GIMA

Geographical Information Management and Applications

Master Thesis

Geo-data animations in television journalism:
Animation classes and their effectiveness in telling stories

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Contents

Summary

The amount of geo-data that is available and produced nowadays is huge. Geo-data is data about the spatial implications of human behavior and physical processes. By visualizing the data these spatial patterns can be revealed. The value of geo-data is slowly realized by storytellers as they increasingly use geo-visualizations in their stories. As stories develop in time, animation is a useful type of visualization to present a story. This thesis will be focused on data-animations for television. One of the few television projects that made use of geo-data animations is the VPRO series 'The Netherlands from above'. The 21 animations made for this series form the case study that is used to answer the research questions. The main research question is: what types of narrative animations can be created based on geo-data? To answer this question a framework of cinematic and narrative concepts is used. The other research questions focus on the use of narrative and visual storytelling techniques to support the story of the animation. The results of this analysis might provide other journalists, educators, or scientist with a new toolset. Storytelling is regarded as an effective way to communicate information. In this thesis an online user study is done to analyze the effectiveness of the animations by measuring the *narrative understanding* and *emotional engagement*.

The results show that it is possible to tell a dramatic story based on geo-data. However, most animations in this case study don't follow a dramatic plot development. Most animations just present processes in chronological order without having an inciting incident or climax. Surprise and curiosity techniques are used to evoke emotions by the viewer. Actions that are subject of the animations can be divided into: following routes, showing connections, changes in intensity, showing patterns or emphasizing non-temporal phenomena. Animations can present a single phenomenon or can present multiple phenomena in relation with each other. To create good narrative I looked for exceptional and interesting phenomena to present. Also, often remarkable spatial, temporal, or categorical manifestations of a phenomenon, causal relationships or correlations are looked for. Subjects about human or animal behavior that have happened in the present are seen as most interesting for storytelling.

Narrative techniques that support the story are the use of isolation of visual aspects of the data, ordering of events, duration and frequency. Voice-over helps in annotating, introducing and concluding the sequence of events. Next, data simplification techniques are used to support the story. Visual techniques that are used to support the story are aimed at preventing confusion, emphasizing entities and to make the animation visually appealing. Data is often visualized in a single class. When differentiation in the data is visualized this is only done to emphasize that there are different categories or values, not how much they differ. To make the animation visually attractive a high level of detail is used, bright colors and 3D effects are used. Trajectories are used to let the viewer observe speed proportional to reality and to see the other routes in context.

The user study gave insight in the narrative understanding and emotional engagement of the animation and thereby their effectiveness. The general conclusion is that the animations had a high degree of narrative understanding and scored average on emotional engagement. The animations mostly were perceived as educational rather than evoking emotions as surprise, curiosity or suspense. Negative aspects that should be avoided are a lack of focus, a high number of changes in a short time and uninteresting correlations.

Foreword

This thesis marks the end of my time as a student of GIMA. I decided to write this thesis after my six month internship as data journalist for the VPRO series 'Nederland van Boven'. My internship was a great time where I learned a lot about the process of creating geo-data animations. It was very inspirational to practice my GIS skills in an environment of journalists. The discussions with the editors about how to create a good story made me realize that presenting information is not only about seeking the best visualization form but also about seeking a storyline to create engagement. I also realized that other journalists, scientists and companies could benefit from knowledge about storytelling techniques in order to present their results in a compelling way to their audience. Therefore, I decided to make *storytelling with geo-data animations* the subject of my thesis. I think the 'Nederland van Boven' animations are a unique research case. The in total 21 animation that were created have been watched by around 1.000.000 people in the Netherlands.

I want to thank in particular my data-journalist colleague Frederik Ruys who enthusiastically helped me with advice and access to the animation files. I also want to thank the chief-editor Geert Rozinga and producer Bircan Unlu for their support. On the side of the university I want to thank my supervisor Ron van Lammeren for his feedback and his support to make a thesis switch (before I did an internship at the VPRO I was half-way another thesis). I have always experienced our conversations as very pleasant and helpful. Next I want to thank my family for their attention. Last but not least I want to thank Evelien for her everlasting encouragement and English help.

I hope you have a good time reading this thesis.

Tim Tensen, August 11th 2014, Amsterdam

Introduction

1.1 Context

Over the last 10 years the interest for geo-visualization has increased rapidly. At first the development of display and graphic technologies is grew very fast. TomTom, Google Maps and other map services are well integrated in our modern society. Secondly, the amount of available geospatial data has increased enormously. Governments, private companies, scientific institutions and individuals have access to relatively cheap technologies to collect, store, share and process data (Nollenberg, 2007). To illustrate the trend of the rapid increase in the creation and storage of digital data: according to the International Data Corporation (IDC, 2014: URL 1.1), the amount of data that is created annually worldwide has grown by a factor of 14 from 2005 to 2011 and will grow by a factor of 50 from 2010 to 2020 (Figure 0-1). The end of 2013 the total amount of digital data created worldwide was 4.4 ZetaByte (4.4 trillion Gigabyte).

German researchers Hahmann & Burghardt (2012) conclude from their research that around 60% of the information that is created is geospatially referenced. When we talk about geospatial data one can think of, for example, route tracking (transport industry), address information in customer databases, satellite imagery, surveying data and transaction data (retail, public transport, bank transactions).

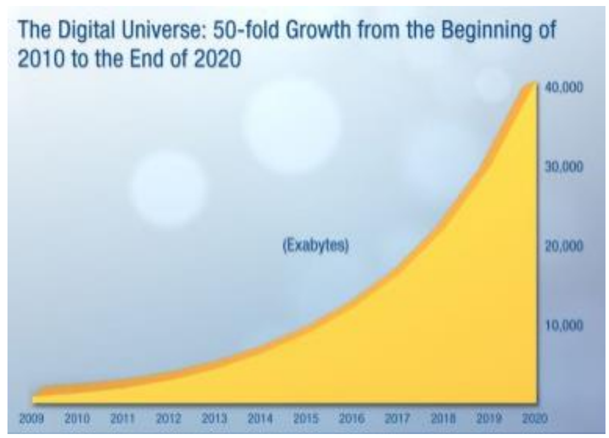


Figure 0-1 Increase of data created worldwide (IDC, 2014)

Geospatial data potentially has, apart from being used for its initial purpose, added value in a wide range of fields, especially when different datasets are combined. To generate added value it therefore needs to be available for others. At this moment governmental bodies are busy creating digital infrastructures to share their data via an open data policy. For example, the national government has created open data portals where governmental organizations can share their data (URL 1.2). A part of this data has a geospatial reference. Geo-data, stored as vector or raster data, is shared via national, provincial and municipal geo-data portals (URL 1.3 / 1.4 / 1.5 / 1.6).

The advantages of the availability of government data, according to the national government (Rijksoverheid: URL 1.7) are in the first place an increase in (financial) efficiency due to re-use of data by other governmental bodies, increase in data quality due to feedback, increase in legitimacy and the advancement of external partnerships. The Open Data Handbook, a project of the Open Knowledge Foundation, (OKF: URL 1.8) adds to this list the increase in participation and self-sufficiency of citizens, the creation of new products and services by private companies (innovation) and the generation of new knowledge for the general public.

The use of the enormous amount of data to inform the general public is still in its infancy. The quote: ´*We are drowning in information but starving for knowledge*' (Naisbitt, 1982) clearly expresses the need for presenting information in a clear way to the public. Tom Fries, contributor to the Data-journalism Handbook, adds to this: *"not the lack of information, but the inability to take in and process it with the speed and volume that it comes to us — is one of the most significant problems that citizens face in making choices about how to live their lives"* (in Gray et al, 2012 – chapter 2). From the information science point of view, MacEachren & Kraak (2001) indicate that finding ways to transform data into a format that enables the public to develop a deeper understanding of the data is a big challenge.

One of the formats to present information effectively to the public is through storytelling. According to Kosara & Mackinlay (2013) a story is an ordered sequence of steps. Storytelling then guides the viewer through the sequence of steps. Segel & Heer (2010) add that storytelling is about keeping the attention of the audience and orienting them to points of interest. Besides being a tool to structure information, storytelling is above all about creating excitement and drama (Ekström, 2000). A story shapes the expectations about how the story will develop. The ways our expectations are shaped determine for a great part the involvement of the viewer in the story (Bordwell & Thompson, 2004). Besides, the authors state that a story lets the viewer attribute meaning to the information that is shown. As storytelling adds context to the presented information, it will help the audience to remember information more easily (Kosara & Mackinlay, 2013).

An emerging field that is practicing storytelling based on data is data-journalism. Data-journalism is increasingly practiced nowadays in different media like news-papers, online news-sites and web-applications. Data is often complex. To tell stories with data, often data *visualizations* are used to convey the meaning. A data visualization makes the data more accessible and clear for the audience. Jerry Vermanen, data journalist for the online newspaper Nu.nl states that "*data-visualizations provide journalists with a new tool to tell stories that are difficult to tell with traditional tools"* (Gray et al., 2012, chapter 2). In data journalism, a data visualization often forms the basis for a story. Traditional storytelling techniques are still needed to create the story. As Cynthia O`Murchu from the Financial Times puts it: "*While numbers can be interesting, just writing about the data is not enough. You still need to do the reporting to explain what it means"* (in Gray et al*.,* 2012, chapter 2)*.*

Geo- data visualizations make it possible to let our mind recognize relationships and identify and compare patterns (Blok, 2005). Looking for what these patterns cause, why differences occur and what relations can be observed when combining patterns offers journalist a new way to find interesting stories. The use of geo-data forms an important part within the field of data-journalism. Famous examples are the data visualizations presented in The New York Times and the Guardian (
Figure 0-2). In the Netherlands, the digital newspaper Nu.nl shows some good examples of stories based on geo-data (
Figure 0-2).

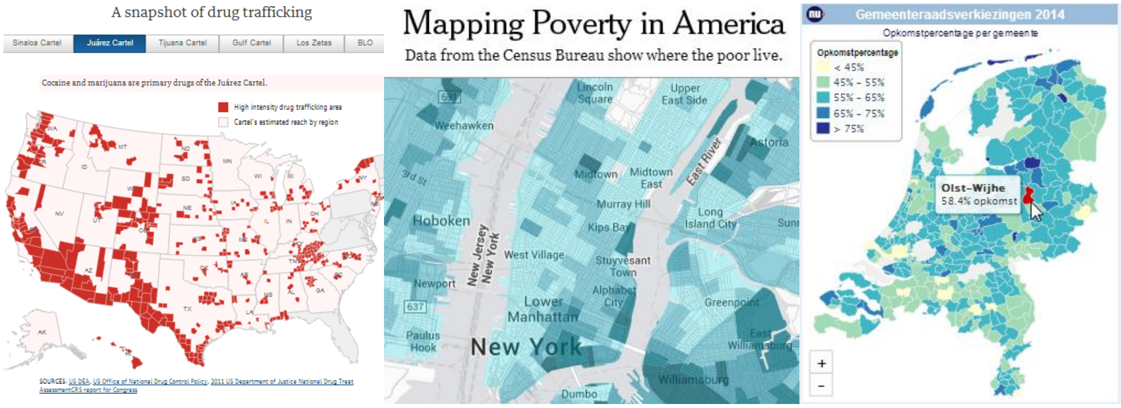


Figure 0-2 Examples of geo-data-visualizations in online newspapers (left: NY Times, middle: Guardian, right: Nu.nl)

Storytelling can be described according to the map use cube (MacEachren, 1994). In this model the use of geo-data visualizations are described according to three dimensions. The first dimension is the purpose of the visualization, ranging from knowledge construction to information sharing. The second dimension is the human-map interaction, ranging from low interaction to high interaction. The third dimension is the use of the visualization, ranging from the private domain to use in the public domain. The lower corner of the cube, which is about revealing unknowns in the private domain with high interaction, can be defined as the *visualization* side. The upper corner, where it is about sharing known information to a broad audience with little interaction, is defined as the *communication* side. Storytelling by geo-data animations can be placed on the communication side of the cube (Figure 0-3). According to Blok (2005), the position of communication in the cube nowadays varies because of technological advancements. New technologies make it possible to also present unknown data to a broad audience and present data interactively to a broad audience.

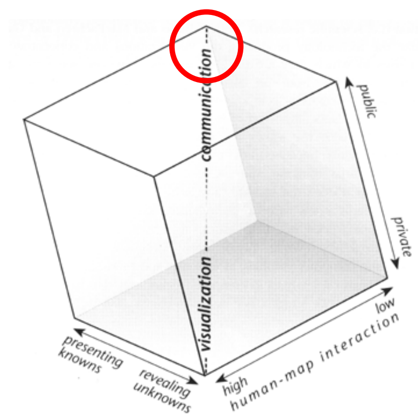


Figure 0-3 Map use cube (MacEachren, 1994)

A visualization used to communicate information to a broad audience is often the end stage of a (journalistic) research project. According to Dibiase (1990) in the beginning of a project, visualizations are used to explore and analyze and encourage *visual thinking* (Figure 0-4). After the research phase, the information is often shared with other researchers (synthesis) and in the end is presented to a broader audience. Storytelling can be placed in this second stadium, that DiBiase calls *visual communication* (Figure 0-4).

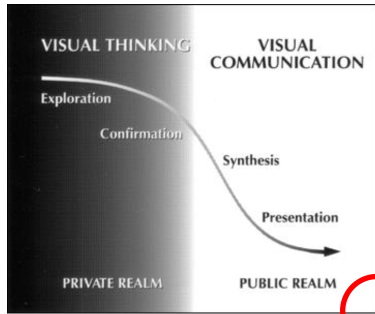


Figure 0-4 Visual thinking and Visual communication (Dibiase, 1990)

Geo-data can be visualized in the form of static 2D maps (see data visualization examples above, Figure 0-2) or 3D representations. Static representations are 'snapshots' in time. Spatial phenomena (that are represented by the geo-data) however are often about change in time. When representing spatial data dynamically in the form of animations, trends and processes can be clarified and insight into spatial relationships can be provided (Kraak & Klomp, 1995). Lobben (2003) defines animations as "any moving presentation – be it through film, video, or computer – that show changes over time, space, and/or attribute". As stories are always happening in time, animations seem to be ideally suited as a storytelling device.

In this research I specifically focus on television as medium for telling stories with geo-data animations. Television is defined as '*the transmission of dynamic images, often accompanied with sound'* (Oxford dictionary). Television is a means of mass communication as it reaches a large audience. In television there is no interaction with the audience (experiments are going on to add interaction to television by the 'second screen').

The application of data-animations on television is relatively new. The series 'Nederland van Boven' (The Netherlands from above) is the first major data-journalistic project of the Dutch public service television (Benjamin, 2011). In this, series The Netherlands is looked upon from a bird`s eye perspective to show the patterns of our daily life. This is done by a combination of helicopter shots, ground shots and data-animations. The data-animations gained a lot of attention and the program was awarded with two prices: the 'Yearly Info-graphic Prize 2012' (BNO: URL1.9), and the ´Geospatial Excellence Award Mass Media' (URL1.10), presented by the Geospatial World Forum. A second season was broadcasted between November 2013 and February 2014.

1.2 Problem statement

Nowadays a lot of geo-data is created. The knowledge that can be derived from these data might be of great interest for a vast audience. Presenting information in an compelling way through a story is thought of as an effective way of communicating information. Data-journalism is a discipline that practices storytelling based on data. It thereby makes use of data visualizations. Data journalism is practiced mainly in static media like newspapers. Presenting geo-data in a story with animations on television is a relative new phenomenon. Literature about storytelling in combination with geo-data is relative scarce. This knowledge can be useful for data-journalists that want to practice this form of storytelling. Also, insights gained by this research might be useful for scientists. It might give them a new toolset for communicating scientific results in a more effective and compelling way to a vast audience.

To understand on this new phenomenon, I will first investigate what kind of stories can be told by geo-data animations (research question *Q1*). Elements that characterize a story are: the setting (*Q1c*), the theme (*Q1b*), and the plot structure (*Q1a*). Stories guide us through a sequence of related events. A story is not about just showing the whole dataset; specific events, that are supposed to be interesting for the audience, are selected from the data by the author of the story. In this research I will try to find out what aspects of data are interesting for storytellers (*Q1e*).

Next, I will investigate which techniques are used in narrative geo-data animations to support the story. Storytelling is about communicating story information to the audience. Dynamic variables can be used to manipulate the timing, order, frequency and duration of the story information (Segel & Heer, 2010; Bordwell & Thompson, 2004; Blok, 2005) (*Q2a*). Dynamic variables are seen as storytelling techniques; more specific, techniques that support the narrative structure. Not only dynamic variables but also spoken word or narration is used to support the narrative structure (Segel & Heer, 2010; Bordwell & Thompson, 2004) (*Q2a*).

Besides narrative techniques, visual techniques are used to support the story. A lot is written about the way graphic and dynamic visualization variables can be used in scientific visualizations to analyze, explore and present data, mainly for a small audience of subject experts (MacEachren, 1995; Kraak & Ormeling, 2010; Blok, 2005 etc.). Knowledge about the way graphic and dynamic visualization variables can be used to communicate information in a narrative format to a general public is scarce. This research will contribute to this knowledge. Besides visual techniques to represent geo-data, cinematic techniques are also used in narrative data animations. Taking this into account, this research will give an overview of data visualization techniques as well as cinematic techniques that can be used in narrative data-animations (*Q2b*).

The result of this investigation will be an overview of different *types* of stories and *types* of techniques that are used in narrative geo-data animations.

Scientific research about the evaluation of data-visualizations to answer the question how well communication and knowledge transfer are supported in a data-visualization is relative scarce (Lam & Bertini, 2012). Less than 5% of scientific literature about the evaluation of data visualizations focuses on this question. Therefore, in this research I will also do a usability study in order to investigate the effectiveness of the narrative data visualizations. As been mentioned, storytelling is about guiding the viewer through a series of events. Storytelling helps the viewer in focusing his attention in order to understand the logic of the story. Also, narrative visualizations are meant to evoke certain emotions by its audience. The stronger these emotions the stronger the viewer is engaged in the story. So, to measure the effectiveness of narrative data animations two variables of effectiveness are focused on: narrative understanding (Busselle & Bilandzic, 2009), (*Q3b*) and emotional engagement (Busselle & Bilandzic, 2009; Reeve, 2006), (*Q3c*).

1.3 Research Questions

Q1: *What kind of stories can be told with geo-data-animations on television?*

Q1a: *What plot structures are followed in journalistic geo-data-animations?*
Q1b: *What themes are most used in journalistic geo-data-animations?*
Q1c: *What is the setting of the stories told by journalistic geo-data-animations?*
Qxa: *What kind of geo-data is most used in journalistic data animations?*
Q1d: *What aspects of the geo-data is most used in journalistic data animations?*

Q2: *What storytelling techniques are used in geo-data-animations on television and how do they support the story?*

Q2a: *What narrative techniques are used?*

Q2b: *What visual techniques are used?*
Q2c: *How do narrative and visual techniques support the story?*

Q3: *Are the variables effective in supporting the storytelling techniques?*

Q3a: *What is the audience of journalistic geo-data animations?*
Q3b: *How well does the audience understand the story?*
Q3c: *How well is the audience emotional engaged in the story?*

1.4 Structure of the report

In the next chapter the central concepts of storytelling and geo-data visualization will be introduced. At first the general concepts of a narrative structure is described, mainly based on literature on fictional storytelling in film and drama. Section 2.2 starts with a discussion on the differences between fiction and data-stories. Next, in the same section, the central concepts of geo-data are described. To tell a story with data, the data first has to be visualized. In section 2.3 geo-data visualization concepts are discussed. Next, in section 2.4 the aspects of geo-data that might be of interest for storytellers and geo-data themes are discussed. In section 2.5 narrative, visual and auditory techniques that support the narrative structure will be discussed. The central concepts of user experience and the choices for variables to measure the effectiveness of the animations are described in section 2.5. In chapter 3, the applied methodology is described. This is done according to the research questions that are described above. Chapter 4 presents the results of my research. The discussion and conclusion that follows from the results are written in chapter 5.

2 Theoretical framework

2.1 Stories

Telling stories (presenting narratives) is something people practice every day to convey information, cultural values, experiences and ideas. Our mind is programmed that we find it easier to understand information that is presented in a story than, for example, in lists of facts (Gershon & Page, 2001). Often, the elements that make up a narrative are events that happen or have happened in the world around us. Randomly listing events doesn`t make a narrative. In a narrative the events are ordered and structured in such a way a meaningful whole is formed. When telling a story, the viewer is guided through this ordered sequence of events. As mentioned in the introduction, besides an effective format to communicate information, stories are used to create excitement by its audience (Ekström, 2000). The author creates excitement by playing with the expectations that the viewer creates about the development of the story. Thirdly, a story contextualizes information which will help in attach meaning to the information. Kosara & Mackinlay (2013) clearly summarize the function of a story by saying that: *a narrative provides the connective tissue between facts to make them memorable".* In a narrative events are related by cause and effect. Since causality works chronological, the events are related in a temporal structure. Bordwell & Thompson (2004) clearly bring the aspects of a narrative together in their definition: *´the chain of events in cause-effect relationship occurring in space and time*.

