



Towards Relatable Climate Change Data: Untangling Tensions in Engaging with a Hyperobject

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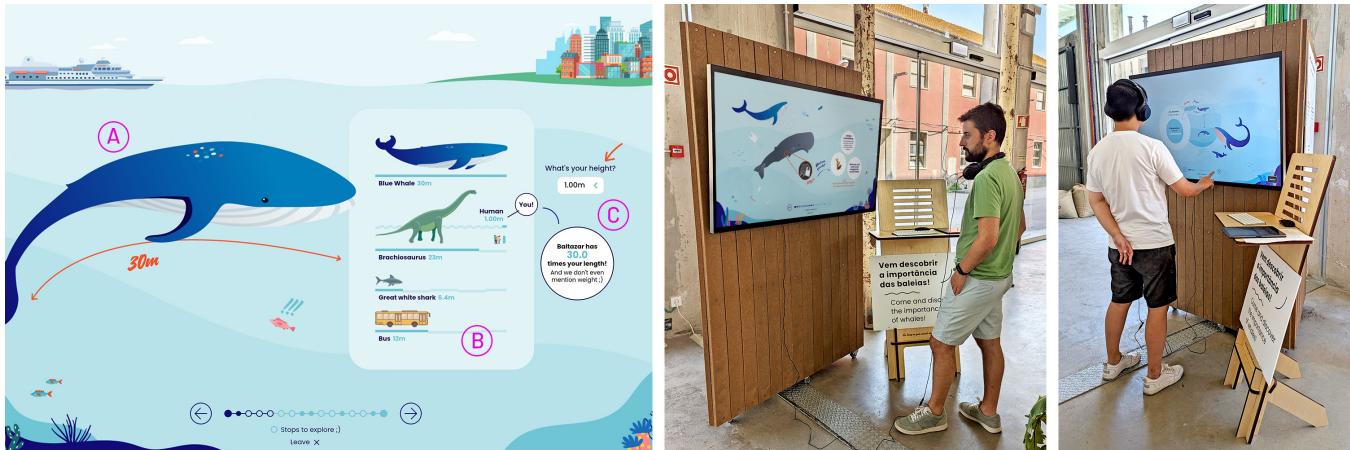


Figure 1: Screen of the data-story with examples of the communication features used: A) Contextualization, storytelling, and decentering the human in the narrative through the more-than-human protagonist; B) Contextualization of the data by comparing to more familiar metrics; C) Personalization of the data-visualization by allowing the user to input personal metrics. On the right are two photos of the prototype implementation in the Creative Hub.

ABSTRACT

This research investigates the potential of emerging communication strategies to enhance engagement with climate change data through HCI, by recognizing the critical challenge of effectively communicating complex hyperobjects. We designed "Finding Arcadia", an interactive artefact centred on ocean climate data, to explore how data humanism, storytelling, decentering the human in the narrative, and positive framing influence user engagement and perception of the information. Findings from a study in-the-wild ($N=42$) and a post-experience survey conducted six months later ($N=19$) foregrounds strategies to foster deeper engagement and connection with the information but also tensions in engaging with such a complex topic. We contribute to climate change communication and HCI research with the design decisions, study outcomes, and reflections on ways in which communication strategies can promote understanding and connection with a hyperobject.



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CCS CONCEPTS

- Human-centered computing → Visualization; • Visualization → Visualization theory, concepts and paradigms.

KEYWORDS

Data Visualization; Storytelling; HCI; Data Humanism; Climate Change; Sustainability

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1 INTRODUCTION

The growing urgency to tackle climate change is compounded by its complexity and broad implications. Hence, it is referred to as a *hyperobject* – a complex and pervasive phenomenon that exists on a scale beyond our usual human perception and comprehension [80]. This scale makes effective engagement strategies both intricate and essential [115]. Although there is an overwhelming consensus that climate change is a human-induced phenomenon [65], it can be difficult to connect its abstract, global significance to individual experiences, leading people to not talk about the issue

[6]. This is particularly detrimental, as "one of the most important actions people can take to address global warming is to talk about it", according to climate scientist Hayhoe [6]. Conversations build understanding and change beliefs and attitudes.

Emerging research underscores the role of the HCI community in championing climate change discourse, emphasizing hope, meaning, and action [62, 66]. Yet, a gap persists in how we communicate environmental narratives to audiences [39]. The challenge of converting intricate climate data into understandable, actionable, and emotionally resonant concepts remains [41]. Studies offer varied perspectives on the efficacy of negative versus positive emotional framing [25] and the challenges of translating complex climate data into understandable concepts that are relevant to people's lives [23, 33]. Recent studies have demonstrated that fear is ineffective in motivating [83], while hope [19, 27] and action [32, 38, 51] can be catalysts for engagement. Such a complex communication challenge, allied with the urgency of engagement, demands further research and proposals of novel approaches. As a field, HCI can leverage technology to engage, educate, adapt, and immerse people in complex phenomena requiring collective action [79].

Design and HCI research often focus on a limited range of topics and strategies when discussing climate change [40]. The clarion call from both scholars and international institutions [26, 82] is clear: we need diverse, relatable, and empowering narratives that resonate with specific audiences [17, 35, 101], including more-than-human [1, 44] and cohabitation [75, 95].

In response to this imperative, we explore how to effectively communicate hyperobjects related to crises, such as climate change, through HCI. To address this high-level enquiry, we explored different communication strategies informed by implications in previous research [39, 40] and current climate change engagement guidelines [21, 24, 82] – data humanism, storytelling, decentering the human in the narrative, and positive framing – through a case-study focused on climate change communication. This artefact – *Finding Arcadia* (FA) –, inspired by a study on the role of whales in carbon sequestration [20], serves as our experimental canvas.

We performed an exploratory study where we created two versions of the artefact – a Base version (vB) and an Enhanced version (vE) – exploring the communication strategies chosen to probe what users are most connected with and how to make hyperobject-related data feel more actionable and human-scaled. We describe the design decisions behind the two versions of FA, and detail our user study in the wild (N=42) and probing six months later (N=19), describing its findings and discussing emerging issues and implications for future work.

Our study foregrounds that audiences value the novelty of the experience and the unfamiliarity of information. Personalization, contextualization, and storytelling, mainly using metaphors and analogies, are crucial for making data relatable. The experience inspired debate and successfully led to conversations. While users find suggestions for actionable communication highly beneficial, they desire more diverse interactivity and closer connections to the information. Storytelling techniques, like foregrounding character development and live interactions, can deepen user engagement and empathy. Still, character consistency and live interactions must be carefully planned.

This year's DIS asks "why design?" to "prompt reflection on the role and power that design has" and "where it can be used to engage with contemporary troubles" [107]. We do so by experimenting with interaction strategies to address gaps in climate change communication and the importance of HCI and graphic design in these exchanges. The insights derived from our study can illuminate designers' path in hyperobject communication such as climate change, advocating for designs that foster meaningful interactions and elevate the discourse within the HCI community.

2 BACKGROUND AND RELATED WORK

This research builds on prior work in sustainable HCI (SHCI) and data visualisation. In the following, we summarise i) the recent debate around SHCI and its shift towards a focus on climate change, ii) Interactive data visualisation approaches in HCI, with a focus on climate change-related visualisations, and iii) Data humanism's application within the HCI field. Our work builds on these recent data visualisation approaches and continues their exploration through the creation of a data-story that combines data humanism and other communication strategies that strive to enhance data interpretation.

2.1 Sustainable human-computer interaction (SHCI) and the shift towards Climate Change

Sustainability should be one of the core focuses of HCI [11]. With this premise in mind, the field of Sustainable HCI (SHCI) has been committed to minimizing the environmental impacts of computing technologies and influencing sustainable behaviours [10, 116]. The possibilities and responsibilities of the HCI community related to sustainability have been debated for years [76]. Discussions looked at the future implications of integrating sustainable principles into current designs [11], as well as the potential of moulding possible futures connected with the broader societal impact and relevance of interaction design [37]. The considerable focus on persuasion and its limiting factors have been questioned (e.g. [14]), as well as the focus on individual behaviour (e.g. [31]) or on incremental instead of systemic change (e.g. [34]). Questions surrounding the unsustainability of digital technologies, in particular data-driven ones [70], have led researchers to call for "more meaningful" digital experiences [113]. Each practice-based SHCI project should clearly define or design specific sustainability objectives and measurements [94], and be transparent about its strategies and materials [111].

