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PEER-REVIEWED ARTICLE

Designing Maps in News Stories: A Longitudinal Visual Content Analysis of Cartographic Design in US Data Journalism

Robert E. Roth (he/him)
University of Wisconsin–Madison
reroth@wisc.edu

Meghan Kelly (she/her)
Syracuse University
mkelly51@syr.edu

Gareth Baldrica-Franklin (he/him)
University of Wisconsin–Madison
baldricafran@wisc.edu

Caroline Rose (she/her)
Wisconsin Geological & Natural History Survey
caroline.rose@wisc.edu

Jake Steinberg (he/him)
Minnesota Star Tribune
jake.steinberg@startribune.com

Luis F. Alvarez León (he/him)
Dartmouth College
luis.f.alvarez.leon@dartmouth.edu

Here, we report on a longitudinal visual content analysis on mapping praxis in popular US news media outlets over the past decade. Maps are integral to data journalism, yet professional practice in storytelling with maps continues to outpace research and education. To fill this gap, we analyzed 119 online news stories containing maps published over two periods in 2014 and 2021 from the New York Times *and* Washington Post. *We coded the sampled news maps according to three considerations: (1) conventional cartographic design (e.g., scale, projection, basemap, time, color depth, thematic map type, layout, map elements); (2) new digital technology (e.g., animation, interaction, real-time updates); and (3) visual storytelling techniques (e.g., story theme, genres, and tropes). The longitudinal visual content analysis provided a benchmark study for digital news mapping and yielded a number of insights into design trends, including: a decrease in the number and complexity of maps used in news stories; a shift away from mapping international stories towards domestic stories; a decrease in interactivity and an increase in animation due to a move towards mobile-first design and scrollytelling; an increase in mapping topics related to health, environment, and science; a decrease in the mapping of conflict, cultural affairs, and society; and a decrease in the focusing attention trope, but an increase in metaphor and designer voice. Based on these findings, we argue for continued critical analysis of news maps within data journalism, and visual storytelling more broadly, because of their pervasiveness in new digital media and associated outsized influence on map audiences.*

KEYWORDS: cartographic design; data journalism; news maps; visual storytelling; content analysis

1. INTRODUCTION: DESIGNING MAPS IN NEWS STORIES

In this article, we report on a longitudinal (i.e., repeated over multiple time periods for comparison) visual content analysis tracking the evolution of cartographic design and visual storytelling praxis in popular US news media outlets over the past decade. Maps are integral to data journalism—the creation of news stories generated from and supported by data analysis and visualization (see Gray et al. 2012, Riche et al. 2018 for overviews)—with professional cartographers increasingly serving as "visual storytellers" through the intentional design and curation of text, images, and data-driven graphics into intuitive and compelling narrative structures (Roth 2021, Kelly 2022). Similarly, storytelling is now an established research focus at the intersection of cartography, geography, and GIScience (e.g., Monmonier 1989, Elwood 2006, Pearce 2009, Phillips 2012, Caquard 2013, Fish 2020b, Harris 2020, Bogucka 2022, Olmedo and Caquard 2022, Song et al. 2022, Prestby 2024, Caquard and Shaw 2025) as well as related, visual-centric fields of information visualization, user experience (UX) design, and visual analytics (e.g., Gershon and Page 2001, Eccles et al. 2008, Segel and Heer 2010, Ma et al. 2012, Kosara and Mackinlay 2013, Hullman et al. 2013, Park et al. 2022). Despite this parallel interest, the professional practice of visual

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storytelling continues to outpace research and education (Wallace 2016, Cairo Touriño 2017).

We work towards filling this gap by examining how established cartographic design principles and emerging visual storytelling techniques are applied in the context of data journalism. Specifically, we ask:

- (RQ1) How are data journalists maintaining or disrupting conventional cartographic design tenets, and how have these practices changed over time?
- (RQ2) How are data journalists leveraging design affordances and constraints of new interactive, online, and mobile technology, and how has this digital practice changed over time?
- (RQ3) How are data journalists employing novel visual storytelling techniques, and how has this practice changed over time?

To answer these questions, we analyzed 119 online news stories containing maps published over two periods in 2014 and 2021 from the *New York Times* (*NYTimes*) and *Washington Post* (*WaPo*), two prominent US-based media outlets and two of the top three most subscribed newspapers in the country at the time of this writing (along with *The Wall Street Journal*). We conducted a visual content analysis (Rose 2022), coding each map within our sample according to three design considerations, each related to one of our research questions: (1) elements of cartographic design (e.g., scale, projection, basemap, time, color depth, thematic map type, layout, map elements); (2) new digital technology (e.g., animation, interaction, real-time updates); and (3) visual storytelling techniques (e.g., story theme, genres, and tropes). We compared our results across the two sampled time periods (2014 and 2021) to identify longitudinal changes and trends in news maps over these three design dimensions.

In the next section, we review useful conceptual frameworks from cartographic design, new digital media, and visual storytelling by way of defining and justifying the coding scheme applied in the longitudinal visual content analysis. We summarize the sampling strategy, coding procedure, and analysis approach in the third methods section. We review salient results from the longitudinal visual content analysis in the fourth section and conclude with a discussion and outlook of cartographic design and visual storytelling in data journalism. To this end, the longitudinal visual content analysis serves as a benchmark study for cartographic design and visual storytelling in data journalism, charting where news map design has been over the past decade while illuminating persistent gaps between theory and practice that inform future cartographic research, design, and education.

2. BACKGROUND: DESIGN CONSIDERATIONS FOR NEWS MAPS

The term *visual storytelling* originates in cinema and commonly is evoked today to describe stories communicated through illustrations, graphics, imagery, and video instead of or in addition to oral, written, and audio forms (Segel and Heer 2010). Research on "narrative cartography" draws from an eclectic set of influences in geography (e.g., Cameron 2012, Caquard 2014, Ryan et al. 2016), with a storytelling approach informing the digital humanities broadly (e.g., Knowles et al. 2015, Scott 2021, Alderman and Inwood 2024), as well as cinematic (e.g., Caquard and Taylor 2009, Muehlenhaus 2014), imaginative (e.g., Joliveau 2009, Caquard 2011), Indigenous (e.g., Chapin et al. 2005, Pearce and Louis 2008), literary (e.g., Moretti 2005, Bushell 2012), multimedia (e.g., Monmonier 1992, Cartwright 1999), and participatory (e.g., Elwood 2006, Miller 2006) mappings, specifically (see Roth 2021 for an extended review of influences). In the following, we use *story* to describe an account of specific events, places, and people, and *narrative* to describe the structure and presentation of story content (Pearce and Louis 2008). Given the focus of our research questions on the structure and presentation of maps within visual stories, we therefore primarily coded for aspects of the narrative that can be manipulated (i.e., designed) by the cartographer regardless of the story content.

Our first set of codes captured elements of cartographic design that impact the communication of geospatial information and therefore the presentation of the narrative (RQ1). These codes included design decisions made early in map preparation, such as cartographic scale (Raposo 2017) and map projection (e.g., class, orientation, perspective; Battersby 2017). We also captured information about how the included geospatial data layers were mapped, such

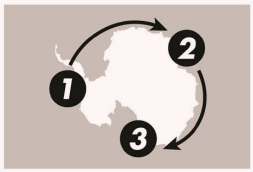
as the type of basemap (i.e., geospatial context, the visual style of which can play a persuasive role in interpretation of the map; Tyner 1982), the kind of temporal information if included (Fish 2018, Steiner 2019), and the number of mapped attributes and their resulting thematic symbolization (Golebiowska et al. 2021), including the color depth used for the symbolization (Christophe 2019). Coding deconstruction of map layers into location, time, and attributes followed Peuquet's (1994) information "TRIAD." Finally, we also coded layout composition (e.g., the map's aspect ratio, size, and placement within the overall story; Tait 2018) and map elements. These codes serve as a baseline for understanding how data journalists are conforming to, but also innovating beyond, established cartographic design principles (e.g., Robinson et al. 1995, Dent et al. 2008, Tyner 2014, Brewer 2015, Kraak et al. 2020, Slocum et al. 2022).

Our second set of codes examined affordances and constraints offered by new "geoweb" or "web mapping" digital media that are inherently interactive, online, and mobile (RQ2; Sieber et al. 2016). These codes documented dynamic animation as an alternative to static spatiotemporal representation (Fish 2018), implementation of interaction operators that enable the audience to change the map display beyond simple scrolling (Roth 2017), and real-time updates, particularly during unfolding events. Shifting visual storytelling towards interactive, online, and mobile media has a cost in both time and expertise, and therefore we expected digital maps supporting visual stories to be more intentional and creative in their designs as compared to more well-established static locator maps designed to work in print, potentially making them more indicative of patterns and trends in data journalism practice. Common strategies—such as inclusion of a "slippy" map that supports the pan, zoom, overlay, and detail retrieval interaction operators (Roth et al. 2014)—also may indicate how popular news agencies are drawing from and contributing to conventions in the use of the geospatial web. As with cartographic design decisions for static maps, changes in the number of animations or interaction operators also may suggest a shift to more or less information (regarding animation) and interface (regarding interaction operators) complexity for the purposes of visual storytelling (Vincent et al. 2019), and thus reveal the data journalists' intention to support an active and exploratory versus a passive and linear experience with the visual story (adapted from MacEachren 1994). We initially attempted to code for other salient characteristics of new digital media, such as responsive layouts between mobile and non-mobile devices or map sharing through social media, but nearly all sampled visual stories from *The New York Times* and *The Washington Post* supported these features. Instead, some patterns and trends in conventional cartographic design (RQ1) suggest new strategies for mobile-first and responsive cartographic design (Roth et al. 2024, Houtman 2025).