2.1.1 Narrative, story and plot

By telling a story, the audience is guided in reconstructing the causal relationships of the events: the narrative.
For telling a story, different media can be used. To present a story, the combination of visual media and words would work best according to Gershon & Page, 2001. In this thesis there is focused on television as a medium. On television it is possible to present the narrative visually in combination with spoken or written words and sound. The narrative can be presented by explicitly showing the events of the narrative on the screen. Also, events of the narrative might be inferred from what we see and hear, but do *not* explicitly see. To infer story information that is not explicitly presented we use our own imagination. The set of all the events in the narrative, explicitly presented and inferred events, is called the *story*. On television, also visual and auditory material can be added that is not part of the story world (for example background music). The combination of all that is visually and audibly presented on screen we call the *plot* (Figure 2-1).

Figure 2-1 Story and Plot (Bordwell & Thompson, 2004).

2.1.2 Plot development

In fictional storytelling (literature, drama and film) often a general pattern of development can be observed. Often a plot follows a pattern of development from a beginning (or exposition), a middle and an ending (or resolution). In the exposition, information is presented that is needed to understand what is going to happen. The characters, objects and environment are introduced. When a certain incident happens that disrupts the status quo, the middle part starts. This incident will become the central theme of the plot. The events that follow the inciting incident will lead to a climax. The whole plot is constructed to lead the viewer to this moment. After the climax the story will come to an end where the chain of cause and effect will be closed. In the ending everything has fallen into place and the viewer can recapitulate the story. In the end the plot will often satisfy the expectations that the viewer has created about the plot as a whole. But in the end also the expectations can be cheated when the plot ends with an unexpected event.

The pattern of development that is followed in the plot is related to the level of suspense that is experienced by the viewer. Gustav Freytag created a graphical representation of this relation (Freytag, 1894): Freytag's triangle (Figure 2-2). The horizontal axis represents time; the vertical axis represents complication or suspense. In the beginning of a story there is no suspense (**1**). During the middle part, the tension rises to a climax (**3**). This phase is called the rising action (**2**). After the climax the suspense level quickly falls down; the falling action (**4**). In the end, the tension is back to zero when everything is resolved (**5**). Laurel (1993) presents a more contemporary schematic representation of a plot based on Freytag's triangle (Figure 2-2). In her scheme, she distinguishes seven general parts of a plot structure. The story starts with the exposition **(a)**. After an inciting incident **(b)** the tension rises via the critical action **(c)** and crisis **(d)** to a climax **(e)**. After the climax the action falls **(f).** In the end a resolution or denouement is reached **(g)**.

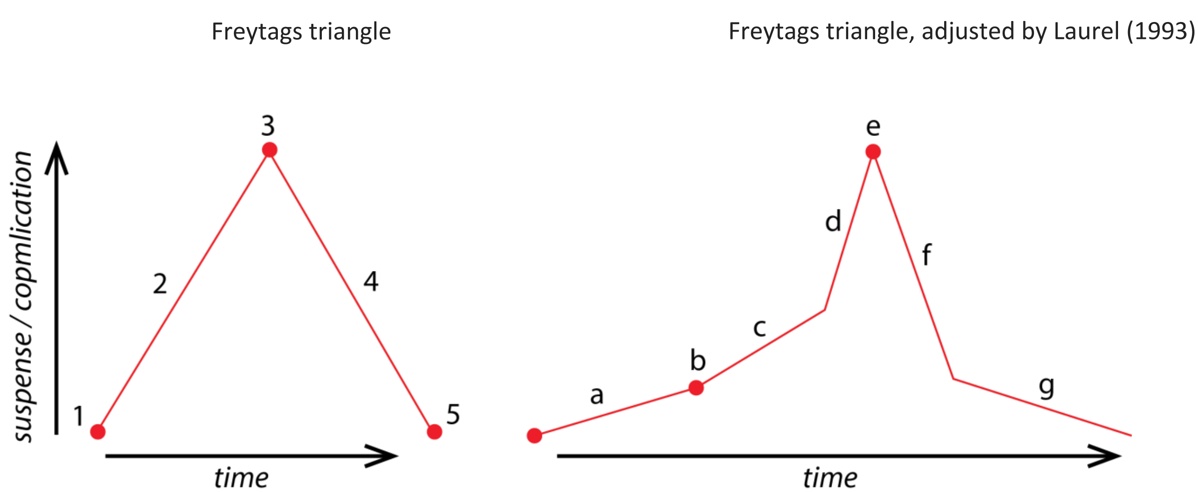


Figure 2-2 Dramatic plot development (left: Freytag`s triangle, right: Laurel`s contemporary version (Laurel, 1993)

The way the plot generates an arc of tension (suspense) by the viewer depends on the way he expects the story to develop (based on cause and effect). According to Bordwell & Thompson (2004) "*the whole point of patterns of development is to engage the spectator in making long-term expectations which can be delayed, cheated, or gratified".* When the events in the plot are ordered in the same chronological order as they happen in the story the engagement of the viewer will be low; the expectations are immediately fulfilled. Changing the order in which cause and effect are presented in the plot can create higher emotional responses by the viewer. When a cause is presented, but showing the effect is delayed this results in suspense. When an effect is presented without information about the cause this creates curiosity or mystery. The viewer develops hypothesis about the cause. To resolve the curiosity, in the end enough information is given to reconstruct the cause. Curiosity is often used at the beginning of a story. Thirdly, when an effect is shown that later on appears to be incorrect, this will lead to surprise by the viewer. Tan (2003) visualized the three strategies of the manipulation of cause and effect (Figure 2-3). In his model, a cause is called the initial event (IE) and the effect the outcome (O).

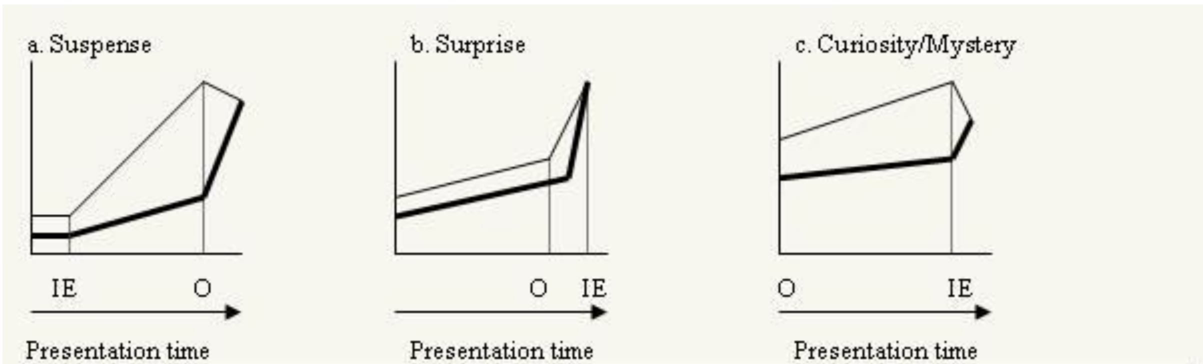


Figure 2-3 Visualization of suspense, surprise and curiosity by Tan (2003)

Elements of the plot

Above I described the plot, as total system of events related by cause and effect. Next, I will describe the structural elements that make up a plot. I hereby refer to the theories of Aristotle. He described six structural qualitative elements of drama (Figure 2-4). These elements can be seen as levels on which you can look at the plot. The theory of Aristotle describes a poetic composition in logical terms and is one of the most comprehensive and well-integrated theories of drama (Laurel, 1993). His framework can still be used in analyzing stories in the present.

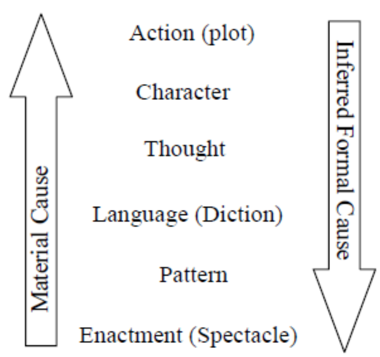


Figure 2-4 Structural element that make up a plot (Aristotle)

As been mentioned, the plot (or action) is the arrangement of incidents or events via structural and causal relationships, on the stage. An action has a beginning, middle and end. Characters perform the actions devised in the plot; they can be described as the agents of cause and effect (Bordwell & Thompson, 2004). A character possesses certain traits that determine how it acts. The process leading to the choices and actions of the characters is called the thought or theme. It are the 'patterns of life' examined by the author. In drama the thought is expressed by words in the form of a dramatic dialogue. The words or symbols are presented in a certain rhythm or pattern. According to Aristotle, the perception of patterns is pleasurable for humans. The enactment, lastly, is all that is heard or seen on the stage in dramatic theory.

A story can looked upon from the perspective of the author or from the perspective of the audience. The arrows in Figure 2-4 indicate this. From the perspective of the author the start point is the plot. The plot determines the characters that are used. The type of characters in turn, determines their thought and their thought determines the language the characters speak; in the end, all what is presented to the audience (the spectacle) is determined by the patterns of the language and symbols. From the audience perspective, the start point is everything what is seen or heard (the spectacle) on a stage or screen. From the spectacle the viewer detects patterns (cues) and via these patterns the viewer understands what the characters, that represent the story, tell us. Via language and thought the viewer is able to understand the choices and actions of the characters. In the end the plot structure is understood.

2.1.3 Conclusion

Journalism is about telling stories. In general, a story is a structured chain of events that is related through cause and effect. In general, a story has a certain arc of development; it begins, builds up tension to a climax and has an ending. The way the viewer experiences tension depends on his expectations about how the story will proceed. A story further communicates a certain meaning by placing the events in a context. In this research I will investigate in what way these traditional story elements are present in journalistic data visualizations. The following questions can be asked:

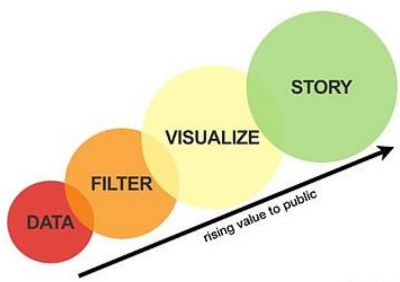
- Does the data animation follow a traditional story structure: begin, middle, end?
- Does the data animation have suspense (delay of effect)?
- Does the data animation have an element of surprise (effect was not expected)?
- Does the data animation have an element of curiosity (effect is presented earlier than the cause)?
- How are the story events related (causality or not?)

2.2 Geo-data

The big difference between data-visualization and fictional storytelling in television and film lies in the nature of the information that is communicated. As Gershon & Page (2001 p-34) mention, the information and the stories that a data-visualization conveys are much more complicated than in traditional television or film. In fiction, a story is devised by the author. In a data animation however, the story is based on actual facts. In this sense they can be placed within the non-fiction genre. Non-fiction is defined as *"prose writing that is informative or factual rather than fictional"* (Oxford dictionary). However, the animations that are subject of this thesis are not just presenting facts (like in the news). In this animations storytelling techniques are used to present the facts in a more compelling and effective way. The animations therefore can be seen as a form of creative non-fiction. According to the creative nonfiction collective (URL 2.1) "*Creative nonfiction allows its writers to access the same techniques available to fiction writers without misrepresenting the actual events in their work"*.

Specifically, the journalistic animations that I research are based on geo-data. Geo-data are observations that are collected by monitoring the real world (Heywood et al. (2011). Geo-data on itself are just facts. By adding context to the geo-data it can be turned into information. To create a story based on geo-data we need ways that make it possible to interpret the facts. Geo-data has three dimensions: spatial, temporal and thematic (Mennis, 2000), see Figure 2-6. The use of the spatial, temporal and thematic dimension of geo-data helps in the process of turning data into information.

The spatial dimension can be used to interpret the spatial relation between data entities. The temporal dimension can be used to interpret the change in the data, the thematic dimension to interpret what the data is about. When telling a story with data, the data first has to be visualized (
Figure 2-5). Three basic symbol types to represent data can be used: points, lines and polygons. In a data-story, the visual symbols can be seen as the 'characters' that perform the action during the story events. The 'action' can be visualized by dynamic visualization variables. Before I describe the techniques of visualization, I will first discuss the characteristics of geo-data in more detail.



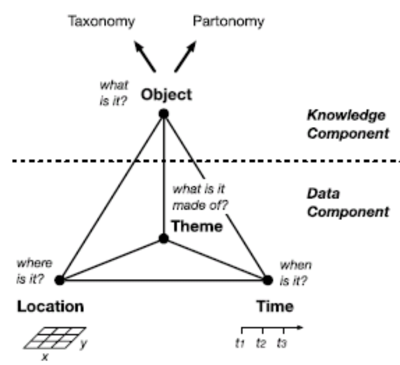


Figure 2-5 (left) The process of narrative data-visualization (Mirko Lorentz, URL 2.2)
Figure 2-6 (right) Components of geo-data (Mennis, 2000)

2.2.1 Location property

A property that makes geo data different from other kinds of data is that geo data is inherently structured in two (X, Y) or three (X, Y, Z) spatial dimensions. Geo-data thus always tells us something about 'where' a particular phenomenon takes place. A phenomenon that occurs everywhere on the earth surface is continuous: *fields.* An example is rainfall or temperature. A phenomenon that only occurs on a specific place on the earth is discrete: these are called *objects* (Huisman & de By, 2011). *Objects* are defined by sharp boundaries (like a house or a neighborhood). Fields and objects can further be physical or non-physical. Physical objects have physical dimensions that you can actually touch (for example trees, houses or streets). Non-physical objects cannot be observed in reality (administrative boundaries like countries or service areas). Examples of physical fields are elevation or air pressure. Distance zones are an example of non-physical fields.

The spatial dimension of the data gives information about the way spatial features occupy space. Different spatial patterns can be distinguished. Often a classification of three types is used: random, regular, clustered distribution (De Smit et al., 2007). Spatial patterns can be associated with each other. A significant association is *spatial autocorrelation,* which involves that spatial features close to each other are likely to have similar attributes

2.2.2 Time property

Spatial phenomena take place at a certain time and are about events and change (MacEachren & Kraak, 2001). Events mark the moment when a certain state changes. A state is a continuous phase between two events. The change from the one stage to the other can be abrupt or can go very slowly. Events and stages are closely related as stages cannot be reached without events. How the physical time of a certain phenomenon is captured in the data depends on the characteristics of the particular phenomenon and the goal of the user. This goal is often not to imitate the real world time as good as possible. There are several ways to model time, all with their own use.

In capturing the data one can choose to focus either on the moment of change between different stages (events) of the phenomenon. Time is then modeled as points; only the specific moment in time is known. One can also choose to focus on the stage itself. Time is then modeled as intervals; start and end time are present in the data. Next, time can be modeled in a nominal, ordinal, or a discrete or continuous time model (Aigner, 2011). A nominal time value refers to a certain period in time, for example: the fifties, WW2 or Easter. In an ordinal time model, the elements are related in a relative order with statements like 'before' or 'after', 'present' or 'non-present'. Discrete time is stored as points in time with a certain temporal distance (seconds, minutes, days etc.). In a continuous time model, for every moment in time a point exists. Thirdly time can be arranged linear or cyclic. The linear time model follows a linear ordered path. Cyclic time follows a path of periodic returning phases like seasons or the day and night cycle. Pure cyclic time data is seldom used. Periodic time is mostly represented by a combination of linear and cyclic time. Aigner (2011) calls this 'serial periodic data'. For example, when storing seasonal data, also linear ordering of years is present.

A spatial phenomenon takes place in time. The time the story takes in the real world is called the story time. Database time is the time a story event is captured in the database.

2.2.3 Attribute

The third property of spatial data is the attribute space (Kraak & Ormeling, 2010), or theme (Mennis et al., 2000). It tells us *what* is happening in the real world at a certain location in time. A spatial feature can have more than one attribute. For example, when data is collected about schools, there might be information about its building year, number of pupils and name. The attribute associated to a spatial feature is a measured value. The attribute can be measured qualitative or quantitative. Qualitative data are descriptions that can be acquired by observations or interviews. Quantitative data are numeric values. Both data types can be described by their scale of measurement. Four measurements scales can be distinguished. The first measurement scale is the nominal scale. In nominal data the measurement value is expressed as a category (non-ordered). The next scale is ordinal where values are described as categories that can be ordered. In the interval scale the distance between the ordered values can be determined and is equidistant. However, the values cannot be related to each other as there is no zero point. Ratio scale data does contain ordered equidistant values that have a zero point and can be used to calculate relations.

2.2.4 Spatio-temporal change

Spatio temporal patterns and processes are typically related to changes. Change indicates development. Changes in the characteristics or behavior of spatial entities are the input for geo-data stories. Blok (2005) distinguishes three different types of spatio-temporal change: appearance / disappearance, mutation, and movement. Appearance / disappearance is about the emergence or vanishing of a phenomenon. Mutation is about the change of the thematic attribute of a phenomenon. Mutation can be at nominal level or at higher than nominal level. In nominal-level mutation the nature of the phenomenon changes. Higher level mutations are changes in the ordinal, interval or ratio values (for example the change of the amount of pupils at a school). Movement is about the change of the spatial location or geometry of a phenomenon. Movement can be distinguished in movement along a trajectory and boundary shift. When a phenomenon moves along a trajectory, the location of the whole phenomenon changes. A boundary shift is the movement of a part of a phenomenon, for example the expansion of an area.

Ping (2008) divides temporal change in geometrical and thematic change. Thematic change relates to Blok`s concept of mutation. The geometrical changes *born* and *die* can be related to appearance and disappearance as described by Blok. Ping (2008) distinguishes further six other geometrical changes. Moving can be related to Blok`s movement along a trajectory. Expanding, merging, contracting, splitting and transformation can be seen as a breakdown of Blok`s boundary shift. Phenomena can also not change. See Figure 2-7 for an overview of the classifications of spatio-temporal change.

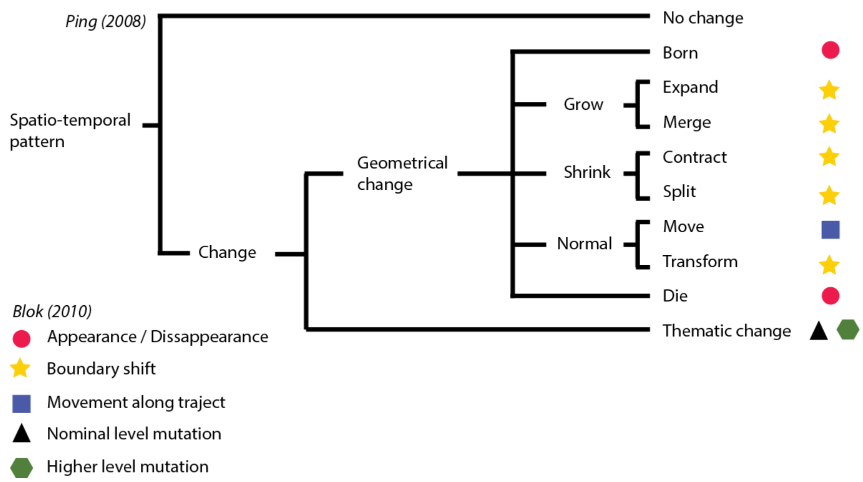


Figure 2-7 Spatio-temporal change; relating concepts of Blok (2010) and Ping (2008)

2.3 Geo-visualization

As been mentioned above, in a journalistic data animation the story is based on actual facts which first has to be translated into symbols that can be perceived. In other words, the data first should be visualized. The concept of visualization is twofold. At first visualization is about making data visible to the human perceptual system by creating visual representations (also called external representations). The translation of data to a visual representation is often a computer supported process. Secondly visualization is a cognitive process. The human mind perceives the visual (possibly combined with auditory) information and forms an internal image. This image is related to a mental model of existing knowledge and now can be interpreted and understood (van den Brink, 2007-p95). The relation between internal and external visualization is clearly incorporated in the definition Card (1999) gives of visualization: *"Visualization is the use of computer supported, interactive, visual representations of data to amplify cognition".* Also, Aigner (2011) clearly expresses the meaning of visualization: "*The human perceptual system is highly sophisticated and specifically suited to spot visual patterns. Visualization strives to exploit these capabilities and to aid in seeing and understanding otherwise abstract and arcane data."*

According to Card et al. (1999) visual representations of data have the capability to let our mind search for patterns and recognize relationships between data. Visualizations at first increase the memory and processing resources available to users. Next they reduce the search for information and enhance the detection of patterns.

Van den Brink et al. (2007) describe visualization as a series of transformations (Figure 2-8). The first transformation is from reality into computer representations. Next, from computer to perceptual representations (pictures) and from pictures to a format that can be understood by the human perceptual system.

