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If Looks Could Kill: The Impact of Different Rhetorical Styles on Persuasive Geocommunication

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This study analyses the impact that different rhetorical styles have on reader trust in, fondness for and memory of maps showing the same exact data. Previous research has identified four unique rhetorical styles used on maps meant to persuade an audience. Four maps of a hypothetical nuclear meltdown in the USA using embellished radiation data were produced, each following the design guidelines of one of the four rhetorical styles. An online survey was created testing: (1) map readers’ inclination to believe the data being shown on the four maps; (2) the impact the representations had on personal views regarding nuclear power; (3) map reader trust in the maps; (4) fondness for the maps; and (5) memorability of the maps (i.e. how likely a map would be recalled). The results indicate that different map rhetorical styles result in different levels of opinion change, trust in the data and confidence in answering questions about the data. Designing convincing arguments with maps requires more than lying; different rhetorical designs can help achieve different persuasive goals.

Keywords: map rhetoric, persuasive maps, map design, map trust, map likability, map interpretation

INTRODUCTION

This article represents an attempt to systematically evaluate and understand how different map rhetorical styles impact (1) map reader affinity for the map being viewed; (2) trust in the data being represented; and (3) the likelihood that the map’s message will be remembered by map readers in the future. Four unique styles of intentional cartographic manipulations for the purpose of persuasion, as identified by Muehlenhaus (2010, pp. 177–198), were tested to see if certain rhetorical styles were more effective than others at convincing map readers that nuclear power is dangerous. Demographic information was also collected from map readers to ascertain whether particular map styles work differently depending on the audience (e.g. sex, age, education and political affiliation). Finally, questions were asked to gauge how susceptible the sample population was to persuasive maps in general – i.e. how critical were map readers of the data they were viewing?; did map readers suspect bias?; did the level of bias detection change depending on the style of representation used? The results show that each of the four rhetorical map styles appears to have certain advantages and disadvantages when it comes to convincing an audience to accept a particular message. Depending on the intended outcomes of opinion moulding, map designers might be wise to carefully consider the overall rhetorical style and design of their map.

LITERATURE REVIEW

Rhetoric and persuasion are two aspects of map design that are often overshadowed in modern research by an emphasis on data accuracy and accurate interpretation. Scholars and armchair map enthusiasts have studied the use of maps as persuasive tools for well over 60 years, beginning in earnest during the Second World War (Quam, 1943). It is now largely accepted that maps and other graphic representations harbour rhetorical, argumentative qualities (Propen, 2007), albeit distinct from written or oral ones (Smith, 2007). It has even been opined and debated that unabashedly biased, rhetorical maps are more honest and ethical than those attempting to strictly adhere to objectiveness of scientific rigor (MacEachren, 1995, pp. 340–341). Maps that look and appear scientific are still forms of communication making arguments, loaded with the biases of their creators.

The role of rhetoric

At its simplest, rhetoric can be defined as discourse that is used to better inform, persuade or motivate audiences via a variety of communication techniques. The definition of rhetoric has constantly been debated and evolving since Greek times. Whereas Plato largely dismissed rhetoric as immoral and dangerous, Aristotle argued that rhetoric is core to philosophy. He noted that rhetoric is the faculty...
of observing in any given case the available means of persuasion’ (Aristotle, 2010). One can have a completely logical and rational argument and fail to be convincing. Examples of this are abundant, but perhaps none more fatal than government attempts to get people to quit smoking by putting printed, text warnings about the health risks of smoking on cigarette packs. Rhetoric can be used to achieve that crucial communicative goal of eliciting an emotional reaction from the audience, better connecting them to the rational, or even irrational, argument being presented. Hence, increasingly governments are mandating graphic pictures of dead smokers or their cancer-ridden organs on cigarette packs in addition to worded warnings.

Today, a trans-disciplinary debate still exists as to the scope of topics and communication methods to which rhetoric can be applied. Some linguists believe that rhetoric only applies to written and oral arguments. Many now disregard this notion, as graphic design theory has shown that images can be more emotional and persuasive than words in many cases (Whalen, 2011). The study of visual rhetoric is fairly new compared to the millennia spent studying written and oral rhetoric. Debate about the centrality of communication mediums aside, several truisms about rhetoric remain constant. First, rhetoric is an attempt to manipulate an audience’s emotions. This often involves omitting facts that contradict the argument being made and including allusions to non-data elements with which an audience might emotionally identify (Shen, 2010, 2011). Second, rhetorical style is central to any argument; different rhetorical methods and styles exist and can be used to different effect in different circumstances.

Maps and persuasive communication

All maps are rhetorical devices; some are better rhetorical devices than others. Many maps are created with the sole purpose of attempting to change, cement or reinforce an audience’s opinion. Persuasive maps are defined here as geovisual representations created with the purpose of eliciting one particular interpretation or argument over competing ones (based on Tyner, 1982). Over the past 60-plus years, a significant amount of research has accrued describing the potential influence persuasive map exposure can have on people’s geopolitical imaginations (Monmonier, 1995) and beliefs about the larger environment (Roberts et al., 1995).

