

# Showing Important Facts to a Critical Audience by Means Beyond Desktop Computing

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**Abstract**—Recent research in Visualization has focused mostly on data analysis systems for domain experts, but also considered presentation to external people in the form of storytelling. The established directions assume that the target audience has an inherent interest in the facts to be discovered, sometimes even to the point of them being willing to learn how to operate a complex visualization system and spend considerable time and effort. In reality, sometimes the opposite is true: people unwilling to face an inconvenient truth actively avert their eyes. As a solution, we propose the presentation of facts by experts who manage to gain a limited amount of attention by means of rapid and expressive visualization. Using conventional desktop systems, this method is hard to implement, but new visual channels will open up new possibilities.

**Index Terms**—Information Visualization, Visual Analytics, Science Fiction

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## 1 INTRODUCTION

In 1997, Edward Tufte argued that the catastrophic loss of the space shuttle Challenger can be traced back to the engineers who argued for postponing the launch, but failed to convince the officials at NASA [13]. Even though his argument was subject to criticism later [10], the critics refrain “to say that the engineers presentation was not flawed or that even if conceptually correct, could not have been better done” [10]. Both publications are several years old by now, and in the meantime, the science of Visual Analytics has emerged that might have allowed the engineers to gain a much better understanding of their data. Afterward, they might, at best, have made a screenshot from their Visual Analytics system and send that to NASA—active analysis by experts has improved much, but for convincing others, research has stalled.

Basically, what Tufte does [13] is nothing else but storytelling [7] which has seen a considerable amount of practical research and is praised as a tool for reporters in writing articles. However, those visualizations are still aimed at people of have an active interest in getting information about a topic. The officials at NASA most likely had a high interest of launching the Challenger, and there was only little time to convince them with one or two highly impressive visualizations.

In this workshop paper, our intent are to

1. analyze the task of convincing other people by a visualization rather than a lengthy discussion;
2. explain how the emergence of non-desktop (or rather console) computer usage helps in that task; and
3. lay out the prospects for the future.

In Section 2, we show what has already been done. In Section 3 we describe three scenarios of a possible future. Finally, in Section 4, we estimate which research is necessary right now to make this future come true.

## 2 RELATED WORK

As already mentioned in Section 1, Tufte [13] describes the example of the catastrophic loss of the space shuttle Challenger. The engineers presented a complex setup of various information tables and pictograms that lead to information overload for the decision makers. Given they had known better themselves [10], they could have shown a simple scatterplot as proposed by Tufte [13], to spark the right decision, postponing the launch, in one single visualization.

Kosara and Mackinlay [7] pick up the concept of storytelling, which is arguably the same thing Tufte [13] does in the Challenger example. In their paper [7], the authors consider several scenarios we intend to do here, but they (1) underestimate the case of an adverse target and (2) mostly discuss conventional presentations that are planned in advance and held in front of an audience, with hardware that usually is a video projector and not a desktop system, but, actually, the joint scion of the desktop and the overhead projector which faced criticism even before the decline of the desktop [13].

To support storytelling in presentations, Lee et al. [8] present SketchStory, a system that lets presenters sketch visualizations that, by application of gesture detection, generates visualizations of real data from the sketches. Storytelling in journalism is the focus on a paper by Segel et al. [11]. Usually, storytelling is seen as any form of visualization sequences. Robertson et al. focus on storytelling using one animated visualization, which can be seen as a special case of the general storytelling [9].

Bateman et al. [2] argue that depending on situation, the guidelines proposed by Tufte [12] might be detrimental to the deeper cause: while it is important for users to clearly understand the information, design choices that do not immediately transfer information (like including pictures) might still help remembering visualizations, which is important for some of the scenarios we will show in Section 3.

