Leveraging storytelling in visual analytics by redesigning the user interface

by

Madeleine Kusoffsky

LIU-IDA/ LITH-EX-G--13/024--SE

2013-05-31
Final Thesis

Leveraging storytelling in visual analytics by redesigning the user interface

by

Madeleine Kusoffsky

LIU-IDA/LITH-EX-G--13/024-SE

2013-05-31

Supervisor: Mattias Arvola (IDA) and Patrik Lundblad (NComVA)
Examiner: Mattias Arvola
Abstract

Storytelling is a way of packaging the knowledge and insights gained from analyzing statistical data. The knowledge is transformed into a format that lends itself to be understood by non-experts more easily. The story with links to interactive diagrams. The purpose of this design study was to improve the interaction design of the storytelling feature. The target audience for the new design was intermediate users. Evaluation of the current design by interviewing and observing beginner and intermediate users gave valuable understanding about the users goals related to the storytelling feature. The new design is a product from design goals derived from the user data and research through design. Sketching and exploring possible solutions was a process that meant producing multiple sketches, documenting design decisions through annotations and a way of keeping track of trade-offs and compromises. Screenshots from the application containing the redesigned interface of the storytelling feature was used during a final evaluation. Developers, a user and the designer evaluated the new design through a pluralistic usability walkthrough. The result showed that the new design had improved the storytelling feature in some aspects but that new problems had emerged. This indicates that interaction design processes should contain iterations. Designs should be tested, redesigned and tested again together with users and stakeholder to ensure that user goals are fulfilled, that design goals are reached and that the feature will deliver a positive user experience.
Foreword and acknowledgements

It’s the beginning of summer and the last adjustments are being made to the text of my final thesis. Three years of studying graphic design and communication has finally come down to this piece of paper. My journey at the university has been brief in some aspects, but it’s astonishing how much I’ve been able to learn and grow from this place, the educators here and my comrades. Gratitude, happiness and relief is mixed with a sense of sadness and anticipation. The trip is almost over and a new chapter will begin. What happens next is still unknown, but I know that what I’ve learned at the university of Linköping will help me face the challenges and difficulties to come. I have been given the tools to do this and made sure to polished and sharpen them, collect new perspectives and supplement old ones, question what is supposedly known and search for new knowledge. I’m curious to meet this next chapter, new people and face new challenges, and I’ll make sure to learn as much as I can, every step of the way. I have strived to make use of the skills that I have acquired from my education while writing this thesis. I chose a subject I have taken much interest in during the past two years, namely interaction design. I believe that good interaction design can contribute to the quality of peoples working life and assist people in their personal endeavors. That is also why I find it important to share the design process, so others can learn from my experiences and hopefully make even better design in the future.

Many thanks to my supervisor Mattias Arvola, your insights and input during the whole process have been very valuable and given me a path forward. I would also like to thank Patrik, my supervisor at NComVA, whom I could turn to with all my questions and who was a great support to have in a nearby office. Also, a big thanks to all who participated in the evaluations and all who contributed to this thesis.
1. Introduction

In the introduction the reader will find the problem and the purpose of the thesis together with the research questions. The structure of the thesis is also presented in this chapter.

The decision to redesign a user interface can come about for many different reasons. User frustration together with signals of users not utilizing the full potential of an application may be a strong indicator. It can evoke a company’s desire to improve their product to increase the satisfaction of the users and customers. Statistics eXplorer is a visual analytics application that have been developed by the company NComVA in Norrköping, Sweden. They noticed that statisticians who uses the application and its’ storytelling feature are experiencing some issues and that some of the features unique possibilities aren't being used by statisticians.

Storytelling is a new approach to communicate statistics and research has recognized it to be an effective way to package knowledge (Kosara, Mackinlay, to appear 2013). Usually, statistics are presented in a static format such as numbers and figures, a format that lend itself badly to engage non-experts (Thygesen 2010). Official statistics contain important facts that politicians and decision makers should have access to. It is also important that these facts and insights are communicated in a way that non-expert understands. Therefore it is crucial that the statisticians have access to tools and applications that help them create and package the stories. The process of storytelling needs to be effective so that it is used by the statisticians. They hold the key to the unveiling of the information that is hidden in the data. Interaction design is about making a task more effective and manageable (Cooper, Reimann, Cronin 2007). With a redesign of the user interface, I am attempting to solve problems connected to the storytelling feature. But the process of modifying a user interface always comes with problems being discovered along the way, compromises and trade-offs.

1.1 Problem and purpose statement

It has been noticed by the staff at NComVA that some users are unfamiliar with the storytelling feature and that the current interaction design causes much frustration and misunderstanding. A key feature in the storytelling process is linking interactive data visualizations through nested links in the paragraphs of the story. Developers suspect that the feature is lacking in usability since some users are not using the technique. This example together with other documented opinions and feedback surrounding the storytelling feature have inspired NComVA to take action. It’s from this information from which I began the process of producing an alternative design for the interface.

The purpose of this design study is to improve the interaction design related to the storytelling feature in Statistics eXplorer. At this stage, the definition of interaction design includes the navigation to and inside the storytelling tool, the architecture of the tool, terminology, and the usability.

The target group for this redesign are operating statisticians that uses Statistics eXplorer for visual analytics.

From the purpose statement, the following research questions were specified:
1. What flaws does the current interaction design of the storytelling feature in Statistics eXplorer have?
2. What changes should be made to improve the interaction design of the storytelling feature?

1.2 Disposition of the report

The study begins with a chapter that covers the subjects that are intertwined with the redesign, such as visual analytics, statistics and storytelling. This theory chapter also covers a summary on interaction design in visual
analytics and usability of user interfaces in visual analytics. Giving the reader a better understanding of the scope will be a preparation for the following chapters. After the theory chapter the methods that have been used are presented. The result chapter contains the insights I gained in the user data collection and excerpts from the sketchbook. Here the reader will also find the new design presented as screenshots from the application. The report ends with a discussion and recommendations for further research.

2. Theory
This chapter covers the subjects that are closely related to the scope of this design study. Here the reader can get an overview of theory about designing and redesigning user interfaces, visual analytics, the application Statistics eXplorer, storytelling and theory about interaction design in visual analytics.

2.1 Redesigning a user interface
During the literature review I researched interaction design, what is being said about redesigning user interfaces and methods about redesigning. A similar study (Marill, Miller, Kitendaugh 2006) covers the redesign of a interface for a website, MedlinePlus. Here the author talks about that interfaces needs to undergo changes for many different reasons. Some websites have to deal with more features being added and that change is needed to accommodate these features. Other interfaces are in need of transformation because of usability issues that might have been discovered after release.

A redesign process is very much an iterative process. The difference between my study and the article about the redesign of MedlinePlus (Marill, Miller, Kitendaugh 2006) is that the iteration is very short in my case. Under the circumstances regarding time and workload, I didn't have the time to follow the iterative process to any greater length. But what the article (Marill, Miller, Kitendaugh 2006) covers is that during an iterative process you test and analyze every design modification along the way and the designs always includes trade-offs as how much time one have to explore and the deadline of release.

Another source (Lewis, Rieman 1994) that have relevance to the topic of this design study states that there are few if any software products in today's computer market that can maintain there sales without regular upgrades. For different reasons it may be inadequate in a few years and due to development in relating fields. Clayton and Lewis (Lewis, Rieman 1994) points out that users and their task also changes and that work patterns changes over time partly because the product itself but also because of other, new concepts, hardware and software. Users gain new skills that needs support and new technology generates new expectations from the user (Lewis, Rieman 1994). The support of users workflow and helping them discover the storytelling feature is one of the aims of this redesign and is targeted at new users. And just as in my case, Clayton and Lewis (Lewis, Rieman 1994) points out that the next version of the interaction design in an application needs to be a response to problems but also to opportunities. Storytelling in statistics is a relatively new concept and the feature in the application needs to be lifted so that it is used by statisticians.

2.2 Visual analytics and interactive visualizations
Official statistics
People generally don't know about existing statistics, can't find them and might not understand them and therefore can't use them in their decision making. Statistics are known for being boring and the representation of them doesn't always lend themselves to be easily understood by non-experts (Thygesen 2010). Official statistics are well suited as a support in the process of decisions made in legislation, government administration and planning of education to name a few examples. Official statistics are also rich and generally built from using scientific methods and therefor the official statistics are a potentially important source of information. But many
facts are hidden in the data. The official statistics are vastly under-utilized and decision makers often turn to other sources or decide without sufficient evidence (Thygesen 2010).