The Anthropocene presents both obstacles and possibilities, necessitating innovative viewpoints [5]. Design practitioners are now compelled to extend their focus beyond products, incorporating services, networks, and experiences which address intricate socio-technical systems [18]. Such systems prompt a departure from conventional design methodologies that primarily concentrate on "the human" towards inclusive approaches encompassing a variety of perspectives. Scholars have argued for the transition from a merely user-centered design to posthumanistic views that de-centers the human in the design process [43]. These take a more comprehensive, diverse approach that includes the relations between human and nonhuman actors [44], multispecies perspectives through nonanthropocentric approaches, for example by being inspired by natural processes such as decomposition [68], or through

multispecies participatory practices [75] that work towards cohabitation [95]. Also, Key[58] asks HCI researchers to embrace the complexities and uncertainties of posthumanistic work and to challenge human exceptionalism through “true” design innovation that considers these tensions.

These proposals expand the notion of participation to designing with the more-than-human [1]. Civic and participatory design approaches [22, 29] can link to broader societal issues such as politics [29], resistance, and diverse modes of civic engagement [30]. The need to empower and support civic and collective action demands the design of interactive systems with a strong social component [64]. Transition Design [103] emerged as one approach that directly considers the complexity of the many wicked problems we face as a global society. It promotes a design-led transition towards more sustainable futures that is more place-based, participatory and connected to the natural environment [104]. Other approaches, such as design futuring [45] and speculative design [97], challenge designers to consider the future of their designs and explore complex problems.

Considering these complex challenges, Knowles and colleagues [62] call for the HCI community to orient around climate change rather than the more expansive and multidimensional concept of "sustainability". This reasoning originates from Klein’s argument that climate change offers a critical unifying narrative that keeps us focused on pressing existential issues [61]. Fifteen years after the emergence of SHCI, Bremer et al. [13] identified a shift from a focus on individual behaviour change towards the design with and for communities (context-oriented) and the increased use of speculation and reflection instead of prescription. This leads to difficulty in measuring impact and questioning if opening design spaces isn’t passing the responsibility of application and evaluation to future researchers.

Diverse discussions have emerged regarding the strategies of SHCI, especially when it comes to addressing climate change. A need for meaning, fulfillment and hope in times of existential crisis asks designers to question *what* and *how* they design as not to add to a passive and limited digital landscape [66]. The relationship between humans and nature has been a topic of extensive debate. For instance, Liu et al. [69] propose an alternative framing to the dominant SHCI models of “correction” of human behaviour or “control” of resource consumption inspired by permaculture’s philosophy of working *with* nature, emphasising human cooperation instead of control. Or Vella et al. [110] explore a deepening of human-nature relations through care and curiosity. One of the latest discussions around the future of HCI and climate change took place at CHI’23 [79] with a focus on data communication and public engagement. This highlights the open-ended nature of HCI’s role within climate change-related interventions, and the growing role of the field in building awareness, inclusion and connection with this complex topic. It also points to a need for further exploration in this area of work. Therefore, we set out to test communication strategies that assisted in decentering the human in the narrative.

SHCI research can take a toll on those attempting to make an impact through their work. The authors of this paper have also realised that “we can’t do it all, but we can do something” [13]. Bendor [8] argued for hope and designerly action for sustainability, saying that “designers are also capable of promoting innovative

ways of seeing and being that may evoke agency”. Climate leader Ayana Elizabeth Johnson [57] proposes that each person focuses on their skills and what brings them joy in climate action. We focused on our particular expertise, in the case of the first author: communication design, and worked towards making a positive contribution through HCI research for better engagement with climate change data.

2.2 Interactive Data Visualisation for Climate Change engagement

Innovative forms of visualising data and storytelling through digital media can influence the public’s understanding of climate change topics [50]. One of the proposals by Mankoff et al. [76] for research in Sustainability through Design was “making abstract environmental data concrete for everyday life”. When looking specifically at climate change, recent studies analyzing a decade’s worth of HCI and design research suggest that a majority of interaction projects transmit an impartial message without any explicit call to action [39, 40]. The research suggests an opportunity for selecting lesser-known subjects, integrating inclusive viewpoints and actionable suggestions, adapting the message to the audience and taking the experience to “where the user is”.

Considering these implications and recent climate change communication guidelines that call for a focus on stories, communities, day-to-day experiences and link to action [21, 24, 82], we focus on HCI research that explores strategies outside the majority’s neutral framing and lack of suggestions for action, demonstrating the field’s recent explorations within these approaches. *RisingEMOTIONS* [3] utilized emotions and community connection to communicate the dangers associated with rising sea levels. The community was engaged in critical discussions through public interventions that guided them towards future action by connecting to local groups [84]. Similarly, *Smart Citizen* [84] connects communities to local services with positive results, highlighting sustainability issues, and fostering citizen participation via engaging location-based experiences. Other projects use data physicalisations of environmental data to elicit collective sense-making and carbon literacy [67] or link to citizens’ subjective experiences to foster community building and activism [28]. These two projects highlight the importance of alternative ways of representing “invisible” environmental data and the importance of collective critical engagement in these complex dialogues. *Ecorbis* [99] deployed in home settings, uses a data sculpture to promote environmental awareness relating to user behaviour, and offer actionable facts, raising awareness and facilitating reflection. *Saving Aid* [98] underscores the importance of data framing in supporting energy conservation decisions. Adding a personal touch, *More Weather Tomorrow* [108] uses a personalized data video story narrated as a weather forecast to encourage families to explore weather data collectively. The study establishes a link between data and memories to boost engagement. The importance of relating to personal contexts and experiences in data exploration is also analysed by [114]. To create awareness about drought and wildfires, [50] created a data visualisation depicting the past, present and future of wildfires, highlighting the positive effects of multimodal interaction.

As these examples show, HCI research on visualizing climate change data is diverse, the concern generally being enhancing engagement and understanding of the information. Furthering these approaches within climate change engagement is crucial. Good practices used in UX, graphic design and psychology can inform the development of more effective visualisations related to climate change data, as these still need to be made more inclusive to non-expert audiences [102]. Considering climate data's complexity and often global and abstract nature, communication strategies such as narrative and connection to user experiences should be further explored for better data engagement. According to Soden [96], we need to carefully consider our choices about what we include or exclude from our environmental data sets and how we use them. They dictate how we abstract the environment and our relationship with it, leading to possibilities of "things to be otherwise".

2.3 Data Humanism in HCI Research

The optimal method for illustrating complex data to non-expert audiences is still a point of contention [78]. For the past thirty years, preeminent authors in data visualisation have heavily emphasized design efficacy and straightforward communication, in what can be called a "neutrality" concept [117]. Tufte argues for a clutter-free approach that primarily showcases the raw data [105], in line with other proposals that underscore the importance of precision and comprehensibility for swift communication [42], cautioning against the manipulative misuse of data visualisation [16].

McCandless has proposed a storytelling approach that consists of four key elements: data (information), concept (story), function (goal), and metaphor (visual form) [77]. Storytelling has become increasingly pivotal in data visualisation design, transitioning from a neutral showcase of information to more humanistic depictions capable of demonstrating ambiguity and complexity. These approaches recognize that data is neither value-neutral nor independent of the observer [36]. Since 2016, Lupi [71] has advocated a paradigm shift in data visualisation that challenges conventional rules, such as striving for simplicity. This new approach, named data humanism, explores alternative chart types and invites audiences to take their time and appreciate the visualisations [86]. These approaches consider the subjectivity of data and its connection to people's understanding and experiences. Within HCI and data science, Strohmayer and Muller [100] recently debated the subjectivity of data sets, and how people *shape* the data through their analysis and how they use it.

Data humanism doesn't conform to the typical 'simplicity' principle and instead explores non-traditional chart types that embrace complexity, incorporate context, and recognize data's inherent imperfection and subjectivity. These compelling and customized data-driven visual narratives intend to bridge the gap between numbers and their real-life meaning: stories, knowledge, people, and behaviours [71, 73]. This is achieved by integrating layers of qualitative information with the quantitative data, adding context and meaning [74], and therefore creating an intimate connection through relatable concepts [72]. These principles align with recent climate engagement communication guidelines that call for making climate data "relatable, local and personal" [82].

