

Just-in-Time Data Literacy Through Conversational Data Comics

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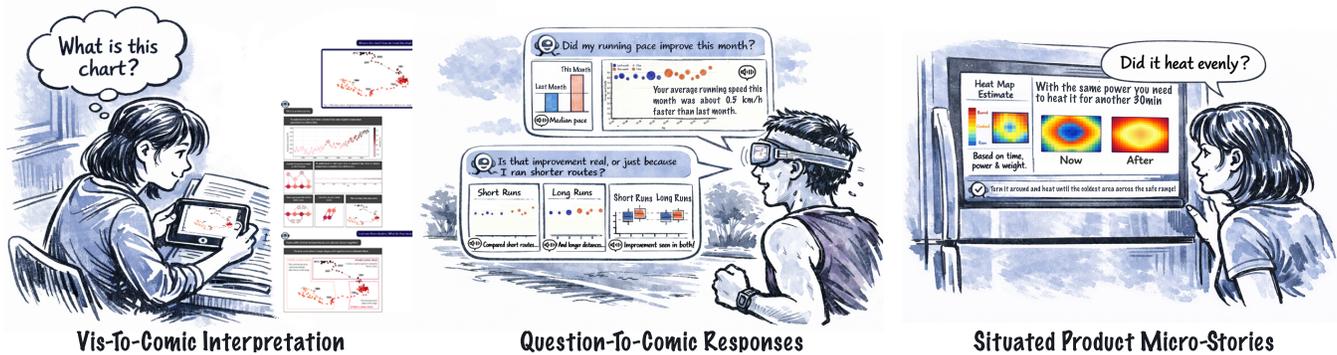


Figure 1: Three example conceptual scenarios of conversational data comics: Vis-to-Comic Interpretation, Question-to-Comic Responses, and Situated Product Micro-Stories.

Abstract

Conversational systems increasingly mediate how people encounter data, yet most still respond with text or single charts that offer limited support for data visualization literacy in real contexts. We propose the concept of *conversational data comics*: system-generated comic strips that answer questions, interpret uploaded charts, or explain situated data through paced panels combining visualizations, annotations, and visual metaphors. We define the concept, distinguish it from adjacent formats, and illustrate three scenarios: vis-to-comic interpretation, question-to-comic responses, and situated product micro-stories. We then outline a research agenda on in-context literacy outcomes, multi-turn comic conversational strategies, and mechanisms for faithfulness, uncertainty, and responsible framing.

Keywords

Data Comics, Data Visualization Literacy, Conversational Visualization

1 Introduction

Data literacy is often framed as a divide between trained analysts [10] (researchers, data scientists, visualization specialists, domain experts) and everyone else, even though most real-world data encounters require people to interpret and talk about visual evidence without being data professionals [7].

In this paper, we propose *conversational data comics*: interactive, system-generated comic strips that combine data visualizations with short narrative panels, annotations, and visual metaphors in response to people's questions, an uploaded chart, or data captured in the moment. Like a chatbot, yet instead of returning a single

chart or a block of text, the system responds with a small sequence of panels that explains what the visualization shows, how to read it, and what the data means in context.

This concept matters because data literacy is increasingly situated. People encounter data visualizations in contexts where they did not design the visualization, lack domain background, and have limited time to interpret. The need is even more acute in on-the-go settings involving immersive analytics [13] and situated visualizations [4] with wearables, IoT systems, and extended reality (XR) devices, where attention is fragmented, and decisions are made in seconds. In such contexts, dense dashboards can be heavy, while text-only explanations can lose the visual grounding that makes the evidence legible.

Data comics are a promising response medium because they naturally support segmentation and pacing [1, 20]. A data comic can introduce context, highlight a key pattern, and land a takeaway across a few panels, keeping visual evidence and explanation tightly coupled [3]. Building on this, we conceptualize three motivating scenarios (Figure 1): (1) *Vis-to-Comic Interpretation*, where users upload a chart and receive an explanatory mini-comic; (2) *Question-to-Comic Responses*, where a user asks a question and the system answers with a comic that includes visualizations and step-by-step explanation; and (3) *Situated Product Micro-Stories*, where devices generate small comics from live or recently collected data to support reflection and action in the moment.