Much, if not most, research on persuasive maps examines previously published maps – i.e. maps that in hindsight are obvious examples of persuasive communication. Propaganda maps (frequently a synonym for persuasive maps created by state governments) are the most common topic of study. Maps created by the Nazis, Soviets and other historically vilified governments have been extensively examined as politically motivated communication tools (Herb, 1999, 1989; Monmonier, 1996, 2004). Indeed, some of the literature on propaganda maps is itself propaganda. During the Second World War, there were several admonitions to the public not to necessarily believe what Axis maps show (see, for example, Starkey, 1942). In the early stages of the Cold War, Boggs (1947) even went so far as to give the danger of map persuasion a name – ‘cartohypnosis’. He lamented that too many people think uncritically when viewing maps and assume that what they are looking at is real (Boggs, 1947), or what has more recently been described as confusing spatial data for phenomena (MacEachren, 1995). One of the earliest analysts of persuasive maps, Speier (1941) attributed the potential dangers of persuasion and misrepresentation on maps to ‘magic cartography’. In his view, propaganda maps represented wanton violations of science, arguing that: ‘[Maps] are essentially scientific. The propagandist who uses them borrows the prestige of the science and at the same time violates its spirit’ (Speier, 1941, p. 330). Just over 50 years later, Pickles would renew a similar line of thought, sans magic, suggesting that the norms of scientific cartography simply ‘break down’ when dealing with propaganda maps (1992, p. 194).

Persuasive maps encompass more than merely state-based, propaganda maps, however. Researchers of persuasive cartography have also analysed how maps are used to convince and sway map readers both overtly and subconsciously for purposes of advertising, public opinion, and news reporting. Wood and Fels (1986, 1992) used semiotics to dissect how meaning and societal values are imbued in and translated through something as common and mundane as state highway maps. Harley (1989) used Foucauldian theory to analyse the communicative power of a map. Perhaps the most widely circulated analysis of persuasive maps was, and still is, Monmonier’s How to Lie with Maps (1996), which provided a surfeit of exemplar maps being used as persuasive tools.

Until recently, most research on persuasive maps has been descriptive and limited in sample size due to the amount of time required to describe maps via written analysis. Using quantitative content analysis (QCA) to analyse large samples of maps is becoming increasingly common, however (Kessler and Slocum, 2010; Muchenhaus, 2011a). Edsall (2007) used QCA to look at what he calls ‘maps in the wild’ – or politically motivated, largely disposable, maps found on t-shirts, bumper stickers and advertisements throughout society. More specifically targeting persuasive maps, Muchenhaus (2010) used QCA to compare the data model, graphic and design composition of over 250 ‘political cartographic manipulations’ created post-1800. He used the method to highlight that persuasive maps appear to have a separate genealogy and evolution from standard thematic maps (Muchenhaus, 2011b). Having analysed each map across 192 variables, he also identified pervasive correlations among the different map elements and design techniques used to make these maps (Muchenhaus, 2010). For example, he could determine if maps in his sample that did not include legends were more or less likely to have appropriate projections.

Identifying map rhetorical styles

The idea that maps have rhetorical styles is certainly not new. Keates (1996, pp. 157–174) devotes two entire chapters in Understanding Maps to the role of rhetoric in map design. He argues that the art of rhetoric is more difficult in mapmaking than in other forms of communication, such as oration and writing. In public speaking, one can change rhetorical style based on feedback from the
authoritative, understated, propagandist and sensationalist. These styles by merely looking at a handful of key attributes is possible to classify and identify different map rhetorical categories based on their design attributes: authoritative, understated, propagandist and sensationalist. Each of these styles is defined by specific variables found within maps themselves. Muehlenhaus hypothesizes that it is possible to classify and identify different map rhetorical styles by merely looking at a handful of key attributes found on a persuasive map. The style definitions from Muehlenhaus (2010) are reviewed below.

Authoritative
The authoritative rhetorical style is scientific visualisation. Indeed, the chameleon capability of looking objective is what makes authoritative style persuasive maps distinct from other, more blatantly biased, persuasive maps. Authoritative maps look scientific, official, and magisterial (Muehlenhaus, 2010). This persuasive style follows most of the graphic rules established in academic cartography. Authoritative persuasive manipulations may largely be invisible to the average map reader (though tests need to confirm this), because the mapped data are often modified before the map is put in graphic form via selection, generalisation and classification. These maps will typically follow the academic norms for graphicacy and map design, though they may break many rules regarding data classification, generalisation and manipulation. It is the hypothesis here that the authoritative rhetorical style is meant to solicit trust among map readers via a professional, scientific look. Indeed, most official government maps produced for policy and legal purposes use this rhetorical style. An example of an authoritative map is found in Figure 1.

The map in Figure 1 below, Columbia Nuclear Plant Meltdown Radiation Model, is designed to look scientific and accurate. Authoritative maps use many layers of data to look detailed and trustworthy. In the case of this map, hundreds of cities were placed on the map and labelled. Shaded relief and land cover were used. Urban areas were also included. Two legends, a scale bar and data sources were added. The map layout was designed off of a standard GIS template, with the formal, objective-sounding title placed at the top of the map. A supplemental text box provided additional information to map readers. Given these attributes, it is no surprise that people might be inclined to trust this map, to succumb to cartohypnosis and simply believe what it presents as reality. On the other hand, if the goal is to scare people, it may not be the most effective method of design. The message that much of America will be under a cloud of radioactive waste is not reinforced in the bland title, the banal looking legend, or via any sense of urgency found in the layout of the map.