Finally, our third set of codes collected novel visual storytelling techniques described in the diverse literature on storytelling across cartography, geography, GIScience, information visualization, UX design, and visual analytics (RQ3). Visual storytelling codes included Vujaković's (2014) eighteen-part taxonomy of geographic news map topics organized into seven higher levels (politics: internal, politics: international, disasters/accidents, environment and science, society, cultural affairs, and economics), a categorization of story content (versus narrative structure) that we were able to code for reliably. We also coded for emerging visual storytelling genres and tropes as synthesized in Roth (2021). A visual storytelling genre is defined by the visual or interactive technique used to structure the continuity (sometimes, but not always, linear continuity) of the narrative content, and includes static visual stories (with continuity enforced through layout and annotation) and a number of narrative forms such as the longform infographic (i.e., "scrollytelling," with continuity from vertical page scroll), dynamic slideshows (continuity from slide advancement), narrated animations (continuity from playback time), multimedia visual experiences (continuity from anchor tags and hyperlinks), personalized story maps (continuity from the temporal order of user generated contributions), and compilations (continuity from the temporal order of real-time updates; Figure 1). A visual storytelling trope is a design technique used to advance the narrative rather than encode information (as in the cartographic design codes above), and for our analysis includes techniques used for setting the mood (primarily through visual style), focusing attention (e.g., highlighting, annotation, dynamism), imbuing metaphors (e.g., associative point symbols, juxtaposition, cartooning and illustration, hyperrealism, collage and montage), and embedding voice (through provision of authorship, bylines, data sources, and explainer text).

A summary of all codes used in the longitudinal visual content analysis is provided in the Supplemental Materials.

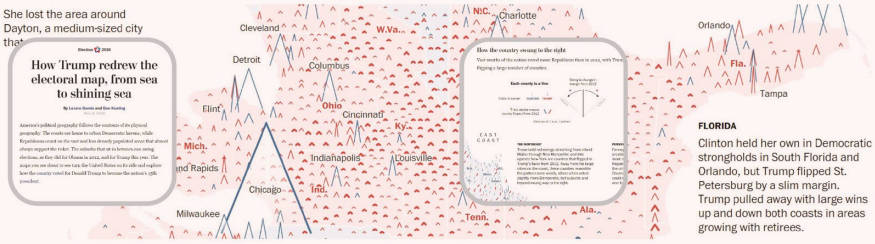
A
Static Visual Stories





B
Longform Infographics





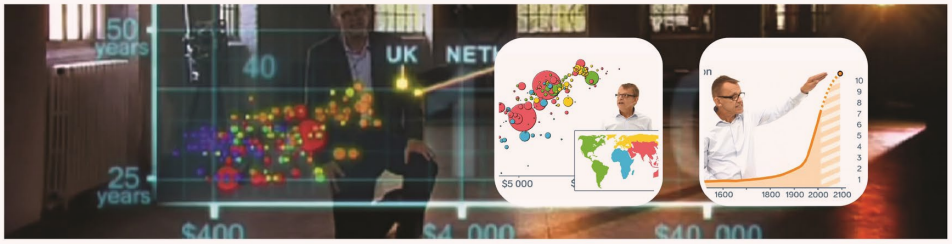
C
Dynamic Slideshows



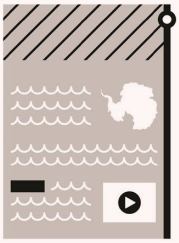


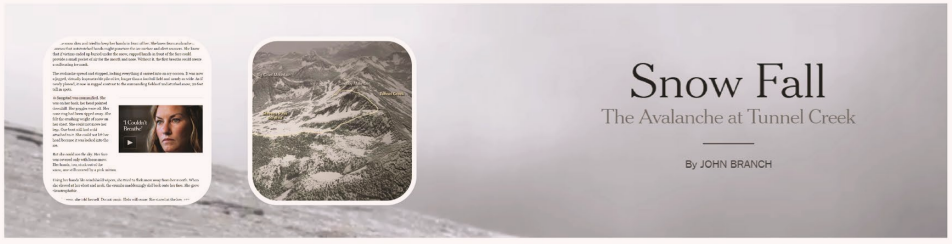
D
Narrated Animations





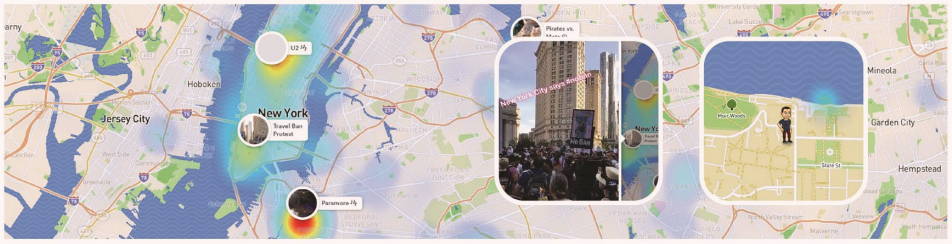
E
Multimedia Visual Experiences



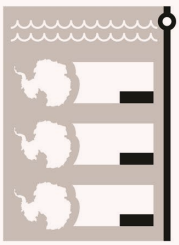


F
Personalized Story Maps





G
Compilations



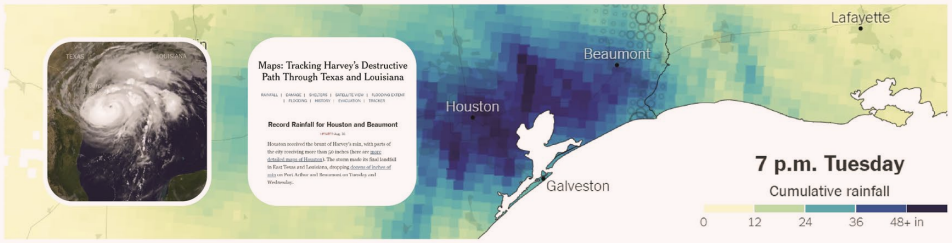


Figure 1. Visual storytelling genres. Visual storytelling genres differ by the visual or interactive technique used to enforce linearity in the narrative sequence. The following overview of visual storytelling genres is expanded from Roth (2021).

(caption continues on next page)

Figure 1. *(continued from prior page).*

A. Static visual stories. "The Melting of Antarctica," published in *National Geographic* (Tierney and Treat 2017), explains the increased susceptibility of Antarctic ice to climate change. The static visual story uses layout, negative space, and annotation to enforce linearity. A comparison of the static magazine version to a narrated animation of the same content is described in Tierney (2018).

B. Longform infographics. "How Trump Redrew the Electoral Map, from Sea to Shining Sea," published online by *The Washington Post* (Gamio and Keating 2016) uses two maps with novel symbolization to illustrate the shift in party voting in the US presidential election from 2012 to 2016. The maps are oriented east-up and read like strip maps, with linearity enforced through browser scrolling. Notably, the scrolling mimics the closing of polls from the Eastern to the Pacific time zones, adding a temporal dimension to the linear storytelling.

C. Dynamic slideshows. "Amazonia Under Threat," published online by *National Geographic* (Baptista et al. 2015) describes risks to biodiversity and the environment from human activities in the Amazon basin. The dynamic slideshow uses a persistent interface docked on the right to enforce linearity. The slide content is dynamic, enabling a break from linear storytelling through vertical scrolling, map panning and zooming, and animations.

D. Narrated animations. Example stills from "The Joy of Stats" videos published on **gapminder.org** (videos collected 2010–2018; accessed July 1, 2018), which use statistics and visualization to describe worldwide sociodemographic changes over the past two centuries. Linearity is enforced through display time in the narrated animation. Beyond just voice narration, Hans Rosling inserts himself into the animated graphics, further humanizing the visual story.

E. Multimedia visual experiences. "Snow Fall: The Avalanche at Tunnel Creek," published online by *The New York Times* (Branch 2012) details the experiences of skiers and snowboarders trapped in an avalanche in the US state of Washington. The multimedia visual experience uses a compelling array of text, images, maps, and videos, activating dynamic content through anchor tags and hyperlinks while scrolling.

F. Personalized story maps. "Snap Map," maintained by Snapchat (accessed July 1, 2018) is a platform for sharing photos and videos as georeferenced visual "stories" that last for 24 hours. The service aggregates clusters of stories to represent current events for viewing online, with linearity within each event enforced by the order of user contributions. In the mobile application, users can embed themselves into the map using an avatar, sharing their location with friends at a high spatial precision as they contribute visual media.

G. Compilations. "Maps: Tracking Harvey's Destructive Path Through Texas and Louisiana," maintained by *The New York Times* (Aisch et al. 2017) tracks the development and impact of Hurricane Harvey in the Gulf region of the US. As the event unfolds, map updates are placed at the top of the compilation, enforcing linearity from newest to oldest updates. Many of the maps in the compilation link to other content from *The New York Times*, enabling non-linear storytelling.

3. METHODS: LONGITUDINAL VISUAL CONTENT ANALYSIS

We followed principles of visual content analysis to identify patterns and trends in the design of maps in news stories. *Content analysis* (beyond the visual) is an established interdisciplinary research method that can examine both quantitative and qualitative relationships in secondary sources (e.g., archives, correspondence, documentation, and other popular or scholarly collections), using these materials as informative externalizations of the authors' meanings, decisions, and values to triangulate with primary sources or replace unavailable primary sources (see Krippendorff 2019 for a methodological overview). Accordingly, our study reported here complements the small suite of contemporary interview studies on news map design with data journalists (e.g., Roth 2015, Fish 2020b, Steinberg 2023). *Visual content analysis* describes the systematic coding process that analyzes the primarily graphic elements and composition of a corpus of visual representations (see Rose 2022 for a methodological overview), and has become one of the most common empirical methods in cartography and related disciplines given the ability to benchmark patterns and trends in design (Fish et al. 2025).

Our analysis aligns with and expands previous visual genealogies that examine cartographic design trends (RQ1) over time in atlases (Muehlenhaus 2011), journals (Kessler and Slocum 2011, White et al. 2017), and textbooks (Nestel 2024). Visual content analysis also has been used to assess changes in cartographic technologies (RQ2) like the influence of interactive (Roth et al. 2015, Fish

and Calvert 2016, Hart et al. 2022) and mobile capacities (Abraham 2019). While visual content analysis has been used to analyze storytelling techniques in data journalism (e.g., Knight 2015), existing studies on news map design primarily focus on a single thematic topic (e.g., Kelly 2016, Fish 2020a, Underwood 2022, Prestby 2024; see Gomes et al. 2025 for a recent, broader treatment of news maps). As such, our analysis serves to exemplify the breadth and utility of a visual content analysis of news maps across cartographic design, technologies, and visual storytelling (RQ3). Our study also extends previously mentioned genealogies of atlases, journals, and textbooks to provide a systematic longitudinal analysis of contemporary news map design, leading to several unique methodological considerations and constraints potentially transferable to other visual content analyses.