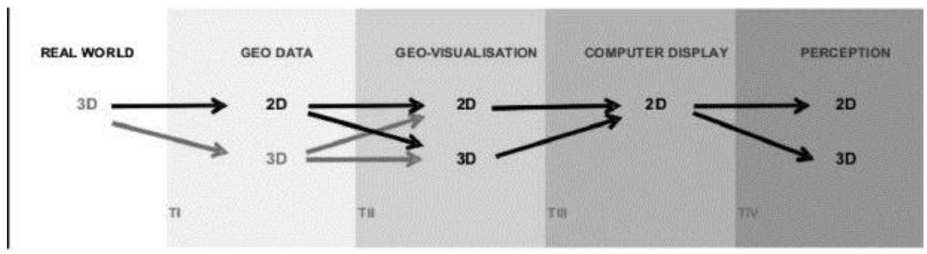


Figure 2-8 Visualization (Van den Brink et al. P 91)

But how does our brain understand the visualized data and recognize patterns and relationship? The human mind makes use of knowledge schemata to understand the spatial context of the information that is visualized (Sluter, 2009). We make use of propositional schemata that contain knowledge about geographical objects and their attributes (declarative knowledge). Secondly, image schemata include knowledge about space and spatial relationships (configural knowledge). Event schemata (procedural knowledge) include knowledge about the sequence of getting from one location to another. Image schemata are most important in understanding maps (static visual representations of spatial data) and are the most fundamental schemata that we possess. Image schemata are for example container schemata that let us understand the categories that are defined in maps, or part-whole and up-down schemata, that let us understand ordered structures in maps (Sluter, 2009).

According to Blok (2005) all variables that can be perceived by the human perceptual system can be used to represent spatio-temporal data. In this research only visual and sound variables are of importance as only these variables can be perceived on television. Visual variables can be divided into graphic and dynamic variables. In the spatial dimensions (2D) the geo-data is represented by graphical variables. Graphic variables are used to reveal the patterns that are hidden in spatial information. Bertin (1974) and Tufte (1983) have created rules and theories to design symbols that take full advantage of the visual perception and cognition capabilities of the human mind. Bertin (1974) described the graphic variables that can be used to visualize geo-data and related these variables to the measurement level of the data. Tufte (1983) described guidelines to design effective graphics.

To observe spatio-temporal changes, dynamic variables are needed. At least one graphic variable is required to see a dynamic variable (Blok (2005). A data animation is thus always a combination of graphic and dynamic variables. Graphic variables and dynamic variables will be described in more detail in the next sections (graphic variables: 2.3.1, dynamic variables, 2.3.2)

2.3.1 Visualizing the spatial dimensions of geo-data

Graphic variables are applied to points, lines or polygons. When visualizing geo-data first the decision should be made which of those three models will be most appropriate to represent the spatial phenomenon. The same real-world phenomenon can be represented in different models. For a part the properties of the spatial phenomenon determine the choice for the spatial data model that will be used. Spatially discrete phenomena are often modeled as points, lines or areas. Continuous phenomena (fields) like elevation are mostly represented by the raster model. Next, the scale determines the choice how to represent an object or field. Scale can be identified by looking at the spatial extent of the data. This can for example be an international extent, national, regional, or local. Depending on the scale one can choose to display a building as a 3-D model, a polygon, or as a point. The intention of the cartographer in the end is decisive in choosing the right model for representation (Figure 2-9). In our case the cartographer is the storyteller. The appropriateness in supporting the story determines the choice for point, line or area representations of the data.

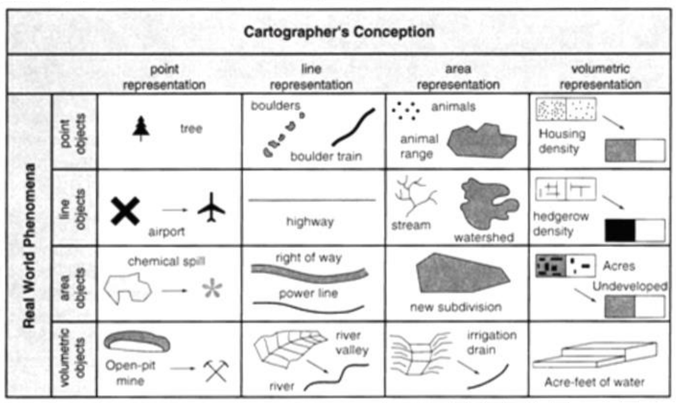


Figure 2-9 Visualization of real world phenomena (Muehrcke et al. (1992))

Bertin (1974) has described six graphical variables that can be used to visualize points, lines and polygons. These graphic variables are position, size, color value, texture, color hue, orientation and shape. Several scientists have made adaptations to the model of Bertin. In the model of Bertin, the variable 'color' is a combination of hue and saturation (Figure 2-10). Morrison (1974) stated that hue and saturation should be considered as separate visual variables. Morrison (1974) also added 'pattern arrangement' as a variable. Next, Caivano (1990) distinguished three aspects of the variable 'texture': directionality, size and density. MacEachren (1995) introduced the graphic variable 'clarity' to Bertin`s list. Clarity consists of the variables crispness, resolution and transparency. Crispness is about the clarity of the edges of a symbol (sharp or fuzzy), resolution has to do with the level of abstraction of the original representation of the symbol.

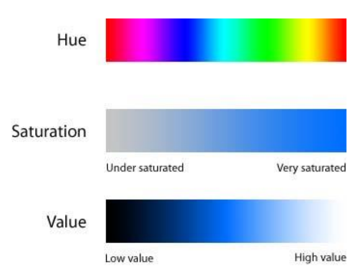


Figure 2-10 Hue, saturation and value (URL 2.3)

Understanding the relationship between the level of measurement of the data and the graphic variable helps in deciding what graphic variable is most suited to represent a certain type of data. Data in a certain measurement level has certain perceptual properties. For example ordinal data has the property of being perceived as ordered and quantitative data of being perceived as proportional. Nominal data has the property of being perceived as distinct categorical groups or as an equalized / un-equalized image. Bertin (1974) has analyzed the relationship between the graphic variable and the perceptual property of the data (Table 2-1, Figure 2-11). After Bertin, different other authors have made adjustments to this scheme (Geels, 1987; Morrison, 1974; MacEachren, 1995).

Table 2-1 Level of measurement and perceptual properties (Bertin, 1974)

Level	Perceptual property	Description
Nominal	• Associative:	Perceive an equalized image and a constant visibility of the features
	• Dissociative:	Perceive a variation in the visibility of the features
	• Selective:	Perceive a certain category from a group of features
Ordinal	• Ordered:	Perceive the features as ordered
Quantitative	• Proportional:	Group all features of similar quantities / estimate ratios between two features

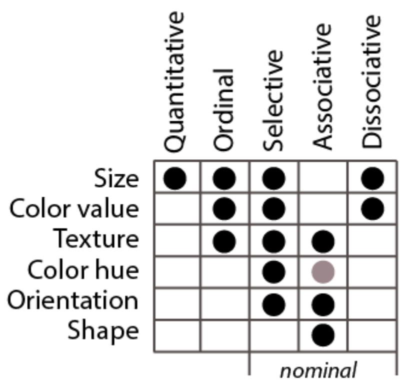


Figure 2-11 Bertin`s scheme of graphic variables (Bertin, 1974)

As have been mentioned before, the measurement system of Bertin (1974) differs from the more accepted and more appropriate four-level measurement system. The main difference between the two systems is that Bertin doesn`t make a distinction between interval and ratio data. Bertin`s term quantitative refers to the ratio level, which thus means that he didn`t include the interval level. It is argued by Robinson (1984) that the interval scale is not relevant in cartographic symbolization as in both the interval and ratio level a range is displayed. The interval level can also be seen as range-grading, which however, *is* relevant. Range-grading is the classification of ratio data into classes. Rød (2000) further argues that the ratio level can be sub-divided in density and absolute values. Taken these new insights into account, Rød (2000) comes up with an adjusted symbolization scheme.

Unfortunately, Rød (2000) doesn`t take into account the ‘new’ graphic variables that were added to Bertin`s by Morrison (1974) and MacEachren (1995). The scheme by MacEachren however, doesn`t take into account the four level measurement system. To make it even more difficult, MacEachren related the graphic variables to three measurement levels (like Bertin), but also related them to the properties of visual isolation and observing visual levels. In my opinion the division in measurement levels as described by Rød (2000) is a useful one. I therefore added the extra graphic variables, present in the MacEachren scheme, in the scheme of Rød (2000). I thereby equate visual isolation to associative and visual level to selective. What MacEachren calls numerical I have equated to interval and density (Figure 2-12). This scheme I will use to categorize the different graphic variables and data types used in the data-animations.

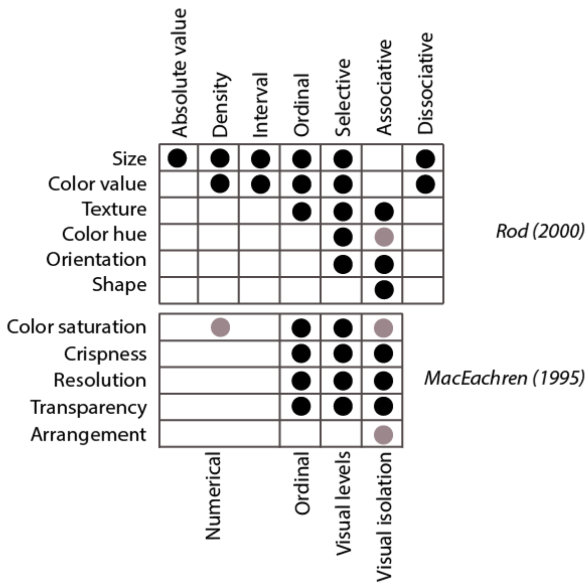


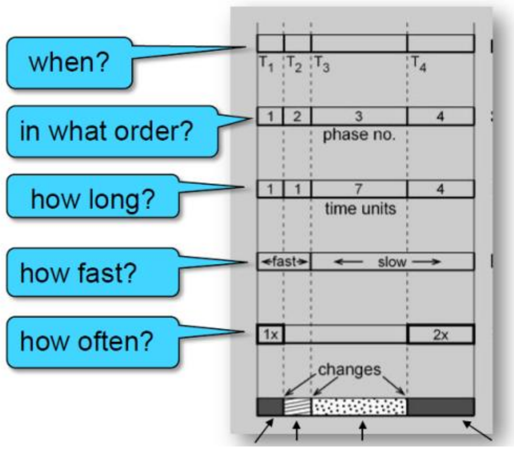
Figure 2-12 Graphic variables and measurement scales (Bertin (1974), Rod (2000) & MacEachren (1995)

There are different opinions about the relationship between the level of measurement and the aim of the visualization. Morrison (1974) argues that when the aim of the visualization is communication, only nominal and ordinal levels can be used. The aim of communication is that people can perceive the information quickly and are able to memorize it. Communicating numerical data involves the use of a legend. Interpretation of a legend should be kept to a minimum as it doesn`t stimulate rapid perception. According to Morrison (1974) to stimulate quick perception, numerical data should be generalized to lower measurement levels. In my research I will discover whether information on a numerical measurement scale is used and whether this resulted in good perception by the viewer.

2.3.2 Visualizing spatio-temporal change

2.3.2.1 Dynamic variables

Dynamic variables are needed to make the dynamics (spatio-temporal change) of the geo-date visible in the animation. In literature often the six dynamic variables introduced by DiBiase et al. (1992) and MacEachren (1994) are mentioned. The first dynamic variable is *moment of display* which is defined as the moment that a change occurs during the animation (*when?*). According to Blok (2005) moment of display is the basic variable. Without this variable the other variables cannot be perceived. The second variable *order* is about the sequence of scenes (*in what order?*). Thirdly, *duration* is defined as the length between two identifiable states in an animation (*how long?*). Duration and order are a function of the moment of display (Blok, 2005). Frequency is defined as the number of changes in the animation per unit of display time (*how often?*). Frequency in itself is a function of duration and order. The variables rate of change and synchronization as described by DiBiase et al. (1992) and MacEachren (1994) are considered as effects instead of being dynamic variables by itself by Blok (2005). In this thesis I follow this concept. Rate of change describes the magnitude of change per unit of display time (*how fast?*) and synchronization is at hand when two or more temporal animations are ran at the same time. Figure 2-13 visually presents the different dynamic variables and Figure 2-14 shows the relation between the four dynamic variables as described by Blok (2005).



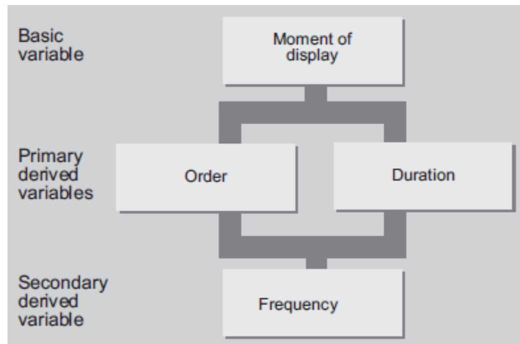


Figure 2-13 (left) Dynamic variables (Blok & Kobben, 2007)
Figure 2-14 (right) Relationship between dynamic variables (Blok, 2005)

In a story, the moment of display, duration, order and frequency imitate the narrative structure of events that is arranged by the storyteller. A storyteller uses dynamic variables in such a way they generate the wished narrative effects. For example duration can be used to emphasize a certain action (expand the duration), moment of display can be used to show certain selections of the data. These effects support viewers in following the story. In section 2.5.1 I will describe what effects can be recognized that guide the viewer through a story and how the dynamic variables can be used to generate these effects.

2.3.2.2 Multimedia-effects: technical and modeling dynamic variables

The dynamic variables as described above (Blok, 2005) are used to make spatio-temporal changes visible in an animation. Next, to emphasize the changes of the spatial entities multimedia effects are applied. Rebah & Zahin (2011) are talking about *technical dynamic variables* and *modeling dynamic variables.* Technical variables are the multimedia effects that are applied to the symbols to highlight the change they represent. This can be for example changes in shape, color, size (blinking) or changes in location (Figure 2-15). The effectiveness of the above mentioned technical dynamic variables depends on the characteristics of the symbols (line, point, polygon), location and measurement type (Rebah & Zahin, 2011). For example, flashing seems more effective when applied to points than to polygons or lines.

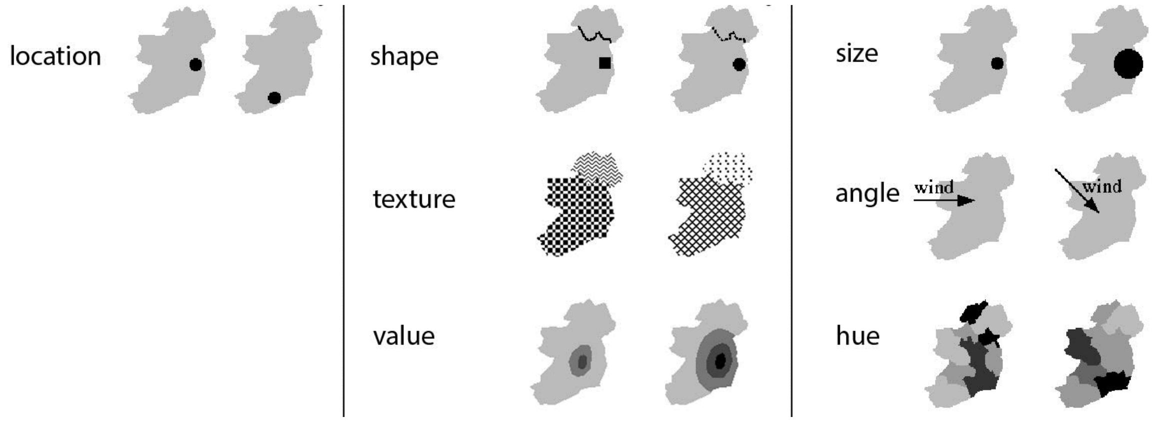


Figure 2-15 Visualizing spatio-temporal change (Ormeling, 1996)

Instead of emphasizing the change itself, modeling variables emphasize the *characteristics* of the change. The modeling dynamic variables as defined by Rebah & Zahin (2011) are proportionality, rhythm and trajectory. Proportionality is the degree to which the duration of an animation scene is proportional to the real time duration, and to which the intervals in the animation reflect the regularity of the real time phenomenon. Rhythm is the degree to which the speed of the animation shows the change magnitude. Trajectory is the degree to which the evolution of a given phenomenon can be retraced. In section 2.2.1.4 I described the different types of spatio-temporal changes as described by Blok (2005). In my study I will relate the use of multimedia effects to the specific types of spatio-temporal change.

Technical dynamic variables are not only used to present data that is about changes in time. Dynamic effects can also be used to emphasize aspects of *non-temporal* data. In non-temporal animations there is not a direct link between world time and display time. Non-temporal animations are often used to clarify, emphasize or highlight spatial or thematic characteristics of a spatial process (Kraak & Ormeling, 2010; Ping, 2008). Techniques that can be used to emphasize certain entities are blinking and flashing. Also, to explain a certain phenomenon one can choose to successively show different spatial or thematic aspects of that phenomenon (*successive built up* animations). The phenomenon is unraveled in different spatial or thematic layers. Instead of changing the visualization of the data in time, one can also manipulate the visual display to highlight certain aspects of the data. Changes in visual display include panning and zooming, change in scene or change of viewpoint. These techniques are similar to the cinematic techniques cinematography and editing described in section 2.5.2.

2.3.2.3 Limitations in noticing changes

As we have seen, graphic and dynamic variables allow us to perceive changes. The human visual system however is limited to perceive change. Changes might be missed due to the 'change blindness' phenomenon (described by Simons and Rensink, 2005). This can happen if there is an interruption between images, when the image is too complex or when the change occurs too slowly or otherwise doesn't draw attention (Goldsberry & Battersby, 2009). A technique that can be used is limiting the number of changing locations that the viewer must focus on. Pylyshyn & Storm (1988) advice to use a maximum of five locations. When classification of the data is used in the visualization, change is about class transitions. When there are two classes, four possible class transitions can occur (from 1 to 2, 2 to 1, 1 to 1 and 2 to 2). When there are three classes, nine transitions, etc. As the human memory is limited to attend to seven transitional events, it is suggested to use maximum three classes (Goldsberry & Battersby, 2009). When classification is not required it is better not to classify the data, but show continuous change of the attribute value. Storytelling is aimed at guiding the viewer through the sequence of events and focus his attention. Storytelling in itself is thus a technique to overcome change blindness as it helps in focusing on certain areas and emphasizing certain aspects of the data over others.

2.4 Geo-Data stories

2.4.1 Aspects of spatial phenomena that are of interest for storytellers

Representing a spatial phenomenon in time is not the same as story. In a story certain aspects of a phenomenon are especially of interest. According to the definition of a narrative, cause and effect relationships are of interest for a storyteller. Often spatial phenomena are caused by other spatial phenomena. Next, according to journalist David Anderton finding a story is about "*locating outliers and identifying trends that are not just statistically significant, but relevant to de-compiling the inherently complex world of today"* (In Gray et al., 2012). Outliers are unexpected or remarkable values or events. Showing something unexpected might evoke an emotion of surprise by the viewer. A trend is defined as a general direction in which something is developing or changing (Oxford dictionary). Relating to geo-data, a spatial trend then can be described as a structured development of the arrangement of a phenomenon: a spatio-temporal pattern. Evaluating spatio-temporal patterns offer us the possibility to understand the complicated processes that have caused the distribution of the values (Chou, 1995). Spatio-temporal patterns are therefore a good starting point for telling a story. Next, showing a phenomenon in its totality is often not very exciting. In a story is often looked for typical examples to emphasize certain aspects of the overall process in more detail. One can choose to make selections in time, location or value.

Not every dataset is suited for telling a story. As Alberto Cairo, author of the book ''The functional art", states: '*You cannot create a story out of data that is not interesting in itself (Cairo, URL 2.4)'.* In the creation of the data animations for the Netherlands from Above series, the chief-editor always used the criteria: ´*What does it have to do with us?´* Apparently a story should use information that we as humans can identify ourselves with. When people hear a story they create mental models by combining the information that they see and hear with knowledge people have about life and about the specific topic of the story (Busselle & Bilandzic, 2009-p323). The story probably won`t attract us when the information that is perceived doesn't have a connection with our knowledge about life.

