How to Tell Stories Using Visualization

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Abstract

The benefits of storytelling's are long-known and its potential to simplify concepts, create emotional connection, and capacity to help retain information has been explored in different areas, such as journalism, education, and others. The necessity to incorporate storytelling in visualizations arises from the need to share complex data in a way that is engaging. Advances in technology have enabled us to go beyond the traditional forms of storytelling and representing data, giving us more attractive and sophisticated means to tell stories.

In this paper, we present the results of a focus group study that was conducted with the purpose of collecting information on the narrative elements in a collection of visualizations and the possible inclusion of storytelling elements in those. In this study information about the visualizations in terms of comprehension, navigation, and likability was also collected with the intent of identifying elements that are appealing in the visualizations. Furthermore, we suggest strategies for storytelling in visualizations.

Keywords—**Storytelling, narrative visualization.**

1 Introduction

Since the beginning of time man has used stories to entertain, educate, and instill moral values. Stories, in comparison to other ways of presenting information, prevail not only due to their power to help the assimilation and retention of information, but also because stories are in fact more compelling. Predating writing, storytelling is still more frequently associated with oral lore even though it is present in our everyday life in written form, video, and audio. However storytelling has come a long way from its traditional roots and is now a useful tool for education, information, entertainment, and other areas.

Like storytelling information visualization has come a long way beyond classical mathematical graphs and representations. Nowadays, new techniques allow access to information that could not be included on traditional forms of visualization formerly, mainly due to technological limitations. As is the case with storytelling the power of information visualization is also long-known. After all, we all began our lives getting most of our information visually [8] and we are so familiarized with the process of interpreting visual representations that this has become one of the favorite ways to consume information.

All technological advancements arising from the emergence and development of computers and the Internet are not only benefiting the field of information visualization, enabling the limitations of textual and visual representation to be overcome, but also all the areas related to storytelling that are now able to infuse their traditional narratives with the sophisticated visualization techniques. Moreover, this marriage between visualization and storytelling is helping to feed information-hungry audiences that do not always want to engage in time-consuming activities such as reading a long article or watching a documentary.

Nowadays the audience is presented with enormous amounts of complex information that would be almost impossible to grasp resorting alone to traditional forms of presenting information. Amid the multitude of information that we have nowadays, boosted by the open data trend, it is imperative to provide ways to make sense of information, which is often abstract, non-spatial, and sometimes even non-visual. Visualization has proved to be very effective in these scenarios [12], however introducing storytelling in this equation could not only help the interpretation of the visualization but also help the visualization become even more appealing. But how can we fuse visualization and storytelling? In what ways can the new forms of media transform and contribute to this end? What strategies of storytelling in visualizations are appealing to the public?

In order to find the answers to some of these questions we carried out an investigation that tries to shed a light on the narrative elements that could introduce storytelling in visualizations. We also tried to understand the preferences of the users regarding to this topic. We conducted a focus group study in which participants looked at several visualization examples collected from various sources such as news media web sites, marketing initiatives, and specialized blogs. In this study, in addition to the general perception about the visualization, we also collected information about the visualizations regarding three specific dimensions: comprehension, navigation, and likability.

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2 Related Work

Until recently visualizations have been used to support traditional forms of storytelling as extra information or supporting evidence [15]. Nonetheless, there has been a great effort lately to transform visualizations in an independent form of storytelling that can exist by itself without support of a traditional form of storytelling such as a video or text. Research about the ways of doing this is being carried out in various different areas but mainly in journalism [15, 3], an area in which there has been a great effort to create multi dimensional stories composed of other media besides text, and information and knowledge visualization [8, 9, 10, 13, 4], two disciplines which were primarily focused on techniques of visualization but are now starting to research strategies to make visualizations that are independent and eschew other types of narratives.

Storytelling is also enabling the approximation of two areas of research that have been historically separated and developed independently: information and knowledge visualization. With the introduction of storytelling the differences between these two areas are getting blurred. According to Bertschi et al. "in order for information to transform into knowledge, one must share some context, some meaning, in order to become encoded and connected to preexisting experience" [1]. Storytelling is one of the tools that is capable of introducing context and meaning in the visualization, not only helping users to establish connections between the complex data represented,but also introducing an important component, particular to knowledge visualization, that is tacit knowledge. This category of knowledge, that encompasses things such as intuitions and subjective insights, is difficult to communicate [12]. However it is known that storytelling has the power to engage and make people relate, and possibly facilitating the sharing of tacit knowledge.