3.1 MATERIALS

The objective of our sampling strategy was to establish reproducible criteria that would yield two directly comparable sets of news maps for longitudinal analysis during our time period of interest (described below) and not to attempt to comprehensively sample across media outlet, time, or thematic topic. We originally considered a wide set of candidates with a diverse target audience and geographic circulation, while still publishing in English (the primary fluent language of the co-authors), including the ArcGIS StoryMaps gallery, the British Broadcasting Corporation, *National Geographic*, the *South China Morning Post*, *USA Today*, and the *Wall Street Journal*. However, we narrowed our focus to *NYTimes* and *WaPo* because they each had a sufficient volume of news stories with digital maps over the time period of interest, enough to enable consistent longitudinal analysis, although at the cost of constraining findings to US data journalism (as we discuss later on in the limitations section).

We selected 2014 as a baseline year because it followed several watershed changes in cartographic design practices (RQ1; e.g., the shift towards multiscale digital map design, such as the 2005 launch of Google Maps and 2012 launch of Apple Maps), digital technologies (RQ2; e.g., the ~2010 move away from rich internet applications like Adobe Flash for web maps and towards mobile-first design), and visual storytelling techniques (RQ3; e.g., following the 2012 Pulitzer Prize–winning "**Snow Fall**" scrollytelling experience published in *NYTimes*; Branch 2012). Thus, we anticipated a new era of map-based data journalism to have coalesced by 2014 that was unlike prior forms of news map design. We then selected 2021 as the comparative year due to similarities in events between 2014 and 2021 that we believed would afford consistency between the samples, including: a major disease outbreak (Ebola in 2014, COVID-19 in 2021), the #BlackLivesMatter movement (incidents and protests related to Ferguson, MO, and Minneapolis, MN, respectively), non-Presidential elections (2014 midterms and 2021 New Jersey gubernatorial and New York City mayoral races), and Israel's occupation of Palestine and blockade of Gaza (activities that have continued to escalate to war crimes, crimes against humanity, and genocide at the time of this writing; Weizman et al. 2024, Albanese 2024, United Nations 2024). However, a perfect parity in events is not possible for a longitudinal study on news map design.

We limited our sample to a pair of two-month time periods: October 10–December 20, 2014 and May 3–July 2, 2021. The 2014 window was longer than that of 2021 due to a gap in published map-based news stories during the US holiday week of Thanksgiving. We selected a time period in 2021 after the COVID-19 vaccine was globally available to capture COVID-19 news stories, but avoided the most potentially disrupted newsroom period of the pandemic in 2020 and early 2021.

We included only news stories with *digital* maps (i.e., designed for screens) in our corpus, given our focus on new digital technologies (RQ2) and visual storytelling techniques (RQ3). We excluded all news stories that did not include a digital map, although we employed a broad and inclusive definition of "map" as any spatialized (two- or three-dimensional) representation supporting a place-based news story. For example, our selection process included maps of outer space as well as air or satellite photos. We did not, however, include maps that were used in advertisements or logos, maps appearing in the background of photos or videos, or historic maps repurposed for the news story. Further, we only included news stories with maps posted on the social media accounts of each outlet's graphics team (specifically, @nytgraphics and @PostGraphics on Twitter, the platform now known as X), rather than all possible digital news maps. This narrowed the analysis to only the most relevant or novel designs, as determined by the people who created them. We utilized Twitter's API for academic research (a reasonable decision at the time, but limited in reproducibility today due to shifts in ownership and participation) to collect all

news stories linked in tweets posted during the two time periods. Finally, we did not include "year in review" articles or other articles primarily based on maps found previously in the corpus.

We captured the corpus of 119 stories in the spring of 2023 and largely completed the analysis and write-up in the 2023–2024 academic year, ultimately resulting in a 2025 submission.

3.2 PROCEDURE

We coded each news story within our sample across the three thematic arenas described above: elements of cartographic design, technology, and visual storytelling techniques.

We reduced an initial coding scheme of 298 codes to the final set of 161 codes (given in the Supplemental Materials) after two project members coded approximately 20% of the news stories in the corpus. We primarily removed ordinal level codes (e.g., degrees of low to high, sparse to dense, etc.) that were challenging to reliably code across coders, converting all codes to binary presence/absence. For news stories that contained multiple digital maps, a code was marked as "present" if any of the maps exhibited the feature represented by the code. The pair of coders then recoded the first 20% of the news stories and the remaining 80% of the corpus, marking any disagreements for group discussion and reconciliation.

We previewed all maps on both mobile and desktop devices, but coded all maps based on their desktop experience using a 1080p screen.

3.3 ANALYSIS

We did not run inferential statistics on the coding results, since the sampled corpus and code frequencies do not meet assumptions of normality, and instead interpreted patterns and trends from descriptive statistics (Muehlenhaus 2011, Rose 2022). We normalized all codes by calculating the percentage of news stories within each time period and outlet that exhibited that code. This allowed us to calculate change between 2014 and 2021 without focusing on the specific house style of either news outlet or differences in the number of sampled news stories in each time period. We then compared our results for each outlet across the two time periods (2014 and 2021) using the difference in percentages within each year (describing the change as a number of "points" gained or lost, much like election news reporting). Thus, for example, a change of "+8%" from 2014 to 2021 could represent a substantially large shift in cartographic design practice depending on the original percentage in 2014 (e.g., a shift from 8% of total to 16% of total at +8% is a doubling in the frequency of the given code). Therefore, in our reporting the use of "+" or "-" indicates the change in percentage points, whereas percentages reported without "+" or "-" indicate the overall percentage for one or both years. The codes are not mutually exclusive and, again, there may be multiple maps in a single news story, and therefore sub-codes within a given design category have a range of 0–100% but do not necessarily add to 100% across sub-codes in the category.

We provide permalinks to and our coding of all news stories in our sample in the Supplemental Materials.

4. RESULTS

4.1 CORPUS OVERVIEW

In total, we sampled and analyzed 119 online news stories containing at least one digital map, across our two time periods (2014 and 2021) from the *NYTimes* and *WaPo* (Table 1). Although 78 news stories met our sampling criteria in 2014, only 41 did in 2021, a potential indicator of decelerating innovation in cartographic design for data journalism, a change in social media strategy, or a shift away from map-focused data journalism altogether. Further, we sampled 47 news stories from the *NYTimes* (31 in 2014, 16 in 2021) and 72 from *WaPo* (47 in 2014, 25 in 2021), resulting in a modest imbalance between news outlets, though each exhibited a similar decline from 2014 to 2021.

The sampled news stories included, on average, 4.1 maps per story, although this declined from 4.2 to 3.8 maps per story between 2014 and 2021. In contrast, both the number of non-map charts (from 0.9 to 2.7) and photos

	NYTIMES	WAPO	ALL 2014		NYTIMES	WAPO	ALL 2021		OVERALL		
	frequency	frequency	frequency	average	frequency	frequency	frequency	average	frequency	average	change
Number of Stories	31	47	78		16	25	41	na	119		-37
Number of Maps	156	174	330	4.2	47	107	154	3.8	484	4.1	-0.5
Number of Charts	22	50	72	0.9	30	82	112	2.7	184	1.5	1.8
Number of Photos	148	13	161	2.1	147	48	195	4.8	356	3.0	2.7
	frequency	frequency	frequency	percentage	frequency	frequency	frequency	percentage	frequency	percentage	change
Text	31	44	75	96%	16	25	41	100%	116	97%	4%
Audio	1	1	2	3%	0	3	3	7%	5	4%	5%
Video	6	2	8	10%	3	5	8	20%	16	13%	9%
Animation	2	0	2	3%	0	1	1	2%	3	3%	0%

Table 1. Overview of the sampled news story corpus for the longitudinal visual content analysis.

(from 2.1 to 4.8) increased in the sample between 2014 and 2021, although on average they remained less frequent than maps across years (1.5 charts and 3.0 photos per story, respectively). Because a news story only was included in the corpus if it contained a map, the relative frequency of maps to other visual media is not meaningful, but the general downward trend of maps versus an upward trend of charts and photos potentially is meaningful and again signals a potential move away from mapping as a driver of visual stories over the time period of interest. While the visual content analysis method cannot confirm the underlying drivers, the overall downward trend of news maps aligns with recent discussions of the transforming political economy of the newsroom placing greater demands on labor (e.g., Usher 2020) as well as the "cartographic silencing" of news maps in increasingly conservative media (e.g., Fish and Kreitzberg 2023, 2492).

Nearly all (97%) of the sampled news stories were accompanied by separated HTML text (i.e., text other than that placed directly on the map), but only 13% of news stories included video, 4% included audio, and 3% included animation. Primarily pairing maps with HTML text indicates the general convention of scrollytelling for news stories and a relative dearth of multimedia cartography across the sample despite purposeful sampling of the more innovative news maps using social media.