We define conversational data comics, discuss why current technical conditions make them plausible, and articulate future research directions for HCI and visualization.

2 Background and Conceptual Grounding

2.1 Data Comics for Narrative Visualization

Data comics represent an emerging genre of narrative visualization that leverages the familiar visual language of comics, such as panels, gutters, speech bubbles, and captions, to communicate complex data stories [1, 14, 22]. Unlike traditional static infographics or linear presentations, data comics utilize *panels* to segment, pace, and break down information into digestible, sequential units [1, 20]. This modular structure allows for rich design space to introduce context, highlight key patterns, and deliver takeaways in a way that aligns with human cognitive processing of narratives [3]. Crucially, data comics possess the unique ability to visually deconstruct complex data visualizations, explaining their components, visual encoding, and underlying data patterns panel by panel, thereby directly supporting visualization literacy [19]. The emergence of interactive data comics allows for a new form of engagement, where viewers can explore data stories through narrative branches and direct data input, transforming passive consumption into an active dialogue with the data [18].

2.2 Conversational Visualization and AI-Mediated Interaction

The paradigm of conversational visualization has shifted the focus from direct manipulation of dashboards to natural language interfaces (NLIs) where people ask questions and receive visual answers [15]. Systems AI-driven chatbots [8] allow users to query data using natural language, making data exploration more accessible to non-experts. However, a recent scoping review by Kavaz et al. [9] highlights that existing Visualisation-oriented Natural Language Interfaces (V-NLIs) primarily focus on basic visualizations with fixed layouts and offer restricted guidance strategies, often failing to support high-level or follow-up queries.

The integration of Large Language Models (LLMs) has further advanced this field, enabling AI-mediated interaction where the system can proactively manage conversational context and provide more nuanced explanations. Yet, a significant gap remains: current systems do not typically produce *structured visual narratives* that combine multiple panels of explanation with visual evidence. Conversational data comics aim to fill this gap by responding to inquiries not with a single view, but with a sequence of panels that explain the *how* and *why* behind the data.

2.3 Potential of Comics as a Conversational Medium

Comics are inherently *dialogic* and *incremental*, mirroring the turn-taking nature of human conversation. The *gutter*, i.e., the space between panels, requires the reader to perform closure, mentally connecting the information from one panel to the next, which facilitates active engagement and sense-making [14]. In practice, data comics have been used to communicate climate science and data through familiar household conversations combined with explanatory visualizations [17]. Similarly, comics created with pre-defined visual element libraries have been used to transform conversational content into visually accessible formats, such as medical instructions and story sharing within patient communities [21]. These

Distinction	Nearby format	Key difference
Not static data comics	Static data comics	Static data comics are authored artifacts; conversational data comics are generated on demand and can adapt across turns.
Not text-only conversational explanations	Text-based conversational answers	Conversational data comics keep visual evidence in view and use panels to structure explanation, rather than relying on prose alone.
Not dashboards with annotations	Annotated dashboards	Dashboards prioritize free exploration; conversational data comics prioritize guided interpretation through paced, sequential explanation.
Not illustrative storytelling without data accountability	Illustrated narratives loosely inspired by data	Even when metaphors or characters appear, the visualization must remain traceable to data and the explanation should preserve analytic intent.

Table 1: Distinguishing conversational data comics from nearby formats.

qualities, including sequential narrative, linearly structured panels, and cumulative context-building, make comics a particularly suitable medium for conversational interfaces, where each turn can be represented as a sequence of panels that builds upon what came before.

Furthermore, the lightweight and modular nature of comic panels supports just-in-time data literacy [6]. In situated contexts such as using wearables or IoT devices, people often have limited time and attention. A mini-comic can provide a *micro-story* that delivers a specific insight or explains a specific chart feature just when people need it, without the cognitive overhead of a full dashboard [12]. This approach aligns with situated learning [11], where knowledge is acquired in the context of its use and data input as active engagement with data visualization [5, 16].