To summarize, aspects of spatial phenomena that might be of interest for storytellers are:

- Cause and effect relationships
- Outliers / Remarkable events or values
- Spatio-temporal patterns / trends
- Datasets about subjects that people care about

2.4.2 Theme & setting

When investigating what kind of stories can be told with geo-data it can be helpful to look at classification schemes for geo-data. In the ISO 19115 norm for the description of metadata for geographic information, a list of 19 topics is adapted (INSPIRE, URL 2.5). These topics are used to describe the main subject of the data. Besides a general topic, INSPIRE defined a theme thesaurus, containing 34 themes (INSPIRE, URL 2.6). In the Global Environment Outlook (GEO) report, 29 data categories are described that are used to classify geographical data (GEO, URL 2.7). In the Environmental Data Explorer, used by the United Nations Environment Program, geo-datasets are described according to this categorization. For an overview of the different classification schemes for geo-data see Table 2-2. For analyzing the data-animations I think the most appropriate classification scheme is the one used in the Global Environment Outlook. This list is most diverse and offers more classes that are related to human activities.

Table 2-2 Classification of geo-data themes (source left to right: URL 2.5, 2.6, 2.7)

ISO 19115 Topics	GEO Categories	INSPIRE Themes
Farming	Agricultural Production	Addresses
Biota	Emissions	Administrative units
Boundaries	Boundaries	Agricultural and aquaculture facilities
Climatology / meteorology / atmosphere	Climate	Area management/restriction/regulation zones
Economy	Economy	Atmospheric conditions
Elevation	Education	Bio-geographical regions
Environment	Elevation And Slopes	Buildings
Geoscientific Information	Energy Consumption / Production	Cadastral parcels
Health	Environmental Hazards	Coordinate reference systems
Imagery / Basemaps / Earth Cover	Food Supply And Caloric Intake	Elevation
Intelligence / Military	Health	Energy resources
Inland Waters	Human Settlements	Environmental monitoring facilities
Location	Infrastructure	Geographical grid systems
Oceans	Islands	Geographical names
Planning Cadastre	Land Use	Geology
Society	Marine And Coastal Areas	Habitats and biotopes
Structure	Population	Human health and safety
Transportation	Private Consumption	Hydrography
Communication	Protected Areas	Land cover
	Rivers And Lakes	Land use
	Technological Hazards	Meteorological geographical features
	Total And Threatened Species	Mineral resources
	Tourism	Natural risk zones
	Trade Balances	Oceanographic geographical features
	Transport	Orthoimagery
	Urbanization	Population distribution — demography
	Vegetation And Land Cover	Production and industrial facilities
	Waste Production And Management	Protected sites
	Water Consumption And Resources	Sea regions
		Soil
		Species distribution
		Statistical units
		Transport networks
		Utility and governmental services

The setting of a story is the period and location it takes place in. The story can take place in the present or can be based on historical data. The story time can be measured in time units: years, months, days or hours. The scale where the spatial phenomenon takes place determines the locational setting of the story. A phenomenon can take place at global, continental, national, regional or local scale.

2.5 Storytelling techniques

Storytelling is the process of guiding the viewer in building the story from the plot (Bordwell & Thompson, 2004). The plot helps the viewer actively seeking the causal relationships between events, and constructing the chronological order and duration of the story events in his mind. As Segel & Heer (2010) phrase it: '*Storytelling is about structuring the viewers' attention and orienting them across transitions*'. The plot guides the viewer in experiencing a story with a begin, middle and end.

In television journalism, different techniques can be used to support the viewer in following the story. These techniques can be used to guide our attention by letting us notice things that are important in the story, emphasize certain narrative elements over others or just on purpose misguide our attention (Bordwell & Thompson, 2004). Secondly techniques can be used to clarify meanings and guide expectations

For narrative data-visualization different authors have described storytelling techniques. Gershon & Page (2001) mention the following five techniques: setting mood and place in time, continuity, filling gaps, increasing attention, and effective redundancy. Segel & Heer (2010) describe two main tactics that support us in following a story: *narrative structure tactics* and *visual narrative tactics*. Visual narrative tactics are defined as visual devices that support the narrative. Narrative structure tactics are non-visual devices that support the narrative. In my research I think the framework of Segel & Heer will be a good framework to describe the techniques that are used in the data-animations. The *narrative structure tactics* are divided into *messaging* and *order*. Messaging (or narration) is the way story information is presented in words. Narration can for example be used to set the mood and place in time, mentioning certain actions and put the events in context. A second narrative structure tactic is order. Order is defined as the way the events of the narrative are ordered in the plot. In my opinion not only order, but all dynamic variables (moment, order, duration and frequency) can be seen as techniques to support the narrative structure of the story. Moreover, I think that also the selection of aspects of the data that are included in the story can be seen as narrative structuring techniques.

Visual tactics are divided by Segel and Heer (2010) into *visual structuring, highlighting* and *transition guidance*. Visual structuring is about helping the viewer to orient himself in the story by giving him an overview shot or by creating a consistent visual platform. Highlighting is about guiding the viewer's focus to particular elements on the screen. Transition guidance makes sure that changes between scenes are experienced as smooth. In film these are called *editing techniques*. Also camera movements can be used to create smooth transitions. In film theory visual storytelling techniques are often described according to four cinematic techniques: *mise-en-scene*, *cinematography*, *editing* and *sound* (Bordwell & Thompson, 2004). Mise-en-scene in film is the design and arrangement of all that happens before the camera, including lighting, appearance of the characters, contrast between foreground and background, composition and movement of the characters. Translated to data-visualization, the way the geo-data (that can be seen as the characters that perform the action) are visualized (by graphic variables) and the way its spatio-temporal change is visualized (dynamic variables) are mise-en-scene techniques. Cinematography is the way the scene is filmed. Thirdly, editing is the way the different shots are related to each other. Sound can be divided in background music, voice and sound effects. The visual tactics of Segel & Heer (2010) can be considered as effects of the cinematic techniques. By applying mise-en-scene techniques a visual structure is created (by creating a consistent visual platform) and characters and movements can be highlighted (by contrast between foreground and background or the visualization of movement or change). The cinematographic techniques framing and camera movement can have the effect of highlighting the elements, visual structuring, and guiding transitions. Editing has the effect of transition guidance and sound can function to guide transitions (sound bleed), highlight events or contribute to a uniform structure. In the Table 2-3 I related the visual tactics of Segel & Heer (2010) to the cinematic techniques of Bordwell & Thompson. In this research I will describe the animations according to the cinematic techniques. This framework offers a clear distinction between the different aspects of visual storytelling: the way the scenes are *visualized*, the way the scenes are *filmed*, the way the scenes are *connected* and the way the scenes are enriched with *sound*. The visual tactics of Segel & Heer (2010) are used as a framework to describe how the use of cinematic techniques supports the story.

Table 2-3 Cinematic techniques and visual tactics (Bordwell & Thompson (2004), Segel & Heer (2010))

Bordwell & Thompson(2004)	*Segel & Heer (2010)*
Mise-en-scene	Visual structuring, highlighting,
Cinematography	Visual structuring, highlighting, transition guidance
Editing	Transition guidance
Sound	Transition guidance, highlighting, visual structuring

Especially when a data visualization is not only used to explain a certain phenomenon but also to bring a message and bring excitement we should beware of manipulation. When data is manipulated in a narrative presentation the data is most of the time not false, but the data is misrepresented by the author (Zer Aviv, 2014: URL 2.8). Mark Monmonier (1996) teach us in his book "how to lie with maps" to evaluate maps with a certain skepticism: *"Because abstract representations of data can distort almost as readily as they can reveal, analytical tools are also rhetorical instruments fully capable of 'lying' in the hands of malevolent, naïve, or sloppy expedient authors"* (Monmonier, 1996). To avoid missteps in this sense, Giner & Cairo (2011) made up a six point checklist of basic standards that should be met to ensure accurate and ethical data-visualizations. The checklist covers five general standards of ethical journalism: integrity, accuracy, credibility and clarity. The first points of the checklist stress the fact that only reliable, and evidence based data should be used. Second, a credit for the source should be presented. Thirdly, no graphics should be used that are only used to make the visualization more appealing and thereby don`t stick to the evidence.

Within the limits of the six points described above, subtle manipulation of the data is needed however to support the story. By subtle manipulating the data we are able to emphasize certain aspects, create clarity and strategically influence the interpretation of the visualization (Hullman & Diakopoulos, 2011). Hullman & Diakopoulos (2011) created a taxonomy of rhetorical techniques that can be applied to do so. The rhetorical techniques that the authors distinguish are: map-, information-, provenance- and linguistic-rhetoric techniques. These techniques can be applied on four different editorial layers. On the data level rhetoric choices about what information to leave out and what not are made. On the level of visual representation there is played with the constraints of the human brain to perceive visual information. Zer Aviv (URL 2.8) argues that on this level there are many options for manipulation: "*We get to use contrast and color, size and composition, shape and typography, movement and interaction… every choice is an opportunity to suggest a specific reading of the data, an opportunity to lie while seemingly telling the truth".* On the annotation level thirdly, one can orient the attention of the viewer to certain areas with annotation. The interactivity level that Hullman & Diakopoulos (2011) mention does not apply in this research as the animations are non-interactive.

In my opinion the rhetorical techniques can be described within the framework of cinematic techniques. Map rhetoric is about the way data is translated into symbols and can be described as a mise-en-scene technique. Information rhetoric can be seen as a narrative technique as it is about the choices what is part of the story and what is not. Below, an overview is presented of the storytelling techniques (Table 2-4).

Table 2-4 Overview of storytelling techniques

NARRATIVE TECHNIQUES			
Variable:	*Based on concepts:*		
Narration	Messaging (Segel & Heer, 2010)	Narration (Bordwell & Thompson, 2004)	
Manipulation of time	Order (Segel & Heer, 2010)	Manipulation of time (Bordwell & Thompson, 2004)	Manipulation of dynamic variables (Blok, 2005)
Data simplification	Information rhetoric (Hullman & Diakopoulos, 2011)		

VISUAL TECHNIQUES		
Variable:	*Based on concepts:*	
Mise-en-scene	Foreground vs background (Bordwell & Thompson, 2004)	
	Appearance of character (Bordwell & Thompson, 2004)	Graphic variables (Bertin, MacEachren, Morrison)
	Movement (Bordwell & Thompson, 2004)	Technical and Modeling dynamic variables (Rebah & Zahin)
	Map rhetoric (Hullman & Diakopoulos, 2011)	
Cinematography	Framing (Bordwell & Thompson, 2004)	
	Camera movement (Bordwell & Thompson, 2004)	
Editing	Editing (Bordwell & Thompson, 2004)	
Sound	Sound (Bordwell & Thompson, 2004)	

2.5.1 Narrative structure techniques

2.5.1.1 Narration

Narration helps us to build the story out of the plot. It is the way story information is presented to the viewer. For journalistic data animations this means that on the one hand narration can be used to explain what the visual symbols represent, also called annotation. On the other hand, narration in data animation is used to communicate the actual story. Narration helps in communicating the causal relationships and context of the events in the story. It can guide our attention to certain important events that are visible on the screen. In journalistic data animations often a narrator is used as there are no human characters that can talk. A narrator is a person that tells us a part of the story by voice. The narrator can be a character in the story (first person) or can be outside the story world (third person). First person narrators are more involved in the story, but give us only information that is observed from the actions of the characters. A third person narrator can give us a broader background of the story as he describes the actions from an external perspective. This type of narrator is considered as more objective and authoritative and thus more reliable. In a good story, the information the narrator gives should not illustrate the visual information but should add a new aspect of the story. The visual and the verbal message however, should not contradict each other as this will diminish the reliability of the narrator.

2.5.1.2 Manipulation of time

Story events take place in time. In the plot we can manipulate the moment when the events are displayed, the order, duration and frequency of the story events. In other words, we can manipulate the dynamic variables as described by Blok (2005) to support the story. Blok (2005) described the manipulation of dynamic variables as techniques to generate effects that support scientific monitoring. These effects of manipulating dynamic variables can for a great part also be effective in supporting storytelling.

Manipulating the dynamic variable moment of display can be used to show certain selections of the data. By making selections certain aspects of the data that are of interest can be isolated (effect). At first, one can choose to show selections in time. One can choose to select a certain continuous piece of time from the real story duration or one can select several short pieces of time from the story. Next, specific locations can be selected by zooming. Thirdly, specific thematic values can be selected, for example values above or below a certain threshold or certain intervals. Moment of display can also be used to show selections of classifications and color schemes (Blok, 2005). The effects of this type of manipulation are however rather meant for scientific monitoring and are not thought to be relevant in storytelling.

Order, the second dynamic variable, can be manipulated by re-ordering the story events. We can for example use flashbacks or flash-forwards. As a chronological order can be visualized as ABCD, a flashback can be written as **BA**CD and a flash-forward as AB**DC**. Also, order can be used to alternate moments or thematic values. This is called swapping (Blok, 2005).

Also, the author can play with the duration of the events that will be presented in the plot. Each events has a certain duration in story time. On screen the duration can be expanded: an event that in the story only takes little time can be stretched out in screen duration in order emphasize the event. Expanding duration is called slow motion. An event that has a long duration in the story time can be compressed to short screen duration. This can be done by accelerating the whole scene (accelerated motion), or by cutting the scene.

Frequency can be used to repeat the same events. When the events is shown multiple times this helps in better understanding the event. In storytelling repeating exactly the same events is unlikely to happen and is more useful in scientific monitoring. However, repeating events at different locations might generate an effect that is supportive for storytelling. The same is true for repeating story time in order to show different sub-processes of the story that happen simultaneously.

2.5.1.3 Data simplification

In a data visualization often not the complete dataset is visualized. To create the structure of the story, first choices has to be made what aspects of the data are included and what are left out. Information rhetoric techniques are used to "*simplify complex ideas in a visual representation as is it often helpful to keep distracting or irrelevant information to a minimum"* (Hullman & Diakopoulos, 2011). Loss of information is often necessary for a quick understanding of the visualization. Information rhetoric techniques can be divided into omission techniques and metonymy techniques. An example of an omission technique is to set a threshold to omit certain values. For example, to show the decrease in expensive houses, only houses with a value over 1 million euros are shown. Also, exceptional values can be omitted to keep a clear storyline without confusing the viewer. The other way around, only focusing on exceptional values can also be seen as an omission technique.

Metonymy techniques are used to manipulate part-whole relationships. One can for example choose to show only a selection of the data. Next, aggregation can be used to present a simpler representation of the original data values, which can be beneficial for a quick perception and memorizing. Aggregation techniques that can be distinguished are calculating the average, sum, maximum and minimum values or count. Categorization or classification can be used to make a certain effect more obvious. Everit (1980) defines classification as: "*a division of the objects or individuals into groups based on a set of rules – it is neither true nor false – and should be judged largely on the usefulness of the results*" This last statement is very important as it makes clear that in deriving a certain classification subjective choices are made. In a narrative data-visualization one can choose to emphasize certain categories more than others. Also, the choice for class breaks can be used to emphasize a certain effect. Aggregation and classification influences the measurement scale of the data. After classification, information is lost as variation within the categories cannot be retrieved anymore. On the other hand, the information can be quickly perceived and memorized.

2.5.2 Visual storytelling techniques and sound

Visual storytelling techniques are all visual devices in the animation that help us following the story. The use of visual techniques to support a narrative is well described in film theory. Visual techniques that are especially related to data-visualization will be described within the classification of cinematic techniques. After describing the characteristics of each technique I will describe how these techniques can be applied to data-animations.

2.5.2.1 Mise-en-scene

Three mise-en-scene techniques I think are important in data visualization: the setting of the environment where the events take place (**a**), the visual appearance of the characters (**b**) and the visual appearance of the movement of the characters (**c**). As been shown in Table 2-3 mise-en-scene is used for visual structuring of the story and highlighting of entities and actions.

The first mise-en-scene technique, setting (**a**), is the way the background in front of which the action takes place is shaped. Color contrast is an important component of the setting. The background is often given an unsaturated color. Saturated, warm colors are often used for foreground items to attract the attention. Lighting can be used to create a contrast in brightness between the object or actions and the background, or highlighting them.

In data-visualization, unlike film, no human characters but visual representations of real world (living) objects, or fields are the characters that perform the action. In data-visualization, the second aspect of mise-en-scene, the visual appearance of characters (**b**), in thus about the way data entities are visually presented. To visually represent geo-data entities graphic variables (as described by Berin, 1974, Morrison, 1974, MacEachren, 1995) are used. In this thesis these are described in section 2.3.1.

Except just representing the data entities, the use of graphic variables can be used to emphasize certain aspects of the data or just make certain aspects seem unimportant. Several map rhetoric techniques (Hullman & Diakopoulos, 2011) can be used. A first map-rhetoric technique is obscuring. For example one can choose to oversize features to emphasize, or just make features too small. Other, often non-intentionally applied obscuring can be to present information not in the most salient visual representation. Classification, thirdly, can be used to prioritize certain clusters by grouping values by color, size or position.

Thirdly, the visual appearance of movement is (**c**), applied to data-visualization, is about the way spatio-temporal changes of the data are visualized. In section 2.3.2 I described that technical and modelling dynamic variables (Rebah & Zahin, 2011) are multimedia techniques that are used to emphasize spatio-temporal change of the data entities. The visual appearance of movement will thus be described by these technical and modeling dynamic variables. These dynamic variables are different than the dynamic variables as described by Blok (2005). Blok`s dynamic variables are used to create certain effects that support the narrative *structure* of the story and not so much the visual representation of spatio-temporal changes of the data itself (Rebah & Zahin, 2011).

To conclude: the following questions can be used to analyze the use of mise-en-scene techniques:

- How do the background and the foreground relate with each other (brightness / contrast)?
- What graphic variables (see section 2.3.1) are applied to visualize the entities that perform the action?

- What technical and modeling dynamic variables (see section 2.3.2) are used to visualize the action?

2.5.2.2 Cinematography

Cinematography is the *way* the scene is filmed. Thereby *framing* is the most important aspect. Framing is defined as the image that we see on screen. The frame determines what we see on the screen and what is off-screen. Camera *angle,* camera *distance* and camera *movement* are three different aspects of framing. All what we see in the frame is framed in a certain angle. In a high angle position, the framed material is looked upon from above, in a birds eye perspective. In low angle position we see the material from a low perspective. The height from which the scene is filmed is closely related to the angle.

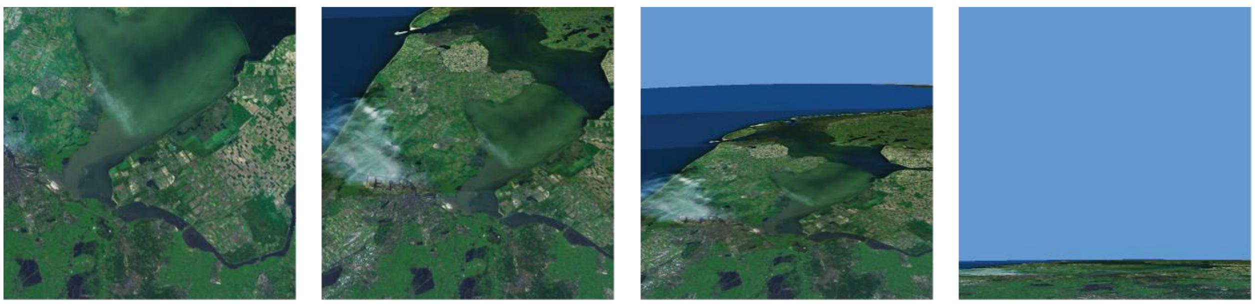


Figure 2-16 Camera angles: top view (left) to low angle (right)

Secondly, framing is about the camera distance to the scene that is filmed. The scene in geo-data animations is the earth surface. In film camera distance is described as range between extreme long shots to extreme close up shots. In an extreme long shot the background dominates, it gives an overview of the situation or process. In a close up details are focused on. To describe the camera distance or zoom-level for geo-data scenes I used the distance in km from the earth surface. I used 13 levels, ranging from 0.5 km till 2500 km above the earth surface (Figure 2-17). Looking at a distance of 2500 km the whole earth is visible: global scale. At a distance of 1 km individual building blocks can be distinguished: local scale. Each level has a tolerance, which is calculated by adding half the distance to the next level above and subtracting half the distance to the previous level. For example, zoom level 4 is on a height of 250 km. The level below (level 3) is at 500 km and the level above (level 5) at 100 km. Then the tolerance of the level is between 175 and 375 km. The zoom-levels will be used to analyze the camera distance.

In general, framing techniques (camera distance and angle) can support the narrative by establishing where the event takes place by the use of a long camera distance or low zoom level. After the establishing shot it is common to zoom in onto the action (close up). When the action has taken place, is it often useful to provide a re-establishing shot. By doing so, the viewer will be able to set everything he or she just saw in place. By the use of short camera distances or high zoom levels important narrative details can be isolated (highlighting). When a framing is used from the point of view of a character, this can let us experience subjectivity. Framing techniques can be applied in data-animations in the same way as in film.

The frame in film often moves during the shot with respect to the object that is framed. Camera movements that can be distinguished are panning, tilting, and zooming. When panning, the camera moves on the same height from one location to the other. By tilting the camera rotates around a horizontal axis and thereby makes a transition between two different camera angles. In a zoom, the camera does not move, but the lens focusses from a low zoom level to a high zoom level (zooming in) or the other way around (zooming out). A zoom-in creates a closer relationship with the object and the attention is guided to details that were first invisible. While zooming out, more of the scene is revealed to the viewer. The speed of zooming is important in affecting the mood of the viewer.

