

Beyond Visual Design: Rethinking Persuasive Data Storytelling to Address Wicked Problems

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Figure 1: Human and contextual considerations beyond visual design that shape persuasive data storytelling for wicked problems.

ABSTRACT

Data visualisations and stories that integrate analysis, visual artefacts and narrative are increasingly recognised for their persuasive potential and ability to influence decisions, behaviours, choices and attitudes. As such, they are used in the communication of complex societal challenges, including wicked problems such as climate change. Existing research on persuasive data visualisation and storytelling has largely focused on visual aesthetics and design, while paying less attention to broader human and contextual factors that shape persuasive impact. Reflecting on findings from a systematic literature review of 54 empirical studies, this paper argues that if data visualisation and storytelling are intended to influence audiences to engage with and address wicked problems, they must move beyond visual design and give greater attention to: audience predispositions; engagement and participation; credibility and trust; and, framing and actionability. The paper concludes by reflecting on actions to support ethical, persuasive data storytelling for future research and practice.

Index terms: Human-centered computing, visualization, visualization theory, concepts and paradigms.

1 INTRODUCTION

Wicked problems such as climate change require people to make sense of increasingly complex data to support understanding, decision making and collective action. These challenges are shaped by interconnected systems, uncertainty, competing values and no single solution [1]. Addressing them, therefore, requires more than generating evidence; it also requires communicating evidence in ways that diverse audiences can interpret, trust and act upon it.

Data visualisations, such as charts, maps and dashboards, are used extensively in research, industry and government contexts to

communicate complex ideas and shape understanding [2], [3]. Data stories extend visualisation practices with narratives to create intentional communication artefacts. These artefacts present data in a way that is poignant and engaging while also being informative and grounded in data [2], [4]. As a result, data visualisations and stories are increasingly used to communicate complex societal challenges, such as climate change, public health and advocacy against gendered violence [3], [5], [6], [7].

Research emphasises that data visualisations and stories hold persuasive potential, with the capacity to influence decision making and shape behaviours, choices and attitudes at scale [4], [5]. They have been applied ethically to encourage behaviour change, raise awareness, support advocacy, counter misinformation and inform policy discussions [6], [8], [9], [10]. Aesthetics and visual design are vital for effective visualisations. However, persuasive impact is not guaranteed; a visually appealing data story does not necessarily change attitudes, influence decisions or motivate action [5], [11].

Persuasion, therefore, depends on more than the visual characteristics of the communication artefact itself. The Elaboration Likelihood Model (ELM) proposes that persuasion occurs through either thoughtful evaluation of the information presented, known as the central route, or through peripheral cues such as credibility, familiarity and presentation quality [12]. While visual design may support peripheral processing, deeper engagement through the central route is more likely to support sustained changes in attitudes and behaviour [13]. Persuasive impact depends not only on the communication artefact itself, but also on the audience and the context in which it is encountered.

Drawing on a systematic literature review of 54 empirical studies, this paper argues that effectively using data storytelling to address wicked problems such as climate change requires greater attention to the human and contextual conditions that shape persuasive impact. The review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) methodology [14]. Searches were conducted in June 2025 across Sage Journals, Scopus, and Web of Science using terms related to persuasion, behavioural economics, data visualisation, and storytelling. Following screening, 54 empirical studies examining persuasive data visualisation or storytelling were included in the

final corpus. An inductive thematic analysis was then used to identify and iteratively refine recurring patterns related to persuasive impact. The complete corpus of reviewed studies is provided as supplementary material.

The paper considers how persuasive data visualisations and stories are currently being used, before reflecting on four recurring considerations that extend traditional visual design principles: audience predispositions; engagement and participation; credibility and trust; and, framing and actionability (Figure 1). It then outlines practical initial actions to help researchers and practitioners ethically use data storytelling to address wicked problems.

2 PERSUASIVE DATA VISUALISATIONS AND STORIES IN PRACTICE

Data visualisations and stories are being applied across a wide range of fields, including journalism, environment, health and politics. Their use expanded significantly during the COVID-19 pandemic, as governments and health organisations relied on visual and narrative tools not only to communicate complex information but also to influence public behaviour [5], [15], [16]. Similar approaches are increasingly used to communicate climate change, where complex evidence must support public understanding, decision making and collective action [7], [9]. Across the review, three broad applications of persuasive data visualisations and storytelling emerged.

Motivation individual behaviour change: Studies explored how data visualisations and stories encouraged more sustainable and healthier behaviours, for example reducing food waste, promoting physical activity and reducing household energy consumption [17], [18], [19]. These applications sought not only to communicate information but also to encourage audiences to reconsider existing behaviours and make different choices.