*The visualization of statistics*

Visualization plays an important role in communicating information in wide and diverse fields and is not exclusive in the field of statistics. To make a visualization solution successful, it has to be designed with knowledge of how humans respond to visualization and be adapted to human perception and cognitive capability. Otherwise, the user might not be able to interpret the visualization (Kalawsky 2009). Visual analytics is one way of communicating statistics to non-expert users. This concept is one step of turning data into knowledge. (Giovannini 2012)

The visualization shouldn't be design in such a way that it goes against the users mental model of e.g what certain colors stand for or what certain symbols mean. There are some conventions that is widely known by many users and therefore should be taken in consideration when the design of the visualization is being made. (Kalawsky 2009)

*Visual analytics*

The challenge nowadays is to extract and harness knowledge hidden in the mountain of scientific data. Visualization technologies empower users to discover important patterns in large amounts of data, identify areas that need further research and make sophisticated decisions. Without interactivity visualization is often considered as an end point of the workflow or as a way of communicating observations (Zudilova-Seinstra, Adriaansen, Liere 2009). Launched in the 1990s, the field of interactive visualization (closely related to visual analytics) has become very successful due to the idea of utilizing the broad bandwidth of the human sensory system in interpreting and navigating inside of complex datasets, processes and simulations from diverse scientific disciplines (Zudilova-Seinstra, Adriaansen, Liere 2009). Official statistics are usually large datasets and is a continuously expanding with more data. Tools like Statistics eXplorer therefore make it possible to analyze large datasets in a more effective way.

In an article by Green et al (Green, Wakkary, Arias-Hernández 2011) visual analytics is defined as the "science of analytical reasoning with interactive visual interfaces". With the expanding volume of visual data, there is a need to develop interaction methods that maximize the user’s understanding of the visualized information. The challenge is to leverage what is known about human perception so user interfaces can be designed to support a typical viewer to intuitively extract relevant information. (Zudilova-Seinstra, Adriaansen, Liere 2009)

*Statistics eXplorer*

The visualization tool Statistics eXplorer was introduced to Statistics Sweden in 2008 (Haldorson 2011). It is a geoVisualization tool and a tool for data visualization which takes full advantage of the latest trends and developments in the area of Web technologies and storytelling. The application enables users to manage a time series analysis, selection of territorial areas that is of interest and which indicators are referred.(Giovannini 2012) The objective of introducing visualization was to avoid boring statistics and create more interest for the information that is currently under-utilized (Lundblad, Åström, Jern 2012). Statistics eXplorer is based on three characteristics that complements each other (1) Authoring is a data provider and manager with coordinated views and several motion visual representations. (2) Storytelling is a mechanism for capturing interactive scenarios (saves how the application is set up at the time when the user hits the snapshot button) and metadata with hyperlinks. (3) Publisher (Vislet) allows the user to create HTML code for embeddable interactive visualizations to be published on a website, interactive report or blog (Lundblad, Åström, Jern 2012).
Data that was confined in numerous spreadsheets before can become, through Statistics eXplorer, more easily available, comparable and visualized online (Haldorson 2011). The user can see movement in the graphs through time animation and the application offers different options of how the data should be represented (scatterplot, table lens, parallel coordinates). This option of viewing can support and meet expert user needs and at the same time allow for the application to be set up so that an ordinary citizen easily can get an overview of e.g. ageing population in a specific area. All views in the application are synchronized and can be shown with time animation (Thygesen 2010).

"Statistics eXplorer takes urban analysis to a new level. It enables cities across Europe and beyond to apply the vast quantities of data that lie presently undervalued and underused to create new insights; to make smarter planning decisions; and to engage the public in shaping the destiny of their city”

(Haldorson 2011)

The user was considered during the design of the application. NComVA had established a small group of users with different backgrounds. They were experts from international and national statistical organizations (OECD, Sweden Statistics and ISTAT), municipal planners and was in 2011 extended to include school teachers and students. This group tested and evaluated solutions in the application in 2010. The group responded positive to the components (Authoring, Storytelling, Publisher) in the application and found it to be an overall useful tool. But some of the users in the group asked for more complex methods for the application while others asked for more simplifications. NComVA realized that they needed to have different levels of versions (service) for different segments in the group of possible users. (Lundblad, Åström, Jern 2012)

An example of how to use the tool is that the statistician can compare variables/indicators such as income and gender and how the average income looks like across the world. Another interesting and simple example is to look at life expectancy of male and females in the world, and investigate how the life expectancy drops or rises over time (from 1975-2008). The drops in male life expectancy in and around 1980s in Iran and Iraq indicates war. One can also locate the genocide in Rwanda around 1994, when the scatterplot bubble for Rwanda drastically drops for both female and male life expectancy. Statisticians have the possibility to choose what variables/indicators to explore in Statistics eXplorer and discover interesting relations and patterns.

2.3 Storytelling in Visual analytics

Storytelling in statistics is a technique for creating the context where statistics can be brought from numbers to knowledge (Haldorson 2011). Storytelling can be explained as a way to effectively getting your point across and making other people remember it. Stories are found to make it easier to remember information and is a way of packaging information into a comprehensive structure. One of the main concerns around storytelling is to draw the user in, evoke curiosity through the title, a picture or some form of teaser (Kosara, Mackinlay to appear 2013). Storytelling encourage the user to reflect and can sometimes change a persons perspective (Lundblad, Åström, Jern 2012). Stories are usually told without interaction, but interaction is one of the most important parts of visualization of data. But interaction could also distract from the story. It poses a risk and can make the user stray off, away from the story. Here, there’s a trade-off between interaction and focus. (Kosara, Mackinlay to appear 2013)

The hope of statistics is to turn data into knowledge, the statistics must communicate a message to the end user. Ideally, visual analytics tools should be able to help statisticians to discover and communicate their discoveries. By accompanying illustrated and dynamic data with a narrated story the statistics can become useful and interesting to a wider audience (Thygesen 2010). Visualization is powerful but in order to tell a story, it needs to be
augmented in some way. Augmentation in this case is adding written text, adding audio, video, links and hints to guide the user through the story when it's being told. (Kosara, Mackinlay to appear 2013)

**Designing a story**

There are a couple of scenarios of how a story can be presented and designed. One scenario is that the story is created first, and then viewed by the audience without the ability to interact with the story or author. Another scenario is that the user needs to click through the story (like a slideshow) and some scenarios offer the user more or less limited means of interaction. All of these scenarios have the same goal of getting a point across with sufficient detail, making the user understand something and trust that the story being told is based on real facts. (Kosara, Mackinlay to appear 2013)

The stories that can be created in Statistics eXplorer consists of dynamic statistical data and can be embedded into websites. It is possible to have links in the story which can activate the animation in the application, or jump to a specific view to support the written story. This solution makes it possible for the reader to follow along in the story in an engaging and interactive way. You don't have to be an expert in visual analytics or statistics to understand the visual representation of the data. The storytelling solution also invites the reader to interact with the application and take control over the timeline and make their own discoveries. (Thygesen 2010)

Insights gained from visual analytics can be presented in other ways than storytelling. For e.g. the result of a analysis can be presented live to a large audience and the presenter can pause the presentation, answer questions and highlight pieces that are being presented. The results can be presented through a pre recorded video. Or, the result can be presented to a smaller group of people which usually result in more interaction between the presenter and the listeners. All techniques for visualizing data and presenting it to a wider audience consist of trade-offs between distraction and engagement. The presentation needs to be interesting to engage the audience, but still focus on displaying the data correctly. (Kosara, Mackinlay to appear 2013)

**2.4 Interaction design in visual analytics**

‘Good design makes users more effective’ is a general guideline for productivity tools. It is up to the designer to figure out how to make the user more effective. It is the users job to focus on the task and the designers job to focus on who the most important user are, identify what their goals are and why (Cooper, Reimann, Cronin 2007). It is important to remember that goals are not the same as tasks or activities. They are just intermediate steps that help the user to reach a goal or a set of goals. A further explanation of the difference between goals and task is that goals are driven by human motivation and changes slowly over time, while task and activities are transient and are based on whatever technology is at hand. For example, your goal when traveling could include, comfortably and fast. Back in the old days this meant traveling in a covered wagon, but today it could mean traveling by high speed train in first class (Cooper, Reimann, Cronin 2007). Helping the user getting around in a software to reach their goal is important. How does a user of a interface know where they are now and where to go next? Sometimes it can be frustrating and energy spent seems wasted. Users might feel like they can do something better with their time, or use another solution to solve the problem. The optimal solution would be to have everything at hand for intermediate-to-expert users. But then lesser-used tools need to be placed on separate screens to avoid cluttering the workspace (Tidwell 2011). Visualization systems are often designed for specific user groups which have specific goals and work in specific environments. Finding out how and why a user uses different information resources is essential to provide interactive visualization systems that match their goals and needs. This analysis should be done in the users context and working environment (Wassink et al. 2009).

“Beyond simply ‘doing what’s needed,’ a successful system has to merge smoothly into the user’s existing world and work. It should request information in the order that the user is likely to receive it; it should make it easy to correct data that’s
often entered incorrectly; its hardware should fit in the space that users have available and look like it belongs there. These and a multitude of other interface considerations are often lost in traditional requirements analysis, but they can be uncovered when the designer takes time to look into the details of tasks that users actually perform.”