Camera movement is mainly used to follow the movement of a character or object. By reframing according to the movement, the compositional balance is preserved. This helps in keeping the attention of the viewer at the subject. The velocity of the camera movement can support the manipulation of cause and effect. Another function of camera movement is letting the viewer imagine three-dimensionality. This can be reached by letting the camera move around an object.

2.5.2.3 Editing

A predominant style of editing that is practiced in narrative film and video is continuity editing (Bordwell & Thompson, 2004). Continuity editing is used to smooth the transitions between shots and to experience a logical coherence between shots. Smooth transitions are used to ensure narrative continuity. It helps the viewer in following the story. Several continuity editing techniques can be used, aimed at preserving temporal (**a**) or spatial (**b**) continuity. The first temporal continuity (**a**) editing technique is to avoid breaks in story time; assuming a film shot in one take is the most continuous. However, cuts often prove to be necessary as the story time is often much longer than the display time. Cutting can be used to change the scene, change the viewpoint of the scene, compress time or building up an image (Chandler, URL 2.9). When cuts are needed, several techniques can be distinguished to smooth the transitions between the shot before and after the cut. These techniques are the use of overlapping sound and matching techniques. If a cut is made to jump to another time period in the story

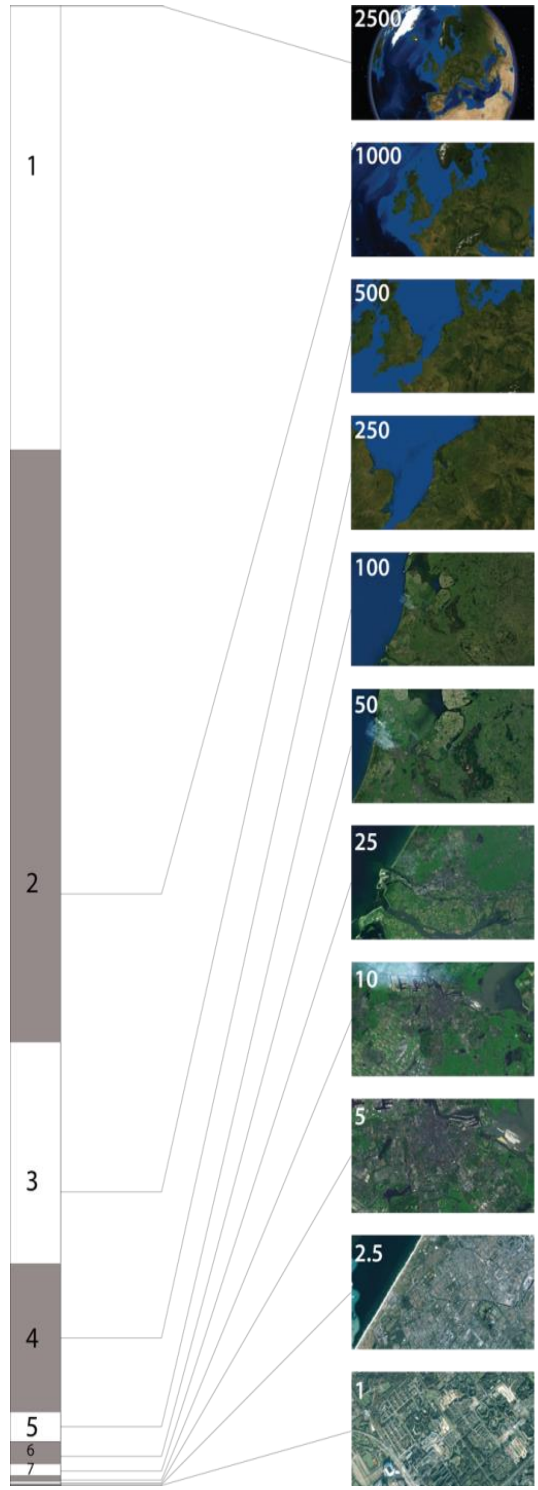


Figure 2-17 Zoom levels

time, also dissolving, fading and flashback techniques can be used to preserve the continuity. To preserve spatial continuity (**b**), establishing shots, the 180-degree and 30 degree rule, and cross or jump shots can be used.

Smooth transitions can be reached by keeping the graphic qualities continuous between the shots, keeping the lighting constant, centrally framing the action that takes place, and balancing the objects within the frame. 'Visual structuring', one of the visual tactics described by Segel & Heer (2010), is realized by creating a consistent visual platform can be seen as a matching technique.

When changing between the viewpoint of the scene one can achieve spatial continuity by using the 180° axis of action rule. The 180° axis is an imaginary line, drawn between two characters that are in the action. To avoid disorienting the viewer, the camera should not cross this axis, but stay within the half circle. The 180 degree rule ensures consistency in the relative positions of the entities that are performing the action. Also, it ensures that the direction of the movements is constant. Another rule is that the angle between two shots should not be within 30°. Smaller changes in angle might confuse the viewer. Although no human characters play a role in data-visualizations, the 180 and 30 degree role can be applied as well while following abstract entities.

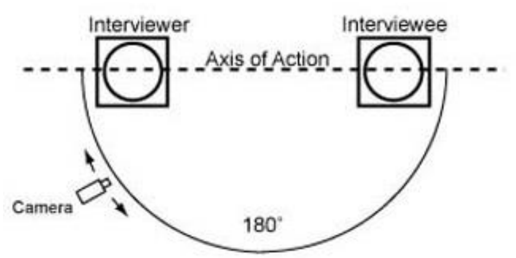


Figure 2-18 180 degree rule (URL 2.10)

2.5.2.4 Sound

Like the other techniques described above, sound is used to guide our attention through the story. According to Dransch (2000) the combination of sound and image makes it possible to double encode information as both memory stores in the brain are activated. In general sound cooperates with the movements on the screen. Sound can be diegetic or non-diegetic. Diegetic-sound means that the source of the sound is coming from within the story space. The data itself don`t make a sound like characters and objects in film, but, when sonification of data (Kramer, 1993) would is used to perceptualize data, we might speak of diegetic sound. Non-diegetic sound is coming from outside the story. Non-diegetic sound can be divided into voice-over, sound effects and background music. According to Sobochack & Sobochack (1987), background music is used to add emotion and rhythm to film. Background music is often used subtle and is often not noticed by the viewer. To announce an exciting moment in the film, dissonant music can be used or the music can be speeded up. A musical theme can have an association with a certain aspect of the narrative. It helps the viewer in observing a motif. Sound effects can be used to give a sense of reality and are often not noticed. Like the ordering of the scenes in the visual image, speech also has a rhythm. When speech is emphasized, often the changes between scenes happen during natural pauses in the line (Bordwell & Thompson, 2004). When sound that belongs to a certain scene is used shortly in the next scene this is called a sound bridge. Sound bridges can help in smoothing the transition between two scenes.

2.6 Effectiveness of storytelling

Until now I have described the structure of a story and the techniques that can be used to support in telling a story via an animation. I described that a story guides the viewer through a sequence of events. By telling a story information can be communicated quickly. Also, a story manipulates the expectations of the viewer and thereby evokes emotions as curiosity, suspense and surprise. A story is described as a format that helps people in remembering information better. Until now, these assumptions were derived from literature. But how does the audience actually respond to stories told by data-animations? How effective did they acquire the message of the story? And to what degree are people engaged in the story?

According to Dow et al. (2007 p-1467) engagement "*refers to a person's involvement or interest in the content or activity of an experience, regardless of the medium*". A classification of engagement in *behavioral, emotional, cognitive engagement* and *voice*, according to Reeve (2006) might be useful in understanding the concept of engagement. When the viewer shows behavioral engagement the viewer shows positive attention, effort and persistence. Emotional engagement is about showing positive emotions of interest, curiosity, suspense and enjoyment. Cognitive engagement and voice are less likely to be present while watching the data animations as there no activity the audience can participate in.

Busselle & Bilandzic (2009) described four variables of narrative engagement. The first variable *narrative understanding* is about the ease at which people are able to follow a story from what is presented. Secondly, attentional focus is about the degree to which a viewer is distracted. Emotional engagement describes the degree of emotional arousal that is evoked during watching the animation. Narrative presence fourthly is about the degree to which the viewer has the sensation of being in the world of the story. Attentional focus and narrative presence I think are hard to measure in animations that only take one minute. To forget the outside world within one minute might probably not happen.

As been mentioned, storytelling is on the one hand considered as an effective way to convey information (Gershon & Page, 2001; Segel & Heer, 2010). On the other hand, a story is about creating excitement and drama (Ekström, 2000; Bordwell & Thompson, 2004). Altogether, a story is effective as the viewer is able to follow it and understands the message *and* when it evokes emotions by the viewer. In this research I will address both understanding and emotion to answer the question whether the data animations are effective.

3 Methodology

The relation between the different concepts that are described in the previous chapter is summarized in the conceptual scheme (Figure 3-1). In the conceptual scheme the relations between the concepts are related to the research questions. In this way the methodology that is followed can be read from the conceptual scheme. The research started with a selection of research units; the animations. The animations that are selected together form the case study. For the selected animations at first the narrative structure will be investigated (Q1) by looking at the plot structure, aspects of interest, causality, theme and setting. Next, the narrative (Q2) and visual (Q3) techniques that are used in the animations will be analyzed as well as the way these techniques do support the narrative structure. So far, the animations are analyzed from the perspective of the author. The next part of the research focus on the perspective of the viewer by measuring experience (Q4). Thereby narrative understanding and emotional engagement are analyzed.

The first part of the research (Q1, 2, 3) is inductive: by analyzing specific instances (animations) I try to come to general insights about how to tell stories with geo-data in an animation. The selection of the sample of animations directly influences the external validity. External validity is the degree to which my conclusions can be generalized across the total population of geo-data animations (Bryman, 2012). In the conclusion (chapter 5) the way my results can be generalized are described. By accurately describing the methods the external reliability of this research will be kept as high as possible. External reliability is the degree by which the research can be replicated (Bryman, 2012).

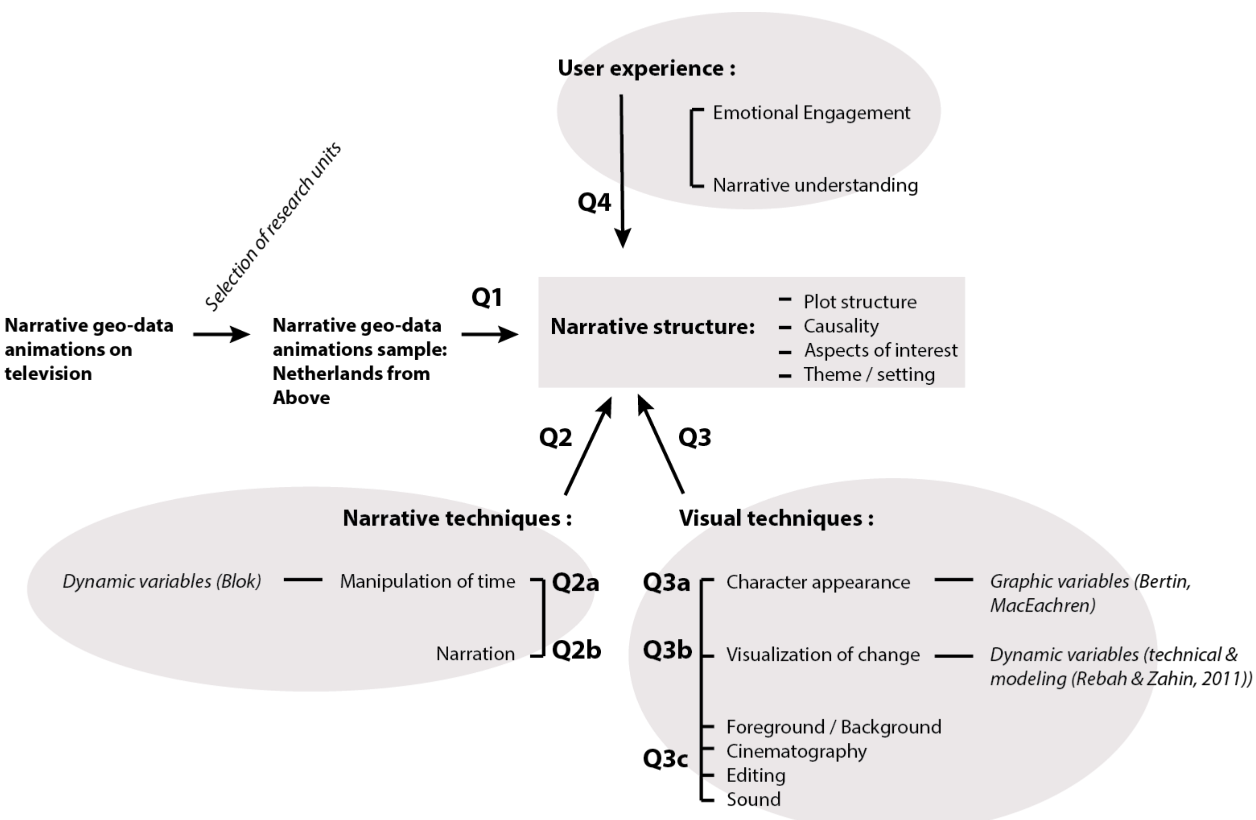


Figure 3-1 Conceptual scheme

3.1 Selection of animations

In this research I focus on journalistic data-animations on television. It is not possible to incorporate all data-animations that are made for television. In this research I will use the 21 data-animations that have been made for the second season of the Dutch television series ´The Netherlands from above' (Table 3-1). The reason for the choice for this sample is twofold. First, data-animations in television journalism are relatively new. The pool of research units is simply very limited. Altogether I think the sample of 21 animations will for a great part cover the different possibilities of telling stories with geo-data. During the production process of the animations, there was no restriction in the type of geo-data to be looked for. There is also a wide variety of topics animated. The sample of 21 animations can be regarded as a representative case. The second reason for choosing these animations is my own personal involvement in the creation of these data-animations. The advantage is that I have access to the animations and to information about the underlying geo-data and storytelling process. The theory that is generated from this study can be useful for the creation of other narrative animations, but doesn't have the intention to be normative. As little literature exists about narrative animation, this study is an attempt to generate theory from research. It is in this sense more inductive than deductive.

Table 3-1 The 21 animations that are selected

no.	date	episode	title	description
1	14-Nov	*movement*	organs	Cars transporting vital organs speeding to hospitals
2	14-Nov	*movement*	crossroads	spreading out of bakers, fisherman and scholars from Bunschoten
3	14-Nov	*movement*	deers	Estrus reddeers crossing ecoduct and roadkills
4	21-Nov	decay	wrecks	Wrecks on the sea floor
5	21-Nov	decay	roadassist	car trouble and roadassist
6	28-Nov	dead	honeybuzz	Couple of honeybuzzards migrating and separating
7	28-Nov	dead	snowplow	Blizzard takes over: saltspreaders and snowplows
8	05-Dec	light	lambs	grazing lambs in the city of Rotterdam
9	05-Dec	light	logistics	Food orders (nationwide) and home delivery (in the city)
10	12-Dec	nest	sedentism	Generations of families moving or staying
11	12-Dec	nest	homesales	Home sales from 2003 to 2012: from boom to downturn
12	19-Dec	blooming	roses	Individual flowers leaving the country as bouqet
13	19-Dec	blooming	waste	Household waste from home (and abroad) to incineration
14	02-Jan	challenge	New land	Timelapse of dredgers building new land (2009 - 2013)
15	02-Jan	challenge	oystercatcher	Oystercatchers along the shoreline looking for food
16	09-Jan	climax	fate	Hit by luck or struck by lightning?
17	09-Jan	climax	wind	Flock of swifts meeting above the lake at sun set
				Wind flows during one whole year + bird migration
18	16-Jan	harvest	import/export	Main import and export of food products
19	16-Jan	harvest	milkyway	Milk transport from farm to factory and store
20	23-Jan	turning point	Urban	Urbanisation in NL
21	23-Jan	turning point	shrink	Closing schools and departing residents

3.2 Answering research question 1 – 3.

Q1: *How can the narrative data-animations in television journalism be described?*
The first research question is about the form of the stories that are told by the animations.

Q1a: *Does the animation follow a traditional plot structure?*
This first question will be answered by investigating how the animations begin, what development is followed in the middle part and how they end. Using a data-matrix for each animation I will examine whether introductions, inciting incidents, climax and resolutions can be observed (Laurel, 1993; Freytag, 1894; Bordwell & Thompson, 2004) see Table 3-2. Also, for each animation the plot structure will be drawn.

Table 3-2 Data matrix plot structure

	introduction	Inciting incident	Climax	Resolution
Animation x	Y / N	Y / N	Y / N	Y / N

Also, there will be looked whether the order at which story information is presented leads to surprise, curiosity or suspense
Table 3-3). In the end, the information that is generated by answering this question will lead to a classification of narrative structure types that are used in narrative data-animations.

Table 3-3 Data matrix expectations

	Curiosity	Surprise	Suspense
Animation x	Begin / middle / end	Begin / middle / end	Begin / middle / end

The animations are all about focusing on a certain type of action: what kind of change does the author want to show us? This will be investigated by watching the animations and filled in in the following data-matrix (Table 3-4)

Table 3-4 Data matrix change

	Actions
Animation x	Investigated by watching the animations

A story is about the presentation of causally related events (Bordwell & Thompson, 2004). I will investigate if the events in the data-animations are in fact related by cause and effect (Table 3-5).

Table 3-5 Data matrix causality

	Relation between events
Animation x	Causal / comparison / no relations / other

Q1b: *What is the theme of the story in the animations?*
Secondly I will be investigating which themes, based on the classification of the Global Environment Outlook, are most commonly addressed in the animations. My conclusion will be drawn from what themes might be most suitable in narrative data-animations. In a data-matrix, (Table 2-2, second column) themes are assigned to each animation. The number of animations that use a certain theme is represented in a frequency table.

Q1c: *What is the setting of the story in the animations?*
Next to plot and theme, the setting is a fundamental component of a story. To describe the setting the geographic location and the time period of the story takes place are looked at. This will lead to insight in what type of setting might be most suitable in narrative data-animations. To describe the geographic location the following categories are used: international, national, regional and local. The classification of the periods in time will be defined after investigating which periods are used in the animation. At first, each period will be

measured in days. Next, groups of similar periods will be distinguished. Per category of geographic location and time period a frequency table will presented in order see what settings are most used.

Q1d: *What aspects of geo-data are used in the narrative animations?*

Is the animation is about trends, extreme values or causal relationships? First, I will determine whether these aspects of data are actually used in the data-animations. Next, by watching the animations other aspects of the data that appear to be interesting for storytelling will be identified. To come to an answer on this question thus both inductive (discovering new types) and deductive (looking for existing types) approach is used.

Q2: *What narrative techniques are used in the animations, in what way do they support the story?*

Narrative techniques are divided in manipulation of time (Bordwell & Thompson, 2004), also described as the manipulation of dynamic variables (Blok, 2005) or order (Segel & Heer, 2010), and the messaging of story information: narration (Bordwell & Thompson, 2004; Segel and Heer, 2010).

Q2a: *How is time manipulated by the use of dynamic variables?*

In section 2.5.1 I described how dynamic variables can be used to manipulate time. I will investigate how the dynamic variables (Blok, 2005) are used in the animations (see Table 3-6)

Table 3-6 Data matrix dynamic variables

	Moment of display: *selections in*:			Duration		Order	Frequency	
	Time	Location	Value	Expanded	Compressed		Show diff. locations	Show diff. sub-processes
Animation x	Y / N	Y / N	Y / N	Y / N	Y / N	ABCD	Y / N	Y / N

Q2b: *How is story information communicated through narration?*

To answer this question the narrated text of all the animations is transcribed. Next, the voice-over texts are analyzed: what types of sentences are used and how do they relate to the visual component of the animation. The data matrix that is used is shown below (Table 3-7)

Table 3-7 Data matrix narration

			Introduction / Summary	Annotation: direct	Annotation: indirect	Context
Animation x	*Sentence 1*	*"These are 12 energy plants"*	Y / N	Y / N	Y / N	Y / N
	Sentence 2	*"Refuse trucks on their way with industrial waste"*	Y / N	Y / N	Y / N	Y / N

Q3: *What visual techniques are used in the animations, in what way do they support the story?*

Visual techniques can be divided into mise-en-scene, cinematography, editing techniques and sound (Bordwell & Thompson, 2004). Mise-en-scene is the way the scene is filmed. Two aspects of mise-en-scene are the appearance of characters and movement. In our geo-data animations the characters that perform the action are the visual representations of the data. In the first sub-question the way geo-data is visualized is answered; it investigates the use of graphic variables (Bertin, 1974; Morrison, 1974; MacEachren, 1995). The second sub-question investigates the way the change of the characters is visualized; the use of technical and modeling dynamic variables (Rebah & Zahin, 2011). The third sub-question is about the other aspects of mise-en-scene, cinematography, editing and sound.

