57 years old, Administrative and Services Staff
3	Bicycle	Male, 57 years old, Professor, Faculty of Sciences

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4	Car	Male, 56 years old, Professor, Faculty of Communication
5	Walking	Female, 48 years old, Professor, Faculty of Education and Psychology
6	Bicycle	Female, 62 years old, Professor, Language Institute
7	Car and Bicycle	Female, 45 years old, Professor, School of Applied Management
8	Bicycle	Male, 30 years old, Professor, School of Applied Management

Appendix B – INFORMATION SHEET

Study title: Smart Campus Living Lab. Strategies for Sustainable Mobility Communication

Principal Investigators: Bienvenido León (bleon@unav.es) and María Carmen Erviti (mcerviti@unav.es), University of Navarra

Study Objective:

This study aims to analyze the perceived effectiveness of different types of messages about sustainable mobility, targeted at members of the university community. Two focus groups will be conducted: one with students and another with university staff (faculty and administrative personnel). The study will examine participants' perceptions, reactions, and evaluations of the presented messages.

Procedure:

You will participate in a group session (focus group) lasting approximately 60–90 minutes, during which you will be asked to evaluate a series of messages related to sustainable mobility. The session will be moderated by the project researchers and recorded solely for analysis purposes.

Participation is entirely voluntary. You may decline to participate or withdraw from the study at any time without providing a reason and without any penalty.

Confidentiality:

The Data Controller (UN) in compliance with Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 regarding the protection of natural persons with regard to the processing of personal data and the free movement of such data (GDPR), informs you that if you participate in this study, your personal data will be processed by the research team to draw conclusions from the Project. Health authorities and members of the ethics committee may also access the data if necessary.

All personal data, including health data if applicable, will be handled in accordance with current data protection laws, especially the GDPR and Law 3/2018 of 5 December on the Protection of Personal Data and Guarantee of Digital Rights (LOPD).

You will not be personally identifiable through any communications generated in this study.

You are responsible for the accuracy of the data you provide and have the right to exercise access, rectification, erasure, restriction of processing, data portability, and objection in accordance with data protection regulations. To exercise these rights, contact the Data Protection Officer of UN at the following postal address: Universidad de Navarra 31009 Pamplona, Spain, or via email at dpo@unav.es. A photocopy of your national identity card or equivalent must be attached.

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Appendix C – INFORMED CONSENT

I, _____, have read and understood the Information Sheet provided to me regarding the study entitled "Evaluation of Communication Strategies to Promote Sustainable Mobility in the University Community."

I have had the opportunity to ask questions, all of which have been answered satisfactorily. I understand that my participation is voluntary and that I can withdraw from the study at any time without giving any reason.

I authorize the recording of the session for research purposes only and consent to the confidential use of the data provided during the focus group.

Participant's signature: _____

Date: _____

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