Kim et al. [6] evaluate that “iconic and metaphorical images triggered more awareness and motivation for future behavior change through emotional attachment, while indexical representation was good for informative and retrospective purposes”, thus backing up the concept of storytelling. They root their work in persuasive systems [4], which are also related to our course, but most of it is a bit further from Visual Analytics. Chih and Parker [3], on the other hand, use Visualization for persuasion and give several examples how to do it. They are, however, proposing methods that might be subject to criticism by persons who consider them misleading.

To sum up the state of the art in storytelling, much work has already been done to deal with the situation that people are lacking the time or interest in important information. To some degree, it is even helpful for information that people are discontent with and therefore are subconsciously fading it out. An example application for such inconvenient truths has been described by Munzner in her famous panel contribution

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at VisWeek 2008 [5]. She describes “total political transparency” as “InfoVis outwards grand challenge” [5]. The recent advances in storytelling presented above can definitely fulfill some of the requirements for this challenge, but not all of them. While there no current publication on the progress by the team around Munzner on that matter, we think that our scenarios deal with situations that include an increase in political transparency, so we hope for mutual benefits in the future.

Even the problem of an unwilling audience, is, however, magnified if things happen quickly and possibly in the heat of a discussion. It is still easier to reason with a person reading a column or listing to a speech than convincing it during a discussion with the audience, or with a third person who contradicts. In our scenarios, we will hint a better future for all three cases.

### 3 SCENARIOS

Heading the call of the workshop, in this section we will switch from the normal scientific writing style to novel-style prose. The discussion from a scientific point of view will be done in Section 4.

#### 3.1 A Day at the Office

“This variant is not part of our product line”, explained Broderick Wyke to his office manager Elsy Kader. Naturally, she was familiar with the products of the company and the sales strategy. The problem was that the strategy partly missed the customer requirements, and they kept phoning about the variant she just had proposed. The course of events was the same every time: the customers described their problem, she acknowledged it, and manually filed the process into the system. Unless an intern happened to be at the phone, then the whole process got more complicated again. Moreover, the demand of the customers had even shifted over the last time. However, she was aware that Wyke took personal pride in his product palette. She needed to make her argument good. Luckily, she had installed her state-of-the-art visualization app on her phone. Connecting to the sales data of the local network was a matter of seconds, as was selecting a sensible default for the visualization. She directed the internal projector at the next wall: “Here is a list of customer inquiries, you see the decline of the conventional palette, paralleled by an increasing demand of custom orders that can be grouped to...”—tap—“...this. Looking at the state of the last quarter aggregated, the distribution is like...”—tap—“...this.” For several minutes it was silent in the office. She started to hear her heart beating. Finally, Wyke took a deep breath and responded: “Ok, perhaps the customer requirements have shifted. I will device a new product palette ASAP!” While he was leaving, Elsy sighed. He would, of course, return with her proposal, believe to have done it himself, and be proud of it. Visualization could do a great deal to solve problems. It couldn’t change people from the scratch. Yet.

#### 3.2 “Working Sucks”

Galen Grippen was a bit at unease. The financial sanctioning for unemployed people who showed to be “unwilling of being reintegrated” were to be tightened. He was not afraid of being unemployed, with long successful record as an economic consultant, but this was not about his personal situation. He was sitting on TV to prevent it—to help other people, and to fight for a free job market. However, things were going badly. “I am aware that regrettable cases exist when people where unduly sanctioned. However, those people have all received rightful legislation by now. Thus, we need to sanction people who actively impede getting into a job.” After Hunter Wynn, president of the employer’s federation was finished with his speech, the moderator asked “But what do the concerned people really think about this, what is your opinion?” The unemployed who was sitting in the talk-show responded: “Working sucks. I guess I will just find another way around the sanctions.” Galen gasped. He had worked long to build up a lobby for unemployed people. He had talked to hundreds of them, to the least. It was just unfair that now as he was sitting here to publicly impeach the hardships of further sanctions against unemployed people, he had to face not only a professional opposing him, but also the concerned person in the round practically against him. He was pretty certain that strings had been pulled in the background to achieve this,