***Q3a:** How are spatial objects and fields represented (graphic variables)?*

The goal of communication is a quick perception of information. Only lower measurement levels (nominal and ordinal) are suited to obtain this goal (Morrison, 1974). At first it will be investigated whether differentiation in nominal, ordinal or numerical values is actually used. If there is a difference between those values I will use the animations to learn which graphic variables are used to visualize these differences. For nominal differentiation the perception goal is of importance. For example, nominal categories can be presented differently in order to stimulate selective perception or associative perception (Bertin, 1974). Thirdly, the number of different classes that are shown simultaneously in the animations is analyzed. The data matrix that will be used is shown below (Table 3-8).

Table 3-8 Data matrix graphical variables

	Differentiation	Measurement scale	Perception goal (nominal)	Graphic variable	No. of classes
Animation x	Y / N	Nominal / ordinal / numerical	Selective / associative	Color / size / shape / etc.	..

***Q3b:** How is spatio-temporal change represented?*

The type of spatio-temporal change that is shown in the animation will be analyzed according to the classification of Blok (2005), see Table 3-9. Also, the way the change is visualized (technical and modeling dynamic variables (Rebah & Zahin, 2011) is investigated and entered into a data-matrix (Table 3-9)

Table 3-9 Data matrix spatio-temporal change

	Movement along path	Boundary shift	Mutation	Appearance / disappearance	Connection	No change
Animation x	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N
	Visual effect	Visual effect	Visual effect	Visual effect	Visual effect	Visual effect

***Q3c**: How are the other visual techniques used in the animations?*

The relation between foreground and background (mise-en-scene), cinematographic techniques, editing and the use of sound are investigated. The data-matrix that is used is shown below (Table 3-10)

Table 3-10 Data matrix cinematography, editing and sound

	Zoom level max	Zoom level min	Tilting	Panning	Editing	Background music	Sound effects
Animation x	12	2	Y / N	Y / N	Y / N	Y / N	Y / N
					Description	Description	Description

3.3 Measuring user experience [Q4]

Q4: *Are the variables effective in supporting the storytelling techniques?*

After analyzing what conventions have been used in the animations (this is the conclusion of **[Q3]**), the next step is a user study to measure the effectiveness of the animations. This is done according to two variables of effectiveness: narrative understanding (Busselle & Bilandzic, 2009) and emotional engagement (Busselle & Bilandzic, 2009; Reeve (2006)).

3.3.1 Reference group

At first a reference group will be selected. The reference group is a sample of the audience of the Netherlands from Above series. In the figure the differentiation of age of the audience that has watched the series is shown.

The biggest age groups are 50+ (21.4%) and 35 – 49 (13.4%), followed by 6 – 12 (10.6%), 13 – 19 (9.9%) and 20 - 34 (9.3%). Male and female viewers are distributed evenly in the target group: 48% men and 52% women (Kijk & Luister onderzoek, 2014). Next, in the description of the target group of the series, eight different groups are distinguished based on a specific combination of demographic variables, personal values, the way leisure time is spend, and media needs (NPO Kijk en Luisteronderzoek, 2014). In the audience, the group "involved believers" (betrokken gelovigen) are most represented (30.4%), followed by (28%) the critical thinkers (kritische verdiepingzoekers). In my research selecting on these life-style criteria will not be done as the criteria are not very clear-cut. I will select a sample group that only resembles the distribution of age and male – female ratio that is found in the target audience.

3.3.2 Questionnaire

The people in the reference group will be approached via the internet. The survey was created using Google Forms. This software offers an attractive format to present the questions and has the possibility to add video content to the survey. Another advantages of this online survey tool is that the replies are immediately stored in a database. Next, the response rate of online surveys is often fast, and a wide range of people can be reached in a short period. A disadvantage might be the lack of nuance or detail. Compared to face-to-face interviewing, to a lesser extent the reason why people answer the way they do can be investigated. The survey was sent to the potential respondents by email (78 people reached + forwards by these 78), the Netherlands from Above Facebook (3991 followers) and via Twitter (1005 followers). The survey was sent on the 10th and 17th of June 2014. In total 64 people responded in a period between June 10th and July 9th. The distribution of age groups can be seen in Table 3-11. Compared to the actual target audience we can state that I missed two age groups: 6-12 and 13-19 years old. The age groups that answered my survey most were people in the age group 50+ (48%) and 20-34 (44%). The high response rates in these age groups can be explained by the fact that people in these age groups are more likely to know me personally. Although I did reach a lot of people I didn't know, people still are more likely to fill in the survey for someone they know. The male-female ratio of my respondents is 47% female and 53% male, which differs from the target group in which 52% where female and 48% male.

Table 3-11 Target audience and respondents. Number per age group

Leeftijd	number	%	number	%
50+	687000	21,4%	31	48%
35 - 49	201000	13,4%	5	8%
20 - 34	84000	9,3%	28	44%
13 - 19	26000	9,9%	0	0%
6 - 12	7000	10,6%	0	0%

I included a selection of four animations in the survey. The selection is based on the spatio-temporal change that is visualized. The way the phenomena that the data represent change in time determines for a great part the characteristics of the animation. For example, animations that show movement along a path (tracks) have a different approach than animations where only appearance and disappearance is visualized in the sense of camera movement, editing and graphic and dynamic visualization effects. I selected the following four animations:

1. Organs - tracks
2. Schools - points appearance
3. Home sales - point appearance
4. Internal migration - connections

The experience of the audience is measured by making use of a semi-structured survey: a combination of closed (Likert scales and multiple choice questions), and open questions. The Likert scale ranges from totally disagree (0) to totally agree (5). For the multiple choice questions selecting more than one answer is possible. The survey is presented in Appendix B or can be read online (URL 3.1)

Based on both theories of Reeve (2006) and Busselle & Bilandzic (2009) I will test to what degree people are engaged in the data-animations according to their understanding of the story (narrative understanding) and their emotional engagement. Behavioral engagement (Reeve, 2006) will not be measured. This is because I choose to use a survey to measure the experience of the viewer which implies that it is not possible to observe the reactions of the viewer.

To measure the narrative understanding questions are asked about the ease of following the story and questions to test whether the viewer rightly understood the general message. The following questions are asked:

Question A:	*It was difficult to follow the events in the animation from begin to end? (Likert scale)*
Question B:	*The structure of the story in the animation is logical (Likert scale)*
Question I:	*This animation is about: (list of 4 different statements, multiple answers are possible)*
Question H:	*Question about specific objects: did the viewer understand what the visual entities meant? (open)*

Next, narrative understanding is measured by relating the experience of the viewer to the intended message of the creator of the animations (the baseline measurement). If the message of the storyteller is understood by the viewer, the narrative understanding appears to be high. The baseline measurement is performed by asking Frederik Ruysch, the creator of the animations, to answer the following questions: "*What in the animation spoke out to you?"* (Question F, Appendix B) and "*Can you describe the story of the animation in one or two sentences? "* (Question G, Appendix B) The result is shown in Table 3-12. Next, these same questions were posed to those filling out the questionnaire to see ifstory was understood as intended.

Table 3-12 Baseline measurement narrative understanding

Animation 1: **Organs**

What in the animation spoke out to you ?

The organs are transported in a short period of time, with different cars, some of them even are transported abroad, sometimes even with a regular flight.

Themes: *speed, international, distances, flying*

Can you describe the story of the animation in one or two sentences?

The organ transport (heart, lungs, kidneys) of died donor bodies in Utrecht and Amsterdam with destination Leiden, Rotterdam, Groningen, Germany and Croatia.

Animation 2: **Schools**

What in the animation spoke out to you?

Areas where the population is decreased, where young families have left, are not only found in the Randstad but are found everywhere. Many schools in these areas are on the list to be closed.

Themes: *schools in danger, geographic spread of shrinking areas*

Can you describe the story of the animation in one or two sentences?

In the Randstad schools have to close, but in Zeeland en Groningen the amount of schools is in relation to the province total the most. This scholastic year 7 schools will close in Zeeland and 11 in Groningen.

Animation 3: **Home sales**

What in the animation spoke out to you?

The financial crisis has a great impact on the price of houses. The number of houses with a value over 1 million is decreased; the number of houses below 100.000 euro is increased.

Themes: *impact on house prices, decrease of expensive houses, increase of cheap houses*

Can you describe the story of the animation in one or two sentences?

The most expensive houses are concentrated in the Randstad and Gelderland. In the border regions the cheapest houses are located. Villawijken tellen minder huizen boven de miljoen.

Animation 4: **Internal migration**

What in the animation spoke out to you?

10% of the families in Staphorst moved from their village. From the poor town of Assen 10% van de families moved to the mining areas in Limburg. Almere not only receives many people from the Amsterdam area but also from elsewhere. People that leave Almere don`t have a preference for a city or region.

Themes: *stable population of Staphorst, mining areas, high volumes of from and to migration in Almere*

Can you describe the story of the animation in one or two sentences?

The way families have spread from Assen, Staphorst and Maastricht. And where house owners from Heerlen and Almere have moved to.

Emotional engagement is about the degree of emotion that is evoked when watching the animation. When people show emotional engagement they show positive emotions like interest, suspense, curiosity and enjoyment (Reeve, 2006). When people are involved in the subject of the animation they are more likely to show a positive emotional engagement. Next, when people are emotionally engaged they more likely want to see the animation again, tell people about it or like to know more about the subject. To measure emotional engagement I asked the following questions (see also Appendix B):

Question C: *The animation interests me (Likert)*
Question E: *I am involved in the subject of the animation (Likert)*
Question J: *After watching the animation I..*
□ *would like to see it again*
□ *wouldn't like to see it again*
□ *tell other people about it*
□ *would like to know more about the subject*
Question K: *The animation especially has..*
□ *Enjoyed me*
□ *Surprised me*
□ *Learned me something*
□ *Bored me*
□ *Made me curious*

In the end of the surveyed people are asked to mention any other remarks about the animations (Question L, see Appendix B). The information that is generated by the answers on this question might lead to interesting insights about their experience.

3.3.3 Analyzing questionnaire

The answers on the open questions are analyzed by coding. Coding is a way to find relevant themes. Coding is performed by reading through the text and trying to assign keywords that best describe a certain expression. In the end all the expressions are attached a certain keyword. Next, groups of keywords are combined to form themes. The themes must not overlap and the list of themes must cover all the information (Bryman, 2012). After the creation of a list of themes, the number of occurrences of certain themes is analyzed in order to find whether certain themes are more prominent than others. Quantification thus helps in getting an idea of the relative frequency and will help in drawing conclusions about the importance of certain themes over others. The results of the analysis of the open question are related to the baseline measurement. If similar themes are present the animation is thought to be effective in presenting the intended message. If different themes are found people might have experienced another message than the creator has intended.

In analyzing the question about the meaning of a specific element in the animation (Question H, Appendix B) I will judge whether the answer is correct or not, compared to the baseline measurement. If a false answer is given this can be an indication that the animation doesn't communicate the information clearly.

The answers to the questions that use a Likert scale ranging from 'totally disagree' (1 point) to 'totally agree' (5 points) are analyzed by calculating the average score. The average scores per animation are compared in order to draw conclusions.

I test the emotional engagement by asking people a multiple choice question (Question J, Appendix B). I ask the respondents whether they would like to a.) not to see the animation again, b.) see it again, c.) tell people about it, or d.) want to know more about the subject. The statements can be ordered from low engagement to high engagement. People that indicate that they don't want the see the animation again are least engaged. I will attach 0 points to this answer. People that want to see the animation again show a higher engagement: 2 points. Most engaged are people that would like to tell other people about it or would like to know more about the subject. Both answers are worth 4 points because they seem equally engaged.

- *Wouldn't like to see it again > 0 points*
- *Would like to see it again > 2 points*
- *Tell other people about it > 4 points*
- *Would like to know more about the subject > 4 points*

To calculate the average score per animation, the times a certain statement is mentioned is multiplied by its score. This number is divided by the maximum possible score. For example, when the question is answered 60 times, the maximum score on the engagement scale would be 60 x 4 = 240 (this is reached when all the answers are the highest score on the engagement scale). In reality however, it appears that 20 times people don't want to see the animation again (0 points), 25 times want to see it again (2 points) and 15 times want to tell people about it or want to look for more information about the subject (4 points). The total score now is 20 * 0 + 25 * 2 + 15 * 4 = 110. On the engagement scale this animations has a score of 110 / 240 = 45%.

To analyze the type of emotional engagement (Question K, Appendix B), the frequency that the emotions (entertainment, surprise, curiosity, educative, bored) are mentioned are quantified. Some animations might appear to be more entertaining, others more informative etc.

4 Results

In this chapter I will present the results of the analysis of the animations performed by the methods described in the previous chapter. First, I will describe which plot structures, themes, setting and data characteristics are used in the animations. Next, I will present the narrative techniques and visual techniques that are used to support the plot structure. The data-matrices that were used to come to these results are presented in Appendix A1 – A3. In section 4.4 I will present the results of the user survey.

4.1 Description of narrative data animations

4.1.1 Plot development

In section 2.1 I described that stories follow a general pattern (Laurel, 1993; Freytag, 1894; Bordwell & Thompson, 2004). A good story has a begin, middle and end. In the time between the begin and the end the story develops according to a certain arc of suspense. In general, a story starts with an introduction of the setting and characters and develops via an inciting incident to a climax. At the moment of the climax the suspense level by the viewer is at its maximum. After the climax the suspense level goes back to zero (resolution) as the viewer is now able to recapitulate the story.

After investigating the animations I discovered that only two animations can be evaluated as 'real' stories (Table 4-1, type E). One of them is the story of two honey buzzards that lose each other in Africa (inciting incident). The male arrives back home and is waiting on his wife to arrive. When his wife finally arrives she founds him with another wife (climax). During her unfortunate search for a new husband, her ex-husband and his new wife die as they are killed by a predator bird (climax). The characters behavior can be related to our own human behavior. Another animation where a dramatic plot structure is used is again about the behavior of birds: oyster catchers. In the first part of the animation their normal behavior is shown (exposition). Then their behavior is disrupted by a storm (inciting incident) that destroys their nests (climax). After the catastrophe, the birds keep defending the locations of their former nests (resolution).

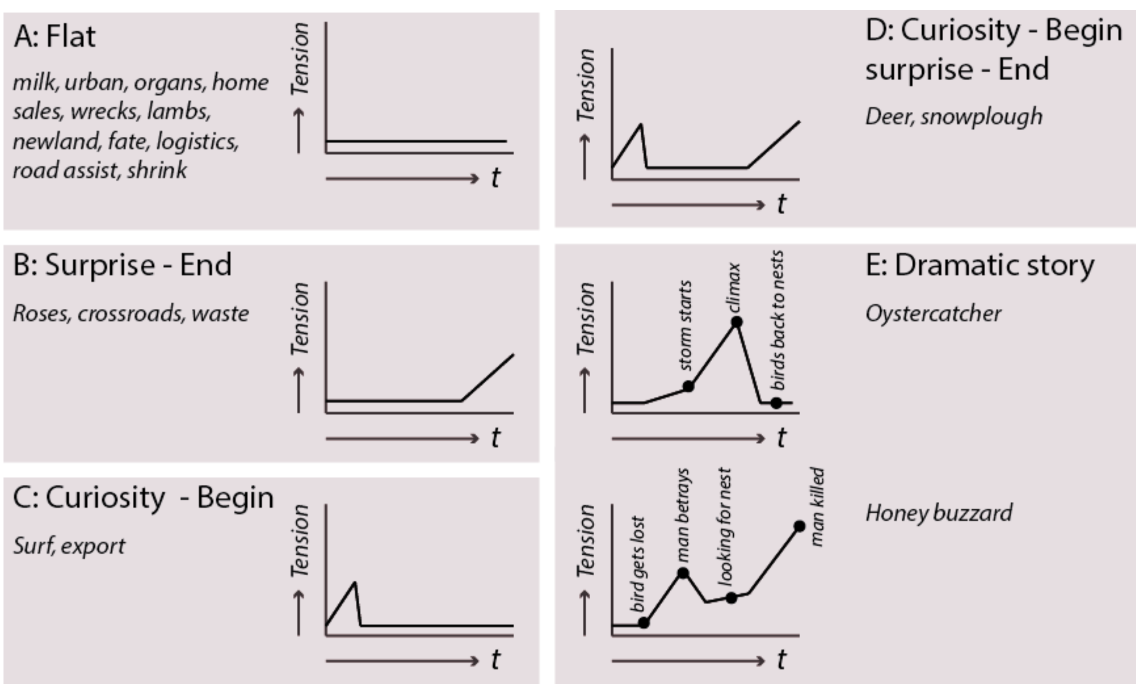
Instead of telling a dramatic story, most animations rather just describe a trend or spatio-temporal pattern without an actual arc of suspense (type A, Table 4-1). For example in the organ animation, the different routes of the different organs are followed in time from their start location to their destination. There isn't an inciting incident or change that leads to a climax. The expectations by the viewer are not challenged: the events are shown in chronological order. The presentation of story information is not delayed (suspense), cheated (surprise) or temporally withheld (curious).

In other animations (type B, C and D, Table 4-1), strategies to create curiosity or surprise *are* used, while an overall arc of suspension is missing. In these animations the information about what we see is delayed to create curiosity or unexpected events are presented to create surprise. Strategies to create curiosity are applied in the beginning of an animation (type B and C). In the beginning information about what we are actually looking at is withheld for a short period. For example the wind animation starts with: "*Every summer above the IJsselmeer a special phenomenon takes place, only the radar can see it…*". Until now the viewer the viewer doesn't know what exact phenomenon the narrator is talking about and is made curious. Then the narrator finally fulfills the expectation of the viewer by giving the information: "*ten thousands of Swallow that gather above the lake".* The same structure is found in the deer animation: *"Almost three collisions a day, especially in the night and mornings, deer…*(curious, collisions with what?), *wild boar in collision with us* (fulfillment)".

Strategies to create surprise are mostly applied at the end of an animation (type B and D). In these animations in the end an unexpected events or an event that contrasts with the previous event (twist) is presented. This creates a feeling of surprise. An example is the deer animation that ends with: *"The last red point is a collision with a motor, not a deer* ***but a human*** *dies here".* All the previous presented points were dead animals. In the end however the location of a dead person is highlighted (surprise). Another example that ends with surprise is the waste animation. It ends with: "*To deliver energy to households only our waste is not enough,… (****even****) waste from England is needed".* The viewer didn't expect that we even need waste from outside our own country (surprise).

It seems that the authors of the animations often don't need a dramatic structure to create an interesting animation. The information itself will evoke emotions by the viewer. In the next sections I will describe what kind of spatial phenomena (section 4.1.4 (themes)) and what aspects of spatial phenomena (section 4.1.6) are mostly used to create an interesting animation.

Table 4-1 Plot structures



Although the animations often don't have a dramatic structure, they all form a coherent whole with a beginning and an ending. Often the beginning is used to introduce the viewer to the setting and characters that perform the action in the events. The end is often used to complete the sequence of events or to surprise the viewer with a twist. Below I describe the different types of beginnings and endings I discovered in more detail.

Beginnings

Three different ways of beginning the animation are distinguished (Figure 4-2). Animations can start with an introduction. This can be a summary of what is going to happen. For example, the animation about milk transport starts with: "*We follow the route of fresh milk from the shelf back to the farmer*". Another example: "*The spread of* *families in a period of 125 years (Sedentism animation)*". Another form of introduction is starting with an indication of the setting (location and time) where the story will take place, often followed by an introduction of the characters. For example: "*Schiermonnikoog in the early spring, these are oystercatcher searching for food (Oystercatcher animation)*", or "*A January in 2013, these are couriers that deliver pizza, sushi, spareribs or roti (food delivery animation)*". As has been described in the previous section, beginnings can evoke an emotion of surprise, while at the same time introducing you to the setting of the animation. Thirdly, animations can directly start with the action without an introduction: "*Road salting trucks working hard (Snow plough animation)*" or "*Onions on their way to Australia, Indonesia, Hong-Kong and Malaysia (Export animation)"*. Most animations start with an introduction of the setting or giving a summary of what can be expected. One third of the animations directly start with the action (Figure 4-2).