2.1 Narrative visualization

Information visualization is much more than the visual representation of data. It is rather the process of dissecting raw data, which by itself has little meaning and presenting it in a way that it is no longer complex. Although, visualization is not a new area, it has blossomed with the emergence of new media. "These new technologies truly allow us to do things we never could with paper, so we should expect it to take awhile to gain sufficient understanding of them before we can apply them as effectively as we would like" [8].

Moved by the rise of these new media Gershon and Page were the first to notice the valuable contribution that storytelling could give to Information visualization. However, according to Kosara and Mackinlay [13], they fail to describe actual visualization and focus mainly on map views without numerical data. In other words, they focus more on simple visual representation.

Later, in 2010, Segel and Heer[15] reinvented this no-tion of using storytelling in visualizations naming it narrative visualization. By studying the elements of existing visualizations Segel and Heer were able to identify some patterns and structures that news media uses to introduce storytelling in visualizations: Martini Glass Structure, Interactive Slideshow, and Drill-Down Story. The first structure begins with an author-driven approach and only once the author's intended narrative is complete, the visualization opens up to a reader-driven stage where the user is free to explore the data interactively. The Interactive Slideshow approach has a completely linear path with some interactivity within the limits of each slide. Finally there is the Drill-Down Story: completely reader-driven, allowing the user to choose any reading/viewing order possible.

2.2 The benefits of storytelling in visualization

Using narrative elements in visualizations often help create a structured interpretation path that usually does not exist in traditional information visualization [4]. Without storytelling visualizations are not able to provide explanations about the subject and depend too much on the audience's ability to interpret the data correctly.

Moreover, they can be entirely independent of other means of storytelling, being able to get the point across easily and in sufficient detail for the audience to clearly understand. The bits of storytelling in these visualizations do not need to be over-informative and descriptive because the audience can fill in "the gaps in the story with their imagination, experiences, and expectations" [16]. Storytelling can be introduced through the use of persuasive/rhetorical techniques and exploratory/dialectic strategies [9].

All of these elements make narrative visualization pleasing, not only because it doesn't require a lot of time and effort to assimilate the information but also because it sparks the audience's curiosity and transforms the task of acquiring information into a fun activity. According to Ma et al. [14], "they leave a lasting impression, either by piquing the audience's curiosity and making them want to learn more or by conveying a deeper meaning than your everyday run-of-the-mill sequence of causally related events."

However there has been an increasing concern with how much the incorporation of narrative will impact the exploration of the data and whether or not this will distract the user from the data [4]. Although having a direction will help users that are less familiar with the subject an undirected exploration can help proficient users find new interpretations of the data and even discover meanings that were not foreseen by the creators of the visualization. It's important to understand every building block of the visualization in order to create a narrative that doesn't overpower the data.

Research [4] has revealed that having flexible narratives that point out particular landmarks for the user to explore, but still allowing the free exploration of the in-between land-

marks, is a good option. Nonetheless there is still research to be done on how the narrative influences the interpretation process [9] and how to effectively create these narratives. More research is needed to understand which rhetorical techniques can be used and if it is possible to build a set of techniques that works for different sets of data.

3 Focus group

The focus group was conceptualized and structured as way to gather information about factors such as comprehension, likability, and navigation. The method was used because it fosters the discussion between the participants and enables us to obtain qualitative and affective information from participants easily. This focus group sessions were conceptualized as an exploratory exercise to obtain an emotional response from the participants, an aspect that could not be evaluated using the survey method.

3.1 Procedures

The study took place at *Universidade Nova de Lisboa* and used the focus group method to collect data. The location for the sessions was a classroom with a computer with Internet connection for each participant at the *Faculdade de Ciências Sociais e Humanas* campus. There were a total of 16 participants, divided into 2 groups of 8 elements each, and no personal information about them was collected. The groups were mixed in terms of gender and age.