Raising awareness and advocating for action: Many studies used data visualisations and stories to raise awareness of complex issues and encourage collective responses. They explored how data visualisations and stories can help audiences understand complex issues and encourage action, for example, in public health, climate action and advocacy against a range of issues [6], [20], [21].

Countering misperceptions and misinformation: Data visualisations and stories are also used to dispel or correct commonly held misperceptions and combat misinformation. Studies have explored their effectiveness in reducing misperceptions on topics such as vaccines and immigration, debunking misinformation through data journalism and shifting attitudes on complex and controversial issues [8], [16], [22].

These applications show the potential of persuasive data visualisations and stories to shape how audiences understand and respond to complex societal challenges. This is particularly relevant for climate change, where communicating scientific evidence alone is rarely sufficient to support public understanding, informed decision making and motivate collective action.

Persuasive impact depends not only on the design of data visualisations and stories, but also on broader human and contextual considerations that shape how audiences receive, interpret and act on the information. The following section reflects on these considerations and considers their implications for persuasive data storytelling aimed at addressing wicked problems.

3 LOOKING BEYOND VISUAL DESIGN

The systematic literature review identified four recurring human and contextual considerations that impact the persuasiveness of data visualisations and stories beyond visual design. These are not presented as fixed rules, but as interrelated considerations for designing data visualisations and stories intended to influence understanding, decisions and action.

3.1 Audience predispositions

Data visualisations and stories reliably support understanding, but they do not influence all audiences equally. This review suggests that designers of persuasive data visualisations and stories must consider not only who their audience is, but also what their audience already knows, believes and values. Persuasive impact is shaped by audience predispositions, including prior knowledge, existing beliefs and attitudes [16], [22], [23]. For example, in a study of environmental communication, responses to pro-environmental infographics were moderated by audience characteristics such as learning preferences and visual literacy [13]. Audiences with weaker prior attitudes or lower levels of knowledge were generally more open to persuasion, whereas those with established beliefs were more likely to resist, reinterpret or discount new information, particularly when uncertainty was communicated alongside the data [22], [24]. Studies in journalism and media demonstrate that data stories can reduce misperceptions and counter misinformation when they provide clear, contextualised and well-sourced information, particularly for audiences with lower prior knowledge [8], [16]. Persuasive impact depends not only on the data story itself, but also on who the audience is, what they already believe and how they process new information. Understanding audience predispositions should be considered a fundamental activity in the design process of creating a data visualisation or story.

3.2 Engagement and participation

From the review, engagement, participation and personal relevance consistently shaped how audiences connected with and responded to data visualisations and stories. Interactive, personalised and participatory approaches can increase engagement and influence by enabling audiences to relate the information to their own experiences [6], [25], [26]. Participatory and vernacular approaches, where individuals collect and/or visualise their own data, have been shown to increase engagement, motivate action and, in some cases, sustain behaviour change over time [10], [17], [19]. Several studies suggest that interactivity and gamification, particularly when combined with narrative and personalisation, may strengthen persuasive impact. For example, a climate change intervention combining data visualisations with an interactive narrative enabled audiences to explore climate actions and their consequences, increasing behavioural intention to mitigate climate change [7]. By increasing empathy, some audiences were more likely to perceive issues as important and to indicate support for policy change [26], [27]. Overall, persuasive data visualisations and stories are more effective when audiences can actively engage with, relate to and, where possible, participate in the data process. Therefore, persuasive data storytelling should move beyond passive communication towards approaches that actively involve audiences in making meaning from data.

3.3 Credibility and trust

Credibility and trust consistently emerged as important influences on persuasive impact across the reviewed studies [23], [28], [29]. Persuasive data visualisations and stories rely on transparent data sources, perceived authority and professional presentation to establish trust. For example, audience interviews examining COVID-19 data visualisations found that perceived trustworthiness extended beyond the visual form itself to the content and context in which the visualisation was encountered [29]. While incorporating visualisations alongside text can enhance perceived credibility [23], [28], aesthetically pleasing designs do not necessarily increase trustworthiness [30], [31], [32]. Instead, persuasive impact depends on audiences having confidence in both the presentation of the evidence and those communicating it. Trust should therefore be

treated as an intentional design consideration in the creation process of data visualisation and stories.