Understated
Understated maps are minimalist. They just appear to present facts. They are extremely judicious in their use of data, tending to only show one or several themes on a single map. Map elements are used, but are generally spartan. Visual contrast is not overly pronounced as is typical in several other map styles. In this way, understated maps look professional and scientific, like authoritative maps. However, unlike authoritative maps, understated maps do not include detailed datasets, base maps or map elements. They rarely have any accompanying illustrations. Whereas both authoritative and understated maps tend to follow Tufte’s (1983) axiom concerning ‘data-to-ink ratio,’ understated maps do not follow the axiom that better graphics are data complex and visually rich. Instead, they tend to abstract data down to a simple, clear, basic level, omitting extraneous, tangential information. Multivariate symbols are rarely used. Base maps are devoid of supplemental visual features – no shaded relief, no oblique perspectives. The graphic hierarchy is simple and clear. The symbology is typically geometric (not mimetic) and the data are displayed in a concrete, static manner. Finally, the data presented on these maps are often simplified. Figure 2 represents an example of a minimalist map. The map in Figure 2 only has four map elements – a neatline, legend, title and a mapped area. The legend is not titled and is not overbearing in size; yet, if a map reader does read it, she will soon realize that some of these colours represent extremely deadly amounts of radiation. Finally, the title does not try to spread fear among map readers, but it also connotes that this radioactive diffusion is inevitable with the word ‘anticipated’. Finally, at first glance, the
colours of this map look inconspicuous enough; a standard red-to-yellow colour scheme. Yet, they were not chosen for clear data interpretation; they were selected because for many map readers, these colours are associated with feelings of danger. This map appears simple and unadulterated, but it was carefully crafted to unsettle the map reader.

**Propagandist**

Propagandist maps are almost exclusively created to quickly and succinctly communicate certain policies, agendas, ideology or jingoist messages. Propagandist maps rarely have any accompanying illustrations. They tend to use graphically appropriate representations, though with much embellishment of the map’s visual hierarchy. For example, propagandist maps are likely to use dynamic or mimetic symbolisations instead of static or geometric ones and high visual contrast using colour. Propagandist maps typically only highlight one theme at a time, rarely two. The messages of these maps are often difficult to miss, as they present one theme very clearly to a map audience. Data that are irrelevant to the simple message being conveyed are omitted, as are data that contradict the message. Humans can visually focus on no more than three-to-four things at once (Ware, 2008); propagandist maps make sure that those three things repeatedly reinforce an argument. An example of a propagandist map is found in Figure 3.

In the case of the *Bang! You’re Dead* propagandist map (Figure 3), the data were generalized to the nominal level. Any state with any amount of potentially fatal exposure, no matter how small, was highlighted as being within life threatening range of the Columbia plant. Every single visual element on the map was designed to reinforce the fact that the Columbia plant is potentially deadly. The title used inflammatory phrasing that was easy to remember and difficult to forget. States within this non-descript life-threatening range were intentionally coloured a toxic green. High-contrast radiation symbols were placed in each ‘threatened’ state as a redundant mimetic symbol of danger. Yellow and black were used as accent colours – eliciting danger. The subtitle was succinct and menacing. Finally, the area of the USA outside of the nuclear fallout area was labelled, not by chance, ‘Non-Fatal Poisoning’. Thus, even when participants looked at this safe area of the map, the words they associated with it were ‘fatal’ and ‘poisoning’.

**Sensationalist**

Sensationalist maps are those most often found accompanying advertising, opinion pieces, news agencies and non-profit publications. Essentially, wherever there is mass media consumption, sensationalist maps are easy to find. These maps are named sensationalist because they attempt to overwhelm one’s senses with a barrage of, often irrelevant, data and visualisations. These maps typically include illustrations, photographs, oblique perspectives, emotive icons and symbols, dynamic representations, and bombard the map reader with a variety of information.
of datasets and themes. Sensationalist maps are exciting, eye-catching and difficult to interpret due to the layers of data and complicated visualisation schemes embraced (Figure 4).

The sensationalist map in Figure 4 combines the data overload of authoritative maps with the aggressive bias of a propagandist map. At first glance, *Cloudy with a Chance of Deadly Radioactivity* may appear to be propagandist. The difference is in the amount of data detail and superfluous graphics and symbology used on the map. Whereas the *Bang! You’re Dead* map showed one theme very clearly and succinctly, the sensationalist map does anything but. A variety of distracting and fear-provoking elements were placed on this map to take away from the fact that the data are relatively simplistic. First, images of people in brightly coloured radiation suits were used. Second, bright red arrows with drop shadows – that have no meaning whatsoever as data reference and are simply illustrations – swoop across the map, guiding the map reader’s eyes. Additionally, the radiation is given a mesa-looking drop shadow effect to add elevation and depth to the data. Hundreds of urban areas are included on the map, not because it informs anyone about places that are under threat, as they are not labelled, but as an excuse to add more red and yellow scary colours. National parks are also included, cluttering the map even further and showing just how many of the USA’s most sacred scenic spots will fall under the radioactivity. The mapped area is presented obliquely to give the radioactive spread a downward slope. Finally, shaded relief is included for no reason whatsoever, merely to add data overload to the map and style. The goal of the sensationalist map is to overload one’s senses with excitement. It might also be referred to as an attention-deficit rhetorical style.