The source of the participant population was university students, either from the New Media or the Communication masters program, that were willing to participate in this research. They were invited to take part in the focus group study by their teachers. Although the participants belong to the same cohort, they have different backgrounds in the area of communication: journalism, design, marketing, etc. This diversity of backgrounds guarantees diversity of responses also ensuring that they had enough previous knowledge to fully understand the stimulus provided during the sessions. The focus group sessions were done on the first day of classes therefore most participants did not knew each other prior to the experiment. This fact reduces the chances of the participants being influenced by the opinion of others.

The focus group session began with a standard introduction and explanation of the purpose of the research. The participants received a rating sheet to rate the visualizations and could see and interact with the visualizations through a computer. The moderator asked the participants to rate, on a scale from 1 to 10, each visualization presented immediately after they interacted with and before the discussion about that visualization started. The rating was not done as a group activity because we wanted them to be independent of the group-think that could be generated by the discussion. The visualizations were rated in terms of comprehension (Was the information presented in a clear, comprehensible way? Was the purpose easy to understand?), likability (Was

the visualization interesting and engaging? Was the interaction enjoyable?), and navigability (Was the data easy to navigate? Was it clear how to interact with it?). The sheets were returned to the moderator at the end of the session.

The participants were given a few minutes to explore and interact with the first visualization and afterwards the moderator asked some semi structured questions about it. This process was repeated for each visualization in this study. These questions were asked in order to start the discussion between the participants. They were asked to explain their answer and to provide their views about the visualizations, discussing them with the other participants. The focus group was recorded for record keeping and their answers were later transcribed.

The moderator also asked some questions regarding two or more visualizations at the same time: Which of the two do you prefer? Which one do you think is more attractive visually? Which do you think tells the story better? The questions about comparisons were asked using similar visualizations or comparable topics.

Sequential Graphic	Evolution of the Web	Introductory Text
Map	Home and away	
	Death penalty in the US mapped	
Poster	How Local News Is Going Mobile	
Photograph	Faces of the dead	
	British Troops Killed in Afghanistan	
Tag Cloud	What does china censor online?	Little or No Text
Drawing	How Much CO2?	
	How Many Households Are Like Yours?	Accompanying Text
Chart/Diagram	Death penalty statistics, country by country	
Model	Ground Zero Now	

Figure 1: Characteristics of the visualizations presented to the participants of the focus groups

The discussions took about one hour and both groups were shown eleven examples of visualizations of different types and different characteristics (Playable, Non-Playable, Introductory text, Accompanying article, and Audio narration). The group was shown the examples on Figure 1. Only three of the visualizations (marked on the figure with a dark gray background) are non-playable. These examples were chosen through a previous research [7] of what is currently being done on online newspapers and magazines, blogs, scientific videos, visualization research websites, and even publicity campaigns, and more importantly what is popular and shared by the users of the Internet.

As we present in Figure 2 most visualizations share common elements, specially in terms of Narrative. Most visualizations chosen for this study also share the same
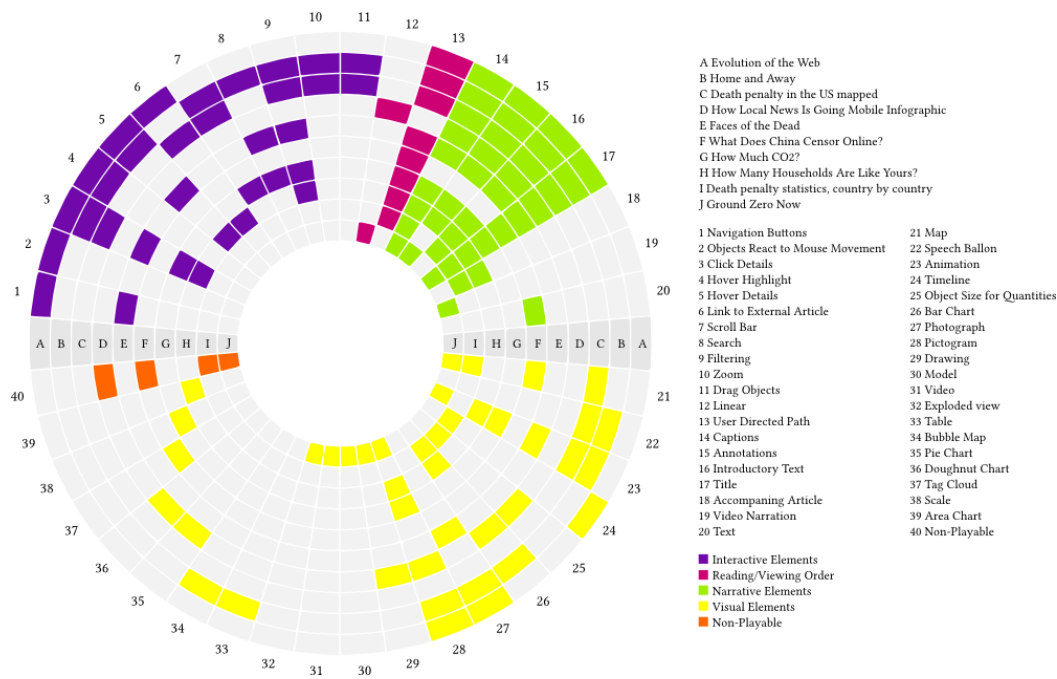
Figure 2: Visualizations used in the focus group study and the elements that compose them