(Lewis, Rieman 1994)

Much of the problems in a user interface can be traced back to communication problems between developers and their clients or between developers and their users (Shneiderman, Plaisant 2010). Many interactive visualization tools interfaces are untested in many areas due to the overwhelming complexity of the analytics process. Because of this, it becomes difficult to acquire a body of useful knowledge that might be used as a basis for future tool building in visual analytics (Green, Wakkary, Arias-Hernández 2011). Interaction is not just the manipulation of interface controls in a software environment, but the discourse the user has with his or her information, prior knowledge, colleagues and environment, something that Pike et al. (Pike et al. 2009) points out.

Current visual analytics design tends to create interfaces based only on developer assumptions of the best layouts, methodologies and interaction metaphors. This approach of developing for the developer is problematic. To put so much effort into a tool before understanding how such a tool should be used assumes enormous risk of time and resources. Further, it may put high pressure on whatever evaluation is conducted to produce findings that agree with the developers’ original assumptions. (Green, Wakkary, Arias-Hernández 2011)

Green et al. (Green, Wakkary, Arias-Hernández 2011) further problematize the fact that its difficult to design interfaces for visual analytics:

"Understandably, developing visual interfaces which meaningfully support analytical reasoning becomes a much more demanding task unless we understand how that reasoning works: what heuristics are used when and in what order or combination, how the feeder proceses such as working memory or perceptual logic feed reasoning, which biases affect inductive and deductive analysis and how these can be mitigated. In both theory and practice, our ability to mine large complex datasets and to visualize these data has outstripped our understanding of the human user we are visualizing for."

(Green, Wakkary, Arias-Hernández 2011)

Green et al. (Green, Wakkary, Arias-Hernández 2011) also explains that designers and users and other stakeholders must be prepared to learn from each other when designing an interface. They must share ideas and work through problems throughout the design process.
3. Method

In this chapter the reader will find how participants were selected, how the interview and observations of users were carried out and how the data was analyzed. I will also present how I arrived at a new design suggestion for the interface and later, how this new design was evaluated.

Many authors in interaction design literature (Cooper, Reimann, Cronin 2007) (Shneiderman, Plaisant 2010) (Tidwell 2011) emphasize the importance of understanding who you’re designing for when dealing with a user interface. In this design study it was equally important. Qualitative research in interaction design can tell a researcher about what, how and why, which is more interesting for the redesign than how much or how many which is the kind of data you get from quantitative methods (Cooper, Reimann, Cronin 2007). It was important to know the user, gain a clearer and more detailed knowledge of the user to be able to achieve success with the redesign (Cooper, Reimann, Cronin 2007). By methodically collecting this knowledge about the users I intended to draft design goals and to arrive at a new and improved design.

A qualitative method was chosen to gain knowledge about Statistics eXplorer’s users and evaluate the current design of the interface. I conducted semi structured interviews and observations. Limited resources have affected the number of participants used in the collection of data. Despite this, I got sufficient material to go ahead with the redesign. I was able to interview two operating statisticians, two undergrad students who studies statistics and one of the developers at NComVA.

3.1 Understanding the user

As a designer of a user interface you need to figure out who is going to use it, what they want to do with it and in what order to be able to produce a good interface. User analysis require close personal contact between the designer and the people who will be using the system, this link can sometimes be difficult to achieve (Lewis, Riemann 1994). In this case the contact was structured into specific and limited sessions. More frequent contact was not possible because of the distance to the location of the users and the time limitation of the project. In order to learn about your users you need to challenge any assumptions you might have about their behavior. Identify what they expect to find in your application, their level of experience with similar concepts, how they think about, group and organize information. (usability.gov 2006)

To design an application one also needs to understand the business and technical context that surrounds it. It is the designers obligation to have the business goals in sight and to understand the constraints before designing a new solution. Therefor it is important to gather information from stakeholders, such as preliminary product vision, schedule, constraints and opportunities and business drivers. (Cooper, Reimann, Cronin 2007)

The purpose of the first part of the design study was to (1) obtain enough knowledge about the users, (2) evaluate the current design by identify specific problems that could be tackled by redesigning the interface and (3) identify constraints and opportunities surrounding the feature.

What does the workflow of an operating statistician look like? What goals does the user have? How well does an unexperienced user find his/her way to the storytelling feature? What does the user experience while using the storytelling feature? These were some of the key questions I needed answers for in order to start working on an alternative design.
3.1.1 Selection of participants

There were five participants in total for the initial evaluation phase. Two students who study statistics and data analysis at Linköping university, two operating statisticians and one developer from NComVA. For the pluralistic usability walkthrough two developers participated but I only managed to get hold of one operating statistician for the session. Potential consequences of having so few users in the final evaluation will be discussed further down in this chapter.

Knowing how to balance the selection of participants was a key question before the initial research phase began. On one hand NComVA wished for an easy to use interface for all users, but on the other hand their users (the operating statisticians) work with very complex concepts and therefore it would be a challenge to create a simplified interface in many aspects. Cooper (Cooper, Reimann, Cronin 2007) states that users often are neither beginners nor experts but rather intermediates.

“One of the eternal conundrums of interaction and interface design is how to address the needs of both beginner users and expert users with a single, coherent interface.”

(Cooper, Reimann, Cronin 2007)

Although all users start out as beginners, they don’t stay in that state for long. Cooper (Cooper, Reimann, Cronin 2007) points out that the goal with interaction design should be neither to pander to beginners nor to stress intermediates into expertise, but to quickly get beginners into the intermediate state.

With this in mind, I wanted to figure out what beginners would need in order for them to more easily move into the intermediate state. I also had to identify what could be improved for the already intermediate users of the application. The students could bring a fresh perspective on the interaction design. I hoped that by including this perspective I would locate problems that a new user faces the first time they use the application and the storytelling feature. Students from the undergraduate program in statistics and data analysis were observed and interviewed. These sessions took about 40-50 minutes each. Operating statisticians would give a more in-depth perspective and would help me locate issues connected to the storytelling process that intermediate users experience. The statisticians were interviewed and one of them was also observed while he demonstrated his workflow. As with the beginner users these sessions took approximately 40 minutes. The operating statisticians would be considered to be appropriate representatives of the target audience. A developer from NComVA was interviewed during 40 minutes to answer questions about decisions that have shaped the current design of the interface. By interviewing the developer I also aimed to gain insight about constraints and opportunities that have to be taken into considerations in the redesign. The history and record of earlier modifications was valuable information and would create a context from which I could begin to state reasonable design goals.

3.1.2 Interviews, observations and think aloud

Interviews can be conducted face-to-face, by telephone or in group and intend to elicit views and opinions from the participants (Creswell 2009). Interview material was structured prior to the interview and the interviews were done face-to-face with the participants. The design of the material was intended to encourage the user to explain thoughts and experiences that he or she have had at specific times in contact with interaction design in the field of visual analytics. I put together the observation protocol by studying two online sources about usability evaluation (usability.gov 2006) (Lewis, Riemann 1994) The questions used and the observation protocol can be found in the appendix.

The evaluation with beginner users began with a short interview to identify pre-existing knowledge about visual analytics and if storytelling were a familiar concept to them. After the interview, the beginner users were observed
while using Statistics eXplorer. The aim was to get a better understanding about the thoughts and reactions a
beginner user have while in contact with the storytelling feature. To make the observation more structured, some
user cases had been prepared. The user then had to work out how to complete the tasks in the cases by navigating
and trying out the interface. The spontaneous workflow of a beginner user could indicate how easy or difficult it
is to navigate to the storytelling feature and also give clues to how the storytelling as a tool is perceived.

Different questions were used in the interviews with the operating statisticians that had pre-existing knowledge
about the application and storytelling. In this case I wanted to extract information about their workflow and
collect user experiences surrounding the storytelling feature. Questions were constructed in such a way that they
would bring focus to how the statisticians work, what is a typical day like and what is currently perceived as
problematic in their workflow.

**Think aloud and observations**

By observing statisticians and how they go about analyzing statistics I could gain a better understanding of the
users goals and thoughts while working. This method was also a way of locating issues surrounding the
storytelling feature.

Observation entails taking notes regarding a participants activities and behavior around selected tasks related to
the problem of the study. When you have selected the participants for your study you need to develop concrete
and detailed examples of tasks that the users want to perform and that your system needs to support (Lewis,
Rieman 1994). Each task states what the user wants to do but doesn’t give any instructions on how the user
would do it (Lewis, Rieman 1994). To make sure I got the most out of the think aloud sessions, the tasks where
specific, described a complete job and where developed to say who the users are.