Does rhetorical style impact a map’s efficacy to convince and persuade? Although evidence of these map styles exists, no tests have heretofore been done to see what impact different map styles may have on shaping map reader opinions – i.e. testing the cartohypnosis potential of each style. It is hypothesized here that these four map styles may be employed by cartographers in different circumstances and with different audiences to serve one’s persuasive communication goals. It is unlikely that any single one of these rhetorical map styles is capable of fulfilling all of the communicative goals of a mapmaker, but different styles may have particular benefits over others depending on the context. Some maps might be trusted more, due to their professional presentation of the data. Others may resonate more fully with map readers due to their emotive and dynamic style. Finally, perhaps the way data are presented using certain rhetorical styles is simply more memorable. Some maps may make it extremely difficult for a map reader to expunge a message from her long-term memory.

The rest of this article reviews the results of a cognitive study examining the impact different rhetorical map styles have on: (1) map reader opinion; (2) map reader trust in the
data being mapped; (3) memorability of the argument being presented in a map; and (4) the overall likability of the different map styles. This study does not specifically analyse which style is most effective for different types of persuasion (e.g., reifying, delegitimizing, etc.). However, it may shed light on why these four rhetorical styles have developed over the past two centuries of persuasive mapping. In the grand scheme of things, this research is an attempt to move beyond merely identifying maps that are rhetorically effective or exceedingly persuasive; the goal is to start synthesizing our knowledge about map rhetoric and persuasive design so that cartographers can start applying certain design decisions to their own maps for effective argumentation and audience persuasion.

METHODOLOGY

The objective of this study was to test how different persuasive map styles have an impact upon map reader opinion, interpretation, recall, trust and overall partiality for the maps they are viewing. The first step was to map the same data four times, each iteration being specifically designed in one of four persuasive styles.

The impact of a hypothetical nuclear disaster at the Columbia Nuclear Power Station in the State of Washington, USA, was chosen as the case study. Using a map of a hypothetical nuclear disaster was chosen for several reasons. First, it was certain to garner an emotional response from study participants residing in the USA (the study was limited to US residents). Second, nuclear power is a contentious issue in the USA, particularly following the Japanese Fukushima nuclear disaster in 2011. Before any maps were shown, study participants’ personal views on nuclear power were measured. Participants were then later tested to see what impact, if any, viewing the map had on their original position.

The nuclear disaster data were not based on any real world models of potential environmental degradation resulting from a meltdown. It was embellished. The author created isarithmic-looking lines in Adobe Illustrator and used Avenza Mapublisher to create a radiation attribute table and exported the drawing as a shapefile. Unrealistic data were intentionally used. Since all four of the maps used the same dataset, it was possible to test for variation in how critical participants were of the data they were viewing among the different rhetorical styles. Participants were tested to see if they had prior knowledge about US weather patterns, nuclear meltdowns and the physical geography of the USA to help test for bias in reaction to the maps based on previous knowledge.

Once the four maps were designed, an online survey was created using Qualtrics (please visit www.ian.muehlenhaus.com/cj/2011survey.pdf to view the survey). A print version of the survey was distributed to approximately 30 undergraduate students in an introductory Maps and Society course in November 2011. The class was divided into small groups of four-to-five people. Each group was given a single map to look at and discuss. The students were asked to fill in a printed version of the survey as they
talked about the maps in their small groups. All of the groups were then dismantled and everyone openly discussed the maps. Feedback about the survey (e.g. confusion about particular questions) was collected. The final online survey was modified using this feedback before it went live.

The survey was posted to the Internet on 5 December 2011, and was suspended on 1 January 2012, after 141 responses were collected. No payment or gift of any kind was provided for participating. The survey was advertised via word-of-mouth, email and Facebook. Participants had to be in the USA to complete the questionnaire. It was also requested that expert cartographers and geographers not participate. Those who participated in the Maps and Society class focus group were excluded from taking the survey online. Out of 141 responses, only 112 were salvageable (71 females and 41 males). Several participants did not agree to the informed consent form on the first page. Another 27 began the survey but never completed it. Nevertheless, the high number of completed responses ensured that at least 25 participants viewed each map style.

The online survey was developed to test a variety of factors and was broken down into three parts. In the first part, demographic data were collected. Four questions were devoted to test participants’ expertise in areas that might influence data interpretation or their critical assessment of the data being shown. Finally, before section one concluded, test participants were also asked about their views on nuclear power. All of these data were collected before the faux hypothetical disaster was visualized.