reading/viewing order, *User Directed Path*, however some examples with a *Linear* reading/viewing order were also shown in order for the participants to state which type they preferred. In terms of Interactive Elements most of the visualizations analyzed share two types of interaction: *Click Details* and *Filtering*. Every other element (*Navigation Buttons, Hover Highlight, Hover Details, Link to External Article, Scroll Bar, Search, Zoom,* and *Drag Objects*) is common to at least two visualizations, except for the Interactive Element *Objects React to Mouse Movement*. This fact occurs because this type of Interactive Element is less common and did not really influenced the example too much.

3.2 Results

The participants had very strong opinions about each of the visualizations and, with few exceptions, most visualizations received high scores in terms of comprehension, likability, and navigation (see Figure 3).

3.2.1 The most discussed

Two visualizations caused a lot of discussion and achieved high scores in all of the categories (comprehension, likability, and navigation): the New York Times' *How many households are like yours?*[1] and The Guardian's *Death penalty in the US mapped*[2].

The first had the most participants giving it a score of

10 in terms of comprehension and likability. It was also the visualization for which more participants gave a 9 in likability and navigation. This visualization also had the highest average rating (8.3 for comprehension, 8.1 for likability, and 8.2 for navigation) and no individual ratings under 4. This interactive visualization for exploring different types of American households is associated with the article *Baby Makes Four, and Complications*. It allows the audience to choose the primary residents of a type of household to see how it compares to other American households. There are animated pictograms used to represent the elements chosen by the user to compose a household: the primary residents (married couple; male/female unmarried partners; single male; single female; male unmarried partners; and female unmarried partners) and the secondary members of the household (child under 18; child over 18; child-in-law; foster child; parent or parent-in-law; siblings or siblings-in-law; grandchild; other relative; housemate or roommate; Roomer, boarder or lodger; and other non-relative). Complementary graphics that update on-the-fly are provided along the bottom to show how the number of households that are like the one selected have changed over time, which races have more households of that kind, and what is the income of those households.

The Guardian's visualization consists of a map where the states are colored according to the number of executions.

[1]http://www.nytimes.com/interactive/2011/06/19/nyregion/how-many-households-are-like-yours.html