One of the most poignant and concerning trends across the sampled years from the perspective of a global sense

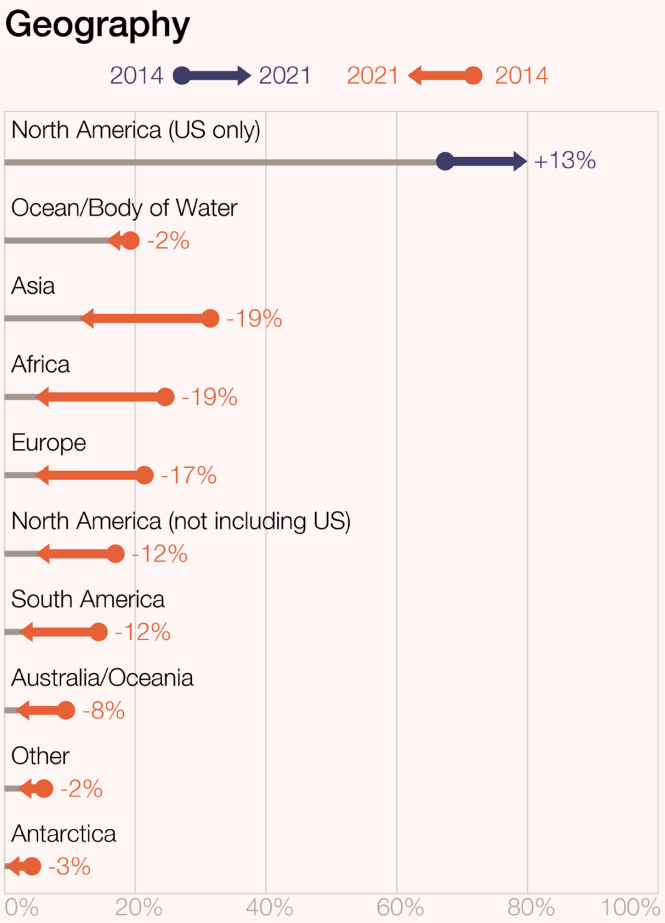


Figure 2. Percentage point differences in news story geography. Note: For Figures 2–20, a blue arrow pointing to the right indicates an increase from 2014 to 2021 in the given code percentage while an orange arrow pointing to the left indicates a decrease from 2014 to 2021 in a given code percentage.

of place (Massey 2008) was a geographic shift away from news stories with an international focus and towards domestic US issues (Figure 2). News stories focused solely on the US increased +13% from 2014 to 2021, accounting for nearly three-quarters (72%) of the sample across years, and 81% of the 2021 sample. In contrast, news stories about all other continents decreased from 2014 to 2021: Africa down -19%, Asia -19%, Europe -17%, North America (including Central America but not including the US) down -12%, South America -12%, Australia/Oceania -8%, Antarctica -3%, and oceans or other (non-planetary) regions down -2% and -3%, respectively. These trends point to an increase in a national (US) focus and framing in these two prominent newspapers, surprising given the range of global issues such as the COVID-19 pandemic occurring during the sampled 2021 time period.

4.2 CARTOGRAPHIC DESIGN (RQ1)

Starting with cartographic design (RQ1), news stories with country-scale maps were the most common across our sample (40% of all maps in the sampled news stories) and increased +14% from 2014 to 2021 (from 35% to 49%; Figure 3). News stories with regional scale maps were second-most common in our sample (32% of total) and increased +7% from 2014 to 2021 (30% to 37%). News stories with neighborhood scale maps (larger than municipal), often as detail or inset maps providing a localized account of events, also were relatively common (21% of total), but increased only slightly between time periods (+1%). In contrast, we observed decreases in news stories with world (-9%), municipal (-9%), and continental (-8%) maps. Overall, news stories with continental and world maps accounted for just 13% of our sample (8% and 6%, respectively), and we did not find a single world map in the 2021 corpus. Taken together, findings by scale again suggest a persistent and growing emphasis of *NYTimes* and *WaPo* on primarily US domestic issues, somewhat expected given their operation in two major US cities but again also perhaps cause for concern given the contemporary rise of nationalist rhetoric (and specifically the nationalization of the US media market; Jaidka et al. 2023) and the outsized impact these two media outlets have on domestic and international geopolitical discourse.

Patterns and trends in the choice of map projection (Figure 4) largely corroborated the increasing focus on a US national geography and scale. Conic projections were the most commonly identifiable class (34% of all maps), and

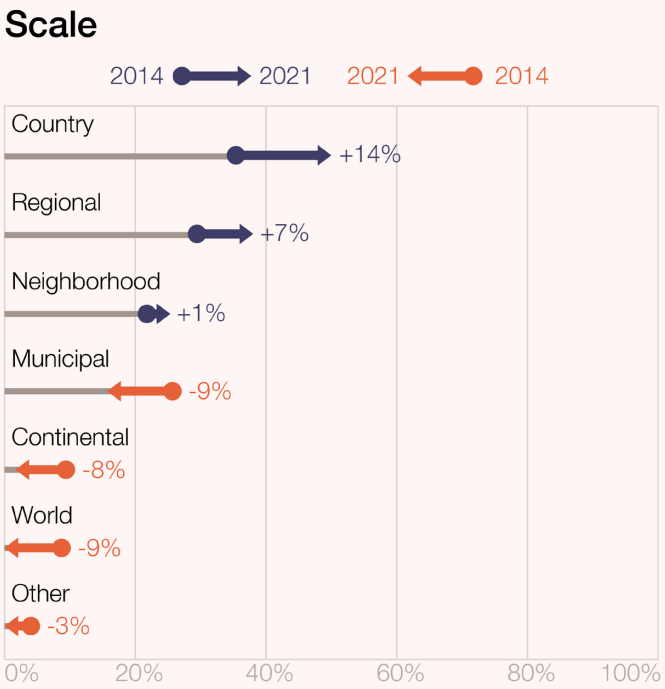


Figure 3. Percentage point differences in scale.

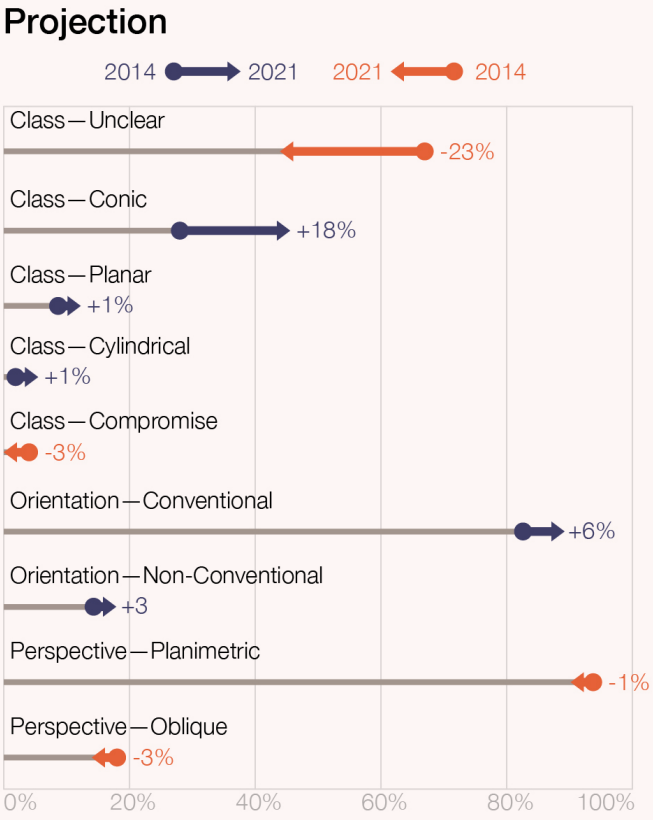


Figure 4. Percentage point differences in projection.

news stories with conic projections increased +18% from 2014 to 2021 (28% to 46% of total). Conic projections are

recommended for mid-latitude country and regional scale maps (Battersby 2017), suggesting an increased emphasis in visual storytelling on the Global North broadly and the US specifically. Notably, we were unable to confirm the projection class in 59% of the news stories (for discussion on visual identification of map projections, see Olson 2006 and Battersby and Kessler 2012), primarily for maps at a municipal or neighborhood scale that probably were in Web Mercator (a cylindrical projection) but do not offer enough visual cues for us to confirm. However, our ability to identify class improved from 2014 (67% unclear) to 2021 (44% unclear; -23% change), again correlating with a shift towards country and regional scale mapping. We found compromise (2%) and planar (2%) projections in just four news stories total, indicating a dearth of maps of global (often using compromise projections) and polar (often using planar projections) issues. There was minimal change in projection orientation and perspective between years, with most news stories following the convention of north as "up" (84%) using a planimetric "view from nowhere" or top-down view (93%). Accordingly, greater creative and intentional design of orientation and perspective for storytelling purposes is a future opportunity for news maps given their support of vantage point and voice (see below), providing a more embedded and humanized view from somewhere and someone to situate a news story in place (Pearce 2008, Pearce and Louis 2008).

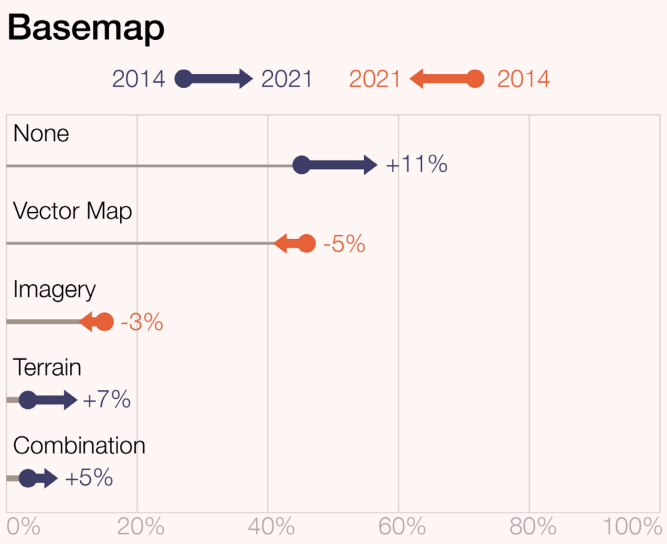


Figure 5. Percentage point differences in basemaps.

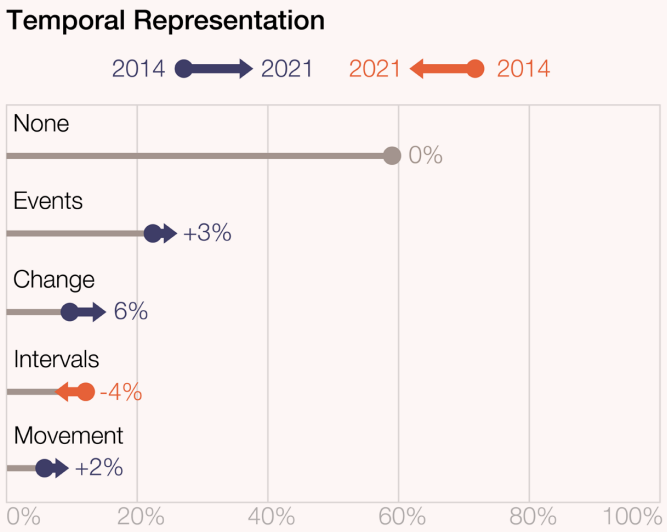


Figure 6. Percentage point differences in temporal representation.