3 What Are Conversational Data Comics?

We define conversational data comics as *interactive, system-generated sequences of comic panels that integrate data visualizations with narrative structure in response to conversational input or situated data*. A conversational data comic is produced when people ask a question, upload a chart for interpretation, or interact with a device that collects data in the moment. The output is not a single view or a paragraph of explanation, but a short strip of panels that coordinates visual evidence (i.e., visualizations), explanatory moves (e.g., annotations, callouts, comparisons), and narrative sequencing (e.g., what is introduced first, what is emphasized next, and how a takeaway is framed). Conversational data comics target moments where interpretation must happen quickly, under attention constraints or immediate decision pressure. They support sense-making at the

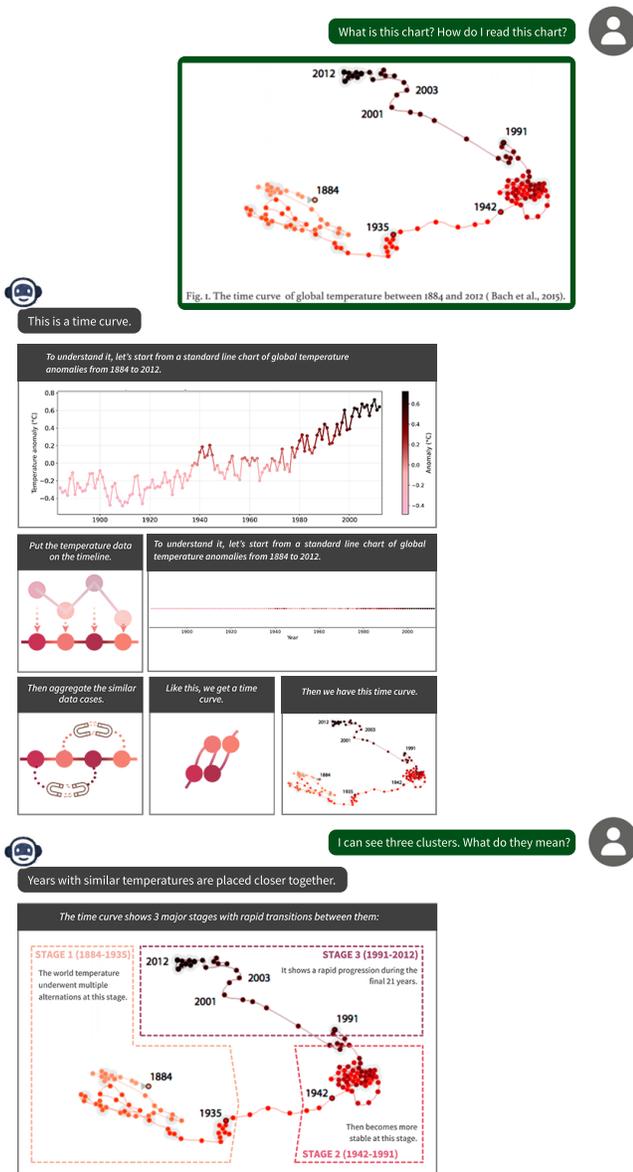


Figure 2: A simulated vis-to-comic interaction: a user uploads a time curve and asks how to read it; the system responds with step-by-step panels and a follow-up explanation of clusters.

point of use by pairing paced visual explanation with automated analytics capabilities. To avoid over-broad definitions, we distinguish the concept of conversational data comics from adjacent formats (Table 1).

4 Conceptual Using Scenarios

4.1 Scenario 1: Vis-To-Comic Interpretation

Uploading an existing chart and asking for interpretation help. The system replies with a short comic that keeps the original visualization as evidence, but adds a paced explanation (highlights, annotations, simple comparisons, and a takeaway).

Simulated Example: A person takes a photo of an unfamiliar time curve [2] of global temperature anomalies and asks, “What is this chart? How do I read this chart?” The system replies with a short comic that rebuilds the mapping: from a standard line chart, to years placed on a timeline, to similar years pulled together into a curved trajectory, clarifying what position, color, and proximity encode. The person then asks, “I can see three clusters. What do they mean?” A second mini-comic labels three clusters (e.g., 1884–1935, 1942–1991, 1991–2012), and notes that clusters indicate the three stages of temperature change (Figure 2).

4.2 Scenario 2: Question-To-Comic Responses

When asking a question, the system generates a compact comic that includes one or more visualizations plus step-by-step explanation of how the answer was derived.