Field notes from an observation can be unstructured or semistructured (Creswell 2009). When the participant for
this design study thought aloud the field notes were taken in a semi structured way. The observation was an
opportunity to get a broader picture of the users need and I was able to ask more questions if necessary. If the
participant didn't understand a certain part of the interface or needed help along the way I could give
instructions. In this case I took note of at what stage in the storytelling process the participant needed help.

### 3.1.3 Affinity diagramming

The data collected should be analyzed in order to establish a good understanding of the users and their tasks.
After the data has been analyzed, the designer should be able to identify several representative tasks that the
system will be used for (Lewis, Rieman 1994). In this design study, the analysis process of the data brought
insights about the users of the Statistics eXplorer and was a method to establish the design goals for the redesign.

To organize the qualitative data I chose to analyze it through affinity diagramming. Affinity diagram is a
categorization method of questions or comments from interviews or observations that are similar or that seem to
go together. It’s a way to record important findings in the data. Usually the notes or questions are written down
on post-its so that they can be rearranged during the categorization process. An example of the method is that
you might group all questions that have to do with how the user chooses the font style, or you might group all
questions that deal with the same topic, regardless if it is already grouped in the interface. The arranging and
rearranging of the notes can be described as a sort of brainstorming session. When you are finished, you will have
a couple of general headings that summarize the data from your inquiries. As long as the grouping or categorizing
make sense to you or the team and promotes the team to discuss the issues, you have a good affinity diagram.
(Raven, Flanders 1996)
Interpretations of the data collected from beginner users, operating statisticians and developers were written down on post-it notes. By going over the interview and observation protocols notes, one at a time, and writing down the interpretations I ended up with an unorganized pile of notes. To order and structure my findings I arranged the notes on a whiteboard. First I organized them in larger categories without any headings established yet. When all the post-it’s were up on the whiteboard I took another turn and made sub-categories from the larger ones. After this I went through each group, one at a time, and tried to identify suitable category names that summarized the notes in the group.

3.2 Design process

To begin the design process I used the insights gained from the affinity diagramming and established design goals. This would help make the design process more structured and help me move forward when exploring possible solutions. By making annotations in a sketchbook I kept track of my design process. The sketches were exploratory and I tried different solutions and evaluated each one of them continuously.

3.3.1 Design goals

The design goal always depends on the context of who the users are, what they are doing, and what goals they have. The designer’s job is to look beyond the tasks and identify these aspects of who, what and why (Cooper, Reimann, Cronin 2007). Any changes or modifications to the storytelling feature would be easier to justify with information to back them up. It would also be appropriate to be able to refer to the goals they would contribute to.

Cooper (Cooper, Reimann, Cronin 2007) talks about three types of user goals. These are Experience goals, end goals and life goals. The experience goals are defined as simple, universal and personal. They express how someone wants to feel. If a user feels stupid because of the feedback (or lack of feedback) from a system he or she will be less motivated to use the system. End goals is what motivates the user to perform the task associated with using a specific product. If you pick up a cell phone you’re likely to have a specific outcome in mind. Example of this is the end goal to stay in contact with friends and family. Life goals are personal aspirations that typically go beyond the context of the product being designed. An example of a life goal is live the good life, be attractive, popular or respected by my peers. The designer also needs to remember that user goals are not the only goals to take into account. Customer goals, business goals and technical goals need to be considered and acknowledged. Although these goals need to be addressed, they must not be met at the expense of the user goals (Cooper, Reimann, Cronin 2007). Due to the scope of this design study the user goals were not investigated in depth. More effort were put into getting sufficient information, describing the design goals and taking the time to explore possible design solutions. The design goals for this design study where derived from the data analysis and interpretations of what the users want to achieve and why.

3.3.2 Exploring possible solutions

A description of a design should be put onto paper first, this forces you to think about things regarding the design. In the early stage possible designs should not be programmed into a computer. The work that is acquired for even the simplest prototype will start forcing the designer to make too many decisions too early in the process (Lewis, Rieman 1994). Therefore I chose to explore possible solutions by continuously sketching and evaluating sketches.

Research through design and reflective design documentation

The method of research through design (RtD) have been used to explore new solutions for the interface. Zimmerman (Zimmerman, Stolterman, Forlizzi 2010) writes about that the field of HCI (human-computer...
interaction) is experiencing a growing interest in Research through design. This is a research method that employs processes and methods from design practice as a legitimate method of inquiry. HCI research is moving more towards "wicked problems" which is a step beyond usability. RtD has its advantages by allowing the researcher to rely on designerly activities as a way of approaching messy situations with unclear or even conflicting agendas. But, like any other research approach or design method, there is some aspects of RtD that one have to be critical about. RtD must develop better descriptions, protocols and guidelines for its processes, activities and procedures. Still this was a method that made it possible to move forward with the interaction design of the storytelling feature and deliver visual suggestions on time. Although further improvements could have been made if time was available for more iterations.

Dalsgaard et al. (Dalsgaard, Halskov 2012) writes about reflective design documentation and that interaction design researchers doing research through design face not only the wicked problems in the practice of doing interaction design, but also the wicked problems that exist in the practice of doing research. Design processes may be understood as reflective conversation with materials, wherein the designer works with different media or materials, and experiments with various aspects of the design. Through an ongoing dialogue between the designer and the materials, he/she apprehends unanticipated problems and potential, in terms of a system of implications for further moves. The authors also (Dalsgaard, Halskov 2012) points out that a significant portion of design activity occurs in informal situations, such as in corridors or around the coffee machine, and when the designer returns to his or her desk or computer, he or she may be more preoccupied with working on the design than documenting what was discussed a moment ago. Another challenge concerns the fact that one cannot document everything, and ultimately, designers are not surprisingly more preoccupied with designing, than with documenting (Dalsgaard, Halskov 2012).

By sketching I used research through design to create the conversation with the material. The method allowed the process of sketching to be lead by the annotations and ideas that came during my sessions with my sketchbook. More of the result from this method is presented in the results chapter, 4.2.4.

3.3.3 Pluralistic usability walkthrough - evaluation of the new design

Even though much analysis has been done when designing an interface, experience has shown that some problems only will appear when the design is tested with users (Lewis, Rieman 1994). For this design study the new design was tested through pluralistic usability walkthrough. The testing should be done with participants that match the real users of the system and should therefore have some background knowledge and similar expectations as a real user would have (Lewis, Rieman 1994).

Pluralistic Usability Walkthrough is a usability method that includes users and system developers together to evaluate a new design of the user interface. The method is a session where users, designers, usability experts and developers also discuss new ideas. The discussions are based on tasks that the participants (both users, developers and usability experts) try to perform with hardcopy panels of the system. The users in the session are representative users matching the system audience description. The pluralistic usability walkthrough method provides reliable data on a specific user interface panel much in the same way as traditional usability testing. But compared to other usability testing, pluralistic usability walkthrough is better in revealing uncertain decisions. 'Lucky guesses' are less likely to go unnoticed and users can easily report that although they had it right, they were uncertain and a can discuss the reason for this during the session. (Bias in Riihiaho 2002)

There are mainly three limitations with the pluralistic usability walkthrough method:
1. The walkthrough must be as slow as the slowest participant on each panel.
2. Only one linear path is available on the hardcopy prototypes
3. All participants must conform to the selected path although their own solution to the task might have been viable.
(Riihiaho 2002)

Two user and two developers were sought after for the walkthrough, but only one of the users could participate. This left me with two developers, one user and one designer (me). Possible participants were contacted two weeks in advance. Two hours were booked for the test and nine panels with associated tasks had been prepared in advance. The participants were given hardcopies of the panels to write down their solutions for each task. The task were solved in silence by the participants. After each task, there was a conversation about the result. Before the 'right' solution was presented the participants presented their solutions. To make the most out of this session, new ideas and comments were discussed during the session. All participants were welcome to comment and give direct feedback on any new ideas. When the conversation faded out, the panels were collected and the test moved on to a new task.

The goal with this pluralistic usability walkthrough was to collect specific feedback on some of the main features in the process of storytelling. The goals with the pluralistic usability walkthrough were:

- Find out how the user responds to the process of creating a new story
- Document how well the user finds his/her way to the feature
- Test the task of embedding snapshots into the written story
- Test the task of embedding an URL into the story
- Test the task of renaming and editing a snapshot
- Understand if there are any possible further improvements
Here are some examples of the tasks that were tested:

1.1 You’re going to write a story. How would you do this?

(1.1) In this panel the storytelling feature lies to the right (a) and more options such as delete, edit, save and so on are under [File] (b). Text that aims at supporting the user have been placed above the button [New story](c).
1.2 The story is supposed to be published on a website, and you want to state your take you further in the process.

(1.2) For this panel, I wanted to investigate if the user found the assisting text in the "Settings" box (a) to be helpful enough to complete the task.
1.3 Do the actions you think are appropriate to move forward in the process.