Nearly half (49%) of the news stories contained maps with no basemap context (Figure 5), a trend that increased from 45% in 2014 to 56% in 2021 (+11%). This reduction in the inclusion of custom-designed basemaps suggests that newsrooms are moving towards more simplified maps, a trend we particularly noticed in thematic mapping, where visually complex basemap tilesets often are not necessary. We observed slight declines in news stories with vector (-5%) and imagery (-3%) basemaps, the latter of which was surprising given the proliferation of commercial satellite imagery services between 2014 and 2021. In contrast, we observed slight increases in news stories with terrain basemaps (+7%) and the ability to interactively underlay different basemaps on demand (+5%), although these basemaps overall remained relatively uncommon (in just 5% and 4% of news stories, respectively).

Temporal representations (Figure 6) were absent from 59% of the sampled news stories, perhaps not surprising given that many geospatial datasets are not configured to include time (Peuquet 1994). Yet, time often is fundamental to advancement of a narrative structure, as the best visual stories have rising action and character development across the plotline (i.e., timeline, Roth 2021), making greater focus on temporal representation an opportunity for news mapping. However, for news stories that did include temporal representations, we observed a shift away from intervals (-4%) and towards change (+6%). Intervals typically are represented as small multiple maps or in an animation, and thus have greater visual complexity than change representations that normalize two time intervals into a single difference map (Fish 2018). Thus, this trend in temporal representation provides a second indicator that

newsrooms are moving towards more simplified maps. Events were the most common type of temporal representation (23% overall), often represented as part of municipal and neighborhood scale maps, while movement was the least common (just 6%), an expected finding given the difficulty in construction of flow maps (Steiner 2019).

Interestingly, coding by thematic map type (Figure 7) revealed a potential shift away from common thematic maps and towards novelty in design. Arguably, iconic point symbol maps are the most common thematic map for qualitative information and choropleth maps are the most common thematic map for quantitative information (Golebiowska et al. 2021). While these thematic maps were the most common in the sampled news stories (14% and 39%, respectively), we observed a decline in both iconic point maps (-11%) and choropleth maps (-7%) from 2014 to 2021. In contrast, we observed an increase in news stories with cartograms (+11%), 3D representations (+8%; not always used for thematic purposes), proportional symbol maps (+4%), and isoline maps (+2%).

Despite this diversification of thematic mapping techniques, many thematic map types remained under-utilized across the corpus, including dot density (2% of total), flow (1%), and value-by-alpha (1%). Further, we observed a decrease in the total number of attributes mapped throughout the news story (Figure 8), with news stories that map one attribute (21% total) and no attributes (i.e., reference maps; 27% of total) both increasing between 2014 and 2021 (+9% and +4%, respectively) with multivariate news stories mostly declining during this period. Additionally, we observed a shift away from full color (-25%) and towards one color (i.e., monochrome) or limited color palettes (+23%; Figure 9). Expectedly, black/white (2%) and grayscale (1%) no longer are common in digital media. Taken together, this analysis by attribute representation provides three additional indicators that newsrooms are moving towards more simplified maps both in content and form, even as they are exploring alternative forms of thematic mapping. However, more complex designs remain,

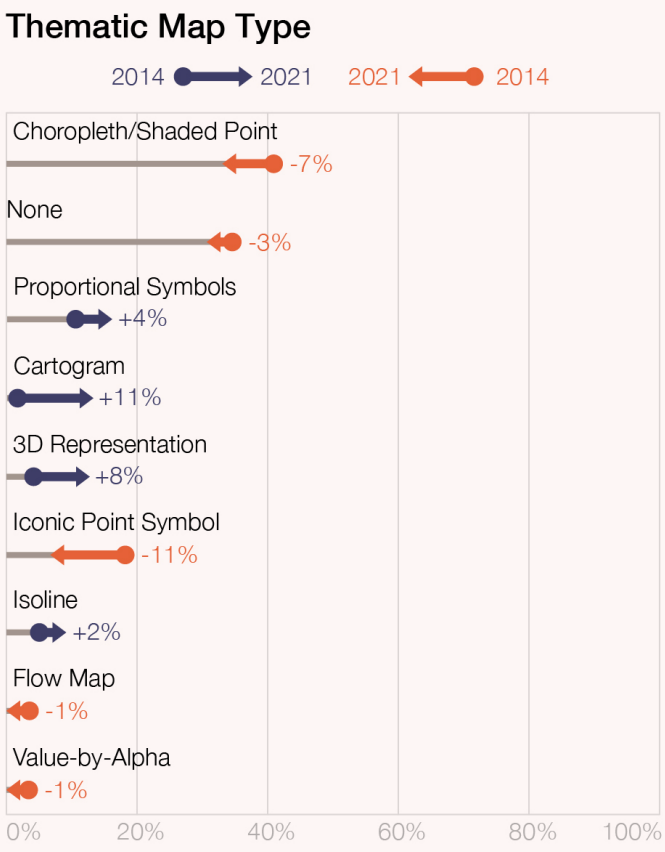


Figure 7. Percentage point differences in thematic map type.



Figure 8. Percentage point differences in the number of attributes mapped in the news story.

and we found 11 news stories with 10+ attributes, including two with over 100, suggesting that more involved data journalism and news mapping still can be useful for deeper treatments of complex news stories.

We observed an increased placement of maps (Figure 10) in the middle of the news story (+20%) compared to the beginning (-5%), or ending (-5%), as well as a decrease in news stories that primarily were composed of maps (-13%). We also observed an increase in the use of a landscape aspect ratio (+7%; explained in part by the increase in country scale, conic projections of the US) compared to portrait (-11%) or square (-2%) maps. Both trends run counter to original "martini glass" scrollytelling designs popularized in the early 2010s (Segel and Heer 2010) and suggest practice is moving away from the map being the central driver of the visual story, a finding also supported by the smaller 2021 sample size. Accordingly, we observed an increase in the number of news stories with intermediate-size maps (occupying the full width of the text column on a non-mobile 1080p display; +9%) and a decrease in those with a small size (less than width of the text column; -15%) or a large size (greater than the width of the text column but not the full viewport; -7%) maps, although there was a notable increase in full size maps taking up the entire viewport on non-mobile displays (+16%)—perhaps to support mobile-first cartographic design (Houtman 2025)—that are otherwise part of a larger scrollytelling experience.

Inclusion of map elements in news stories (Figure 11) overall decreased, including: titles (+10% with*out* titles, -17% with a main title heading), legends (+6% with*out* legends, -23% in nominal legends, -5% for comprehensive legends containing all map symbols), and indications of scale (+18% with*out* scale, -18% scale bars). Accordingly, map elements for news stories now most commonly include a title subheading only (46% overall), a nominal (59%, although again on the decline) or numerical (43%) legend (with legends increasingly omitted), no indication of scale (69%), no indication of north (92%), and no context map (83%). Overall, reduction in map elements again corroborates other indicators that newsrooms are moving towards simplified cartographic design of digital news maps, in this case with less context for interpreting the map.

4.3 NEW DIGITAL MEDIA (RQ2)

Regarding new digital media (RQ2), we observed an overall increase of some form of animation in news

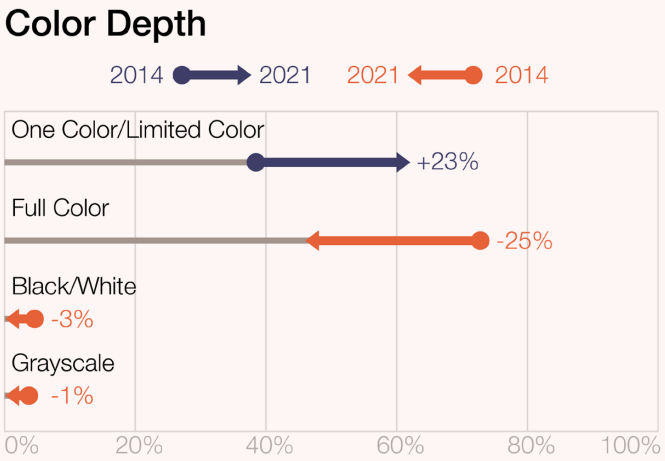


Figure 9. Percentage point differences in color depth.

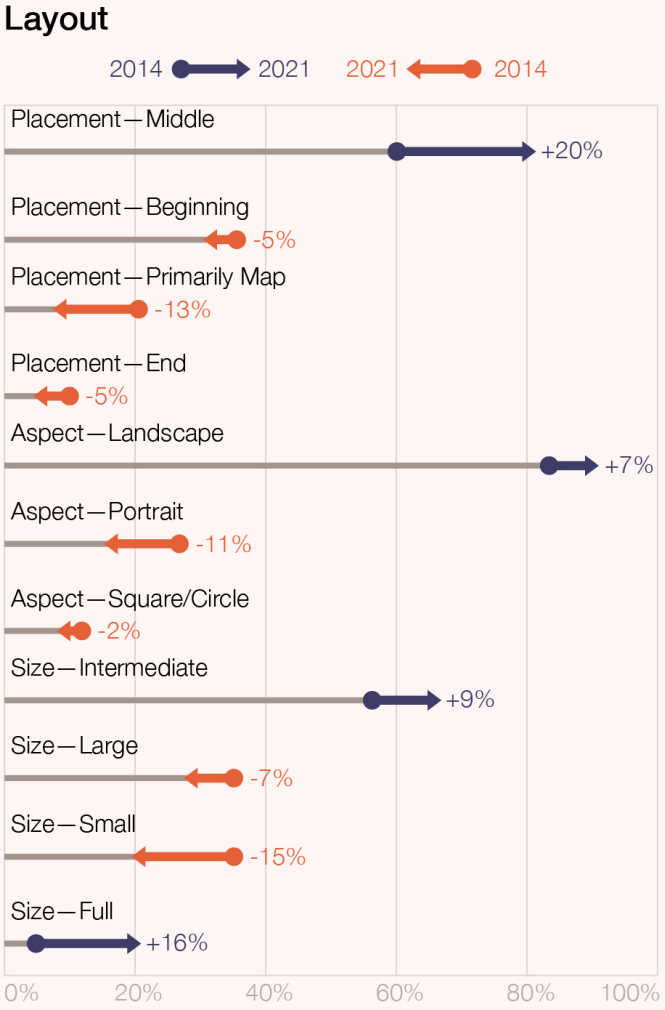


Figure 10. Percentage point differences in layout.

stories from 2014 (6% with, 94% without) to 2021 (20% with, 80% without; Figure 12). News stories with passive (no playback control) and active animation increased +5% and +12%, respectively. This finding was somewhat