but for the sake of keeping the public opinion at the truth, he needed a solution, and he needed it fast. In that moment, the moderator was asking a question to him, already trying to shift the topic forward, so he knew he had to make his move. He activated the wireless connection between his phone and the video-in of the station. Since the freedom of visualization act, everybody who was eligible to speak his or her mind was also eligible to visualize it. “This is the number of sanction cases over time”, he started, “but if we...”—tap—“... separate this into legitimate and illegitimate sanctions, we see that the illegitimate sanctions decline fast while the legitimate sanctions decline slowly. Of course, this means, that currently, most sanctions are legitimate, but this also means that the systems works—we do not need to change it. Moreover, if we purge the aspect of people adjusting to new regulations from the data, we have...”—tap—“... an almost constant line. I would have liked to assign this to people, because that would have shown that a number of people that, in my estimation is far below one percent of the long-term unemployed people, is continuously lawfully sanctioned. The others are playing by the rules, and the proposed legislation would just induce another round of this: ...”—tap—“... Here you see the time interval after the last aggravation of sanctions. Some people I supported volunteered their data to me, and it shows that employers tried to get the better of them. The results were those lawsuits, when attorneys, paid by the state via lawsuit aid, won against the state, resulting in a total cost you see...”—tap—“... in this bar chart. The bar next to that shows what it would have cost to just pay the people their welfare aid ignoring the sanction. I made my point: this whole thing just costs the tax payer a lot of money in order to punish a few people.” He breathed again. That should at least have thwarted at least this little scheme, even if the discussion would go on.

#### 3.3 The Price of a Degree

Merlin Stoyer organized his data. He intended to combine several sets in order to assemble important information. One was a set of donations of private persons to political parties. Another one was about owners of company shares. A third one was about political decisions regarding CO<sub>2</sub> boundaries. Those datasets together already told a story: A number of stakeholders from electricity companies had filed a large number of donations to the governing party. A week later, the prime minister had loosened that laws governing petroleum and coal plants. As a result, the shareholder had gained a considerable amount of money from rising stocks. Sadly, Merlin knew that this story would not be big in the news. It was too remote for people to consider, nothing that concerned “their world”. Thus, he decided to break it down for them. To do that, he needed to consider the current models of global warming and calculate how much the additional exhaust would affect the climate. He saw that considering profit from power stations, a tremendous amount of money was gained from one degree of global warming. Finally, he calculated the price people had to pay for one degree by means of increased costs for things like cooling, water, and supporting economic refugees. He realized that the price of a degree was even manifolds higher than the gain from it. Armed with these numbers, he could calculate what every citizen had to pay for this event, what every shareholder got from it, and what the governing party got from it. From that, he generated visualizations to show people which amount of money they just payed to some shareholders, and to the governing party—and which amount of money was lost in entropy. Of course, that was polemicized, but it would definitely have stronger reception than just providing some weak statement. Satisfied, he went on for another thing. A friend of his, Lilliam Vangelos, had chosen a different approach. She had developed a plugin that showed people who bought things only who earned what from their money. People would be surprised how the governing party gained from them buying a new air conditioning, and those who clicked on the provided links would further his reputation as exposure journalist.

### 4 REQUIREMENTS

As a matter of fact, the scenarios from Section 3 are more or less loosely based on true events that happened in the real world. Sadly, they did not have the happy endings in reality, and this might be the

fact because as of today, the technical and scientific requirements are not fulfilled. However, by aiming for scenarios like the ones shown above, we might be able to provide for a better future.

The journalism-related scenario (Subsection 3.3) is perhaps the one closest to existing research, like the one by Kosara and Mackinly [7]. However, the way similar events are unfolding in the world of today shows that journalists fail to spark enough interest in enough people throughout the population. . We do not know for sure, but it seems that people rely too much on media that supports their personal beliefs, filtering away the rest. We believe that the already impressive research of visualizing data in journalism needs to be pushed further. However, for people to benefit from important methods like interaction, they need to apply electronic readers. The trend from desktops to mobile devices, like tablets, has (1) increased the acceptance of this way of reading news as a whole and (2) provided are more unified user environment compared to the rather divergent situation of people sitting at their desktops and people holding physical paper. In addition to the general research described above, specialized research for this devices is necessary. However, this scenario shows that not only the research aspect is important, but also social standards have to develop with it.