The concept of 'making with data' has taken diverse forms within HCI – from data sonification (using sound parameters) to data edibilization (using edible materials) to data physicalisation (an artifact that encodes data), among others [81]. Several innovative data representation approaches share goals or concepts with data humanism. Storytelling augments data representation and meaning [88], and strategic interactive elements engage in data exploration [93]. In terms of environmental data, eco-feedback experiences manifest energy and sustainability-related data, especially in residential [7, 85] or communal settings [9]. Projects like *Indoor Weather Stations* [49] and *Energy Babble* [47] explore the physicalization of environmental data. By exploring location, [48] introduced external data into the home, while [46] related users to "big data" about their areas – connecting users to somewhat abstract or intricate data, bringing it into everyday contexts. Data physicalization [52, 56] assists in understanding data via physical depictions to enhance reflection and public engagement [4]. Similarly, tangible user interfaces (TUI) enable users to interact with digital data via physical objects [53, 106]. Both strategies engage audiences with intricate data, particularly in public spaces [54], and can facilitate emotional responses, reflection, and memorability despite data translation subjectivity [112].

Data humanism shares commonalities with these established HCI disciplines. However, we argue that this approach can contribute to novel avenues within HCI data visualisations and data narratives, particularly within complex subjects like climate change. Whether in two or three-dimensional form, data humanism avoids oversimplification and prioritizes aesthetics, exploration, storytelling, and a deep connection to emotional and personal values, enabling a transition of data ownership to people. Inspired by the latter point, Kim et al. [59] used personal data collection and depiction for self-reflection and engagement. Similar techniques were used in educational contexts [15, 63], and with marginalized communities [60, 87]. Houben et al. [55] humanized the exchange by merging qualitative and quantitative data in a public display, while Sauvé and Houben [92] focused on data visualisation tools for laypersons to inspire action. Angulo et al. [2] applied data humanism in an interactive infographic game about sustainable food. Other studies [59, 89] used personalization through bespoke visuals to enhance engagement.

These HCI projects underscore the importance of connecting non-specialist audiences with data through less 'neutral' and more engaging methods, opposing the traditional research focus on a limited variety of visualisation types [78]. However, to the best of our knowledge, no other HCI research has applied data humanism to climate change-related visualisations outside of our recent contribution as part of this work [41]. The importance of actionable communication and engagement with climate change topics through positive stories that link to action, communities and personal values is fundamental [26, 82]. Therefore, data humanism emerged as a promising communication strategy to test. Interactive systems that allow for easy update, personalization, engaging and participatory experiences can assist in the crucial task of creating more diverse narratives associated with climate change [17, 35, 101] and meaningfully engage diverse audiences with this complex data. These experiences can lead to urgently needed dialogues [6, 65].

Our work is set to contribute to the gap in Climate change communication and HCI by exploring how data humanism can assist in these urgent pursuits.

3 METHODOLOGY

In response to HCI's call for innovative approaches in climate change communication, this study advances an empirical contribution by describing the design of an interactive artefact centred on the ocean ecosystem and carbon sequestration. By drawing inspiration from the International Monetary Fund (IMF) study on the significance of whales in ocean health [20], we designed a comprehensive story embedded with ocean-related data, paving the way for deeper human-data interaction and advancing the HCI field for climate change communication. The following describes the concept, design decisions, and study methodology.

3.1 Author Positionality

This section points to challenges that arise from tackling such a complex topic as climate change and how the author's individual perspectives and lived experiences can influence the work.

Living in a Southern European country, the authors' personal contact with the consequences of climate change is limited, and we acknowledge our privileged position. This research was conducted in Europe, and the authors' social and geographical networks are in the global North. This context plays a significant role in shaping our understanding of climate change, even if we strive to have a global understanding of the issue. The first author, therefore, focused her work in the contexts that are familiar to her, both in the audience and in the focus of the research.

The first author is a communication designer interested in environmental engagement, collaborating with a multidisciplinary team of engineers, designers, and psychologists. These intellectual affiliations have influenced the direction of the work, the language incorporated in the research, and the themes highlighted during the analysis.

Considering this positionality, the artefact and the study methodology focus on visualisation/communication strategies and users' perceptions and feelings toward the information.

3.2 Designing Finding Arcadia (FA)

The design process of FA follows our Data Humanism R&D framework proposed in [41] and extends on other previous work we presented in [40] by:

- (1) Stressing the importance of actionable communication;
- (2) Incorporating audience-targeted interactions;
- (3) Taking these experiences to public, everyday spaces;
- (4) Engagement with underexplored topics; and
- (5) Offering an inclusive narrative.

FA went through several design iterations, informed by co-design sessions with experts – the ocean data was validated in consultation with a marine biologist; the communication and interaction strategies were iterated based on the feedback of several HCI and storytelling experts. A couple of studies, in a science museum and at a local market, shaped the study design and refinements to the experience. The details of these previous processes, design decisions and iterations are discussed in [41]. With this study, we delve

deeper into the communication features and focus on understanding user perception and relation with the data. FA proposes a shift from merely nudging to deeply understanding users' connections to data, moving "*from 'nudge' to 'think' as a strategy for public engagement*" by "*engaging hearts and minds*" [21].

To achieve this, we designed two versions of the artefact: a Base version (vB) and an Enhanced version (vE) improved with the communication strategies selected. Both versions implement some of the guidelines mentioned by [40], namely i) focusing on a non-obvious topic (whales as a nature-based solution for carbon capturing), ii) displaying the information in a public space of passage, and iii) focusing on including proposals for action. However, while both versions retain similar structure and graphical elements, they differ significantly in data presentation.

The **Base version (vB)** is data-focused and the data is lacking in comparative or personalized nuances (Fig.3 – B.1, B.2), detailed below in vE. This version does not explore storytelling strategies – the data is reported in an impersonal third-person manner through a human voice narrator. Interactions are limited to basic flipping.

The **Enhanced version (vE)** uses diverse communication strategies to foster relatability (Fig.2 and 3). The employed communication strategies are:

- (1) **Data humanism:** Through contextualization and personalization of the data applied with user-specific adaptability. For instance, users can input their birth year, prompting the system to adjust the visualisation and provide a relevant fact from that year about climate change or sustainability (Fig.3 – vE.1). Another example is users being able to input their height and compare it to a whale's size. Also, context is added through comparisons to familiar metrics like juxtaposing the carbon sequestration of whales with that of trees or equating it to a user's national emissions (Fig.3 – vE.2)
- (2) **Storytelling:** Use of storytelling conventions and features, such as character development and basic plotting of the whale life journey, according to the IMF whale life cycle [20]. The data throughout the story is reported in the first person by Baltazar (Fig.2 – vE), the personified whale, who tells the audience his life story. The data shown is intertwined with Baltazar's story – from birth to adulthood, when he narrates his benefits to the environment and climate change mitigation, but also when faces the threats of the Anthropocene, to his death of old age and how even this stage of his existence is beneficial to the environment.
- (3) **Decentering the human in the narrative:** FA centres the discourse around the more-than-human, fostering a connection of humans with a global ecosystem. Exploring a non-human protagonist and highlighting whales' carbon-capturing processes casts them as iconic symbols of nature preservation and under-estimated but hopeful nature-based solutions for climate change. We strived to be accurate with the data but also mindful of the unknown factors surrounding these entities (e.g., the marine biologist suggested several editions to adjust the narrative to these unknowns). We employed a Large Language Model (LLM) to breathe life into "Baltazar" and enrich the narrative. Our prompt asked the model to personify a blue whale and recount the data "facts"