(1.3) Testing this task was important since the feedback in the original design was left out of this step. In the original design the user only pushed [Create](b) in the previous step, and had no feedback about the creation of the initial view. The initial view is what the developer chose to name the snapshot that is the first one to load when a story starts or is loaded. It can simply be explained as the first page of the story.

3.3 Limitations and methodological critique

Resources and finding participants
After the data was collected through interviews and observations it became clear that a few more intermediate users would have been beneficial to understanding the goals of an intermediate user better. They would probably have brought even more knowledge about issues surrounding the storytelling feature to work with. Intermediate users, in contrast to beginner users, gave more closely related and specific information to work with during the redesign process. Beginner users were to unfamiliar with storytelling in some aspects. They showed much more interest towards the application as a tool for analyzing statistics during their brief contact with the tool. Storytelling is possibly something that a beginner user might explore after he or she has become more familiar with how to use the tool for analytics. The students didn't match the target audience and goals were presented in the tasks and therefor not genuine. On the other hand they gave much information on how an absolute beginner reacts to the storytelling process.

During the pluralistic usability walkthrough I only had access to one intermediate user (a part from the two developers and my self) to participate. To strengthen the walkthroughs validity and reliability more representative users should have been present. This was the data I was able to collect under the given circumstances regarding time and available resources.
Autobiographical methods

The designing is very much influenced by my own reflections and judgement and therefore it's appropriate to point out that the solution presented in this study is probably one amongst many. Assumably the design would have been different had another person been in my position or if there had been time for more iterations. Decisions had to be made at some point to be able to move forward with the design, considering the purpose statement of the design study.

The new design will probably only be one step towards a more improved interface and will have aspects that would need further improvements after the evaluation. The new design can also be viewed as a starting point for further improvements.
4. Result

In this chapter the reader will find the original design of the storytelling feature and the result from the evaluation. The design goals are stated and the finalized design is presented in this chapter together with the results from the pluralistic usability walkthrough. Some sketches from the sketchbook have also been placed in this chapter to give the reader an understanding of how the new design was made.

4.1 The original design of the Storytelling feature

Since the first implementation of the storytelling feature, achieving the optimal design for the interface and steps in the process has been challenging. The developer pointed out that Statistics eXplorer’s storytelling feature is a currently a result from modifications that have been done on customers requests.

The following pictures are snapshots from Statistics eXplorer, the original design. On the following pages I will present the steps that the user goes through in the storytelling process. I will also go into some specific details which were relevant for the redesign. Some of the details will reoccur and in 4.3. There I will compare the old design to the new design suggestions.

This screenshot (4.a) shows the application when the user have opened it. It is possible to have more diagrams than the map and the scatterplot. But since this redesign was focused on the storytelling feature, only two diagrams were chosen to be visible.

(4.a) A screenshot of Statistics eXplorer. The storytelling feature is placed to the right (a) The top panel is a browser for loading stories into the application(b). The lower panel (c) contains the title, text and links that the reader interacts with while moving through the story. The button [Create] (d) takes the user to the next step, 4.b.
(4.b) This panel appears after the user selects [Create] (d) in 4.a. The settings in this panel (4.b) needs to be done in order for the user to save to the correct format. Either the story is planned to be published (a), or the story is just going to be used internally (b). The Additional settings (c) are used for more expert users to be even more specific about how the story should be saved. The user selects [Create] (d) when the settings are done.

[Create], (d) in 4.a, gives the user the settings regarding how the story is going to be saved. When the user hits [Create], (d) in 4.b, a snapshot is captured that is called the initial view. This is what the chapter will begin with when loaded in the readers web browser. The system expects the user to choose [Create], (d) in 4.b, after he/she have adjusted the diagrams and time series to the desired starting position.

(4.c) This panel appears after the user has chosen [Create], (d) in 4.b. Title (a), name of the author (b) and which
organization the author writes for (c) can be entered here. The input to these fields are optional and the user could just chose to select [Next] (d) without entering any information.

After this step (4.b) the user can give a title to the story, enter the name of the author and organization (4.c). The user then selects [Next], (d) in 4.c.

(4.d) The story editor appears after the user has selected [Next], (d) in 4.c. The snapshot panel (a) will contain a list of the snapshots captured during the process of creating content for the story. These can be linked to the text in the textpanel (b). Chapters (c) can be added, this will make it easier to organize the story content so that it is easier for the reader to follow along. The user selects [OK] (d) when heshe is satisfied and want to save and close the story editor. (e) is an arrow that will expand the panel shown in 4.e.
(4.e) Here the user can access the title, author and organization information again. The panel is the same one as saw in 4.c. To close the panel, the user selects the arrow again (a).

[Next] will bring the user to the text editor (4.d), the main component for telling the story. Here the user can embed links in the text of the story that will be further described or illustrated with the help of the visualized data. These links is a way for nesting the snapshots of the visualizations to the text. The snapshots aren't still images or screenshots of the diagrams, they are better described as bookmarks of the applications current set-up. The snapshots captures the settings in the whole application; from what types of diagrams that are currently visible, to what time the diagrams are displaying and selected countries and even scatterplot bubble’s trails over time.
An example of how the editor looks like when links have been attached to sentences or words. The snapshot panel (a) has four captured snapshots, including the initial view which is the loading view of the story and was captured between step 4.b and 4.c. (b) shows how the text looks like when snapshots have been linked.

Panels presented above was, as mentioned, the original design. They were the starting point and therefore I first needed to evaluate the design. In the following section the result of the evaluation process is presented. The method for the evaluation is described in the method chapter.

4.2 Evaluation of the interaction design

Storytelling as a part of the statisticians workflow is a method that is fairly new and proved to be unknown to the beginner users. This fact needed to be considered during the design of my research methods for this design study. This fact also affected decisions regarding the new design.

4.2.1 User needs and motivations

As stated in the theory chapter about storytelling in visual analytics, statisticians are now able to communicate the result, insight and knowledge they gain from the statistics they analyze. This is a user goal since it is an expectation of an end condition; the insight should be used in making important decisions and therefore it needs to be communicated (Cooper, Reimann, Cronin 2007). The difference between a goal and task in interaction design is that goals are driven by human motivation and changes very slowly over time. While tasks are based almost entirely on whatever technology is available (Cooper, Reimann, Cronin 2007). The same can be said about communicating knowledge, this is a goal and is something that changes slowly. There was also a difference
observed between how beginner users wanted to communicate results and how intermediate users wanted to communicate results. Beginner users talked about written reports and power points while intermediate users were more focused on the possibilities with storytelling. Probably since intermediate users were familiar with the concept while beginner users did not know what storytelling in visual analytics was.

Besides this difference in how intermediates and beginner users look at how the insights and knowledge can be communicated, they also acknowledge problems on different levels regarding the interaction design of the storytelling process. This could be expected considering that the beginner users had no knowledge about the application before the evaluation.

Beginner users

The observations showed that both beginner users found the steps in the storytelling process to be difficult to understand. Only one of the beginner users knew what visual analytics was. He also had a positive attitude towards the technique.

"Visual analytics makes the statistical data more interesting and it saves you time. I think the usage of visual analytics will be used more and more"  
(Beginner user)

Both the layout and the written text in the storytelling feature wasn’t that helpful and many of the choices that the user made were guesses. Throughout both of the observations it was evident that a user that is unfamiliar with storytelling is not given enough clues that describe the concept or process further.

As stated earlier in the method chapter: Storytelling is possibly something that a beginner user might explore after he or she has become more familiar with how to use the tool for analytics. It was never made clear to the user that the story could be published on a website and all that that would entails, at least not in a way that was understandable to a beginner user. Beginner users thought of the feature as some sort of tool for taking analysis notes and that these notes were something that could be used during a live demonstration using the whole application.

"Here I can place my notes for a presentation (pointing to the story editors text field)"  
(Beginner user)

Filling in story title, author and organization was clear to the beginner users. Snapshots, however, was never explained and the beginner users interpreted the function as a way of saving still images from the application. What the button actually does is to save the applications settings (state of the diagrams and graphs, selected trails and so on). In contrast to taking still images, the snapshot function allows interact with the information to be maintained. Embedding any kind of link (snapshot or URL) into the written text never occurred to the beginner users. They were never able to find hints during the process and often got stuck.

Intermediate users

NComVA had noticed that some of the operating statisticians that produces stories and publishes them doesn't use the storytelling feature to its full extent. For example embedded links to diagrams are missing in some published stories. Interesting insights about how statisticians experience problems around the feature were collected from operating statisticians who have used the application and storytelling feature before. Here the problems were more focused on details and also, surprisingly, concerns about the readers of the story.
"I think it is difficult for our users (referring to the reader of a story, a non-expert/non-statistician) to know how to move through the story and in the interactive diagrams. One example is that the chapter buttons aren't clear to the user and many users also don't notice the play button for the time series”

(Intermediate-to-expert user)

One statistician talked about the problems surrounding the interface that comes with a published story. This participant found that some of the problems with the feature rested in how the story looked when it was published on a website. The participant pointed out that a lot of readers miss the buttons for navigating between chapters and that reader also doesn't realize the possibility to interact with the diagrams. It also escapes the reader that he/she can hit play and watch the diagrams change over time.