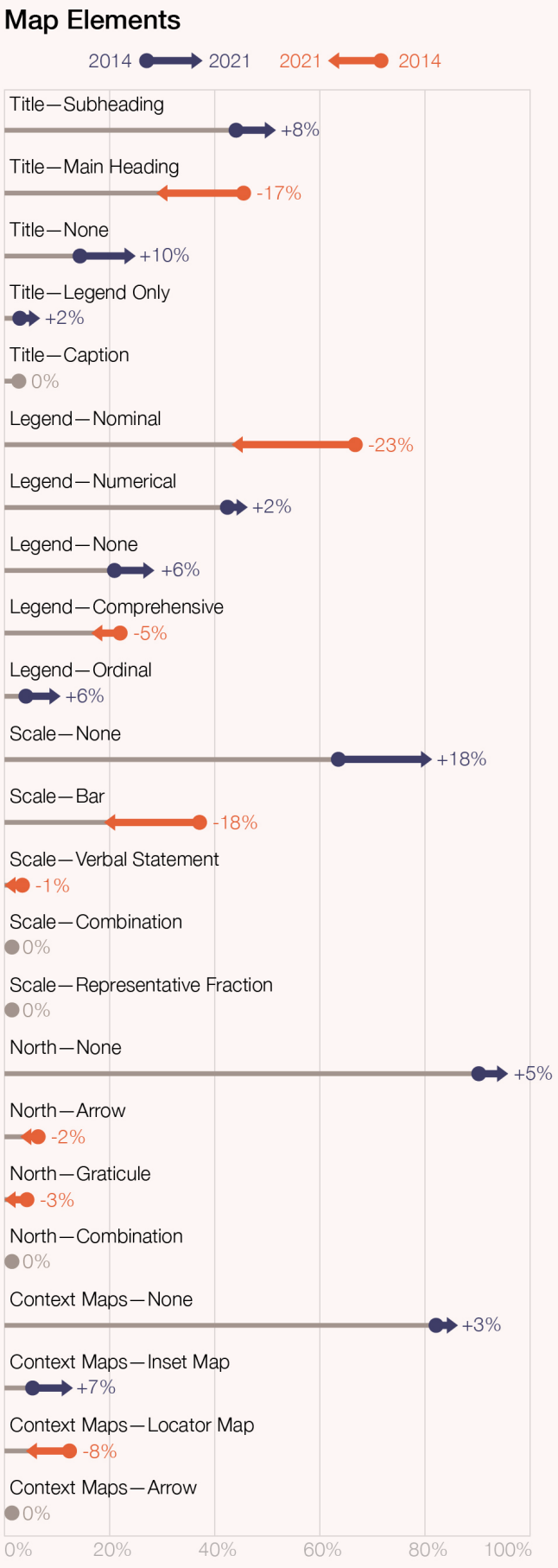


Figure 11. Percentage point differences in map elements.

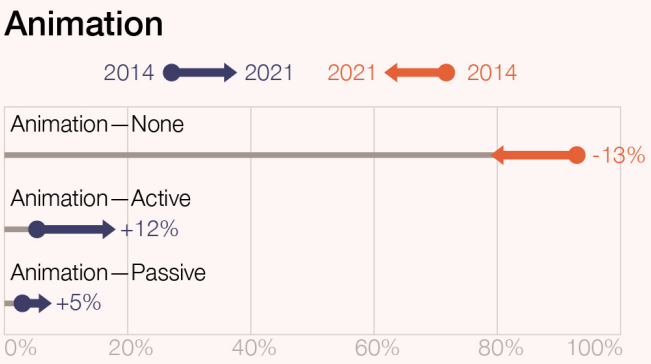


Figure 12. Percentage point differences in animation.

unexpected given the perceived shift away from animation in both cartographic research and education to other new digital media topics like interactivity, social media, user customization, and artificial intelligence. On one hand, an increase in passive animation parallels a move towards simplification in new digital media similar to our observed simplification in cartographic design (RQ1), as passive animation (e.g., animated GIFs) is a responsive design strategy for reducing visual and interactive complexity for mobile devices (Horak et al. 2022, Roth et al. 2024). However, the substantial increase in active animation provided through the sequence interaction operator from just 5% to 17% provides additional evidence that more involved data journalism and news mapping, here using multimedia, still can be useful for deeper treatments of complex news stories.

Overall, interactivity (31/119, or 26%) was more common in news stories than animation (just 13/119, or 11%). However, we observed a +6% increase in news stories with*out* interactivity from 2014 (72%) to 2021 (78%; Figure 13). Further, only one more news story had some form of interactivity (9/41, or 22%) compared to animation (8/41, or 20%) by 2021. This contrast of interaction versus animation does point to a simplification in the use of new digital media for news maps, confirming Tse's (2016) argument for and intention to replace interactives with scrollytelling at the *NYTimes*.

The frequency of most interaction operators decreased or exhibited no change. Pan exhibited the greatest decrease (-6%), noteworthy because panning often is a suboptimal interaction indicating that the user is disoriented or "lost" while zooming, but nonetheless often is implemented as a default function in slippy web maps (Roth and MacEachren 2016). Thus, this decrease indicates a

recommended shift towards interface constraints to keep user attention on the area of interest. However, we also observed decreases in overlay (-5%) and zoom (-4%), two additional operators commonly available by default in slippy web maps. Taken together, reductions in pan, zoom, and overlay suggest a move away from multiscale basemaps in news stories. Notably, retrieve—the fourth affiliated operator commonly implemented in slippy web maps—exhibited no change between years. Retrieve was the most commonly observed interaction operator, found in 22% of all news stories (the declining pan and zoom were next at 13% each) and in 26 of the 31 (84%) news stories with interactivity, suggesting that interactivity primarily is used in news maps to provide clarifying details about specific places to the audience and that this need is persisting despite the decline of slippy web maps.

Unexpectedly, search also declined -4% between years, with only one news story containing search in 2021, and overall was uncommon in the sample (found in just 5% of all news stories). We anticipated search to be more common in the news story sample given its support for basic identification of known locations, making it more appropriate for public-facing interactive maps (i.e., those found in news stories) versus other more sophisticated operators like reexpress, resymbolize, sequence, and, in particular, filter that support more complex tasks and thus more expert or specialist map use (MacEachren 1994, Roth and MacEachren 2016).

Reexpress (i.e., the ability to change thematic map type or its visual variables) was the only interaction operator that increased in frequency (+6%), an interesting finding suggesting that data journalists are more willing to let the audience view data-driven visual stories in multiple ways and thus to come away with potentially different understandings of the story. Accordingly, a move towards more simplified representation and interaction map design does not necessarily indicate an intention to have more control over the story interpretation itself.

Finally, we observed an increase in news stories including automated real-time updates to the map (+7%) and a corresponding decrease in manual updates (-12%; Figure 14). This finding potentially signals a trend towards automation in the newsroom, aligning with recent interest in GeoAI for cartography, although this practice remains uncommon, with 82% of the sampled news stories exhibiting no updates.

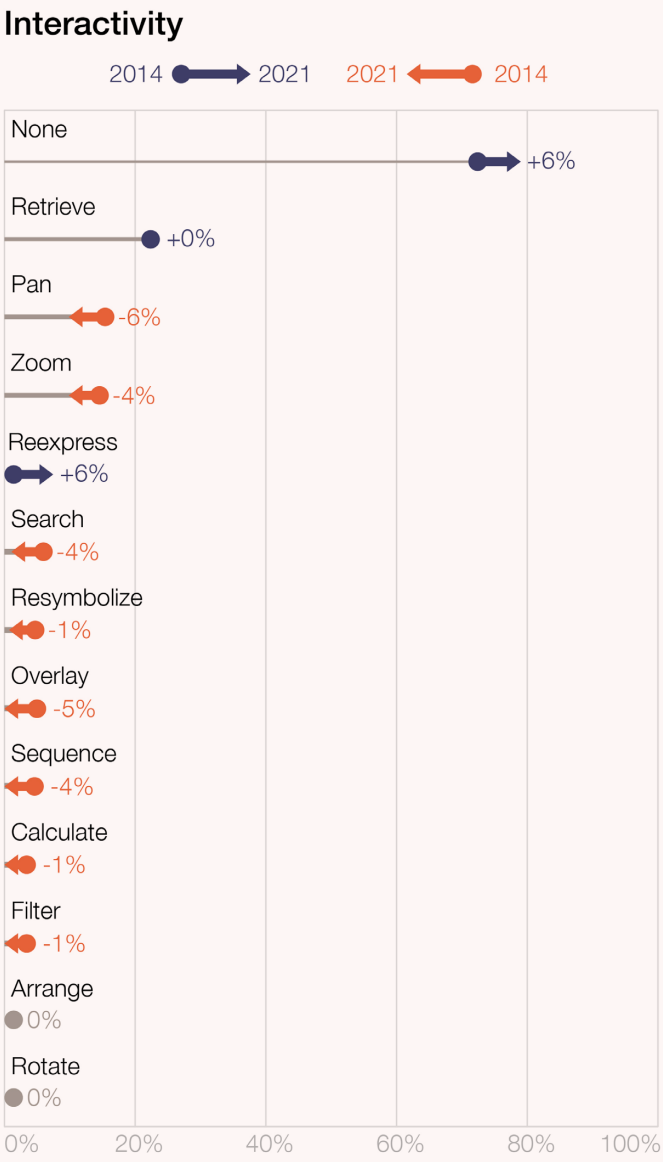


Figure 13. Percentage point differences in interactivity.

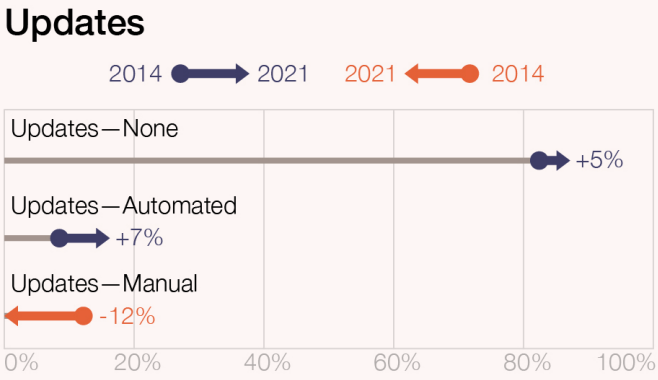


Figure 14. Percentage point differences in updates.