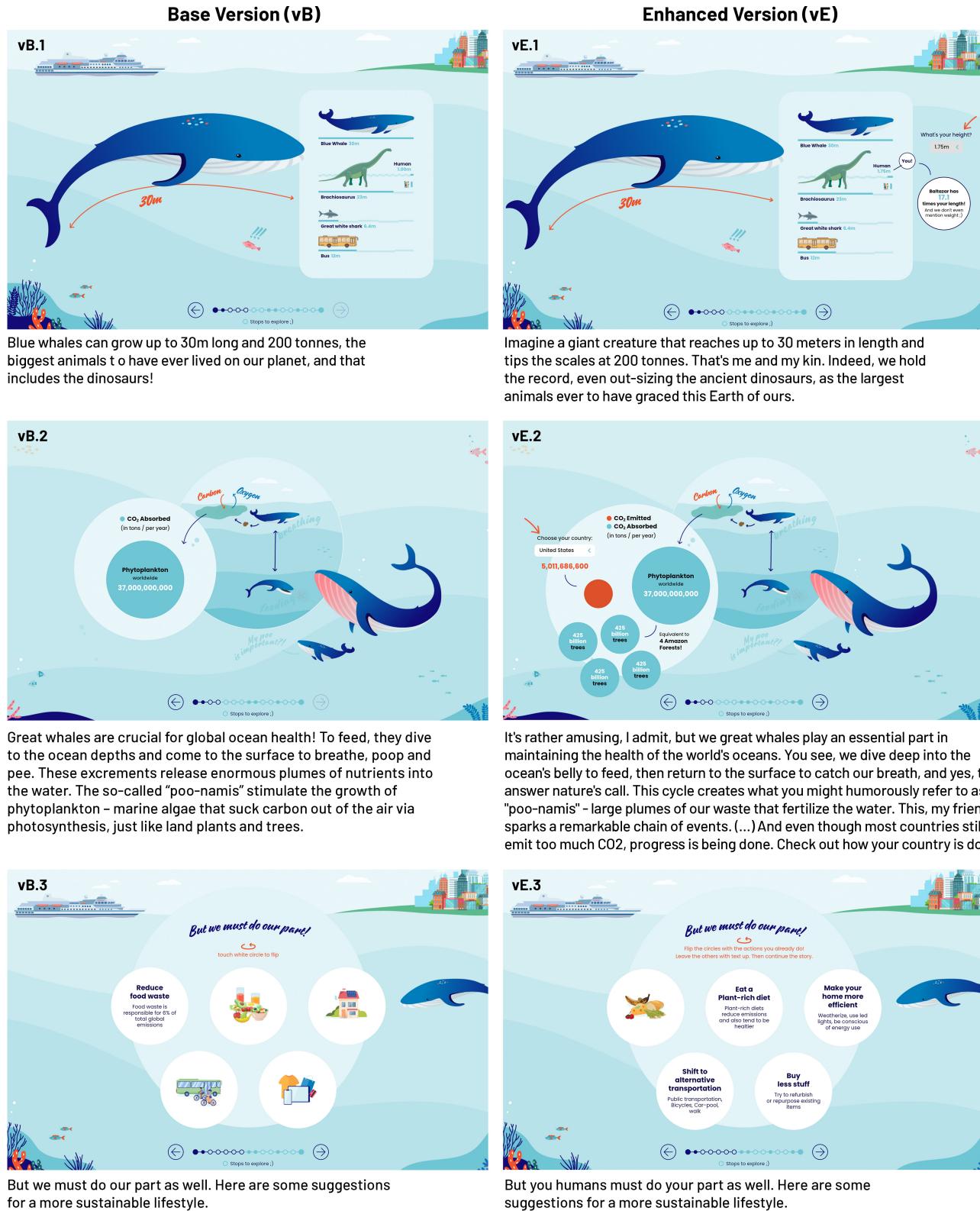


Figure 2: Three screens from the data-story comparing the Base version (vB) and the Enhanced version (vE) with narration script below each: base version versus AI enhanced). vE.1: the user can input their height. vE.2: the data is compared to more familiar metrics and the user's country. vE.3: asks the user to flip only the actions they do, so the remaining are showcased in the reminder at the end of the experience.

of vB through his first-person perspective (Fig.2). Besides the narration, we also used the LLM to allow users to "chat" with Baltazar at the end of the experience (Fig.3 – vE.4). These narrative strategies were designed to amplify empathy and deepen user connection with the data through another tool to further explore the content. Some limitations of these approaches are debated in the Discussion as we acknowledge the challenge of representing more-than-human entities through these human-made features and perspectives.

- (4) **Positive framing:** Highlighting positive aspects in the data (Fig. 3 – vE.1) and linking to action (Fig.3 – vE.3) to inspire a hopeful outlook on climate change, focused on solutions and connection of the individual and the community with the environment. This version offers personalized solution suggestions based on users' existing practices (collected throughout the interaction with the artefact). The narrative concludes with a summary of potential areas of contribution specific to each participant.

3.3 Participants Recruitment and Demographics

To understand the impact of the chosen strategies, we conducted an in-the-wild study comparing the two artefact versions, vB and vE. The two versions were set up sequentially in the same public space – the atrium of a Creative Hub, where businesses, research and innovation centres reside (Fig.1). Capitalizing on this public location, we casually approached Hub residents and passers-by for participation. Furthermore, we promoted the installation with the local community via email and social media channels. The recruiting phase lasted one week.

Before starting the experience, participants were given an overview of the study, including that it consisted of evaluating the artefact and not themselves and that they could withdraw at any time without consequences. They were then asked to sign a consent form where all this information was detailed, and the researcher's contacts were listed. This study only engaged with adult participants (over eighteen years old). Besides age, there were no other disqualifying criteria.

In total, the study engaged 42 individuals. Participants age distribution is as follows: 18-24 (n=10); 25-34 (n=12); 35-44 (N=15); 45-54 (n=5). Twenty-one users identified as female, nineteen as male, and two preferred not to say. Their education level is distributed as Middle and Secondary School (n=5); Bachelor and Master degree (n=22); and Postgraduate (n=15).

3.4 Procedure and Methods

The study (N=42) occurred over four consecutive days, Monday to Thursday. The first author oversaw the study and conducted the interviews. The study was divided into four stages.

First, the user answered a questionnaire about their demographic information (age, gender, and education level) and prior understanding and relation to climate change topics. Participants were individually assigned to alternate artefact versions (vB or vE). The overall experience took c. 5 minutes for vB and c. 10 minutes for vE. Secondly, after the experience, the user would answer a questionnaire adapted from the Intrinsic Motivation Inventory's (IMI) *Interest/Enjoyment*, *Value/Usefulness*, and *Relatedness* scales [90, 91]. The

questions were selected to assess feelings of interest, usefulness, and relatability towards the data, providing a base comparison between the two versions. The three sets of seven questions each (Fig.4) were randomly ordered and answered on a scale of 1 – Strongly disagree to 5 – Strongly agree. Thirdly, we conducted a short interview (c. 4 minutes), further probing the three engagement aspects explored in the questionnaire and feedback on the strategies used. All participants went through the complete data-story and replied to the questionnaire and the open interview, resulting in forty-two valid answers, twenty-one for each artefact version (vB users: S.B1 to S.B21; and vE users: S.E1 to S.E21).

Lastly, after six months of engaging with the data-story, a subsection of participants (N=19) was probed with an online questionnaire – nine vB users (F.B1 to F.B9) and ten vE users (F.E1 to F.E10). This follow-up aimed to probe users' remembrance of the data, possible changes in perception or habits, and overall relation to the topic. This follow-up half a year later was performed to gain more longitudinal insights into the impact of the experience and the communication strategies used, as suggested by [3]. The online questionnaire was chosen for its ease of deployment and minimal impact on participant's lives. Participants were selected based on their voluntary availability to further engage with the study and answer the questionnaire. The survey questions were designed to provide further data to discuss against the original feedback. Below is a sample of the questions asked:

- Since you did the experience, have you been more attentive to any topic or issue? If yes, which ones?
- Were you motivated to take any action or change any habit? If yes, what changed? If not, why?
- Did you feel connected with the information/story? Why?

One researcher analysed the quantitative output of the scales, while another researcher analysed the qualitative interviews and questionnaires. Results were discussed and agreed upon among all authors, sharing insights and points of view to shape the discussion and contribution of the study.

3.5 Sustainability Considerations

In line with our commitment to sustainable research and given the ongoing discussions surrounding SHCI's role and obligations, we report on the sustainability measures adopted during this study's design phase.

While our research delves into sustainability-related topics, we acknowledge our systems' inherent material and energy consumption. On the energy front, the venue of our study uses solar energy to a certain extent. Nevertheless, we remain contingent on externalities. Going forward, it's pivotal that lab policies take on a more autonomous and adaptable approach towards fueling our digital outputs.