[2]http://www.theguardian.com/news/datablog/interactive/2011/sep/21/death-penalty-us-map
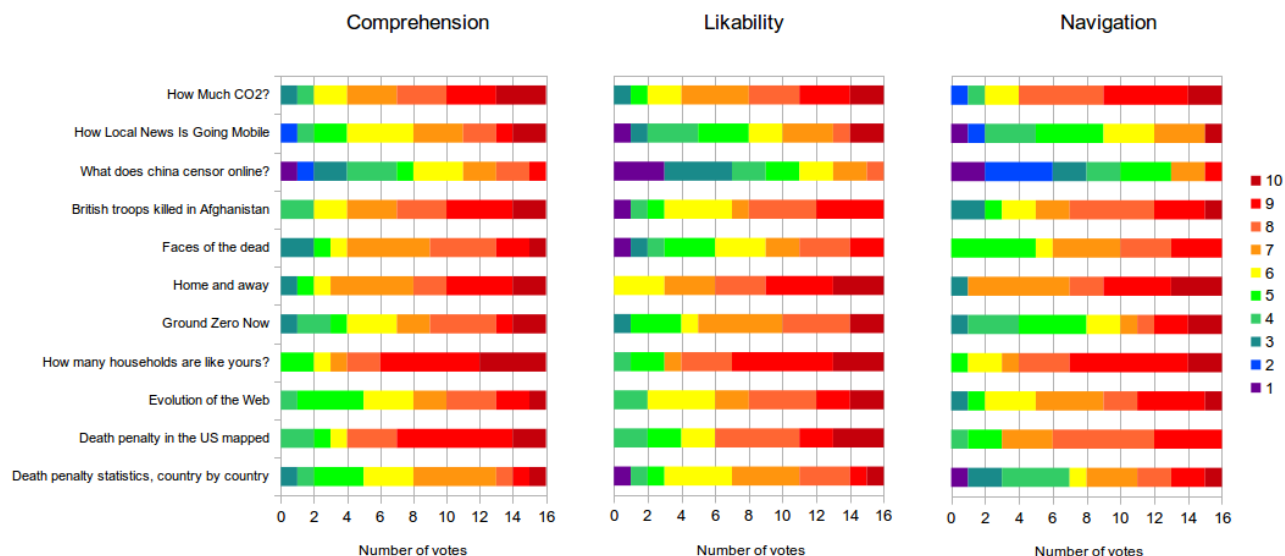
Figure 3: Scores given by the participants to each visualization in terms of comprehension, likability, and navigation

When we click on a state, a bubble pops up with further information for different years. This interactive is also part of a larger article. *Death penalty in the US mapped* had the same number of participants giving it a 10 in terms of likability but had more participants giving it a 7 in comprehension. On average, the visualization ranked 3rd in terms of comprehension and likability and 4th in terms of navigation. The overall scores were not as high as the ones given to the New York Times' visualization.

In the sessions the *Death penalty in the US mapped* visualization was compared with a visualization of a similar subject: *Death penalty statistics, country by country*[3]. This visualization by the Guardian accompanies an article about countries that maintain the death penalty. The visualization is composed of a map with bubbles of different sizes that represent the number of individuals executed and the number of death sentences handed down in 2012. On the bottom there is a timeline representing the number of countries carrying out executions, since 1991 till 2012.

The participants were very vocal about the these visualizations mainly because the first was playable and the second wasn't. Most participants preferred the one that allowed interactivity even though they noticed that the other provided more information on the subject. Some participants stated that the fact that the information was immediately presented caused confusion and they would prefer if it showed that information only on click.

Another popular example among the participants (having an average of 7.6 for comprehension, 8.1 for likability, and 7.9 for navigation) was CNN's *Home and away: Iraq and Afghanistan war casualties*[4] visualization. This map visualization is composed of two maps where the audience can find the birth place of a trooper that has fallen either in Afghanistan or Iraq and relate with the location where he/she died. By clicking on the points that represent a fallen soldier the audience can learn more details about them on their profile page. There are also complementary graphics at the bottom that show statistics of age, location, and date of death. The data can be navigated through these complementary graphics or through a search box. This visualization, along with *Death penalty in the US mapped*, had the highest number of participants giving it a 10 for likability and had a higher number of participants giving it a 10 for navigation.

3.2.2 Links as context

The *How Much CO2?*[5] visualization done by David McCandless for GE was also one of the most popular visualizations among the participants. This visualization ranked 2nd in terms of comprehension and likability and 3rd in terms of navigation. *How Much CO2?* is an interactive visualization that shows the amount of carbon that different activities, entities, or events emit. Although the participants liked this visualization they thought that something was missing:

text. One of the participants stated that if instead of the visualization just showing the fact that web searches in the US produce 5,019 tons of CO2 he would prefer that they also explained how this happens. According to him "it is lacking support stories."

Another visualization that the participants said suffered from the lack of storytelling was the *Faces of the dead*[6]. This visualization ranked 4th in terms of comprehension and likability and 5th in terms of navigation. It was also the one that had a higher number of participants giving it an 8 in terms of comprehension. This visualization consists of a picture of a soldier that fell in Iraq or Afghanistan composed by little squares that represent other soldiers that also died in these wars. Every time we click on one of the squares the big picture becomes the photo of that soldier that we clicked on. One of the participants said that this visualization looks more like a work of digital art, but does not give sufficient information to become interesting as a visualization. Furthermore the fact that the pictures were in black and white made it more difficult for the participants to relate with it. One of the participants even stated that because the features were blended by the lack of color, the soldiers were too homogenized.