The right for “freedom of visualization” (Subsection 3.2) goes perhaps even further into social standards and politics, yet if it could be implemented, it would provide a whole set of completely new channels for visualization. Actually, the analogue variant of showing a printed panel has become a staple of Austrian debate culture. However, the method is abused sometimes to show wrong or misleading information. This shows that the problem of truthfulness is important in showing visualizations to a broad audience as much or even more so than for exploratory visualizations. In his second degree on Business Informatics, [1] shows that an audience actually mistrusts visualizations by now because they are aware of it being possibly misleading. Lying with words seems to be less effective and more tolerated than with visualizations. For us, this is not a problem, but a challenge, considering that our interest as scientists has to be showing the unbiased truth. As a matter of fact, the method is unpopular among journalists—which is disappointing, as they could, given the experience, pick up the visualization and analyze its truth, e.g. by calculating the lie factor. Anyhow, Tufte’s Challenger examples [13] shows that with visualization, complex yet important information can be communicated much better. As many visualization researchers might agree, visualization is just another form of saying things. Consequently, it seems logical to include a right of visualization into the right of free speech. There might be severe political and juristic ramifications though, as things like lying with visualizations need to be tackled, as well as the question how big the visual space a person can get is—after all, people sometimes try to peak each other verbally as of today, so similar things might happen visually. From a technical and education perspective, the scenario has a campaigner (not a visualization expert) generating new visualizations (however, most likely based on sensible defaults), in real-time.

The first scenario (Subsection 3.1) is, from a hardware point-of-view, not too far-fetched. Cellphones with integrated projectors do already exist, yet they are not very successful. Beside limitations regarding size and battery capacity, the main problem is a lack of practical application. Here, visualization research could lead to a useful tool that can be applied just as described in the scenario. Using a projector for presentation is most likely superior to turning a small phone screen around hoping for the other side to take a close enough look at it.

What is generally missing in related work is how to deal with an audience that is only willing to pay a limited amount of attention, which would need one compelling visualization that could then be followed possible by a longer story. Also, related work is focused on classic “ex-cathedra presentation”, analysis using desktop systems, or websites, which are partly viewed on desktops, but also on mobile devices. What is missing, based on the current hardware state of the art, is using a mobile device to show something to somebody, as well as convincing others while collaborating in a big-screen environment. The difference to classic collaboration is that the target might not only have a different opinion, but be generally unwilling to collaborate at first.

These kinds of visualization include a form of interaction that integrates the classic visualization aspects of exploration and analysis directly with presentation: the audience is actually interacting, but not with the data, but with the presenter, who, in turn, has to relay the interactions to the system. Currently, presentation is most frequently applied a-posteriori, when exploration and analysis have been finished. At the same time, the focus might shift to more classic visualization types, like line charts or bar charts, as the visualizations must not be too complicated for a random target to grasp immediately.

Moreover, the community definitely needs to think about how to teach outsiders the necessary basics to apply visualization tools properly, because otherwise, what we develop will end up not being used. This includes the fact that these people often have uses cases that are partly different from the ones currently researched.

## 5 CONCLUSION

We have identified a new task for visualization: the demonstration of information to an audience that might be uninterested to unwilling. In several scenarios, we have shown the importance of this task and explained how new visualization devices and concepts can help this task in comparison to classic desktop visualization. Based on those scenarios, we have addressed a number of requirements that would need to fulfilled for this scenarios to become true. However, the requirements are no concrete research goals yet. It remains open which exact research projects need to be conducted in order to get most out of this new developments. We will definitely need to cooperate with philosophers, jurists, political scientists, didactics, and others, for topics like personal rights, rhetoric, and visual literacy.

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