Focusing on the installation's physical aspect, the public display's principal frame is predominantly crafted from upcycled plastic, excluding components like screws, wheels, and screen-mount. This material was procured from a nearby enterprise specializing in repurposing plastic for outdoor constructs. Notably, the adornments can be removed, allowing the structure's reuse in subsequent projects and as a lab fixture. Pre-existing lab resources like the

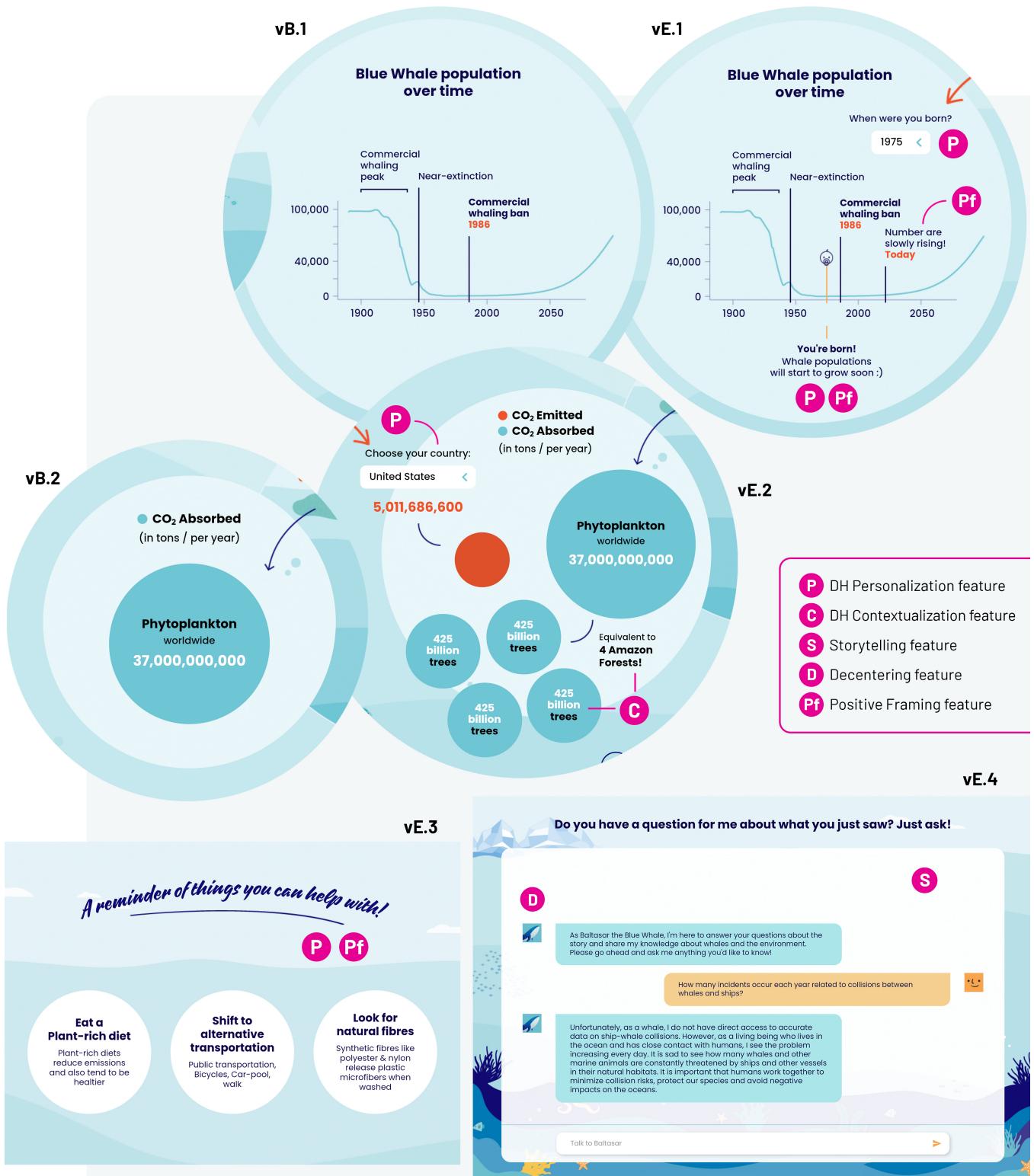


Figure 3: Examples of the data visualisations (details) and the communication features explored. B.1 and B.2: the Base version (B). vE.1: The data-visualisation is personalised through the user's input of their date of birth, the visualisation adapts, and a fact related to sustainability is narrated for that year. Positive data is highlighted. vE.2: Contextualization of the huge global numbers by comparing to more familiar metrics (Amazon forest) and the user's country (Personalization). vE.3: Reminder for action at the end of vE only shows the ones the user doesn't yet do. vE.4: Enhancing the storytelling by allowing the user to "chat with Baltazar".

touchscreen, computer, and accessories were repurposed, eliminating the need for new acquisitions for this project.

4 FINDINGS FROM THE STUDY

In this section, we present the results from our mixed methods study, consisting of: i) the analysis of the Intrinsic Motivation Inventory (IMI) scales [90, 91] (quantitative), ii) the qualitative analysis of the semi-structured interviews, and finally, iii) the qualitative analysis of the post-experience questionnaire.

4.1 Intrinsic Motivation Inventory (IMI) scales

Responses from the IMI questionnaire were organized in a table and analyzed using the IMI scale [90, 91] (Fig.4), with average scores per question and total per scale, per version of the artefact. Answers were given on a scale of 1 – Strongly disagree to 5 - Strongly agree.

The questionnaire's *Interest/Enjoyment scale* results are positive for both versions of the artefact, with 4.56 (vB), and 4.58 (vE) on a 1 to 5 scale. These results indicate that users perceived both experiences as enjoyable and interesting.

The results for the *Relatedness scale* indicating relatability to the data were also high for both versions: vB scored 4.41, while vE scored 4.46.

Finally, the *Value/ Usefulness scale* questionnaire results point to users seeing the information as useful. vB scored 4.13, and vE had a slight edge with a score of 4.36.

4.2 Semi-structured Interviews

The interviews were thematically analyzed according to [12]. To address the study's exploratory aim, the first author started by coding the interviews through utterances that indicated: a) users' interest in the data, b) users' relatability with the data, and c) users' expressions about the usefulness of the data. Following the data coding, all authors discussed and agreed on clustering the information into higher-level themes. In the following, we present the themes highlighted in this analysis.

4.2.1 Novelty of the Topic – Ocean/Whales Data.

The theme of *Ocean/Whales Data* as a topic of interest was mentioned by most users (n=40). These comments were frequently linked to the novelty of the data: “*I didn't know that whales absorbed carbon and that this influenced global warming.*” (S.B5); “*The CO2 part, how much the whale takes with it. It was new.*” (S.E7). The data-story added perspective to more frequently explored topics: “*I thought because with cows, for example, they also output a lot of CO2. So I was surprised that other animals are, like, actually helpful.*” (S.B16).

4.2.2 Novelty of the Output/Context – Interactive Public Installation.

Likewise, users also positively remarked on the *Originality of the Installation*: “*It was quite creative. I had never interacted with anything like this before...*” (S.E19); “*I think there should be more applications like this.*” (S.E8); “*Maybe the walls, the object [the installation]. It's, for me, a very different object.*” (S.B7). One user focused specifically on how climate change is being communicated: “*The issue of communicating these issues interactively in a common space. It has to be done and it is not being done.*” (S.B4).

4.2.3 Engagement through Interactive Features.

Most users commented that they liked the *Interactive Features*. However, the two versions were perceived differently. The three users from vB discussed what they enjoyed about the communication by focusing on the interactive features: the *ability to control what they read* (S.B12, S.B17), and the *relation of the narration with the interactive elements* (S.B16) – “*I liked those little pieces of paper that were rotating and I think it was really cool. I only see it if I want to.*” (S.B12). On the other hand, comments from users of vE focus on the communication of information being *well presented* (S.E14, S.E15), *immersive* (S.E4), and *leading to better understanding* (S.E8, S.E19, S.E20). These features led them to *want to explore or know more* (S.E4, S.E13). For example: “*I think what is being looked for here is a way to captivate more and interact more and not just show numbers and things like that. (...) I think it makes the data more immersive.*” (S.E4).