Most participants preferred another visualization with a similar topic that was compared to *Faces of the dead*: The Guardian's *British troops killed in Afghanistan*[7] visualization. This visualization ranked 3rd in terms of comprehension and likability and 4th in navigation. The Guardian's visualization also uses pictures of fallen soldiers but shows them in color and includes a link to the story of how that soldier died. Because the pictures were in full color the participants felt closer to those people and felt that they could relate to them more easily. The fact that they could also read the story also contributed for that sense of closeness with the visualization. The participants felt that in this visualization the soldiers were not a number, a dot, or a square, they were real.

One visualization that also plays on this idea of the stories appearing as support information is the *Evolution of the Web*[8] visualization. This was also one of the participants' favorite visualizations. The average rating for this visualization was 6.8 for comprehension, 7.3 for likability, and 7.3 for navigation One of the participants said that this visualization was almost perfect. "First it is a timeline and timelines give this idea of story, of flow, and moreover we are automatically placed at present time, which is probably what we have the most interest in, then being able to

then navigate backwards," he added. Other participant referred that she enjoyed the fact that the visualization didn't present all the information at once but allowed to explore by clicking on links, and that sparked her curiosity.

3.2.3 Non-playable

The participants were also shown two other visualizations that did not have any kind of interactivity: *What does china censor online?*[9] and *How Local News Is Going Mobile: Could the iPad Be the New Sunday Press?*[10]. The first is a simple non-playable tag cloud in which the shape that the words make the map of China. This visualization had the lowest overall scores. The average rating for this visualization was 5.2 for comprehension, 4.2 for likability, and 3.9 for navigation. One of the participants even stated that she took a long time to realize that there was no interactivity in the visualization and that she probably just did not understand where she was supposed to click. When inquired about what could have been done to improve this visualization, and make it more interesting, some participants responded that on mouse hover additional information could be shown and that could make the visualization much better. The overall feeling was that they did not learn anything new with that visualization

The second non-playable visualization shown is a poster like visualization with drawings, pictograms, bar charts, and doughnut charts. Although the ratings given were not completely bad (6.6 for comprehension, 5.8 for likability, and 5.3 for navigation) the participants were almost indifferent to the visualization *How Local News Is Going Mobile: Could the iPad Be the New Sunday Press?* One of the participants said that this visualization was not very stimulating and that after seeing visualizations with so much interactivity this one just looked even worst. The overall opinion was that they lost the interest in the visualization because there was nothing more to discover.

The participants were also shown a video based visualization and surprisingly, although the video had no interactivity, most participants showed a overall positive response to it. *The Ground Zero Now*[11] visualization is part of the Rebuilding segment of an article about 9/11 entitled The Reckoning. The visualization has three animations that include models of buildings, pictograms and drawings, but does not have any interactivity. About the audio and video narration the opinions were divided and although some participants said that they really enjoyed this kind of storytelling the majority

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[6]http://www.nytimes.com/interactive/us/faces-of-the-dead.html

[7]http://www.theguardian.com/world/interactive/2011/sep/20/british-troops-killed-in-afghanistan-interactive

[8]http://www.evolutionoftheweb.com/

[9]http://www.informationisbeautiful.net/visualizations/what-does-china-censor-online/

[10]http://old.columnfivemedia.com/work-items/how-local-news-is-going-mobile-infographic-could-the-ipad-be-the-new-sunday-press/

[11]http://www.nytimes.com/interactive/2011/08/30/us/sept-11-reckoning/ground-zero.html

did not express much interest in it.

4   Analysis

The focus group results can shed a light on what may be good strategies for storytelling in visualizations. Interactivity seemed to be the most important strategy. One the participants even said anecdotally: "With a video you retain about 8 to 15% of the information, if the video has some interactivity that percentage skyrockets to about 70%. That says a lot about the power of interactivity."

Although the level of interactivity was pointed over and over again as an important feature another characteristic also stood out. What made the New York Times' *How many households are like yours?* visualization be the overall favorite was the fact that it enabled the participants to relate with the visualization. "The fact that the visualization allows us to identify with the subject instantly sparks an additional interest. In fact, the article that is linked to the visualization is about a family that is so different from mine that it probably would not even catch my attention, but since I'm already interested in the subject because of the visualization I would probably read the article also."