Endings

Six different endings of the animations have been used (Figure 4-1). Animations can end with a summary of what has been shown. This summary is often the communication of totals or averages by the narrator. It is often used to leave the viewer with a feeling of amazement and help the viewer to remember the message of the story. Two examples: *"Thanks to two donors, within 48 hours 6 patients are given a better live (organs animation)"* or "*At the end of the day 428.000 meals are delivered (food delivery)".* Visually a summary can be accompanied by an overview shot. Some animations just end after showing the sequence of events. A third type of ending is when an animation ends with an event that is unexpected or contrasting with the previous event; a twist. These animations leave us with a feeling of surprise. Also, extreme events can be shown in the end. For example the school animation ends with showing a school with so few children enrolled that it has to close. The story about the behavior of oystercatchers ends with a resolution. This story ends with telling that the birds, although their nests are destroyed, still keep and defend their territory. It tells us how the behavior of the characters of the story has changed after the climax. Lastly, the honey buzzard animation ends with a climax: both birds are eaten by a predator bird. Most animations just end or and with an unexpected event. In only 19% of the animations concluding remarks are made. Ending with a resolution, focus on an extreme value or climax are least used (Figure 4-1).

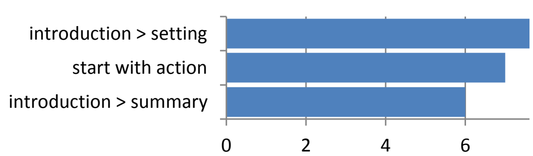


Figure 4-2 Occurrence of certain beginnings

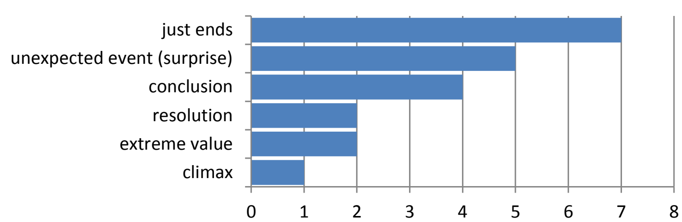


Figure 4-1 Occurrence of certain endings

4.1.2 Type of story events

Animations are about spatial phenomena. As spatial phenomena are often about changes in time, most animations focus on temporal changes. After this investigation I discovered that three types of change or activities can be focused on in the animations. The movements of characters are focused on in 66% of the animations. In 52% of the animations we follow the exact routes that the characters have traveled to come from A to B. 14% of the animations show the lines that connect start and end location. In the animations that show exact routes the *individual behavior* is the focus of the story. When only the connection lines are shown, the story is merely about showing *general patterns*, like differences in distance or difference in intensity. For example, in the 'roses' animation, the exact routes of the flowers are followed. In the animation about food deliveries only the lines that connect customer to restaurant are followed. In this animation it is merely about pointing us to the general trend that the number of connections increase during the day (with an explosion during 18.00) and to the locations where especially long distances are traveled.

Another type of change that is presented in the animations is differences in intensity. In these animations the number of objects per surface unit changes to illustrate a general trend of increase or decrease. This type of change is the focus in three animations. In the urban animation the increasing intensity of populated areas is shown; in the home sales animations we see the decrease of the number of sold houses; in the snow plough animation change in the intensity of requests for winter tires is shown.

Next, animations can show the development of certain remarkable spatial patterns. For example, in the deer animation the locations of road kill accidents form a pattern that makes the road structure visible. In the fate animation it is about showing certain clusters of lightning impacts.

Two animations don't show spatio-temporal changes but are aimed at emphasizing certain aspects of a non-temporal phenomenon. For example in the wrecks animation we see all the wrecks that lay on the bottom the sea. During the animation different clusters of sunken ships are emphasized (ships that sunk in the 17th century near Den Helder, a concentration of wrecks near Rotterdam etc.).

The types of change plus the number of animations they are used in are shown in Figure 4-3.

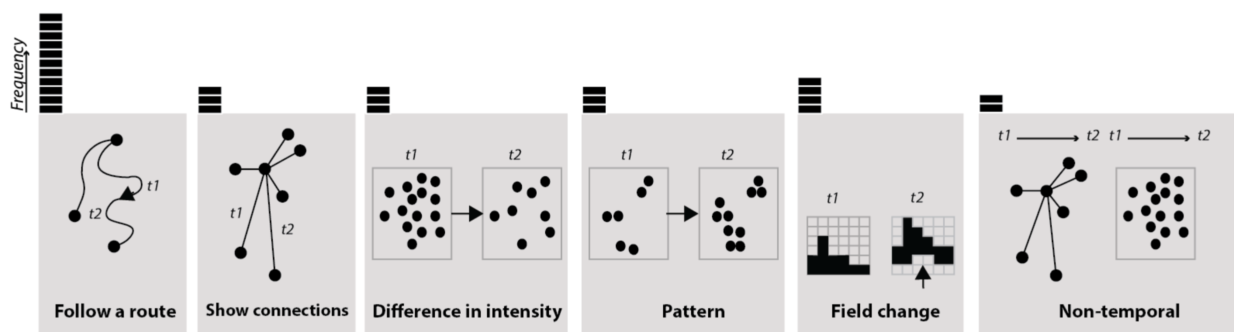


Figure 4-3 Type of change

4.1.3 Relation between story events

In the previous section I described the different types of change that can be focused on in the animations: following routes, connections, differences in intensity, patterns, and non-temporal change. Animations can present only a *single* phenomenon and focus on a single type of change. For example, in the organs animation it is purely about following the routes of different organs from donor to patient. An animation can also present a combination of *multiple* phenomena. In these animations the focus is not the behavior of a single phenomenon but rather *comparisons, correlations or causal relationships*. For example in the deer animation the route of deer is followed in combination with showing the pattern of road kill accident locations. It appears that the road kill pattern correlates with the deer behavior.

A single phenomenon can be represented by a single dataset (Figure 4-4, A1) or can be a combination of different sub-processes that together represent the single phenomenon (type A2 and A3). For example, in the 'roses' animation the routes of the different flowers are sub-processes of the whole transportation process of a bouquet. The same is true for the process of organ transport. The sub-processes can happen simultaneously (A3) or sequentially (A2).

Most of the animations that present multiple phenomena reveal causal relationships, compare spatial patterns or show correlations. An animation where a causal relationship is shown is the road assistance animation: in the animation the appearance of car breakdowns (cause) and help activities (effects) are related. The same is true for relating the snowstorm (cause) to the road salting activity (effect), wind pattern (cause) to surf behavior (effect), flood pattern (cause) to oystercatcher behavior (effect) and dredge activities (cause) to the appearance of new land (effect). Animations that compare spatial patterns in order to present correlations (B2) are for example the 'deer' and 'fate' animation. In the 'deer' animation the movement pattern of a deer is combined with the distribution pattern of road kill locations. When showing both datasets together it appears that the deer track never crosses roads where animals are killed. In the 'fate' animation, the spatial patterns of two phenomena (lightning and lottery prices) are compared. It appears that the locations of the highest prices resemble the area with the highest number of lightning impacts. In the Bunschoten-Spakenburg animation, the movement pattern of food trucks (wide spread) is compared the movement pattern of students (go to the same location). Both phenomena are presented to show the dual nature of the city of Bunschoten-Spakenburg.

Multiple phenomena can also be used in an animation to emphasize different aspects of a bigger story. In these types of animations the different phenomena are not directly related with each other. In fact the animation consists of multiple sub-stories that in the end form the complete story [B3].

How do the type of change that is presented relates to the structure of the animation (Figure 4-3)? I investigated that all types of change are used in single phenomenon animations: there are animations that show routes, connections, intensities or patterns of a single phenomenon. In animations that focus on causal relationships the effects are mainly routes and causes are changes in continuous fields or appearance of points. For example, the routes of oystercatchers are influenced by tidal changes and the routes of salting trucks by the change in cloud cover (which resulted in snowfall). Animations that focus on comparisons show routes, connections and patterns.

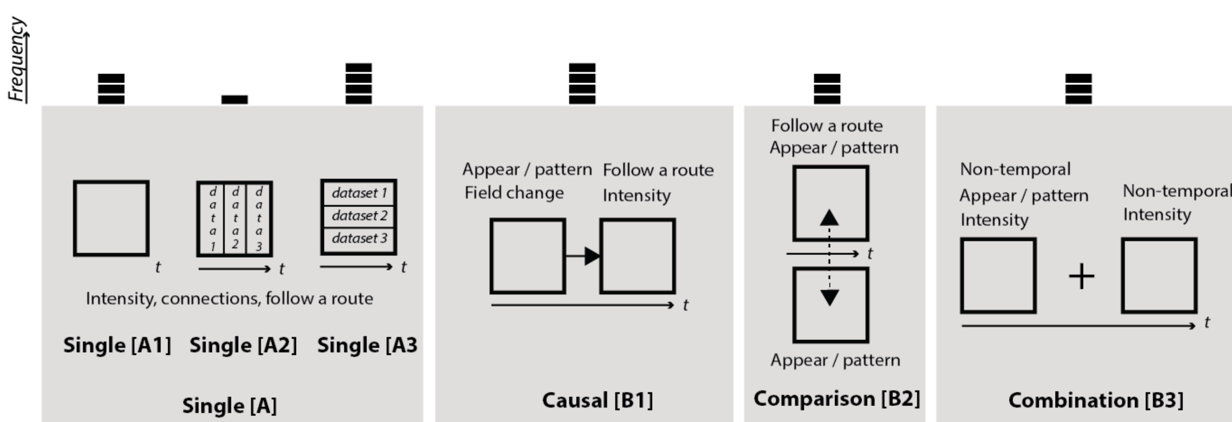


Figure 4-4 Possible structuring of events in an animations + used types of change per structure type

4.1.4 Theme

Each animation has a certain theme or themes. For example, the animation about the decrease of the population in certain areas and its repercussion on the viability of primary schools can be described by the themes: education, population and urbanization. From this investigation the following results can be presented (Figure 4-5). Almost 2 out of 5 animations are about transportation of goods (like flowers, organs, waste etc.). Also the behavior of animals (24%) and infrastructure (19%) are themes that are used in many animations. When classifying the themes according to the geographical sub-disciplines human, environmental and physical geography the following can be said: 70% of the animations are related to human geographical themes, 26% of the animations address physical geographic themes, and animations about environmental issues are scarce (4%). Within the human geographic themes most attention is given to the spatial repercussions of demographic trends; population, urbanization, human settlements (all 14%).

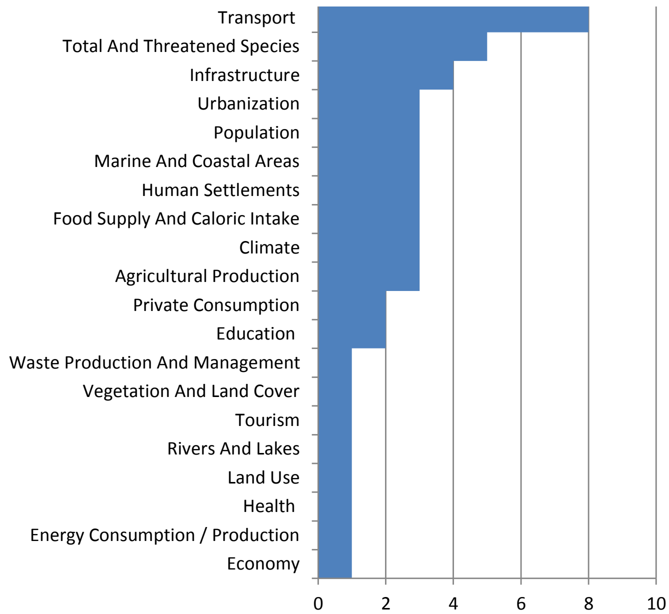


Figure 4-5 Themes used in the animations

4.1.5 Setting

Most animations are about events that take place in a short period of time (a year or less) in the present (most of them in 2012). Among the animations that have a story time of a year or less, animations that take place in less than a week are most frequent. In 5 animations a process is shown over a long-term period (decade or more). In these animations it is about showing a long term trend (for example the urbanization of the Netherlands over 100 years). For an overview of the periods that are represented in the animations see Figure 4-6.

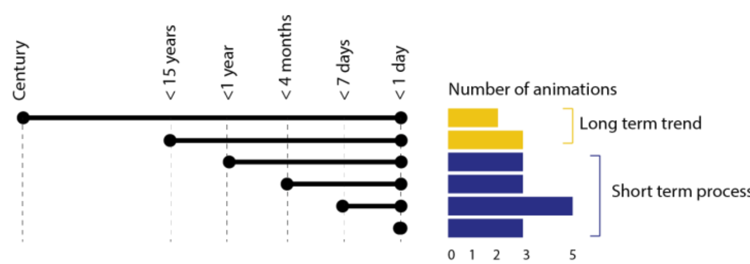


Figure 4-6 Time periods used in the animations

All the animations are set in or are connected to the Netherlands. The animations can be classified according to the scale level or range between minimum and maximum scale level the story takes place. Most animations take place in a range between national and local scale level or on national level. In three animations international processes are the input for the story. Most animations take place at multiple scale levels. Making use of different scale levels adds depth to the story. Often the lower scale level is used to provide an overview. Zooming to a higher scale level is used to isolate details that are important for telling the story. For an overview of the scale levels used in the animations see Figure 4-7.

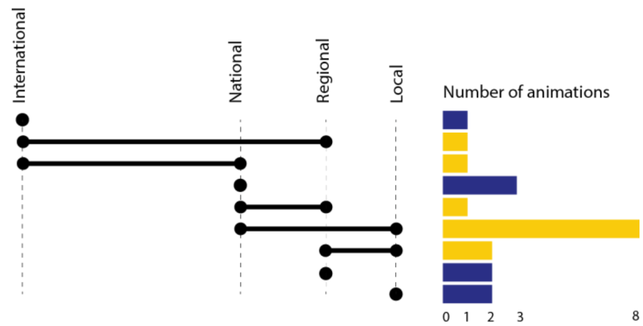


Figure 4-7 Scale levels used in the animations

4.1.6 Aspects of phenomena that are used for storytelling

Not every spatio-temporal phenomenon can be used to tell a story. As Alberto Cairo states: "you cannot create a story out of data that is not interesting in itself" (Cairo, URL 2.4). I came to the conclusion that an animation can be interesting in four ways (Table 4-2):

1. the phenomenon the animation is about is interesting or exceptional in itself,
2. certain moments in time or locations of the phenomenon are interesting (selections),
3. combinations of phenomenon create interesting stories (causal relationship, correlation),
4. extreme or remarkable values of the phenomenon are worth telling (outliers)

Examples of animations that present phenomena that are interesting in itself are the animation about lambs and about the 2nd Maasvlakte: the movement of lambs over a bridge in Rotterdam is in itself an exceptional situation, and the creation of new land with dredge ships is a fascinating phenomenon in itself.

Also, when the phenomenon is not exceptional or surprising in itself, the fact that the phenomenon is presented as a data-visualization can make it special. The animation reveals patterns that are normally not visible and offer the viewer a new experience. For example the distribution of milk from farm to the supermarket is not a very interesting phenomenon when filmed. But when data-visualization is used patterns that are normally not visible are revealed.

To find a story often specific moments or locations within a phenomenon that are interesting are selected. For example, in the oystercatcher animation the behavior of the birds is followed on a day that an extreme situation occurs: an extreme high tide. In the animation about car breakdowns and food delivery exceptionally busy days are selected.

In a story there is often looked for extreme and exceptional values. For example in the animation about the export of agrarian products only the most exported goods are included. In the animation about internal migration, only cities where an extreme migration pattern can be observed are shown. The animation about schools focus on schools with an extreme low number of pupils and in the home sales animation only changes in the number of extreme low and extreme high valued houses are shown.

Next, comparing phenomena with each other often leads to interesting stories. Combining phenomena might reveal unexpected correlations or causal relationships.

In Table 4-2 the aspects of the presented spatial phenomenon that is thought to be interesting by the authors are investigated per animation.

Table 4-2 Aspects of the animation that are interesting per animation

Animation	*Aspects that are interesting*	*Aspects that are interesting in specific animation*
Snowplow	Causal relation	The snowstorm + road salting truck behavior + winter tires requests
Deer	Correlation	The amount of road kill + a deer that doesn't cross dangerous road
Fate	Correlation	Most heavy thunderstorm / biggest lottery prices
Lambs	Phenomenon exceptional in its own	The bridge crossing is an exceptional event
honey buzz	Phenomenon exceptional in its own	The behavior of these particular birds is exceptional
new land	Phenomenon exceptional in its own	Creation of new land with dredge ships is fascinating
oystercatcher	Phenomenon exceptional in its own + causal relation	The moment of extreme high tide is exceptional
road assist	Phenomenon exceptional in its own + selection of extremes	Both days an exceptional number of people has a car breakdown + focus on extreme case
milky way	Phenomenon interesting in its own	Speed of process and amount of milk
Organs	Phenomenon interesting in its own	Speed and number of patients helped by donors
Roses	Phenomenon interesting in its own	The long distances that are traveled for a bunch of flowers
Crossroads	Phenomenon interesting in its own + selection of remarkable event	The geographical reach of products from a small town + exceptional behavior of one student
Waste	Phenomenon interesting in its own + selection of remarkable events	Collecting waste for energy generation + focus on 2 extreme patterns of waste collection
Shrink	Selection of extremes	Threatened schools
home sales	Selection of extremes	Extreme low and high valued houses
Surf	Selection of extremes	Maximum speeds of surfers
Logistics	Selection of extremes	Most busy cities and longest distances
Export	Selection of remarkable events	Products that are most exported
Urban	Selection of remarkable events	Regions that show special patterns (fast growth / pattern of polder roads)
Wrecks	Selection of remarkable events	Locations where many or very old ships sunk
Migration	Selection of remarkable events	Cities where least people move and cities where most people move

4.2 Narrative techniques

Narrative techniques are used to support the story. At first, the use of dynamic variables is evaluated. Next the way narration is used is described according to the voice over texts. Thirdly, techniques that are applied to simplify the data are discussed.

4.2.1 Manipulation of time

Moment of display can be used to show selections of locations, moments in time or certain thematic values. In four animations no selections are made; the whole process is shown and is visible during the whole animation. A movement can be followed (and thus the whole process is always visible), (D, figure 4.8) or a not moving phenomenon can be kept in focus in its totality (E, figure 4.8). This is the case for the animations about milk transport, movement of lambs, migration patterns and lightning. Selections of locations are present in 17 animations (B, figure 4.8). The selected locations are used to emphasize certain details of the phenomenon. In four animations some parts of the story time are skipped (A, figure 4.8). In the oystercatcher animation for example not the whole process of foraging is shown, but only some important moments. In five animations moment of display is used to show selections of the thematic values (C, figure 4.8). This is for example true for the school animation: first schools with less than 100 pupils are shown, then the schools with less than 23 pupils.

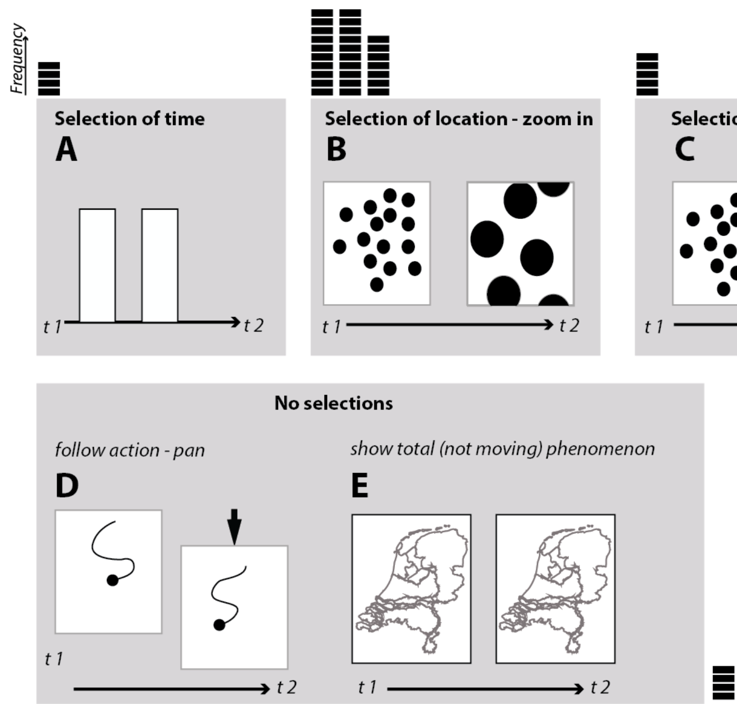


Figure 4-8 Use of moment of display to isolate selections + frequency of use

Order can be used to change the expected chronological order to create certain effects by the viewer. 90% of the animations just follow a chronological order without manipulations. One animation is played backwards. The reason of the author was to give the viewer another perspective of the phenomenon. Another animation first shows the process of the animation backwards and continues by showing the process in chronological order.

In most animations no manipulation of the duration is observed. In the animations about the behavior of oystercatchers, honey-buzzards and lambs, time is expanded to emphasize certain aspects of the behavior of the animals. In the animation about lightning a heavy thunderstorm is selected and is shown over a day instead of over the year. Time is compressed in the snow plough animation to end the pattern of salting trucks quickly to move on to another scene. Also, the time of a flight to Croatia in the organs animation is compressed to save time.