Differences related to perceived interest were noted between the two versions when discussing data presentation features, with vE users linking the interactive features to a deeper sense of engagement and curiosity.

4.2.4 Relatability Through the Overall Experience.

The interview analysis resulted in 64 comments connected to relatability with the data, with most of the comments being from users of vE (n=40), compared with vB (n=24).

Users from vB felt the data was made relatable through a variety of features: *the Information* (n=3); *Suggestions for action* (n=3); *Audio narration* (n=2); *Narration and visuals* (n=2); *General interactivity* (n=2) or the *Visuals* (n=2). In general, these comments tend towards generic aspects, such as the relation with the climate topic and its relevance nowadays, the narration as an important factor to connect them to the data, or seeing the proposals for action as a connection thread to their day-to-day. Interactivity and the visuals are also commented upon, but users do not describe what they particularly enjoyed about these aspects. Nevertheless, these features effectively made the data relatable, as shown by the scale results.

Users (S.B7 and S.B9) also appreciated the metaphor of whales as floating trees. This points to the importance of metaphors and analogies to assist users in interpreting the meaning of the numbers.

4.2.5 Relatability Through Personalization and Contextualization.

Comments by users of vE when replying to what made the data relatable cluster around three main themes: *Personalization* (n=15); *Contextualization* (n=7); and the *Visuals* (n=7). Here we see a clear contrast with vB answers described in the previous section. Two of these three themes are based on data humanism principles. We separated the comments into Personalization and Contextualization, but to note some of these comments relate simultaneously to both features. These clusters are followed by *General interactivity* (n=4), *Audio narration* (n=2), *Suggestions for action* (n=1), and the *Information* (n=1). Finally, two comments say it wasn't any particular aspect but the *Experience or story as a whole*.

Personalization features were mentioned as the most compelling. Certain expressions highlight the user's positive reactions to these features: “*that's cool, because the information is surprising (...) I wasn't expecting it*” (S.E3). Some comments illustrate a deeper and more personal connection with the data, as one user puts it “*by introducing these personal elements, you apprehend the information*

Version	Interest/Enjoyment Scale								Total
	I enjoyed this experience very much.	This information was fun to learn about.	I thought this was boring information.(R)	This information did not hold my attention at all.(R)	I would describe this information as very interesting.	I thought this information was quite enjoyable.	While I was interacting with the information, I was thinking about how interesting it was.		
vB	4.52	4.48	1.38	1.71	4.76	4.71	4.52	4.56	
vE	4.76	4.81	1.33	1.76	4.71	4.43	4.48	4.58	

Version	Value/Usefulness Scale								Total
	I believe this information could be of some value to me.	I think that this information is useful for learning what I can do about climate change.	I think this experience can help me relate climate change to my day-to-day life.	I would be willing to do this again because this information has some value to me.	I think this experience could help me to understand what I can do related to climate change.	I believe this information could be useful to my daily life.	I think this is important information for me personally.		
vB	4.10	4.43	4.00	3.95	4.24	4.05	4.14	4.13	
vE	4.48	4.48	4.29	4.19	4.38	4.19	4.52	4.36	

Version	Relatedness Scale							Total
	I felt distant to this information.(R)	I doubt that this information is relevant to me personally.(R)	I feel like I could really relate to this information.	I'd like a chance to interact with this information more often.	I don't see the point of interacting with this information in the future.(R)	I don't feel like I could really connect with this information.(R)	It is likely that this information is relevant to me. I feel connected with this information.	
vB	1.24	1.57	4.29	4.24	1.48	1.48	4.14	4.41
vE	1.48	1.52	4.38	4.14	1.05	1.43	4.19	4.46

Figure 4: Table with questionnaire results for the Intrinsic Motivation Inventory scales [90, 91], with average scores per question and total per scale, per version of the artefact. Answers were given on a scale of 1 – Strongly disagree to 5 – Strongly agree.

in an even deeper way." (S.E15). These features assisted in putting the data into perspective by comparing it to themselves: "*and the date of birth part gives you a point of comparison with yourself.*" (S.E14); "*The fact that it also asks for our input helps us relate to the information that is on the screen. Because, like, when we have to put our height, for example, our year of birth, it's like it forces us to create a relationship with the information.*" (S.E15). Likewise, by making the user part of the data-story: "*Putting in your data, I think it helps you relate. (...) It's about connecting you and what is being said.*" (S.E10); "*The elements that have to do with me, that is, age, height, which in some way bring me more into the information.*" (S.E3).

Users mention contextualization as helping to give meaning to the numbers: "*I think that visualizing the numbers, for example, visualizing the size of the whale, it's interesting to have an idea of what 30 meters are compared to a bus.*" (S.E9). Contextualization also assisted in showing new angles about the topic: "*Yes, puts things into perspective. We don't live isolated and are in an ecosystem.*" (S.E8); "*Contextualization. That is, given global numbers, for example, CO2 emissions, how could this help?*" (S.E15).

4.2.6 Lack of Connection with the Data.

To note is the clustering of users to whom nothing connected them to the information (n=7), mostly from vB (n=6): [feeling connected to the data] "*No, nothing that specific.*" (S.B8). Three users from vB point to the importance of storytelling in relating to the data and the *Experience or story as a whole* being the reason for a relation with the information, not a particular feature: "*I don't know, there's no special part. I liked the graphics, I liked the colours.*" (S.B14).

Throughout the interviews, some users made suggestions for improvements to the experience. Notably, users from vB pointed to

the need for strategies that made them closer to the information, through comparisons to other metrics – e.g. "*When you say 33 tons (...) it's such a big number. That's the same as, like, however many thousand? Compared to some more relatable number.*" (S.B6) – or linking to more personal issues – e.g. "*There was nothing special that made me put myself there.*" (S.B3).

These clusters highlight a clear difference between vB and vE, with a subset of users, almost exclusively from vB, commenting on a lack of connection with the data and suggesting improvements for better relatability.

4.2.7 Data Perceived as Useful.

The coding process resulted in three main clusters for "degrees of usefulness" derived from users seeing the information as: 1) Not particularly useful; 2) Somewhat useful; and 3) Useful.

Most users thought the information was useful to them (n=22) – vB n=9, vE n=13. We grouped them into five themes: i) *Suggestions for Action* with users (n=7) finding suggestions useful for their daily lives; ii) users (n=6) associated usefulness with *Information about the ocean and whales* – for example, giving a holistic sense of environmental issues or being surprised by the importance of these marine ecosystems; iii) users (n=4) who *Learned new information or gained a new perspective*; iv) *Reinforcing current knowledge or actions* (n=3); v) users (n=2) who found the information *Good to know in general*. All users but one from vB fall within the first (n=3) or second (n=5) clusters, while users from vE are more distributed, again showing more heterogeneous responses.

A few vB users didn't think the information was particularly useful for two main reasons: i) already being *familiar with the information* (n=3); and ii) *feeling disconnected* from it (n=1): "*This is*

a lot of things I already knew and things I already do in my daily life. So it's not useful, for me personally, not." (S.B3).

The remaining users (n=16) fell in the middle, finding the information useful to a certain degree. The majority (n=9) replied that they *Already knew the information* (or most of it), but they still think it is useful or they still learned something. The remaining users thought the information linked to *Current behaviour* (n=3) or was *Useful with limitations* (n=4). These limitations were mostly connected to finding the proposals for action insufficient or with a limited range.

4.2.8 Actionable Suggestions for Daily Life

Connected to data usefulness, another cluster highlights suggestions for action users mentioned throughout the interviews. Forty-five comments mentioned actionable communication. The themes highlighted the following: *Fibres* (n=12); *Plastic/Recycling* (n=12); *Consumption* (n=9); *Transportation* (n=5); *Ocean tourism* (n=4); *Food* (n=2); and *Energy* (n=2).

Users from vE commented on "actions" more often (n=31) than users from vB (n=15), focusing on "useful" suggestions, i.e. actions to improve (n=33) when compared to mentions of actions users already do or feel are hard to implement (n=13). This result aligns with seeing the interactive artefact overall as useful and connected to users' daily lives: "*Yes, of course. Reinforcing. The information you already knew and, above all, try to continue to change habits.*" (S.E6); "*Yes. So there are some tips that people can, actions that they can take in their lives. These are easy things.*" (S.E9).