4.4 VISUAL STORYTELLING (RQ3)

Concluding with visual storytelling techniques (RQ3), we adapted Vujaković's (2014) seven higher-level news map themes based on the topics observed in the corpus. Health was the most commonly mapped topic in 2021 (so much so that we delineated health from science in adapting the Vujaković 2014 taxonomy), increasing +14% to nearly one quarter of the 2021 sample (24%) due to the impact of COVID-19 in 2021 relative to Ebola in 2014. We also observed a +8% increase in news stories about the environment and science, a noteworthy and potentially exciting trend given the contemporary politicization of many topics at the intersections of geography and science in the US, such as climate change, clean energy, conservation, and green transportation. Further, we observed a +5% increase of mapping disasters, which often were related to environment and science but focused around specific and potentially more memorable events.

In contrast, we observed a decrease in coverage on conflict (delineated from politics under the Vujaković 2014 taxonomy; -11%), cultural affairs (-8%), and society (-3%), a potentially problematic finding given the importance of covering sensitive events and social movements. On its face, a decrease in conflict mapping should be a desirable indicator of peace; however, in our sample this was related to unexpectedly low coverage of the #BlackLivesMatter movement as well as the shift away from international news stories, including Israel's occupation of Palestine and blockade of Gaza. We did not observe any news stories that explicitly mapped Vujaković's (2014) economics theme, but did add a separate code for elections—separating it from politics, given the presence of the pair of domestic elections in the sample—which accordingly was stable between years (-1%).

We observed only a small increase in the longform infographics genre (just +4%) with static visual stories comprising nearly half of the corpus (48% overall, although declining -10% from 2014 to 2021; Figure 16). We had expected to find continued and growing popularity of scrollytelling in the 2010s (Stolper et al. 2016) as well as increased ease in making scrolly maps through platforms like Esri StoryMaps, Mapbox Storytelling, and Story Maps JS. However, this result has more to do with the definition of longform infographics in contrast to multimedia visual experiences, with the former enforcing continuity through browser scrolling and the latter enforcing continuity through anchor tags and hyperlinks, which can be activated through scrolling. Accordingly, we observed a substantial increase in multimedia visual experiences



Figure 15. Percentage point differences in story topic.

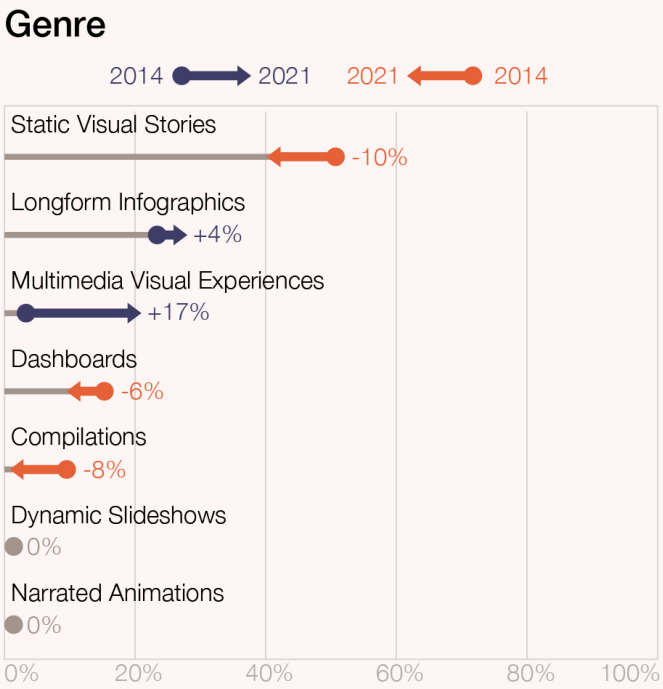


Figure 16. Percentage point differences in story genre.

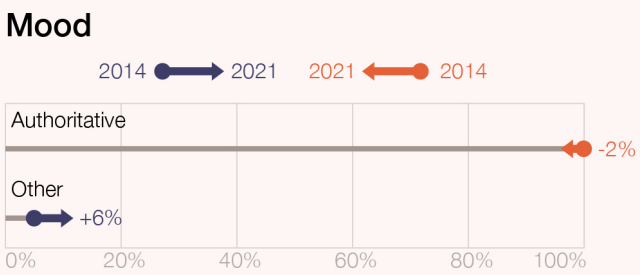


Figure 17. Percentage point differences in mood.

(+17%) that also make use of user scrolling, but include a greater amount of dynamic visual elements activated through HTML tags while scrolling. This shift towards multimedia integration with scrolling largely explains the decrease in static visual stories as well as the increases in intermediate size maps and a landscape aspect ratio, as these are more easily integrated into large, dynamically activated text blocks. Altogether, our difficulty in cleanly delineating longform infographics and multimedia visual stories suggests that these structures are colliding into a single "scrollytelling" genre in the Roth (2021) taxonomy; longform infographics and multimedia visual experiences together accounted for nearly one third (39/119; 33%) of the corpus.

Other genres decreased or exhibited no change, with compilations (-8%) and dashboards (-6%) becoming notably less common in 2021. We did not observe a single instance of the dynamic slideshow or narrated animation genres across the corpus, indicating these forms of visual storytelling have been mostly phased out from newsrooms.

Turning to visual storytelling tropes, the overwhelming majority of news stories used an authoritative visual style (after Muehlenhaus 2012) for their maps to set the mood, reifying a sense of accuracy and trustworthiness in the mapped information (Figure 17). While overall uncommon, an increasing number of news stories included at least one map in an alternative style (+6%), falling somewhere between persuasive and propagandist (we had difficulty further delineating these two rhetorical styles, and therefore collapsed them into "other"), primarily using a darker color palette to set a more ominous, foreboding mood.

Unexpectedly, techniques for focusing audience attention were less common in 2021 (Figure 18). Specifically, we observed a decrease in the use of highlighting (-19%), leader lines (-18%), callouts (-14%), and geometric frames (-3%). A decrease in attention as a visual storytelling trope might be explained by the overall move towards simplicity in

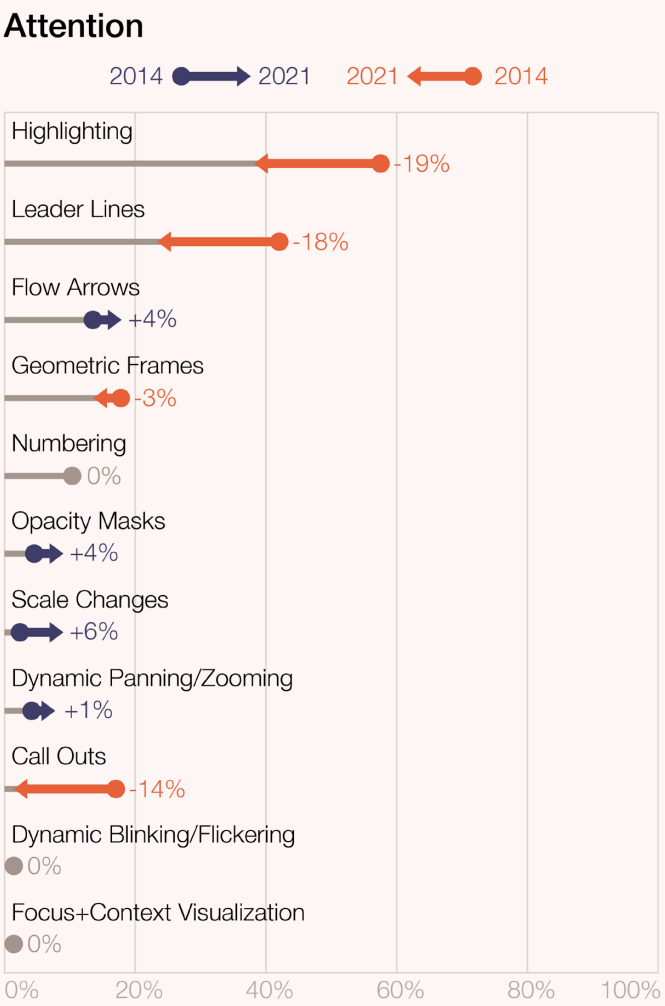


Figure 18. Percentage point differences in attention.

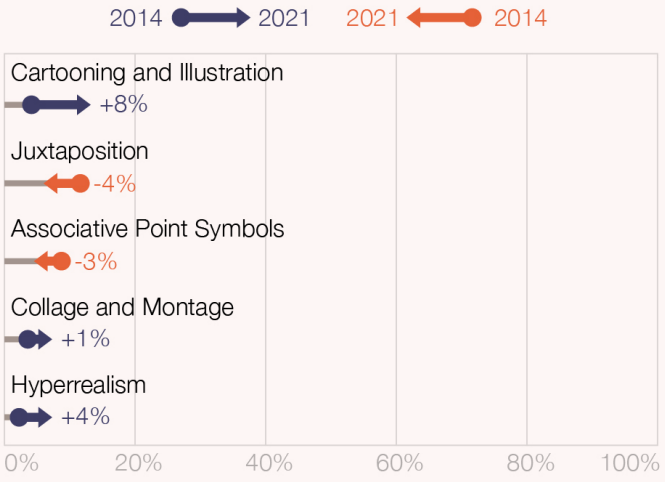


Figure 19. Percentage point differences in metaphor.

cartographic design (RQ1), as less visually complex maps and charts may require less annotation to highlight key places and patterns. Comparatively, we observed relatively

modest increases in the use of map scale (+6%), flow arrows (+4%) and opacity masks (+3%) in place of other focusing attention techniques.

In contrast to attention, metaphor techniques were more common in 2021 (Figure 19). We observed increases in cartooning and illustration (+8%) and hyperrealism (+4%). This finding indicates a noteworthy shift towards more artistic and creative methods of expressing visual stories, a counterpoint to other signals of a move towards automation in news mapping.

Designer voice also was more common in 2021 (Figure 20). Using definitions of designer voice from Steinberg (2023), we observed a notable decrease in news stories with*out* designer voice (-10%) and increases in stories that featured a cartographer byline (+18%), author byline (+23%), method explainers (+24%), and, especially, expanded data sources (+29%). Each of these signals a shift towards greater transparency and accountability in data journalism.