The second part of the survey was designed as a between-subjects study. Participants were randomly shown one of the four maps. They were allowed to look at the map as long as they liked, and were asked to look at it long enough to answer questions about it. Participants were then asked a series of questions regarding their current zip code and the level of fallout to which this zip code would be subjected as inferred from the map. They were also asked a multiple choice question concerning what per cent of the USA would experience deadly levels of radioactive fallout. Upon answering these questions, several additional Likert-scale questions were asked regarding how participants now felt about nuclear power and if their views on nuclear power had changed at all. Finally, participants were asked about whether they felt the data on the map was accurate and whether the map was biased (they also had the option to note that they had not thought about the accuracy of the data or whether the map was biased).

Figure 4. *Cloudy with a Chance of Deadly Radioactivity.* The sensationalist map used in this study
The third part of the survey was designed as a within-subjects study. It consisted of ranking questions. Participants were shown all four of the maps side-by-side in random order. They were then asked to rank the four maps by: (1) how much they trusted what was being shown on the maps; (2) how much they liked the style and design of the maps; and (3) which map they believed they would remember most vividly if asked about the maps a month from the date of the survey. Participants were also allowed to give open-ended answers explaining their rankings.

Kruskal–Wallis tests were used to test the significance of variation among the ordinal Likert scores between map styles, as ANOVA cannot be used with ordinal and nominal level data. Somers’s and Fieldman’s two-way ANOVA tests were used to test the strength of relationships between various Likert scores.

The demographic characteristics of the survey participants were as follows. Only 20% had completed a two- or four-year college degree; however, the majority was currently enrolled in undergraduate classes. Only 29% said they used maps frequently; conversely, 14% said they only used maps when absolutely necessary due to ‘map anxiety’. A majority of participants (56%) opined that they used maps about as much ‘as an average person’. Politically, the participants leaned slightly to the left (described as sympathizing with the Democratic Party in the USA), but were fairly well balanced across the political spectrum with more people describing themselves as ‘moderates’ than any other affiliation. The distribution of male-to-female participants analysing each map style was roughly the same, although the ratio of females to males was closer to 1:1 for the understated style map (Table 1). The age distribution of participants analysing the different map styles was very similar (Table 1).

### Feelings about nuclear power

Feelings about nuclear power before viewing the maps were moderate (Figure 5). More people described themselves as ‘Somewhat Pro’ nuclear power than any other opinion (25% of participants). This was surprising, as the Japanese Fukushima nuclear disaster in March 2011 had occurred merely nine months before the survey was distributed. The second largest category was indifference toward nuclear power (21%). The smallest group consisted of those who were extremely opposed to nuclear power 8%, though those ‘Opposed’ and ‘Somewhat Opposed’ to nuclear power comprised 36% of the sample (18% each). None of the 112 participants were ‘Extremely Pro’ nuclear power. Aggregating the categories together based on pro- or anti-nuclear power: 44% of participants described themselves as opposed to nuclear power; 56% as pro-nuclear power. Male participants were slightly more pro-nuclear power than females, though the difference was not significant ($\chi^2=9.669$, $P=0.085$). Political affiliation showed no relationship with how people felt about nuclear power. All participants who considered themselves very knowledgeable about nuclear meltdowns were pro-nuclear (only 3% of participants).

### TESTING MAP STYLE DIFFERENCES

Responses were divided into groups based on the map with which participants were randomly presented in part two of the survey. Differences in interpretation, confidence in interpretation, suspicions of map bias and beliefs about the accuracy of the data being presented were then cross-tabulated and compared. Central to this study, shifts in opinions on nuclear power before and after viewing the maps were also tested. Differences among males and females, as well as those with different political affiliations, were examined. Significant differences among these groups, when they occurred, are noted below.

### Zip code exposure

After looking at the map for as long as they liked, participants were asked to answer several questions about the data being shown on the map. One of these questions dealt with the impact that the hypothetical meltdown would have on their home zip code. This was followed with an interactive slider asking them to rate their confidence in their answer on a scale of 1–5, with 5 being most confident. The vast majority of the participants recalled what level of exposure their zip code would be exposed to. However, participants’ level of confidence in their responses varied significantly depending on the map type viewed ($\chi^2=12.750$, $P=0.005$). Authoritative, understated and

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### Table 1. Demographic data of between-subjects participants

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<thead>
<tr>
<th>Age (years)</th>
<th>Understated</th>
<th>Sensationalist</th>
<th>Propagandist</th>
<th>Authoritative</th>
<th>Total</th>
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<td>7.7%</td>
<td>6.3%</td>
</tr>
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<td>36–40</td>
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<td>61–65</td>
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<td>3.8%</td>
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<td></td>
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<th>Propagandist</th>
<th>Authoritative</th>
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<td>32.3%</td>
<td>30.0%</td>
<td>38.5%</td>
<td>36.6%</td>
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sensationalist maps had nearly identical distributions of confidence regarding zip code exposure levels. Those looking at the propagandist maps, on the other hand, were far more confident in their zip code’s level of exposure than those looking at the other maps (Figure 6).