Another problem that was discovered wasn't directly about the design of the interface but was still connected to how well users can utilize the application and storytelling feature. One of the participants explained that because of the structure in the organization the storytelling feature was difficult to use to it’s full extent. Apparently, the statistician had to cooperate with another department to make the statistics visible on the website. The file with the saved diagrams and settings of Statistics eXplorer was sent over to the department of communication, and they in their turn had to put the file on the server. Then the statistician could reach the visualizations and write a description directly on the webpage, instead of inside the storytelling feature. This solution gave the statistician a better opportunity to edit the story, without having to start the whole process over. This is one example that points out the fact that there are many levels of problems involved with the storytelling feature. As mentioned in the theory chapter users might feel that their time is wasted if the navigation is dull and long to get to where you want (Tidwell 2011). The result of this might lead a user to take another path or use another solution outside of the application. In this case, It might not have been because of the navigation but instead because of the organizational structure where the participant worked.

Developer
The application was developed thanks to research done at Linköping university and has been furthered developed ever since. The interaction design for the application has often been based on how the developers solved the problems and thought about how the application should be used. Some user tests were conducted in 2010. The Interaction design have also been examined by researchers at the university and commented on by customers. The developer is aware that the feedback given from researcher could have been more detailed, since the developers now have been made aware of problems with the interface through customer and user emails and backlogs. The storytelling feature has been modified continuously, usually according to customer requirements. Modifications have had to be done quickly and therefore there has not been time to evaluate the interaction design. The application is not developed from a coherent vision but is rather as a result from a series of modifications carried out based on customer feedback and new features. Reasonably this will create problems along the way and focus on user goals and motivations seems to have taken a back seat since the release. Larger changes to the applications can be implemented if the developers determines that many of their users will benefit from them. Adding features in this manner, constantly modifying and redesigning, result in consequences regarding the overall usability of the application.

Steps that the user have to take to produce a story have been design from a very technically point of view. Developers have though about what sort of information that needs to be retrieved from the user and therefor based the design of the interface according to how the tool was developed. There aren’t many technical constraints that limits the modifications, but rather how many customers or users that will benefit from a modification.
User feedback will probably continue to influence the design of the interface. But every user and customer wants something different and this could present a risk to the usability of the interface. How can usability be maintained while an interface is modified here and there continuously? This is a problem that probably will be present in the development of the application in the future.
4.2.3 Design goals

More control and overview was a prominent category from the affinity diagramming. From the data I also interpreted that users would not write a whole finished story in on go. The users were more keen on having support for a process of adding and editing in an unstructured manner to produce a story. Since they rarely have the whole thing finished in their head. Why statisticians wanted to communicate was also a category that stood out. I saw that these reasons were important to keep in mind since they declared hints on user goals. Then there was a batch that stated different concerns and problems. One example is the concern for the reader not being able to understand the published stories’ interface and that the whole process of trying to create and manage a story was unclear.

Operating statisticians are the target audience for the redesign therefor the design needs to support their motivation and needs the most. But there is still possibilities to add details that beginner users can gain support from. Narrowing down and focusing on one type of user or target audience means trading-off designs that might have been more supportive of beginner users. A wizard, for example, would only become annoying after a while if it were over simplified and would also slow down an intermediate user. This would contradict the purpose to improve the workflow of creating a story more efficient.

I saw that the goals for the new design were to keep the original design in many cases. I came to this conclusion in when working on sketches. The fact is that improvements doesn’t mean a total redesign. As a designer one needs to consider who the users are going to be. Are they totally new or will they have a learning curve? Users in this case are working with a fairly complex analytics tool and I would consider the participants to be intermediates to expert at this. Therefor the design needs to support the intermediate-to-expert.

Problems that have been pointed out by NComVA, for example that links wasn’t always embedded by the statisticians had to do with an organizational issue rather then an interaction design issue.

The following figure (4.g) is the result of the affinity diagramming process. Here I have chosen to present summarized comments (a) based on the data that was collected.
(4.g) Affinity diagram result. I identified four categories during the analysis process. In the frames, such as in (a), I made summarized comments to clarify and pinpoint the interpretations.

The Design Goals

As stated in the method chapter, goal directed design means understanding your user on many different levels. It also means acknowledge business and customer goals but not compromise the users goals (Cooper, Reimann, Cronin 2007). Marilla et al (Marill, Miller, Kitendaugh 2006) also talks about that there is a balance between satisfying regular users and daring to go a head with a new solution at the cost of annoying regular users, but at the same time reaching an over all improvement. This was something that needed to be considered in my redesign of the storytelling feature. I came to the conclusion that evolution was better that revolution. This decision was based on the knowledge gained in the data collection process. The operating statisticians could be considered intermediate users and they had different needs and motivations compared to beginner users.

Through the analysis of the data and the literature on statistics, visual analytics and storytelling the following user goals were identified. Experience goals: (1) Feel in control during the process, (2) Get feedback on actions. End goals: (1) Communicating information to decision makers, (2)spread statistics to a wider audience and to non-experts (3) Catch a non-experts interest. Life goals were never investigated in depth. The scope of the design study was limited and the aim was to present a new design at the end.

After a good understanding of the users and their tasks is established, several representative tasks that the system will be used to accomplish should be identify by the designer(Lewis, Rieman 1994). Before I started sketching, a
couple of tasks were identified and used as design goals. These design goals were derived from the previous goals (experience goals, end goals) and is a result from the affinity diagraming process.

The goals are:
- Support intermediate users
- Evolution of the interface, rather then revolutionizing it
- Make the storytelling process more effective
- Clarify the process to new users
- Change terminology to assist new users better. The terminology still needs to be recognizable to intermediates users
- Discover details that can be added to help the storytelling process more clear
- Help users understand how links are embedded into the text of the story

Supporting intermediate users became a goal since the operating statisticians are the larger user group and are the ones that the tool have been developed for. Visual analytics is a complex task and many users spend much time inside the tool. Re-grouping became a goal from observing new users interact with the feature for the first time. Much of the semantics and the explanatory text were difficult and frustrating for the beginner users and intermediate users don’t bother looking at all that text very often. They have learned the options. Many beginner users would benefit from input clues in text areas. This would be a subtle way of getting help and would not be in the way of regular users. This and other small details could be the balance I’ve been looking to achieve with the redesign - improvement but not with huge consequences for regular users who are familiar with the environment. These smaller changes are hopefully more easily to implement then large modifications.

4.2.4 Exploring possible solutions

During the sketching phase I used annotations to track compromises and design decisions regarding the interface design. As mentioned in the theory chapter, research through design is a method of inquiry (Zimmerman, Stolterman, Forlizzi 2010). I have relied on designerly activities as an approach to the situation of trying to improve a feature inside an application. The design process has been a reflective conversation through the annotations that were made next to the sketches (Dalsgaard, Halskov 2012). The following pictures are excerpts from the sketchbook.

4.h
Excerpts from the sketchbook. Annotations next to sketches of possible solutions for a new design of the user interface.
(a) Experiment with input hints / assisting text. In these sketches one can see the process off making annotations beside each panel. One can also start to see hints that later were incorporated in the finalized design.
Here you can see some sketches of the feedback and smaller panels that appears during the creation of a story.

The finalized design that was later tested through a pluralistic usability walkthrough was derived from these sketches. Because of the timeframe for this project and the writing of this thesis, I had to limit the amount of time spent on exploring possible solutions. I will present more about this fact in the discussion chapter. The following section is a presentation of the alternative design that was finalized and later tested. The reader will also find some comments about how the old and the new design compare to one another.
4.3 The new design

In the new design, the focus of the storytelling feature is to clearly invite the user to do produce a story. This was clarified by taking away all the other buttons and sorting them under "file" in the top right corner.

(4.i) The new design of the storytelling. The application has just been opened. In 4.i (a) the old and (b) the new design can be viewed side by side.
As shown in 4.i (a) is the old design and (b) is a close-up of the new design. The buttons in (c) have been placed under [File] (d) to reduce clutter. Gradients have been replaced with a solid grey to clean up the design further. The button that remains is [New story] (e) and a short text that will be assisting new users, but will not be in the way and annoy intermediate users.
(4.j) New design for the panel presented as 4.b and 4.c earlier.