4.1   Interactivity and its relation with context

The benefits of using interactivity in visualizations have been long known. According to Kosara and Mackinlay [13], "being able to not just see the data, but quickly change the view, add different data, etc., makes analyzing it much faster and more effective." However, Ma et al. [14] consider that it should be carefully balanced, otherwise the creator of the visualization loses control over how the story is told.

The opinions collected in this study seem to hint that the audience prefers short moments of storytelling that they can access if they feel the urge, rather than having a dense storytelling that they have to carefully follow. The participants showed a lot of interest in exploring the visualizations freely and seem to prefer to be moved by their own curiosity.

Another interesting feedback regarding interactivity is that the participants believed that the visualizations they liked the least could probably be fixed with an overlay of information, presented through the use of interactivity. According to them, the use of some interactivity such as hover or click details would change these visualizations completely, because it would make the data more meaningful. The participants also stressed that they enjoyed the visualizations that provided links to other content and that this possibility does not prevent them from returning to the visualization. Although none of the examples shown had this feature, when confronted with the possibility of having external links, for example for Wikipedia pages, the participants referred that they would value this option.

Some research about how information visualizations with annotations are a promising way to complement articles has already been done [11]. These annotations have the capacity to add context that otherwise would be very difficult to provide, easing the user's interpretation and suggesting conclusions. Hullman et al. [11] developed an approach to automatically generate these annotations: Contextifier. In this case the narrative visualizations created were meant to accompany online news.

It would be interesting to see how the participants would react to more game like visualizations. After all computer games are the most popular example of interactive storytelling [13] and maybe their form of storytelling can be successfully replicated in visualizations.

SPENT[12] is one of the few attempts of merging visualization and games. It was launched in February 2011 by McKinney and the Urban Ministries of Durham. The objective is for the audience to understand if it is possible to live on $1,000 a month. The game lets the player make the everyday choices necessary to get by on a tight income: choosing a job, food to buy, pay the for the car insurance or take the son to the dentist, etc. SPENT has a timeline for the player to see in which day of the month he/she is, pictograms, animations, and speech balloons. Once in a while it also gives additional data such as how many families choose not to go to the dentist because it is too expensive.

This additional data makes SPENT more than just a game, but is this enough to transform it into a visualization? According to Bogost et al. [2], "even if they are not games quite like Pac-Man or The Sims, infographics can become game-like, exploiting the properties of games in numerous ways: to encourage the manipulation of information for replayability, to allow pleasurable engagement with a system, or to invite exploration."

Nicholas Diakopoulos [5] points out that there are several challenges with the gamification of information graphics, specially when these deal with data that is variable through time (updated, refreshed, dynamic). He compares *game-y* information graphics (information graphics that include formal elements of games such as goals, scores, competition, and the notion of "winning" [4]) with traditional games, which usually benefit from a carefully developed design component and consequently take time to be released.

Most of the *game-y* information graphics, or playable infographics (the alike term coined by Bogost et al. [2]), have been produced by news media (for example *Budget Hero*[13], created by American Public Media) or marketing initiatives (*SPENT* by McKinney). The fact is that these organizations depend on deadlines and usually cannot invest too much time developing these types of visualizations.

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[12]http://playspent.org/
[13]http://www.marketplace.org/topics/economy/budget-hero

However the level of gamification used doesn't need to be as complex as in commercial computer games, nor does the data used need to be ever changing as it happened with Salubrious Nation by Diakopoulos et al. [6]. Specially in news media the information has a short life cycle and is often preferable to have a stable visualization than to have one that will forever be up-to-date.

Diakopoulos et al. [6] conducted one of the few researches about the reaction to more game-like visualizations. They tested a *game-y* version of Salubrious Nation against a *Non-Game-y* version of the same infographic. The *game-y* version of Salubrious Nation uses geographically tagged public health data to create a game where the goal is to accurately guess the extent of the given health parameter for a randomly selected target county. The data helps the player to do an informed guess. The *non-game-y* version of Salubrious Nation is still interactive but does not include the guessing game component.

