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The Influence of Narrative Structure on Story Map Engagement, Performance, & Trust: A Preliminary Study

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Abstract:

We report on an empirical map study to investigate the influence of audience scrolling and direct cartographic interaction on the engagement with, performance on, and trust of map-based visual stories. *Visual storytelling* describes the use of illustrations, graphics, imagery, and video (i.e., the graphic sign system) in addition to, oral, written, and audio forms (i.e., the linguistic sign system) (Gershon and Page 2001; Roth 2021). In the following, we adopt Pearce's (2008) distinction between *story* as an account of specific events, places, and people and *narrative* as the presentation and structure of the story content. Specifically, we examine how differences in author-driven versus reader-driven narrative structures influence engagement, performance, and trust (after Segel and Heer 2010).

While there are infinite ways to design for differences in author- versus reader- agency in experiencing a visual story, we focus on two existing alternatives. First, browser scrolling—often referred to as *scrollytelling* in data journalism—is a common author-driven structure for enforcing a linear narrative in an otherwise non-linear map. Accordingly, mostly static visuals and text are arranged in a pre-determined order to form a beginning, middle, and ending of the story, a structure sometimes described as a three-act narrative from set-up (Act 1), problem (Act 2), and resolution (Act 3) (Roth 2021). Evidence suggests that the scrollytelling genre is now the most prevalent narrative structure used in data journalism (Roth et al. forthcoming), with the focus on scrolling considered less about author control over the narrative and more to support a single interaction on mobile-first viewing (Houtman 2026).

In contrast, a reader-driven structure empowers the audience to bring the story to their own geographic proximity, providing multiple pathways through the narrative structure, often available through direct interaction with the (e.g., panning, zooming, Segel and Heer 2010). Reader-driven, interactive digital narratives (IDNs) can take branching, hierarchical, and radiating structures, and often do in more complex multimedia such as gaming (Baldrica-Franklin et al. forthcoming). Given our emphasis on scrollytelling, we narrowed our focus into the *martini glass* reader-driven structure, which breaks a visual story into two sections: the *stem* (the author-driven linear narrative, supported through scrollytelling) and the *bowl* (the reader-driven open narrative, supported by an interactive map) (Segel and Heer 2010;). Specifically, we test how differences in placing the interactive map at the beginning (the *reverse martini glass* structure, with the metaphorical bowl first) versus the ending (as defined by Segel & Heer).

We recruited 135 participants from Prolific. We purposefully sampled (45 each) into three groups based on geographic proximity to create an independent variable for RQ3: *california*, *texas*, and *other-us.* We created the survey using MapStudy (https://github.com/uwcartlab/mapstudy), an integrated and modularized framework for quickly creating and administering mixed-methods empirical research on interactive and online maps (see Vincent et al. 2019; Song et al. 2022 for prior implementations of MapStudy for empirical research). Specifically, we developed a new module called "Story" that enables scrollytelling. Notably, the Story module tracked the amount of time the browser displayed a given html element (i.e., static or interactive visual assets), as well as any interactions (as defined in Roth 2013) with interactive maps embedded within the visual story.

We designed two visual stories on Vujaković's (2014) "Environment & Science" category: *hurricanes* and *wildfire*. The *hurricane* story focuses on the impact of Hurricane Harvey on Texas, particularly the City of Houston, demonstrating the damage caused by climate-related disasters. The *wildfire* story focuses on the impact of the Tubbs Fire on California, particularly the City of Santa Rosa, demonstrating the damage caused by climate-related disasters. Both

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visual stories follow Philip's (2012) "cause-effect" narrative arc and are designed as a linear sequence of ten narrative elements following Song et al.'s (2022) three-act narrative element template: three static visual assets for acts *one*, *two*, and *three*, respectively, comprising the scrollytelling stem and the *interactive* map comprising the bowl. Of the static visual elements, three were *regional maps*, three *local* maps, and three *non-map* infographics.

Participants first completed the IRB and a training block using a visual story from Vincent et al. (2019). Participants then reviewed each visual story separately, with viewing time and interactions captured to measure engagement. After each visual story, participants responded to separate pages of questions on comprehension (coded by narrative element after Song et al. 2022), reaction (Likert scales for affective engagement and trust after Prestby 2024), and retention (map reading tasks after Roth 2013). The position of the interactive map (*reverse* at the beginning, *martini* at the ending) varied between the pair of visual stories, balanced with the visual story (*hurricanes* and *wildfires*) using Latin squares. Participants concluded with general reactions and background questions.

Our study design included independent variables (with a linked RQs and hypotheses) and dependent variables organized by engagement, performance, and trust (Table 1). We used a Bayesian statistical approach to test our hypotheses, allowing for flexibility and robust interpretations of multilevel models with small sample sizes.

RQ	Independent Variable	Map Influence	Dependent Variable
RQ1	Story (*hurricanes*, *wildfires*)	Engagement	Viewing Time (milliseconds)
RQ1	Act (*one*, *two*, *three*, *interactive*)	Engagement	Interactions (frequency)
RQ1	Visual Asset (*regional*, *local*, *non-map*)	Performance	Comprehension (by narrative element, frequency)
RQ2	Martini Glass (*martini*, *reverse*)	Performance	Retention (accuracy %)
RQ3	Geographic Proximity (*california*, *texas*, *other-us*)	Trust	MAPTRUST (Likert)
		Trust	Affect (Likert)

Table 1. List of independent and dependent variables used in the map study.

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