The first panel (4.j) was re-grouped (4.b and 4.c) and paired with selecting a title and author (a) in the same step. This solutions remains due to the fact that the following tasks rely on the settings (b) to be able to start taking snapshots. Some terminology have been changed (c1, c2) to support new users in understanding what the settings mean. Elements have been re-grouped in order to have fewer steps in this ”wizard”. Input references have been placed in the input areas, (a) in 4.j, to give users a more comprehensive workflow.

(4.k) The story editor appears after the user has selected [Create] in 4.j.
Here in 4.k, I aimed at supporting the users task by grouping elements and adding headlines so the controls are more self-explanatory (a1 and a2). Especially for the links there are hint placed both by having the headline (b1) and and input reference in the text editor (b2) as what the user should do there. These hints are meant to disappear when the user places their marker in the editor.

(4.L) The user is about to embed a link in the text. First the user highlights, then select snapshot (b) and then choose the snapshot to link to the text (c)

Here in 4.L, the user is just about to add a link to the highlighted text. (a) Snapshot has been selected and (c) link buttons have appeared in the snapshot panel. An example of how I have worked with feedback to the user is shown in 4.m and 4.n.
(4.m) The system is working on capturing a snapshot. Feedback is given in the form of a loading circle and an explaining text.

(4.n) The user is deleting a snapshot. Instead of a pop-up panel as used in the original design, the snapshot panel is greyed out and (a) the selection of canceling or [OK] has appeared.

I tried to limit the amount of pop-ups, so the user doesn't have to go all over the place to move forward in the process of creating a story. One example of this reduction was to transform the area that the action was located...
to. In 4.n the panel transform while the user is deleting a snapshot. This makes it safer and more clearly what is going on.

4.0 The story have been saved and the story editor is closed. To edit the story, the user just has to select [Edit story] (c).

In 4.0 the story has been saved and have some links attached. (a) is the body text of the story and (b) is the title and the author of the story. [Edit story] (c) will bring the user back into the story editor. Since writing a story is a process of editing, saving and going back and forth, this buttons placement needed to be easily accessible.

There are a lot of similarities to the previous designs. This is a conscious choice and the reason is to maintain recognition and due to the technical aspects regarding how the system grabs the snapshots. As mentioned earlier in the report I also aimed for an evolution rather then a revolution surrounding the user interface. Hopefully it will make the design easier to implement and encourage further investigations on possible improvements for the applications user interface.

4.4 Pluralistic usability walkthrough results

Evaluation of the new design was an effective approach to understand the consequences that the new design would have. New ideas were welcomed during the session and the discussion were positive and opened. Direct feedback came from all participants on new ideas. During the session non of the participants were particularly quiet. All of them seemed to gladly share there thoughts and ideas.

Summary of the session:

- Developers and users had a productive discussions
- Designer gained interesting insights about the solution
- New problems were discovered and improvements were confirmed
- New Ideas emerged that would be good to try out
- There is still a lot of work to be done, but this is one step along the way
The walkthrough confirmed both improvements and new problems and possibilities. In the new design the evaluation confirmed that it was easier to find the storytelling feature and how to start the process. The written explanations around the settings of the story had been improved. But the additional settings still showed problems regarding the written explanations for each choice. They were hard to understand for the user and the developers had thought about whether they should hide the selections under an ”Advance” tab or maybe call the whole collection of settings something else to make it easier for beginners to ignore them. It also was a good opportunity for the developers to collect ideas about smaller changes that could be implemented in the future, outside of the storytelling feature.

**Limitations with the method**

Animations and to show transitions or loading screen (feedback) was difficulties to take into account with the pluralistic usability walkthrough. On hardcopies your limited to what is shown, and there can be no subtle animations that sometimes is the solution regarding the usability in the interface. An example of this is that it was not possible to test the linking of snapshots fully. In the new design it is meant that a small animation would happen when the preview, edit and delete buttons are transformed into the ”link” button. Feedback after pushing ”Capturing new snapshot” was hard to show and this caused the participants to wonder what happened between steps. Then I had to go back, give a quick explanation and then return to the panel that was being evaluated. Even though the developers also were instructed to take a users perspective, they knew a lot of the answers or ”how it was supposed to work”. This was something to take into consideration during the discussions but also something that could be challenged during the session. The discussions made it possible to present the users view to the developers and their explanation for what is the correct way of creating a story was put in a different light. The initial view is one example, the user and one of the developer hadn't viewed it as something different from a snapshot but understood it's purpose.
5. Discussion and conclusion

As mentioned in the theory chapter, without interactivity, static visualization is often considered as an end point of the workflow and a way of communicating observations (Zudilova-Seinstra, Adriaansen, Liere 2009). This is something that is changing through storytelling which incorporates interactivity and presents information to the user in a more appealing way. Improvement is hard to achieve and something that can only be stated after an evaluation of a design suggestion. As Lewis and Clayton (Lewis, Rieman 1994) points out, a new version of a user interface needs to be a response to problems but also to opportunities. Exploring the opportunities makes the design process more time consuming. Approaching deadlines forced me to compromise the time in exploring opportunities. Instead I chose to focus on evolving what was already there making changes that hopefully would be more easily to implement and recognizable to regular users of the application. This is what I mean with evolution rather then revolution for this redesign.

Flaws in the current design

New users gave the insight of that storytelling is not an expected part of this visual analytics tool to a beginner. They mainly saw a tool for taking notes or preparing a presentation. The new users’ interaction with the tool also made it clear that the steps in the wizard where too text heavy and that the text didn’t help the user understand what choices to make. Linking snapshots or URL was something none of the inexperienced users figured out. Partly because they had no preexisting knowledge of the possibility and no hints in the user interface to tell them that it was possible.

Intermediate users pointed out the organizational complexity that hindered them from using the storytelling feature and instead turn to using only some parts of the feature. This fact obviously couldn’t be helped by redesigning the interface. But still this gives us an explanation why some users don’t link snapshots to the story.

During my own design process I found the current design of the interface somewhat cluttered, and that the written instructions were to long and clumsy. Inconsistent placement of [Cancel] and [OK] is one example that could be resolved easily and were minor modifications that would improve the interaction. Some elements in the feature could also benefit from being re-grouped, since their placement weren’t obvious. The choices of how and why tasks have been split up the way they are isn’t self explanatory.

What has been improved

Minimizing clutter by reorganizing the layout and re-grouping elements. The aim was to support intermediate users but still incorporate hints for new users and help them along the way. This was done by placing input clues in text areas and in panels to give new users a better understanding of the features. Input clues are a small detail that can help a new user without being in the way for intermediate-to-expert users. More feedback was incorporated in the storytelling process. The initial view is no longer captured without the users approval. This gives the user more control of the process. Capturing a new snapshot has also gotten more clear, with a feedback panel so that the user knows that the system is working. The user is also prompted to name the snapshot right after the snapshot is captured. Fewer steps was the result from regrouping and reorganizing elements. With fewer steps, an intermediate user can move forward more easily, while beginner users will get a better overview. My concern was that to many steps would make the new users uncertain if every choice was right and would worry the user about the possibility to go back.
Discussion about the finalized design suggestion
A part of the problem in this case is that the redesign in some way did go beyond the statisticians, to inflict on the end user, but this wasn't taken account for in the redesign process or the research phase. Statisticians were concerned about their end users, the decision makers and politicians. Fact is, the redesign wasn't aimed at including the end user. That would have required a lot more time and resources that simply wasn't available for this thesis. But it is still important to point out this problem for future research. What are the consequences of having interaction design spill over to another target audience (user) without including them in the design process? And what is the designers roll in this and how should one prioritize when the assignment is limited to only focusing on one user, and not the other? You will effect both, but will design for only one user group in mind.

Conclusions
A new design in the interface could mean that it has been improved for a beginner, but at the same time this may affect an intermediate user in a bad way. Maybe an intermediate user will be frustrated and slowed down if the interface have been to much adapted to support absolute beginners. Problems are often discovered along the way in a design process. As you investigate what you think is the problem, another one presents itself. This analysis of wicked problems in interaction design process was something that were pointed out by some of the authors in my literature review (Zimmerman, Stolterman, Forlizzi 2010; Cooper, Reimann, Cronin 2007; Lewis, Rieman 1994). As you research the problem or test a solution, another parallel problem becomes visible. An example of this is the regular user (an operating statistician) who explained his concern in using the storytelling feature because he though that the end user (decision makers and well informed citizens) might not understand the interface. The concern for the end user affected how the statisticians saw the applications usability. This made it harder to know the users own experience. Trade-offs between many choices and the ability to balance between opportunities and constraints is constantly present in the design process. A designer has a lot of factors and forces to deal with, but to get anywhere, decisions have to be made regarding the design. Stating that an interface can be improved through redesign is often oversimplified. You have to know who you will improve it for in order to go ahead with any plan.