3.4 Framing and actionability

The way information is framed and the extent to which it is actionable also influenced its persuasive impact [5], [15]. An actionable and locally relevant approach strengthens the persuasive impact of data stories and can be extended to broader topics and collective issues [10], [11]. For example, research on household food waste found that audiences wanted both evidence of the financial and environmental benefits of changing their behaviour and clear steps they could take to reduce waste [17]. Data visualisations and stories were generally more persuasive when they employed a holistic-localist framing, that is, they connected broader issues to local or personal relevance and communicated achievable actions alongside the evidence [5], [11], [18], [19]. Persuasive impact is strengthened when data visualisations and stories go beyond simply communicating the scale of a problem. Effective data visualisations and stories frame information in ways that support understanding, decision making and action by helping audiences recognise both why an issue matters and what can be done in response.

3.5 Interpreting the considerations

Viewed through the ELM, the interrelated considerations illustrate how persuasive data visualisations and stories engage in both central and peripheral routes to persuasion. These findings suggest that persuasion emerges through the interaction between the communication artefact, the audience and the broader context, rather than through visual design alone. Audience predispositions, engagement and actionability generally encourage deeper cognitive processing and evaluation of information, while credibility, trust and framing largely shape responses through peripheral cues such as presentation, affect and perceived authority [12]. Importantly, these considerations do not operate independently or exclusively within a single route. Rather, they interact to influence how audiences interpret, evaluate and respond to information overall.

Persuasive impact arises not from any single feature of a data visualisation or story, but from the interaction between the communication artefact, the audience and the context in which it exists. For wicked problems such as climate change, this highlights the need to look beyond visual design and focus on broader human and contextual considerations that shape persuasion when using data visualisations and stories to communicate information, influence decision making and motivate action.

4 ACTIONS FOR CLIMATE DATA STORYTELLING

The identified considerations point to several practical actions for researchers and practitioners when designing persuasive climate data storytelling. These actions extend, rather than replace, established principles of effective visual design and should be applied with the ethical responsibilities outlined in Section 4.1, recognising that increasing persuasive potential also increases responsibility for how evidence is framed, communicated and used.

Understand the audience before designing the story: Use audience research and testing to identify prior knowledge, beliefs and values, and where additional context or explanation may be required. This is particularly important for climate change, where audiences may hold strong prior attitudes and interpret evidence through existing values, experiences and political identities.

Create meaningful opportunities for engagement and participation: Where appropriate, enable audiences to interact with, contribute to or personalise climate data. Connecting large

scale evidence to local contexts, lived experience or potential consequences can make abstract climate issues more tangible, encourage deeper engagement and motivate behaviour change.

Establish trust through the evidence and its presentation: Make data sources, relevant assumptions and uncertainty visible, and provide sufficient context for audiences to assess the evidence. For climate change, where audiences may encounter complex evidence alongside competing claims, consider the perceived credibility of both the evidence and those communicating it, recognising that aesthetic appeal alone does not make a data visualisation or story trustworthy.

Frame the information to support action. Climate data visualisations and stories should help audiences understand not only the scale and consequences of climate change, but also what responses are possible. Linking evidence to achievable actions at relevant individual, community or collective scales can help audiences understand how they might respond rather than leaving them only with the urgency of the problem.

4.1 Ethical responsibility

Any deliberate attempt to influence attitudes, decisions or behaviour through data storytelling raises ethical questions. The same persuasive strategies can also be used to selectively frame evidence, mislead or manipulate audiences [33]. Ethical persuasive data storytelling should therefore prioritise factual integrity, transparency and audience autonomy, including sufficient context to support informed interpretation and safeguards against misleading framing [33], [34]. This is particularly important for wicked problems, where people may disagree on the evidence, underlying values and appropriate responses. Persuasive effectiveness should therefore be considered alongside how influence is achieved and whether audiences retain meaningful agency in interpreting and responding to the evidence.

5 CONCLUSION

As data visualisations and stories are increasingly used to influence responses to wicked problems such as climate change, greater attention is needed to the conditions that shape their persuasive impact. Effective visual design remains essential, but persuasive outcomes are influenced by what audiences already know and believe, how they engage with the data and process, whether they trust the information and if they can see a pathway to action.

The considerations and initial actions presented in this paper provide a starting point for broadening the understanding, design and application of persuasive data visualisations and stories. They argue that persuasion is shaped through the relationship between the data visualisation or story itself, the audience encountering it and the broader context in which it is received. This broader perspective may help persuasive data storytelling better support informed decision making and collective responses to complex societal challenges such as climate change.

Future research should further develop these considerations and initial actions into more specific guidance and investigate how they operate across different audiences, settings and societal challenges.

SUPPLEMENTAL MATERIAL

The supplemental material provides the full corpus of 54 empirical studies included in the systematic literature review and additional information on the search and screening process.

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