4.3 Engagement with the AI Live Dialogue Feature

The end of vE included the possibility of initiating dialogue with the main whale character, Baltazar, through an LLM. Seven of the twenty-one users actively used the "chat with Baltazar" feature. However, none of the users mentioned this particular feature in the interviews. Users asked fifteen questions, eight were related to the information in the story – e.g. "*How much CO₂ do you have in your body?*" (S.E15); "*How many incidents occur a year because of collision routes between whales and ships?*" (S.E8). One regarded whales in general – "*Do whales have predators?*" (S.E9) – while four connected to Baltazar – e.g. "*How are you?*" (S.E7); "*How old are you?*" (S.E19). The remaining two questions were grouped as "Exploratory" as we saw them as users testing the system's creativity – "*Who is your creator?*" (S.E9); "*What is whale heaven like?*" (S.E13).

4.4 Post-experience Questionnaire

4.4.1 Ocean/Whale Data Recollection.

Nearly all of the nineteen users mentioned whale or ocean data (n=16), generating 28 comments expressing interest, especially in *interspecies relations* (vB n=5, vE n=4): "*I pay more attention to the marine environment and the relationship between the ocean and me.*" (F.B6); and the *carbon/oxygen cycle* (vB n=2, vE n=5): "*I think of whales when talking about carbon capture.*" (F.E4). Comments highlighted increased marine environment awareness and whale empathy, along with whales' positive impact on CO₂ consumption. Other topics included *whale ecosystem benefits* (vB n=2, vE n=3) and *human impacts on climate change* (vE n=3).

4.4.2 Attentiveness to Topics/Issues.

Eight users reported no change in attentiveness post-experience (vB n=5, vE n=3), while eleven users noted an increased focus on *whale/ocean topics* (vB n=1, vE n= 3): "*I became very curious about the role played by whales in helping circulate nutrients in the ocean.*" (F.E8); *actions* (vB n=1, vE n=3): "*Yes, especially regarding buying clothes with the less amount possible of polyester.*" (F.B4); and the *topic in general* (vB n=2, vE n=1): "*I have been more attentive to news about climate change.*" (F.E7).

vB users mostly reported no increased attentiveness, with a few citing general topics. In contrast, attentive vE users mostly focused on specific issues like whale/ocean conservation and actions, showing a difference in engagement between the two groups.

4.4.3 Data Relevance.

Most users found the information generally relevant (vB n=8, vE n=7): "*Yes, it is always relevant to understand the impact of life on life.*" (F.B8). A few connected it personally to their actions or awareness (vB n=1, vE n=3), though without specifying individual connections: "*Yes definitely, even if only to make me aware of this topic.*" (F.B4). The difference between the two versions is subtle, with users of vE showing a slightly more pronounced tendency to mention more personal reasons.

4.4.4 Connection with the Data.

Most users reported feeling connected to the information or story (n=16), with only three exceptions (vB n=1, vE n=2). Four attributed their engagement to the compelling narrative and visual elements (vB n=2, vE n=2). Three users had a previous connection with the themes presented (vB n=1, vE n=2), while three others were drawn to specific content such as whale and ecosystem information (vB n=2, vE n=1). Personal connections were also mentioned, including how the information related to *actions proposed* (vB n=1): "*I think some of the more concrete examples were very easy to map into my day-to-day life, it helped me feel connected.*" (F.B2); *geographical connections* (vB n=1, vE n=1): "*Above all, the Portuguese connection to whaling and, more recently, tourism associated with whale watching.*" (F.E4); and the *personalization features* of the story (vE=1): "*Yes, especially when they ask about age, height and weight and put us in context with the history of whales and create empathy with this type of animal.*" (F.E3).

Besides the two vE users that specifically mention more personal metrics, there is no clear difference between the two versions.

4.4.5 Inspire Action.

Nine users reported no habit changes post-experience, seven attributing this to already sustainable habits (F.B5, 6, 8; F.E6, 9), lack of new actionable insights (F.E4), or perceived lack of influence (F.B3, F.E6). Two users felt the experience reinforced existing behaviours (F.B2; F.E3). Eight users did note changes or heightened attention to behaviours: "*The use of plastic in clothes and in other unexpected places.*" (F.E2); "*I've paid particular attention to anything related to food or all sorts of product consumption for a while.*" (F.E8). These actions were categorised as: *Consumerism* (F.B4, 7; F.E2, 8); *Plastic in Fabrics* (F.B4, F.E2, 10); *Water Pollution* ((F.E1, 8); *Food* (F.E8), *Waste* (F.E7), and *Knowledge* (F.B8).

4.4.6 Motivating Conversations.

Five users did not discuss their experience afterwards (vB n=3;

vE n=2), citing reasons such as lack of opportunity (F.B6, F.E5), not remembering (F.E9), or simply not having engaged in such conversations (F.B1, 9). In contrast, the majority did engage in discussions – three with colleagues (F.B3, 5; F.E3) and the remaining talking about the information to friends and family (F.B2, 4, 7; F.E1, 2, 3, 4, 6, 7, 8, 10): *"I did share some more curious aspects of it with my family."* (F.B7); *"I remember talking to my sister about the thing that we learned from having the whale die."* (F.E6); *"With friends and family about microplastics."* (F.E10).

5 DISCUSSION

With the present research, the authors extend on the call to rally around the complexity of *climate change* [62], and the need for diverse solutions and perspectives. Echoing Han and Khanduja [50], we also *"believe new ways of visualizing data and storytelling with new media technology will have an impact on the public for their better understanding of climate change"*. The current study examines specific communication strategies through HCI for climate change engagement, investigating their potential to enhance understanding and connection with a hyperobject.

Results from the IMI scales were cross-referenced with the interviews and post-experience questionnaires to evaluate the progressive influence of data humanism, storytelling, decentering the human in the narrative, and positive framing in interactions with climate change data. While both artefacts scored similarly on the IMI scales, the interviews and post-experience questionnaires pointed to key differences between the two versions. In the following, we discuss this analysis, the highlighted tensions, and research implications for the design of engaging climate change-related interactions that bridge complex and often impersonal data with lay audiences. Building on recent SIGCHI debates [79], we further the HCI discourse with climate change by exploring novel communication design approaches.

5.1 Engagement and Dialogues by Going Beyond Presenting Facts

We built on the implications for design proposed by [39] derived from gaps found in previous climate change interactions. Our study results point to these implications assisting in generating curiosity and engagement with the experience. The interview results support the outcome of the IMI scale in picking interest in both versions of the artefact. As demonstrated by [3], engaging users in less-explored contexts was highlighted as relevant. The unexpected placement of the interactive physical installation in a public setting triggered a sense of curiosity that helped with engagement. Likewise, the clustering around the topic's novelty points to an enhanced engagement through this less-known subject. It also highlights the importance of presenting less familiar information when discussing climate change.

Results from the interviews and questionnaire suggest that users from vE had a deeper interest in the information through positive framing and a more-than-human narrative. Linking lay audiences with climate change data through emotional engagement has been successfully explored in HCI, despite the challenge of balancing accurate data and visual presentation [3]. We navigated these tensions by presenting the data and the consequences of the Anthropocene

through a nature-focused lens, positive framing and a story of resilience.

The number of users who mentioned having conversations with friends and family after the experience was particularly encouraging to show engagement. It is noteworthy that most of these users are from vE. This result validates the apparent enhanced interest in the data shown by vE users in the interviews. Building on previous research that worked towards enhancing engagement with environmental data through community [3, 28, 67, 84] or more personal [99, 108] connections, our work points to possibilities for HCI research to help address much-needed conversations about climate change in our everyday [6]. We created a story beyond data as numbers by adding context and creating an emotional connection with what was being showcased.

5.2 Towards Human-Scaled Climate Change Interactions

The scale and complexity of climate change – a hyperobject [80] – makes it difficult to connect to our daily experiences. The challenge becomes presenting it on a relatable human scale that transforms it from overwhelming phenomena to solvable problems where we feel we have some agency to affect change. Throughout this study, we explored the importance of "humanising" the data by linking complex data sets to local contexts and personal experiences, aligning with recent climate change communication guidelines that call for making climate data "relatable, local and personal" [82].