Exposure of the USA to deadly radiation
Another question asked ‘Approximately what percent of the area of the contiguous United States would be exposed to life-threatening levels of radiation?’. Significant differences existed in how much of the country was perceived to be exposed ($\chi^2=14.9, P=0.002$). As might be expected due to its simple state-by-state, nominal simplification of the data, the propagandist map resulted in far more people overestimating the percentage of the USA being exposed. All propagandist participants said that at least 50% of the contiguous USA would be exposed, with 63% of them believing 75% or more of the country would be threatened (Figure 7). The understated map resulted in the most accurate interpretation of the data; yet, conversely, it also resulted in the lowest level of confidence among participants. Again, propagandist map viewers were more confident in their responses than any of the other map viewers. The distribution is shown in Table 2. However, the differences in confidence levels regarding deadly radiation exposure were not statistically significant ($\chi^2=4.02, P=0.26$).

Feelings about data accuracy
Fake data were used in this experiment to measure the impact design has on how much people trust mapped data. Because the data were completely false, it was possible to see just how much trust some persuasive map designs instil in map readers compared to other designs. Variation among the maps in how accurate map readers believed the data were just missed the threshold for statistical significance ($\chi^2=7.3, P=0.06$), but the fact that variation was not statistically significant is in itself significant. For some of the maps were so overtly biased, it was presumed that data trust might be an issue yet it was not.

Authoritative and understated maps were the most trusted when it came to feelings of data accuracy. Fifty-four per cent of participants viewing the authoritative map assumed that the data shown were accurate, 4% believed that they were extremely accurate and 23% thought that they were accurate but generalized due to the limited size of the map. Only 19% of participants thought that the mapped data were inaccurate or extremely inaccurate.

Understated maps garnered trust too, with 42% of these participants assuming the data were accurate, 4% believing...
Figure 6. Confidence in whether or not participant’s zip code was in a fatal radiation area or not by type of map viewed

Figure 7. Participant responses to the question of ‘Approximately what percentage of the United States would be exposed to deadly levels of radiation?’ broken down by map style viewed
the data to be extremely accurate and 42% that the data were accurate but generalized due to the limited size of the map. Only 4% felt that the understated map was inaccurate; no one felt that it presented extremely inaccurate data. Twelve per cent of the participants viewing understated maps simply did not think about whether the data were accurate or not.

Sensationalist and propagandist maps were trusted less than the other map types. Still, these maps scored relatively highly in areas of trust. Propagandist map viewers thought that the data were accurate but generalized 48% of the time, 20% felt that it was accurate and 3% that it was extremely accurate. Only 20% thought that the data were likely to be inaccurate and only one person out of 30 thought that it was extremely inaccurate. Seven per cent of those viewing the propagandist map did not even think about the accuracy of the data. Sensationalist maps scored very similarly to the propagandist maps. One-third thought that the sensationalist map was accurate or extremely accurate; 48% of viewers felt that it was accurate but generalized due to the limited size of the map. Only 17% felt that it was inaccurate, and 7% never thought about the accuracy of the data.

Feelings of map bias
Rhetorical style had an impact upon whether or not a map reader assumed that a map was inherently biased or not ($\chi^2=17.266$, $P=0.001$). The authoritative map was least likely to be viewed as biased, though, 19% of people viewing this map felt that it was mostly or extremely biased. Understated maps were considered trustworthy by map viewers as well (46% thinking that they were factual versus 23% believing that they were biased). Sensationalist and propagandist maps were considered the most biased. Only 26% of map readers felt that the propagandist map was mostly or extremely factual, whereas 53% felt that it was mostly or extremely biased. None of those viewing the sensationalist map believed it to be extremely biased, but 33% felt that it was mostly biased. Only 32% felt that it was mostly or extremely factual.

The likability of different rhetorical styles
Another question on the survey examined how much people liked each map’s design – before ranking them. In this case, variation among the different map styles was not significant ($\chi^2=3.96$, $P=0.266$). The authoritative and understated maps had median scores of two (out of five possible, with one being best looking and five being worst). The sensationalist and propagandist maps both had medians of three. Importantly, neither the authoritative nor understated maps had any negative scores, whereas both the propagandist and sensationalist maps were deemed mediocre and even downright ‘ugly’.

Change in opinions on nuclear power
A non-parametric Friedman Two-Way ANOVA was used to explore ordinal variation in opinions regarding nuclear power before and after viewing one of the maps. Change in opinion was significant within every group except those viewing the understated map. (Participants rarely realized that their opinions had changed, as determined through a secondary question; only those viewing the propagandist map observed a slight change in their own opinions. This result may be useful to cartographers attempting to insidiously change people’s minds via maps – avoid propagandist design.) Each group was more anti-nuclear power than it was before viewing the map (Figure 8). Sensationalist ($\chi^2=11.84$, $P<0.00$) and propagandist maps ($\chi^2=12.25$, $P<0.00$) induced the most dramatic shift towards anti-nuclear power. Authoritative maps were also effective ($\chi^2=4.571$, $P<0.033$).