The authors have concluded that sometimes the game features steers the attention away from the actual data. However it can also "successfully motivate interactions and cause users to explore and bias both the exploration of parameters and the nature of insights in interesting ways." [5] They were also able to conclude that *game-y* infographics are as enjoyable as non-game infographics and that it might be useful in helping to structure the interaction [4]. Further research can provide insights on which types of gamification limit the users attention deficits or play with this fact in order to channel the users attention to particular data.

4.2 Empathy and Temporality

Another issue that kept coming up in the focus group discussion was empathy. The participants kept talking about how much they related or not to the visualizations' subjects, sometimes not even knowing exactly why.

Kosara and Mackinlay [13] asked in "Storytelling: The Next Step for Visualization" what makes a visualization memorable. Everything seems to point out exactly to what they refer to as a possible cause, that the visualization is memorable when people relate to it.

One of the best examples of this is the New York Times' *How many households are like yours?* visualization. The participants in the focus group elected this visualization as their overall favorite and in their responses they stressed the fact that what made this visualization so interesting was the fact that they could chose to explore families similar to theirs. They also said that they would like if there were smaller articles about each type of family so they could see if they have a similar lifestyle. One of the participants stated that when he chose a kind of family he was declaring an intention, therefore he would be interest in reading an article about the type of family that he chose and not another type of family even if they had a more interesting lifestyle.

In a test focus group we have done in the University of Texas at Austin, in the USA, the *Home and away: Iraq and Afghanistan war casualties* visualization was one of the most popular examples, mainly because the participants could relate with the subject. Most of the participants either had family members in the military or had friends that were stationed in Iraq or Afghanistan, therefore, they not only related more with this visualization but also felt very passionate about it. Not all the responses were positive though. Some of the participants felt almost offended to see that the visualization had pictures of the fallen soldiers and that it contained a lot of information about the soldiers, etc. Nonetheless, this response was a product of the participants close relation with the subject.

A final characteristic that the participants appreciated was when the visualizations provided some temporal structure. In fact, according to Kosara and Mackinlay [13] "one of the fundamental features of stories is that they provide a temporal structure, even if not necessarily linear." Therefore if visualizations are able to not only introduce storytelling elements but also have a story flow they will be more successful and then can be considered narrative visualizations.

Conclusion

In the same way that a well-told story is able to convey a large amount of information in a simpler and more compelling way (enabling the audience to assimilate and retain the information transmitted [8]) a well structured visualization can also captivate the audience. Technology provided us with new tools to convey information in a story-like fashion[8] and that is clearly transforming our preferences. People get excited with good visualizations and the proof of this fact is that people are sharing these visualizations online, often not even caring if they have an article associated with it. They just care about the visualizations alone.

Therefore we have to be able to understand the audience's preferences. We have to be able to successfully introduce storytelling in these visualizations, to tailor visualization systems to accommodate storytelling, because we do not know if the audience will go beyond the information that the visualization provides.

We believe that this topic is greatly relevant and the questions we pose are important not only for the Information Visualization community but also to every area that wishes to elevate visualizations to a more complex form of dissemination of information/data. Empirical study is much needed for the field to move forward.

Nowadays, most research on visualizations is merely based on the time it takes to complete a task [13], but this makes little sense when what we want to produce is engaging visualizations, that people spend time on. This area of research is still very new and there is still little information on how to introduce storytelling in visualizations and even

less research on what techniques work for the audience. It would benefit from rigorously studying and measuring the impact of visualizations. Although the study presented is somewhat preliminary and exploratory we believe that it still provides some insights on what the audience cares about. The results of this focus group study showed that interactivity, drilling-down, additional context, and the ability to create a sense of relatability are important factors for the users to feel engaged. These have already been intuitively understood by others (visualization designers, data journalism teams, etc.) but it's still useful to observe what the public thinks of it, how they relate to these visualizations, and what they think could be improved.

The domain of storytelling in visualization is only just starting to take shape and, although quite a few research contributions have appeared recently on this subject, there are still ongoing discussions. There are ample opportunities to make an impact and this study tries to contribute to it.

A specific direction for future work is to test other visualizations with the focus group method and probably focus on one particular design element to conduct an in-depth evaluation. Moreover we want to continue researching the elements that make a good visual storytelling in order to create a set of techniques and conventions for designing visualizations with a strong storytelling/narrative component.

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