5. DISCUSSION AND OUTLOOK

In this article, we report on a longitudinal visual content analysis tracking the evolution of cartographic design and visual storytelling praxis in two popular US news media outlets over the past decade. Following Fish et al. (2025), this study makes five scholarly contributions:

- *conceptual* in synthesizing, validating, and modifying design frameworks in cartographic design, new digital media, and visual storytelling;
- *empirical* in producing a benchmark study based on secondary sources for cartographic design and visual storytelling in data journalism unspecific to a single thematic topic;
- *methodological* in developing a longitudinal approach to content analysis for cartography;
- *technical* by suggesting design opportunities and gaps for narrative cartography and data journalism; and
- *applied* in a case study specific to US data journalism in the *NYTimes* and *WaPo*.

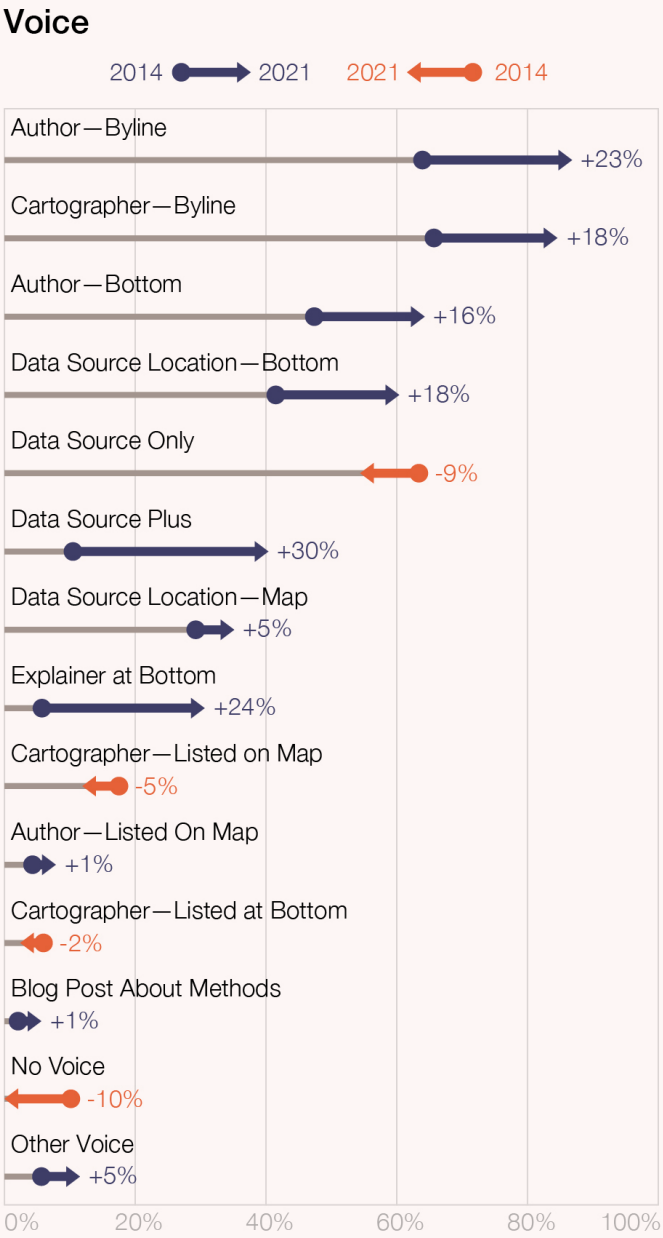


Figure 20. Percentage point differences in voice.

Specifically, we asked:

1. *How are data journalists maintaining or disrupting conventional cartographic design tenets, and how have these practices changed over time?*

Overall, we found a decrease in the use of maps in news stories and a simplification of these maps from 2014 to 2021, a trend that aligns with recent discussions of the transforming political economy of the newsroom placing greater demands on labor (e.g., Usher 2020) as well as the "cartographic silencing" of news maps in increasingly

conservative media (e.g., Fish and Kreitzberg 2023, 2492). This trend towards simplicity is reshaping the look of news maps in several ways:

- less frequent basemap context with fewer custom styles;
- a shift towards mapping change over specific time intervals;
- a decrease in the number of mapped attributes;
- a move from full color to monochrome or limited color palettes;
- overall smaller sized maps;
- more frequent map placement in the middle of the story versus the beginning or end; and
- elimination of map elements or reversion to their simplest form.

Further, we also observed a shift away from mapping international stories towards domestic stories, leading to an increase in conic projections and landscape layouts, design features that are recommended for maps of the US. Taken together, these trends present some cause for concern about the state of cartographic design in contemporary data journalism.

However, there were some interesting examples suggesting creativity still is encouraged in the newsroom, including:

- a shift away from common iconic point symbol maps and choropleth maps to alternative thematic map types such as cartograms, 3D representations, proportional symbol maps, and isoline maps;
- examples of maps that show over 10, or even over 100, attributes;
- an increase in full size maps taking up the entire viewport; and
- an increase in non-authoritative visual styles (RQ3).

Thus, cartographic practice in newsrooms has embraced simplicity while still enabling opportunities for creative design in some contexts.

2. *How are data journalists leveraging design affordances and constraints of new interactive, online, and mobile technology, and how has this digital practice changed over time?*

Unexpectedly, we found an increase in both passive and active animation but a decrease in interactivity, with static maps remaining the most common form of digital maps. We observed a decrease in interaction operators associated with slippy maps, including pan, zoom, and overlay, with retrieve remaining the most common operator across years. Accordingly, we suspect some of the move towards simplicity in representation (RQ1) and interaction design (RQ2), alongside an increased use of animation, is explained by newsrooms embracing mobile-first design and scrollytelling (RQ3). We also unexpectedly observed a decline in search, an operator commonly associated with public use cases aligning with the intended audience of news maps, but an increase in reexpress, an operator commonly associated with specialist use cases. Accordingly, a move towards more simplified design does not necessarily indicate an intention to have more control over the story interpretation itself. Further, we found an increase in real-time updates, one signal of automation in the newsroom.

3. *How are data journalists employing novel visual storytelling techniques, and how has this practice changed over time?*

Finally, we observed an increase in news maps about health as well as environment and science, a potentially exciting finding given the contemporary politicization of many topics at the intersections of geography and science. In contrast, we observed a decrease in coverage on conflict, cultural affairs, and society, a potentially problematic finding given the importance of covering sensitive events and social movements. From the analysis, we advocate for combining the longform infographic and multimedia visual experience genre into a single scrollytelling genre, and observe a substantial increase in scrollytelling accounting for a decrease in static visual stories. Dynamic slideshows and narrated animations appear to be mostly absent from newsrooms, or at least deemed not interesting enough to be circulated on social media. Notably, we saw a decrease in the focusing attention trope—again pointing to simplicity in cartographic design (RQ1)—but an increase in the use of metaphor and designer voice. An increase in metaphor again points to embracing creative design in some contexts while an increase in designer voice points towards greater

transparency and accountability in data journalism, both encouraging developments.

Our longitudinal visual content analysis study has several limitations suggesting rich avenues of future research. First, many results may not generalize beyond a US context. We selected *NYTimes* and *WaPo* because of their outsized impact (due to their high total subscriptions) on domestic and international geopolitical discourse, as well as their overall influence on visual culture in the US. The maps and graphics from these news outlets have some of the widest reach of any US cartography and therefore have a disproportional impact on what the general public conceives of and expects as "cartography." However, the outlets are biased towards US interests and events, increasingly so, as we found through the content analysis. Further, the US broadly, and these news outlets specifically, have a unique political economy around news media that is constrained by capitalist interests and labor tensions (Usher 2020). Accordingly, more research is needed on how such market forces influence cartographic design choices. Independent, nonprofit news organizations, such as *High Country News* and *ProPublica*, also produce maps, and their cartographic design strategies could serve as a point of comparison to larger news companies.

Second, our content analysis does not capture the contemporary moment of data journalism, which may have shifted significantly while writing this article. All benchmark studies effectively are locked in time, and arguably are useful not because they reflect current conditions but instead because they illuminate future opportunities for cartographic research, design, and education. However, since we conducted the study in 2023, the political economy of US newsrooms and online social media has transformed fundamentally, as several noteworthy US news media institutions have narrowed their topical coverage and accordingly reduced their staffing, ostensibly at the behest of politically active ownership (Parker 2026). Data journalism has not escaped these cuts, a troubling development for news mapping after cartographic expertise already was in the process of being replaced by related—but inequivalent—data science skillsets in the newsroom and elsewhere (Thatcher et al. 2024). It is possible that political economics explained some of the shift towards simplicity in news maps from 2014 to 2021, although visual content analysis as a method is relatively limited in its ability to reveal the underlying political economic conditions at work upon cartographic design decisions when compared to other social science methods like interviews and observation. However, it is possible that we are in the midst of a third wave of digital news mapping requiring a follow-up longitudinal content analysis from our results presented here—perhaps combined with additional non-visual archives such as correspondence and budgetary expenditures—as well as deeper investigation into the political economics causing these changes.

Finally, our analysis does not account for the intentions of the data journalists producing the news maps or the requests from editors and peers shaping the broader news stories. While a cluster of content analysis and interview studies now exist on news map design, these studies do not touch on what designs did not make it past the editor's desk, nor do they ask why. Based on these findings, we argue for continued critical analysis of maps within data journalism vis-à-vis alternative forms of visual storytelling because of their pervasiveness online and their impact on map viewers. Further, this cluster of studies does not explore how cartographers can and should be contributing back to data journalism. Particularly, we advocate for continued expansion of "investigative cartography" where the professional cartographer/geographer collaborates with the field journalist for news stories requiring onsite mapping and place-based research aligning with cartographic and geographic research (Usher 2019). There are many examples of such site-specific, map-driven journalism in the *NYTimes* and *WaPo* (e.g., Fox et al. 2019, Wallace and Watkins 2017, Abraham et al. 2024), with future efforts towards building nonprofit news organizations (e.g., *High Country News* and *ProPublica*, referenced above) and university partnerships (e.g., Fontes 2019, Marion and Cohan 2021, Underwood 2022) offering additional alternative strategies for attaining and enriching truly cartographic-first journalism.

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The authors report there are no competing interests to declare. Artificial intelligence was not used at any stage in the project.

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