Rankings of map style, trust and recall
The final section of the survey allowed the participant to view all four of the persuasive maps simultaneously. Participants were given as long as they liked to view all four images and were encouraged to spend some time looking at them. Participants were then asked to provide a series of rankings dealing with trust, style and impression (i.e. likelihood of being recalled). Variation among the maps ranked first was significant in each category. The authoritative map was trusted far more than the others ($\chi^2=105.64$, $P<0.00$), followed by the sensationalist map, and with understated and propagandist maps coming in a distant third and fourth (Figure 8). Variation among the likability of the different map styles was also significant ($\chi^2=9.64$, $P=0.02$), with the authoritative map being liked most, followed by sensationalist, propagandist and understated (Figure 8). Predicted recall was significantly affected by the type of rhetorical style as well ($\chi^2=34.07$, $P<0.00$). Just under half of the participants thought that they would remember the propagandist map most 1 month from the date of the survey; the propagandist map was followed by the understated, sensationalist and authoritative maps, respectively (Figure 9).

Cross-tabulations
The results for style, trust and impression were then cross-tabulated with a variety of other attributes to see if any

Table 2. Confidence levels by map style in response to how much of the USA would be affected by deadly levels of radiation

<table>
<thead>
<tr>
<th>Map style</th>
<th>None</th>
<th>Low</th>
<th>Average</th>
<th>High</th>
<th>Extremely confident</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understated</td>
<td>40%</td>
<td>13%</td>
<td>24%</td>
<td>24%</td>
<td>22%</td>
</tr>
<tr>
<td>Sensationalist</td>
<td>20%</td>
<td>50%</td>
<td>32%</td>
<td>25%</td>
<td>17%</td>
</tr>
<tr>
<td>Propagandist</td>
<td>0%</td>
<td>25%</td>
<td>20%</td>
<td>27%</td>
<td>39%</td>
</tr>
<tr>
<td>Authoritative</td>
<td>8%</td>
<td>13%</td>
<td>24%</td>
<td>24%</td>
<td>22%</td>
</tr>
<tr>
<td></td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>
significant relationships existed. No significant bias was detected due to which map had been viewed first. In fact, no group of participants ranked the map it viewed first as the most liked. Political affiliation was also not significant.

Gender did not have a significant correlation with which maps were deemed most likely to be trusted ($\chi^2=0.498$, $P=0.48$) or recalled ($\chi^2=3.7$, $P=0.06$). Females were slightly more likely to believe that they would recall the propagandist map. Males equally ranked both the understated and the propagandist maps as the most likely to be recalled. There was no significant difference between gender when ranking maps based on style. However, looking at the data descriptively, males were more likely to rank the authoritative and sensationalist maps as the most liked. Although females also ranked the authoritative map as the most stylish of all four, the other three map styles were well represented and of near equal distribution, with propagandist maps being the second most highly regarded map for females (Figure 10).

Figure 9. Percentage of first place ranks for trust, fondness and recall
Finally, style, trust and impressionability were cross-tabulated by participants’ initial positions regarding nuclear power. Although not statistically significant ($\chi^2=16.071$, $P=0.377$), the authoritative map was overwhelmingly the most preferred map by those who were initially pro-nuclear power. Forty-two per cent of all participants who were pro, and 43% of all who were somewhat pro, liked the authoritative map most. Propagandist maps were overwhelmingly ranked first in memorability by those who were initially pro-nuclear in disposition (50% pro-nuclear and 35.7% of the somewhat pro-nuclear, participants); though, this result was not statistically significant ($\chi^2=18.21$, $P=0.25$). Regardless of one’s position on nuclear power, the propagandist map was the most likely to be remembered.

DISCUSSION

Maps can be tailored to enhance particular communicative goals. The results of this study add to the evidence that maps are not only tools for argumentation, but that they also possess certain rhetorical qualities. Moreover, the rhetorical style used to design a map will impact the effectiveness of, and audience’s reaction to, the argument being presented.

Each of the four persuasive map rhetorical styles tested has its own particular instrumental benefits for argumentation. The utility of these will obviously change depending on a variety of factors (e.g. the type of persuasion being attempted; the map audience; and whether one is relying or attempting to persuade others to a particular point of view). However, in this case study, participants’ opinions and feelings were influenced differently depending on the rhetorical style of the map being viewed.

In sum, the authoritative style map was most trusted; though, it resulted in a low level of confidence in what was being read and was not the most effective map at persuading people to become more opposed to nuclear power. The propagandist map style was deemed most memorable by those viewing all four maps. Participants only viewing this map were also far more confident in their assessment of various nuclear dangers, regardless of whether they were correct or not in that assessment. The propagandist map style was also effective at inducing map readers to become more anti-nuclear power. The sensationalist map style elicited excitement and was liked by a large proportion of map viewers. Oxymoronically, the sensationalist map was assumed by many map readers to be both accurate and patently biased. The understated map did not excel in any areas of persuasion. It did not convince map readers to become significantly anti-nuclear power. One thought is that the understated map may not have been frightening enough compared to the others. The understated map was not particularly trusted either (only 7% of participants trusted it most). It was fairly memorable – second only to the propagandist map – but it was not well liked compared to the others when it came to style. The author’s assumption before conducting the study was that the understated map’s unassuming characteristics would score moderately well in many categories – neither high nor low. This largely proved to be correct.