5.4 Significant questions for future research
Improvements are sometimes hard to define and improvements are often related to one target group. This problem of adapting the application to one or the other group of users have been noticed before during an evaluation done in 2011, when users in the test group asked for more complex methods for the application while others asked for more simplifications (Lundblad, Åström, Jern 2012). A user experience is difficult to put into words and it is difficult to capture a users experience of a user interface and understand his/her experience fully. And how does one take a users empathy for another user group into account? These questions and the following needs to be considered in future research.

More iteration of the new design should be done. As mentioned, the time and resources limits this design study to only one evaluation of one possible solution. I would also recommend to look into the user backlogs before another redesign. Something I didn't have time to do. The user experience needs to be coherent and therefor NComVA should also look into the possibility to evaluate the applications interaction design as a whole. This will demand a lot of resources but as mentioned earlier in the report, softwares today needs improvements and development to survive and meet the users ever changing needs.

This thesis is just a small example of the complexity a designer deals with in a process. The process will always contain some controlled aspects like gathering information about the users, but also have the intangible moments
of serendipity that can determine the new design. This random strike of luck may be the solution to problems in
the usability.

As a designer of a user interface you have to be aware of the circumstances that may create the solution to shine
through and also be critical towards every possible solution but know when it’s time to make a decision.
Otherwise you will never be effective and able to rise to the challenge of improving the interaction design of a
user interface. Designs should be tested, redesigned and tested again together with users and stakeholder to
ensure that user goals are fulfilled, that design goals are reached and that the feature will deliver a positive user
experience.
References


Appendix
Observationsprotokoll

URL: http://webstaff.itn.liu.se/~patlu77/world/#story-0
Antecknare:
Datum:
Tid:
Deltagare:
Miljö:

Syfte
Syftet med detta användbarhetstest är att se hur väl en person som studerar statistik och dataanalys kan tolka och använda sig av Statistic eXplorerers storytellingfunktion. De delar som kommer utvärderas inkludera arkitekturen i verktyget, navigering till storytellingfunktionen, termer och om verktyget möter användarens förväntningar.

Inledande frågor och uppgifter

Berätta om hur du går tillväga för att presentera dina statistiska analyser.

Hur gjorde du sist när du skulle presentera en analys mot en externuppdraggivare? (Hur berättade ni? Vad lämnade ni över?)

Berätta den senaste gången det gått bra och gått dåligt att presentera sin statistiska analys

1. Har du hört talas om visuell analys? Y/N

1.1 Om ja, berätta om din uppfattning

1.2 Har du använt det? Berätta om dina erfarenheter

2. Har du hört talas om storytelling inom statistik? Y/N

2.1 Om ja, berätta vad du vet om storytelling

[Öppna Statistic eXplorer]

[Visar deltagaren programmet enligt url:en]
Scenario - Krig
Vad skulle du göra för att berätta med statistik och text om krig. Du vill ge läsaren en möjlighet att jämföra statistik före och efter kriget på ett snabbt sätt.


Väg(ar)

Genomförandet lyckades

Avslutning
Berätta om hur du upplevt programmet som helhet

Notiser
Varför användaren lyckades eller inte lyckades
Intervjuunderlag
Vän användare av Statistic eXplorer och storytelling funktionen

Syfte
Syftet med denna intervju är att få en bild av hur en statistikers arbete ser ut och vad han/hon upplever i sitt arbete. Syftet är att få en van användare av Statistic eXplorer att ge sitt perspektiv på sitt arbetsflöde. Fokus på intervjun kommer ligga vid att få användaren att återberätta sina upplevelser genom att återge händelser.

ÖVERGRIPANDE
Namn

Tjänst

Hur länge han/hon jobbat

Berätta hur en typisk arbetsdag ser ut för dig

Kan du berätta lite om de verktyg du tar hjälp av i ditt arbete som statistiker

Berätta och ge exempel på en applikation/ ett program inom ditt område som du upplevt som enkel att använda och varför du upplevde det.

Har du något exempel på när du upplevt att det varit frustrerande eller gått dåligt under tiden du utför ditt arbete i dessa verktyg?

SPECIFIKT OM STATISTIC EXPLORER & STORYTELLING

Hur länge har du arbetat med verktyget Statistic eXplorer?

Berätta om ett tillfälle där du använt Statistic eXplorer och vad du gjorde i applikationen under detta tillfälle

Berätta om någon gång då du har använt dig av storytelling i ditt arbete som statistiker och hur du gjorde och varför.


Berätta om någon gång då du haft problem med storytelling funktionen. Vad hände?

Vilka övriga åsikter har du om storytellingfunktionen?
Intervjuunderlag
Utvecklare av Statistic eXplorer och storytellingfunktionen i sitt nuvarande tillstånd

Syfte
Syftet med denna intervju är att få en bild av hur en utvecklare som varit involverad i utformandet av interaktionsdesignen av storytellingfunktionen resonerat. För att kunna påbörja en omdesign är det lämpligt att identifiera vilka tekniska krav utformningen ha behövts anpassats efter i tidigare upplagan. Syftet är även att få en bättre förståelse för storytelling som koncept och utvecklingen av hela applikationen.

Namn

Tjänst

Hur länge deltagaren arbetat på att utveckla applikationen

Berätta om hur Statistics eXplorer kom att utvecklas.

Har ni använt er av några förlagor till applikationen (liknande program)? om ja, vilka och varför?

Hur kom ni fram till konceptet med storytelling inom visual analytics?

Har ni använt er av några förlagor till storytelling? Om ja, vilka och varför?

Vilka faktorer har spelat in på utformningen av interaktionsdesignen för storytellingfunktionen?

Har det skett någon modifikation i interaktionsdesignen under tiden storytellingfunktionen funnits tillgänglig i applikationen?

Vilka av dessa (tekniska) faktorer behöver man ta hänsyn till vid en ny utformning av interaktionsdesignen?

Kommentarer:

Slutsatser:
Pluralistic usability walkthrough - Test plan

The goal with the session
Finding the storytelling feature
Create a new story
Embed snapshot
Embed URL
Edit a stories' snapshot

The procedure of the session
4 assignments are given. Each assignment comes with panels from the system on hardcopies. The Participants sits in silent and solves each task by taking notes on the hardcopies. E.g circle a button they would push or the menu they would selected and explain the action.
Pluralistic Usability Walkthrough - Underlag
Den här metoden går ut på att göra en uppgift per skärm bild.


OBS: alla tar rollen som användare under det här tillfället

Därefter är det en genomgång där användaren börjar berätta om din lösning, hur man tänkt osv. Efter att användaren berättat färdigt så är det utvecklarnas tur.

Sen går vi vidare till nästa skärm bild och nästa uppgift.

Miljö

Uppgifter

1.1 Du ska börja skriva en story. Hur går du tillväga?
Användaren
Utvecklarna
Slutsats:

1.2 Storyn ska upp på en hemsida, du heter Björn Svensson, ta dig vidare i processen
Användaren
Utvecklarna
Slutsats:

1.3 Gör de handlingar du tror är rätt för att ta dig vidare i processen.
Användaren
Utvecklarna
Slutsats:

((1.4) anteckna vad du tror händer.)
Användaren
Utvecklarna
Slutsats:

1.5 Gör de handlingar du tror är rätt för att ta dig vidare i processen.
Användaren
Utvecklarna
Slutsats:

1.6 Du ska berätta ”Vi kan se här att befolkningsmängden ökade kraftigt mellan 1990 och 2002.”
Användaren
Utvecklarna
Slutsats:
1.7 Anteckna, ringa in och berätta hur du skapar en länk i det här gränssnittet. Berätta i vilken ordning du gör dina handlingar.

Användaren
Utvecklarna
Slutsats:

(1.8 Anteckna vad du tror händer)
Användaren
Utvecklarna
Slutsats:

1.9 Ta dig vidare i processen att skapa en länk (extra)

Användaren
Utvecklarna
Slutsats:

1.10 Berätta hur du avslutar processen (mha gränssnittet) nu när din story är färdig

Användaren
Utvecklarna
Slutsats:

3.2 Ta bort dom snapshots som inte används

Användaren
Utvecklarna
Slutsats:

3.2 Ändra namn på ett av snapshoten

Användaren
Utvecklarna
Slutsats:
The publishers will keep this document online on the Internet - or its possible replacement - for a considerable time from the date of publication barring exceptional circumstances.

The online availability of the document implies a permanent permission for anyone to read, to download, to print out single copies for your own use and to use it unchanged for any non-commercial research and educational purpose. Subsequent transfers of copyright cannot revoke this permission. All other uses of the document are conditional on the consent of the copyright owner. The publisher has taken technical and administrative measures to assure authenticity, security and accessibility.

According to intellectual property law the author has the right to be mentioned when his/her work is accessed as described above and to be protected against infringement.

For additional information about the Linköping University Electronic Press and its procedures for publication and for assurance of document integrity, please refer to its WWW home page: http://www.ep.liu.se/

© [Madeleine Kusoffsky]