Simulated example: A runner asks, “Did my running pace improve this month?” The system replies with a three-panel comic: Panel 1 shows last month vs this month using median pace. Panel 2 explains why median is used and marks a few outlier runs (e.g., intervals or unusually slow days). Panel 3 summarizes: “Yes, modest improvement, but based on fewer runs.” The person follows up: “Is that improvement real, or just because I ran shorter routes?” The next comic adds a pace-by-distance view: Panel 1 groups runs into short vs long distances. Panel 2 compares medians within each group. Panel 3 concludes: “Improvement holds for both, but stronger on short runs.”

4.3 Scenario 3: Situated Product Micro-Stories

A device or app produces brief, context-aware comics from live or recently collected data to support quick reflection and action during an ongoing task.

Simulated example: After reheating leftovers, a person asks a smart microwave, “Did it heat evenly?” The microwave replies with a three-panel comic that teaches how to read the evidence. Panel 1 shows a small heatmap with a legend (color = estimated temperature) and a note about the inputs behind the estimate (time, power, weight). Panel 2 highlights a likely cold spot near the center, explains how to interpret the legend, and flags uncertainty (“estimated, not measured”). Panel 3 shows a quick before/after comparison (now vs after stirring + 30 seconds) and summarizes a reusable rule: “Stir and reheat until the coldest area crosses the safe range.”

5 Future Research Directions

Conversational data comics are an agenda-setting concept. Turning them into a robust approach for data literacy requires research that spans evaluation, interaction design, and accountability.

5.1 Evaluating Conversational Data Comics in Situated Use

A core question is how conversational data comics perform in the context. Future studies should test outcomes aligned with literacy: understanding encodings and legends, identifying what evidence supports a claim, noticing uncertainty, and making reasonable interpretations under time pressure. Beyond average effects, work should map boundary conditions: novice vs expert readers, familiar vs unfamiliar chart types, and explanation-focused tasks versus exploratory analysis.

For real adoption, designers and domain experts need control over permissible claims, narrative templates, and visualization choices. Research should explore authoring models (templates, grammars, mixed-initiative editing) and evaluate conversational data comics in situated contexts where literacy matters most: devices and applications used while cooking, exercising, commuting, or planning. Longitudinal and field studies can assess whether these interactions improve users' ability to read future charts, not just understand a single response.

5.2 Exploring Interaction Design for Multi-Turn Visual Narratives

Conversational data comics raise design questions about how visual explanations evolve across turns. For example, how should a system respond when users request clarification (e.g., "Average of what data?"), challenge an interpretation (e.g., "I don't think this is abnormal"), or ask for alternative framings (e.g., comparing against historical baselines versus peer groups), while maintaining stable encodings and narrative coherence? This also motivates a broader question: what comic-conversational strategies should a system apply to manage revision, disagreement, and reframing without losing the visual thread? Research is needed on interaction operations such as regenerating a panel, drilling into a region, switching comparison baselines, and keeping a consistent visual reference across updates, especially on small screens and in on-the-go settings.

5.3 Faithfulness, uncertainty, and responsible framing

Because comics structure attention and interpretation, they can amplify framing effects and overconfidence. Future work should develop mechanisms that keep narratives traceable to data and analytic operations, for example, evidence linking, uncertainty cues designed for quick reading, and "what would change this answer" explanations that communicate sensitivity to assumptions. This direction also includes studying visual metaphors: when they scaffold comprehension of unfamiliar encodings, and when they distort quantitative reasoning or introduce unintended connotations.

6 Conclusion

Conversational data comics reframe data literacy support as an interactive, visual conversation: instead of static charts or text-only answers, they offer paced, panel-based explanations that keep evidence and interpretation tightly coupled in situated, on-the-go moments. In this paper, we define the concept, distinguish it from

adjacent formats, and illustrate three scenarios (vis-to-comic interpretation, question-to-comic responses, and product micro-stories). We think that current conversational AI and visualization tooling make this direction feasible, but the core research agenda lies in orchestration and evaluation: designing coherent multi-turn comic strategies, and studying literacy outcomes, uncertainty communication, and faithfulness in real contexts.

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