This study tested the impact of viewing maps on people’s perspectives on one, controversial topic – nuclear power. Thus, with the caveat that more research needs to be done before we can make any steadfast hypotheses about the specific impact of persuasive styles on map readers, the following conclusions can be made about map rhetorical style and persuasion based off of this test’s initial results:

1. Ugly is memorable. Maps that are aesthetically obnoxious by design and cartographic standards are more likely to make a lasting impression on map readers and be remembered than those that look like a scientific geovisualisation.

2. Bias is attractive. Maps that are overtly biased in their data presentation may be more likely to sway an audience to the position being espoused than those that appear objective.

3. Ignorance is confidence. Maps that present less data, in less detail, may be more convincing for many map readers. People viewing data-sparse maps are also more confident in what they believe they recall from the map.

Intriguingly, the above arguments contradict many of Tufte’s (1983, 1991) tenets regarding ‘graphical excellence’, ‘data-to-ink ratios’, ‘chart junk’ and ‘ducks.’ Tufte’s axioms pertain to accurate representation of quantitative data. He presumes that ‘graphical excellence’ means being true to the data by representing it in as much detail and as accurately as possible (Tufte, 1983). The results of this study demonstrate, however, that though detailed data visualisation may make maps look sophisticated and authoritative, it will not necessarily convince an audience to see something in a particular light. If these results hold up in future studies, map designers may be wise to ditch certain aspects of standard geovisualisation protocol when designing a map to persuade readers.

It is the belief of this author that we should distance ourselves from axioms of ‘graphical excellence’ and instead more comprehensively analyse maps based on how effective they are at making their arguments. Every map has a communicative purpose. The goal of a cartographer is
to communicate as effectively as possible. Thus, analysing map effectiveness needs to move beyond only measuring the accuracy of map reader interpretation and start incorporating measurements of argument memorability, map likability and the effectiveness of the visual argument. Although analysis of rhetorical exemplars from cartography’s past is useful, this research highlights that we do not merely need to comb the past to find examples of great map persuasion to study. We can actively begin creating and testing maps in different rhetorical styles. Learning more about designing effective maps for argumentation will benefit mapmakers broadly.

LIMITATIONS

There are limitations to this study. First, though every effort was made to sample a population of different age groups, 78% of the people replying to the survey were between the ages of 18 and 25 years. There were also more females than males (63% and 37%, respectively); no significant differences were found between genders. Second, this study was limited to citizens of the USA or people currently residing in the USA. Cultural factors can play a role in how people interpret maps and images (Montello and Freundschuh, 2005). Also, the USA has not suffered a major nuclear accident since the Three Mile Island incident in 1979. The results of this study are specific to the USA.

A map of a nuclear meltdown harnesses many people’s pre-, and often ill-, conceived fears regarding nuclear power in general. The results of a user test with maps showing the spread of diabetes in the developing world, a far more deadly and non-hypothetical crisis, for example, may elicit different results. Admittedly, this is a limitation to the study that should be addressed in future work. Since this work is looking at the impact of rhetorical style on map design, however, it was determined that a hypothetical nuclear disaster would likely elicit more readily apparent differences in responses. Compared to maps highlighting radiation sweeping across their country of residence, few participants are likely to become as emotionally attached to maps showing the spread of diabetes, and therefore, measuring their responses would have been more difficult for an initial study. Now that this study is concluded, the influence of rhetorical style on less provocative topics can be studied and contrasted with this one.

Some participants may have known for certain that the data were grossly exaggerated or faked, which may have impacted their responses or ability to be persuaded by any of the maps. Three percent of respondents answered that they were very knowledgeable about nuclear meltdowns. Having participants view one of the maps first, and answer a series of questions about it before viewing the other three maps and ranking them, may have introduced bias into this study. Bias for the map that was viewed the longest (the first map shown) was tested for. No significant relationships were found. In fact, in all map categories, there was a measurable but insignificant bias against the map viewed longest. Future studies could eliminate this potential source of bias in the ranking system.

The results regarding which map style would be best recalled one month later should also be cited with reservation. Unfortunately, due to the survey being anonymous in nature, there was no way to ask a follow up question of the participants one month later. It is likely that what people believe they will remember most will vary from what they actually do remember most. More tests studying map memory using a different surveying method would be useful.

Finally, one thing that was not controlled for and may have affected the results is the design of the maps themselves. They were designed to fit categorical criteria. However, there was no way to control for the fact that some of the maps may have been better designed than others. Although all of the maps were designed by the same cartographer, using the same software packages, this is an element of the study that might be better controlled and tested for in future research.

FUTURE DIRECTIONS

It appears that the four styles of persuasive maps have different strengths and weaknesses. However, this study only tested hypothetical nuclear meltdown data. Future research might look at map persuasion using myriad themes, including maps that do not present data with the potential to directly impact participants. For example, it may prove fruitful to explore differences in how people react to persuasive maps promoting whale hunting, as would analysing people’s reactions to maps that attempt to delegitimize cultural norms.

Surveys and recall tests are only one avenue of research for testing the rhetorical power of maps. It should not be too difficult to study how people actually read maps differently depending on the style in which data are presented. Eye-tracking studies may yield more data on this.

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