Our study showed that making climate data more relatable by personalizing the interaction and linking it to individual experiences can enhance engagement. The interview's qualitative insights point to vE leading to stronger data relatability thanks to the more contextualised data (e.g. personalised and situated metrics). Users commented on the effectiveness of seeing how the data related directly to their own lives. This approach to data interactions leads to a meaningful experience for the user [113].

Likewise, the suggestions for improvements to the experience by vB users highlight the importance of data humanization, creating connections between the person, their experiences, and the data. Data humanism has the potential to enhance data connections and assist in communicating a *hyperobject* in a manageable scale, but post-experience results suggest that further exploration is needed to extend it to longer-term engagement.

The feedback by users six months later shows limited differences between vB or vE users' relatability with the data. However, it is positive that vE users mentioned personalisation aspects, such as relation to their country (F.E3, 4) and their height and age (F.E3), many months after one brief interaction. The challenge becomes how to sustain the enhanced relatability shown by vE users after the experience, continuing to translate complex global data into a relatable and understandable human-scale.

5.3 Empowering Actionable Communication

Acting to mitigate the consequences of climate change is more pressing than ever. However, previous HCI research seldom proposes action or solutions through climate change interaction projects [39, 40]. Our study has demonstrated the importance of a positive framing and an action-focused narrative.

The interviews indicated that vE users perceived the information as more valuable than vB users. The sense of usefulness and its connection to people's daily lives largely came from the call for action proposed throughout the data-story, adapted to user's current habits in vE. In the post-experience questionnaire, most vB users ($n=6$) reported no habit changes or reinforcement of existing behaviours, similar to half of vE users ($n=5$). However, a notable variation between the two versions was observed in the diversity of mentions of types of actions, with vB users mentioning three and vE users eight. This greater variability in actionable applications points to a deeper engagement and broader practice changes among vE users. These results align with the more profound sense of usefulness in vE seen in the interviews.

Users mostly commented positively on the proposals for action but debated their usefulness and limits. We argue that this open debate is important for productive climate dialogues and an important tension to consider in future applications.

5.4 A Step Towards Posthumanistic Perspectives

The SHCI community has called for diverse perspectives and climate change narratives, such as more-than-human cohabitation [95] and collective relations to nonhuman actors [44]. We have built on this research by exploring communication strategies that decenter the human in the narrative. Previous work has explored how human-defined concepts like time determines human-nature relations [95]. The challenge becomes questioning these human-centric notions and opening up to alternative conceptions of time and space. Cohabitation demands from humans the understanding that they are not "apart" or "superior" to nature but instead are just one part of a diverse and complex system. Our experiment points to storytelling and decentering communication strategies working towards more inclusive perspectives and a sense of inclusion in a broad, global ecosystem. The exploratory work done in urban gardens by [110] underscores the importance of improving human-nature relations through design by highlighting interdependencies. Our study builds on these experiments by evoking empathy and a sense of global responsibility that is an encouraging step towards posthumanistic stances. We were particularly encouraged by users' comments in the interviews about gaining a more holistic understanding of our global shared ecosystem. These insights were corroborated in the post-experience questionnaire, where the generalised comments related to ocean and whale information pointed to a raised consideration for the more-than-human, the entanglements between humans and marine ecosystems, and human effects in natural environments. Klein argues that the changes needed to respond to the climate crisis are an opportunity to re-assess our relationships with each other and with nature [61]. This research not only linked climate data with users on an individual level, but it also connected them to a sense of global belonging that includes non-human actors.

5.5 Reflections on LLMs for More-than-human Representation

The use of AI-powered models assisted in bringing the global scale of climate change to the individual sphere of each participant through personalised date and location information. Furthermore,

we used the LLM to breathe life into the whale character by adapting the narration to "his" perspective and allowing a dialogue between this entity and the user. The AI Live Dialogue feature was meant to satisfy the curiosities of the users while improving engagement with the information and building empathy with the non-human story protagonist.

A few users engaged with the LLM chat feature, pointing to a need for better integration with the story. However, most of them used the chat to delve deeper into the topics communicated – a promising result considering the main purpose of developing deeper interest and engagement with the data. Furthermore, the exploratory questions demonstrate the user's curiosity about the tool and point to interesting avenues for exploration. Future experiments should integrate such a feature more carefully into the story. Crafting engaging narrative hooks is essential to ensure user participation, especially towards the end of the experience. Designing AI prompts that maintain the character's story and personality is crucial. These conversations with the character, in crucial points throughout the story, could link more clearly to each data set and enhance engagement with the tool.

AI-powered conversations between humans and more-than-human characters can be explored to inspire empathy and posthumanistic perspectives. We acknowledge that using AI systems to give voice to more-than-human entities could be problematic as "AI technology itself imports a traditional, humanist form of logic" [109]. Building on the challenges posed by [58], we tried to work through the discomforts of designing in the intersections of human and non-human relations. The use of these systems demands a careful critical lens. Besides the dangers of possibly spreading misinformation [118], one needs to consider which perspectives are represented or what stereotypes might be inadvertently reinforced, depending on the information the LLM uses or is fed with. Also, one should question how these systems can help represent more-than-human entities since this information is human-made and inevitably carries a human perspective. This work is an initial experiment at using, in particular, storytelling and an attempt at decentering the human in the narrative to work through these tensions. We look forward to further delve into how these tools can be harnessed in this urgent context to enhance the sense of personification and empathy with a non-human character.

5.6 Future Directions

Besides the above suggestions related to LLMs, we point to other directions for future exploration derived from the insights discussed.

Considering the need for long-term engagement after the experience, strategies for deeper personalisation and more continuous connection are promising avenues to explore. For example, we see the great potential of AI for further personalised engagement.

One aspect to note in our study is using a large touch-screen display to convey the data-story. This mode of interaction can impact the user's engagement with the data. As discussed in 3.5, this output was used because it was already available in the lab and required no new purchases. Also, it was appropriate for a public display instead of having users engage with the story with a more common but less practical mouse and keyboard. Nevertheless, the nature of the communication strategies and interactive features allowed

for using these “more common” modes of interaction. Future work should test whether user engagement changed with other outputs and contexts.

The success of the action-focused strategies to empower users, particularly in vE, but also their criticised limited range led us to envision future work that explores a broader set of proposed solutions and uses deeper personalisation strategies to connect users with actions that are appropriate and stimulating to each person. Users tend to focus on what they already know and do, even when they mention that they learned something and will start to pay attention to it (e.g. S.B2, 10, 12). Interactive strategies focused on more personal data connections can assist in linking to less obvious and more impactful suggestions, for example, by allowing users to “zoom in” on what interests them and what they can help with, including within their particular communities. These experiences can assist people to “find joy in climate action” [57]. Furthermore, such features can help address the largely debated challenge of engaging lay audiences with broader social change (besides individual behaviour) [11, 14, 76] also mentioned by [41]. The current study also faced the difficulty of connecting users with actions outside their personal frame of influence as they feel they have no agency in such matters. Future work should continue to explore strategies to narrow this gap, for example, by promoting civic engagement [30] through adapted suggestions that still feel relevant to an individual actor. The HCI and Design communities can further develop interactive systems with a strong social component [64] that connect to community and global challenges. This is no small feat, but only through experimentation and testing can we hope to contribute to this global challenge.

6 CONCLUSION

This research explores the crucial intersection of climate change communication and HCI, demonstrating how thoughtful communication strategies and intricate design elements influence users’ engagement and perception of data-centric content for climate change. By contrasting two versions of an interactive narrative through a mixed-methods study, we shed light on the tangible benefits of introducing data humanism allied with storytelling, decentering the human in the narrative, and positive framing into HCI design – chiefly regarding its potential to enhance engagement, lead to posthumanistic perspectives, inspire productive dialogues and influence action.

The implications for the HCI community include filling a pivotal gap in the literature and emphasizing the importance of key communication strategies in creating engaging and relatable user experiences for communicating complex hyperobjects like climate change, particularly pointing to paths of making climate data more actionable and human-scaled. The presented communication and interaction pathways offer new models of how climate change engagement can be explored and the role of digital technologies within these exchanges. We hope that our contribution potentiates ever greater, and more efficient, engagement with climate change topics through HCI.

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