Frequency: three animations show a repetition of story time to show sub-processes the same phenomenon. For example, in the animation about migration patterns, the spatio-temporal patterns of three different cities are shown subsequently. In the actual story time, all these three patterns happen in simultaneously. In three other animations, the *same* event is presented at different locations. For example in the animation about surfers, the story time is rewind to show the behavior of three different surfers at three different locations. In the rest of the animations no repetition of events is applied.

4.2.2 Narration

Narration is used to guide the viewer through the story. Narration performed by a narrator is about spoken words. Different types of sentences can be distinguished (Figure 4-9). At first, sentences can directly point the viewer to what is shown on the screen at that moment: *"The red points are all fatal accidents in a year (deer animation*)", or can more indirectly point at what we see when it is obvious on the screen what the message is about: "*Garbage trucks swarming through the center of The Hague (waste animation)"*. These descriptions of what the object that we see on the screen represent function as a legend does in a static map. When pointing to the characters on the screen, often sentences are used to describe the important aspects of the behavior. This helps the viewer to focus on that behavior ("*In 100 years, the city is spreading"*). Also, aspects of the behavior that we cannot infer from the screen can be communicated, often the total number of objects that are shown or other facts are mentioned: "*19 schools with less than 23 pupils must close"* or "*In the country-side the pizzas are delivered up to 29 km".* As been mentioned in the discussion of begin and endings, narration can be used to introduce or conclude an animation by giving an overview or conclusion of what is or shall be shown. Next, sentences are used to add context to the actions that we see. The sentence is not directly related to the action that we see, but on the overall impact of the total action. It helps to place the events in perspective. For example: *"For the couriers it is the most busy day of the year (food delivery animation)"* or "*The dairy factory is supplied 24-7"* or "*We export for 70 million of agrarian products".*

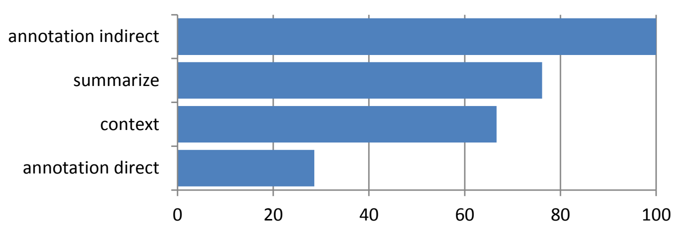


Figure 4-9 Purpose and use of sentences

As shown in Figure 4-10 five of the animations actually present cause and effect data (Figure 4-4, type B1). For example wind data is visualized (cause), followed by data visualization about the behavior of surfers (effect). In other animations only data that shows an effect is presented, without showing the data that caused the effect. In these animations the cause of the presented effects can be communicated by the narrator. For example in the animations about the organ transport only the tracks of ambulances that transport organs are visualized. In the voice-over the cause is mentioned: a man dies. In the deer animation points are shown that represent dead animals. The voice over tells us that their death was caused by a collision with a car. In the honey buzzard animation the narrator mentions the reason for the journey to Africa: the climate forces them to look for a place to winter. The behavior of the scholar that returns home is explained by mentioning the cause: a flat tire. The reason for not visually showing the cause is that it is often impossible to find the data that caused the presented effect. On the other hand, presenting the cause in these animations is not part of the story and would make the animation unnecessary complex.

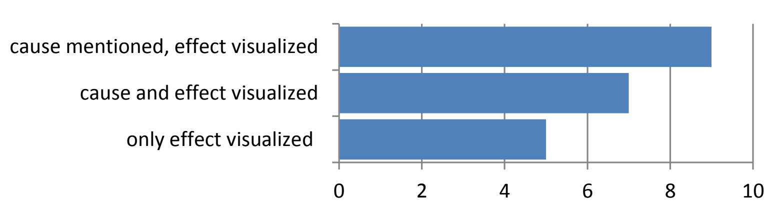


Figure 4-10 Narration vs visual presentation of cause and effect

4.2.3 Data simplification

Often reduction of information is needed to be able to communicate a clear message to the viewer. As been mentioned in section 2.5.1.2 several techniques can be used: omission, aggregation or categorization. I investigated if techniques to simplify the data are used in the animations. In most animations, data that contains information about different categories is aggregated to a single category. For example the dataset that is used in the deer animations contains information about different species (5 different species). The data could have been visualized by giving each species a different color. However, all the species are visualized in the same color. The voice-over communicates that the points represent the 5 different species. The same is true for the organ tracks that however they all transport different organs they are all visualized in the same color. In other animations thresholds are used to simplify the data. For example, only schools with less than 100 and 23 pupils are shown in the schools animation and only house above 1 million euro and below 100.000 euro are presented. Also, selections of different sub categories in the data are used to create a clear story. In the import-export animation only a selection of eight products out of a dataset of around 100 are shown. The same is true for the selection of different cities in the migration animation.

4.3 Visual techniques

4.3.1 Mise-en-scene

4.3.1.1 Visualization of spatial entities (graphic variables)

The greatest part of the data is point data (75%). Of these point data, more than half (57%) are movement tracks, collected by GPS. The other 43% of the point data are points that represents the presence of an object in time (for example the locations where in a certain moment lottery prices are won). In three animations lines are used that represent connections between an origin and destination point. Polygons are used in 5 animations and raster data is used in 4 animations. Most animations use only tracks or tracks combined with points (together 43%), see figure 4.11.

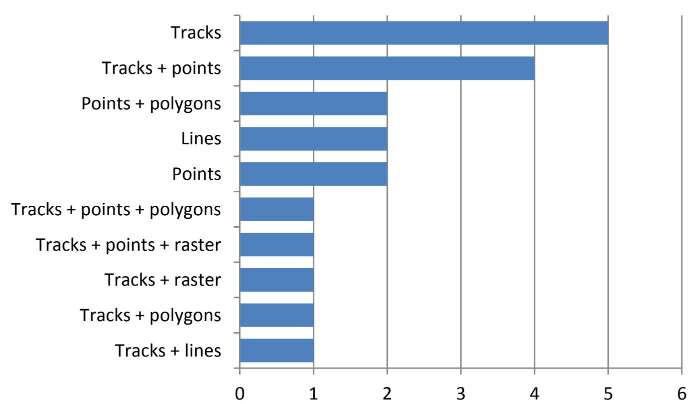


Figure 4-11

Figure 4-11 spatial entities used

In most animations data is represented without any differentiation between categories (57%). For example, in the animation about milk transport, all the trucks have the same color; in this animation the general pattern of transportation is more important for the story than the behavior of the individual trucks.

In other animations nominal differences between data values are visualized. In the animation about the construction of the 2nd Maasvlakte in Rotterdam the different dredge boats (categories) are distinguished by use of different colors. Also, in the animation about the behavior of oystercatchers (birds) the different birds (categories) are distinguished by color. In these animations, identifying the different objects is not important. Using different colors only make clear that there *are* different boats or oystercatchers at work. To speak in term of perception according to Bertin (1974), in both animations it is about selective perception (Bertin, 1974). In other animations difference in color is used to differentiate between groups; associative perception (Bertin, 1974). No ordinal data is visualized in the animations.

Two animations show differences in quantities which are visualized by the graphic variable size. The variable size is applied to points by making use of rings. Only the outline of the circle is visible, the inner part is transparent which makes it possible to see the background. It prevents clutter. Difference in size is used to visualize lines that differ in quantitative value. The lines are however not visualized as solid lines but are deconstructed into a bundle of points (
Figure 4-12 right). The creator of the animation thus implies a lower data aggregation level than is present in the data to make the data more visually appealing. It creates a feeling of detail that doesn't exist in the data. The way graphic variables are used to represent points, lines and areas and the perceptual characteristic of the used graphic variables is shown in
Figure 4-12 left.

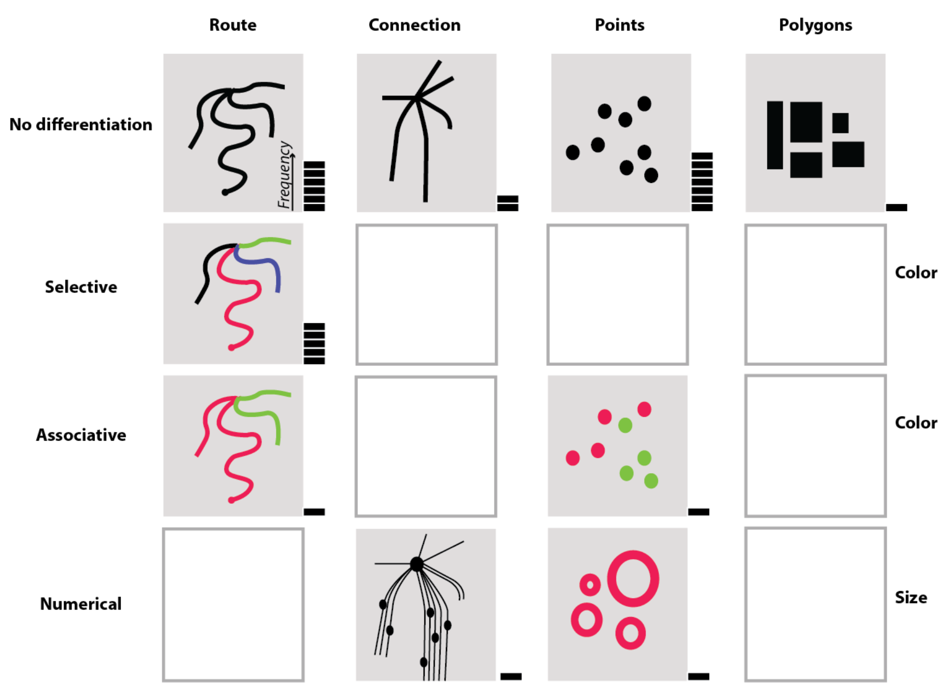


Figure 4-12 Graphic variables used (left). Disaggregation of line data in points (right)

In the animations not only the difference between objects within a dataset is visualized, but also the difference between different datasets that are not simultaneously presented. To emphasize that the first dataset is different from the other difference in color is used (for example in the home sales animation, expensive houses are presented in orange, later on less expensive houses are presented in a green).

In the animations different design techniques are used to represent points, lines and polygon Figure 4-13). In some animations points are visualized as 3D spheres. It emphasizes the location of the point when filming the scene from a lower angle. Next, points are often visualized with a glow effect. The edges of the points are fuzzy. Fuzziness of edges is also present in the visualization of polygons. In some animations important point locations are visualized as rings. In this way the points can be larger, but don`t block the sight of the background.

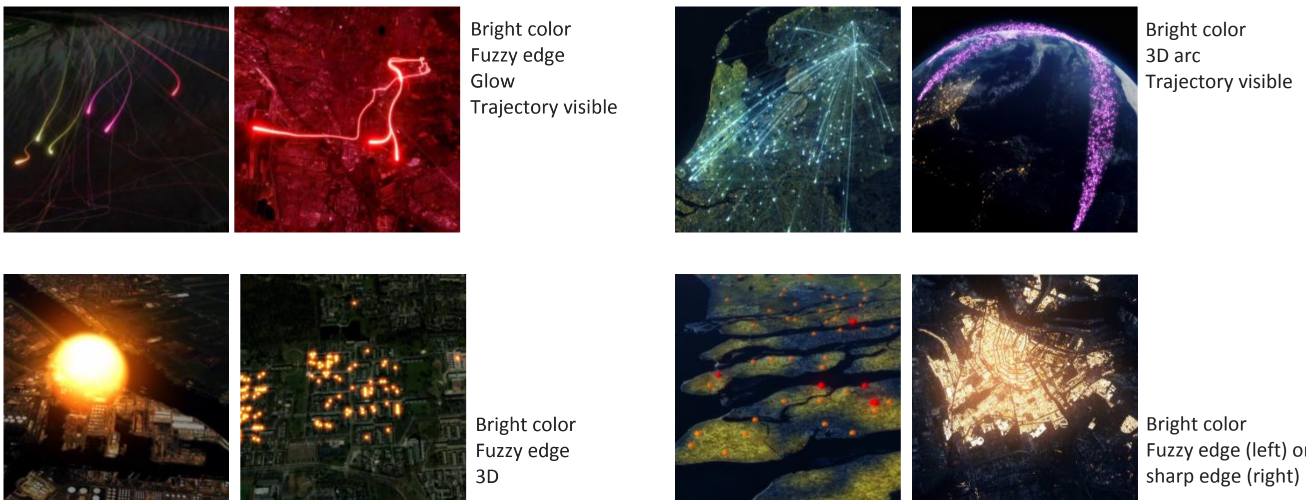


Figure 4-13 Visual techniques to represent routes (top left), connections (top right), points (down left) polygons (down right)

4.3.2 Visualization spatio-temporal change

Here I will investigate what type of spatio-temporal change (as described by Blok (2005)) are visualized in the animations. The combination of the change types *movement along a path* and *appearance / disappearance* is most widespread (29%), followed by only movement along a path (19%) and appearance (14%). In 67% of the animations movements along a path are visualized and in 52% of the animations appearances. Mutation is present when dealing with raster data. Mutations of attribute values over time in polygons, points or lines are not present. There is one boundary shift visualized (the expansion of the 2nd Maasvlakte).

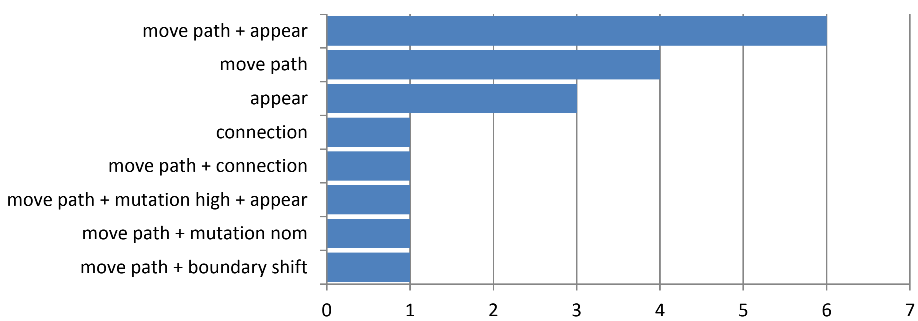


Figure 4-14 Types of spatio-temporal change used in the animations

As described in section 4.1.2 five different types of change can be the input for the story: following routes, distribution of connections, difference in intensities, patterns, changing fields and non-temporal change. These types of change can be related to the spatio-temporal change classification of Blok (2005), see Figure 4-15. Routes are visualized by movement of points along a path. Also connections are visualized by movement along a path. Although the data regarding connections has no information about the duration between A and B, in the animation the duration is created. The time interval is created to emphasize the connection and the direction of the connection (in static visualizations often arrows are used to point directions).

Differences in intensities are visualized by appearance and disappearance of points or polygons. The appearance is not emphasized; the points or polygons just appear. To visualize difference in intensity the rate of change between two states must be big enough so the viewer is able to observe the difference. In the urban animation we see the increase of new houses per year. It is easy to observe the change as the entities are relative big (polygons) and the growth follows a certain expected pattern (from center to periphery). When the change is gradual and randomly distributed it can be very hard to observe differences in the data. In these cases the interval between the changes can be increased or only the intensity at the start and at the end can be shown. This technique is applied to the home sales animation: when change in the number of sold houses was shown continuously it was very hard to observe the downfall after 2008 (the start of the crisis). Instead the sum of the sold houses in 2008 was shown, followed by the sum of the sold houses in 2012. Now a big difference in intensity could be observed.

Patterns are built up by letting points appear in time. In these animations, appearance *is* emphasized.

Changing values of fields is represented by mutation of raster data. Raster cell values change nominal (for example: no flood > flood) or show gradual changes in value (for example: 20% transparent to 60% transparent). Non-temporal aspects of a dataset are emphasized by the appearance of points or movement of points along a path (see figure 4.14). Time is used to get guide the attention to the wished locations (blinking, appear in random order).

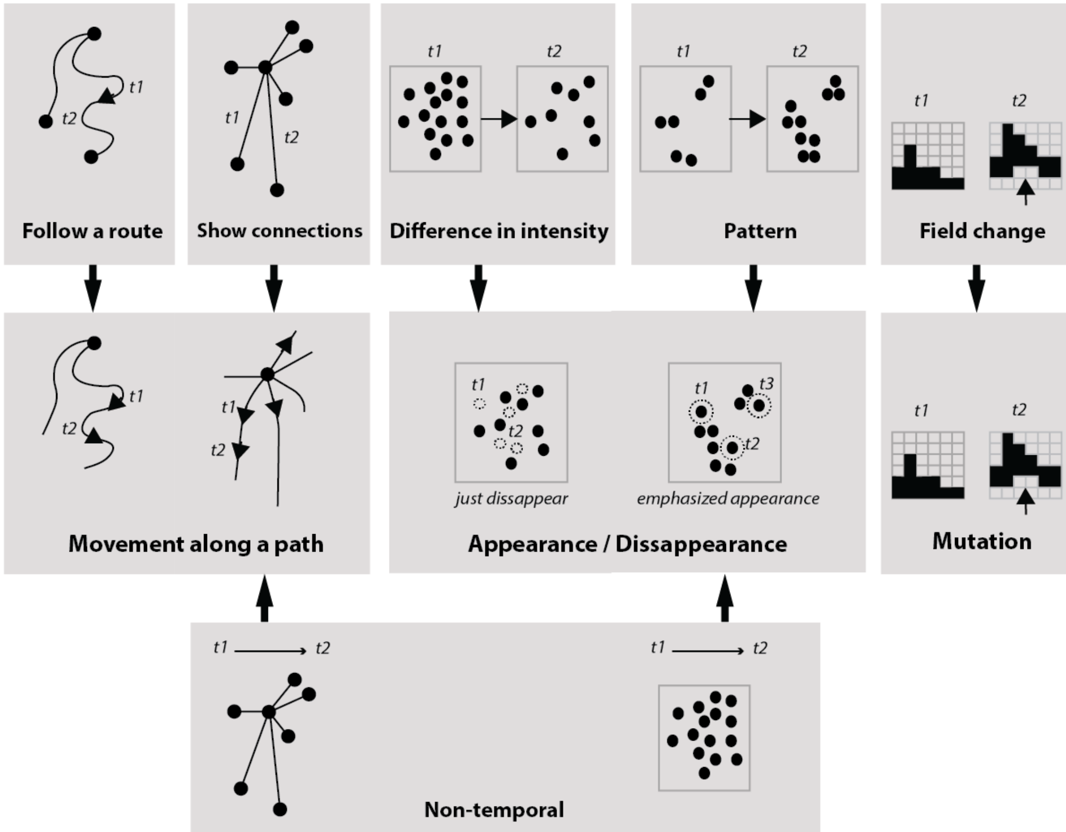


Figure 4-15 Change types and visualization method

Different multimedia affects (technical and modeling dynamic variables (Rebah & Zahin, 2011)) are used to visualize change. Movement along a path is visualized by making use of a bright point that is moving (Figure 4-16). The path that that is followed stays visible for a while to accentuate the movement (trajectory). The length of the trajectory is proportional to the speed of the movement. After the movement has happened, often the path stays visible very lightly (high transparencey) on the background. This makes the total pattern visible of all the movements. In some animations some important points like start and end points or other points that are visited along the route are emphasized by blinking.

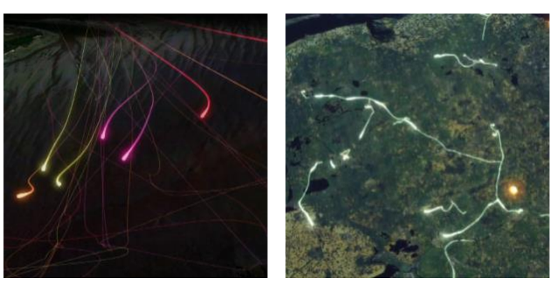


Figure 4-16 Visualizing movement along a path

Showing the distribution of connections is visualized as a movement along a path (Figure 4-16). To emphasize the movement, the path that is followed is a 3D arc. The function of adding a 3rd dimension is used to make the animation more exciting. It makes it possible to film the connections from lower perspectives. In the animation about the restaurant – customer connections the location of the customer (end point) is accentuated by a point symbol in another color than the movement to the customer.

Figure 4-17 Visualizing connections as movement along a path

Different techniques are applied to emphasize the appearance of objects. When appearance / disappearance emphasis is used to show the occurrence of certain events, the appearance is emphasized by blinking the point (brighter and bigger) for a short period (Figure 4-18, left). In one animation, apart from showing the moment of occurrence also the difference in value has to be communicated to the viewer. Here extreme differences in size are used to emphasize difference in value and extreme expanding (short period) to emphasize the occurrence ('fate' animation).

The same visual techniques that are applied to emphasize appearance of objects are also used to emphasize non-temporal aspects of a dataset. For example, in the animation of wrecks in the North Sea and IJsselmeer different locations are highlighted by letting them appear in a random order and by lighting them up (brighter and bigger), (see Figure 4-18 third picture from left). The same happens in the schools animation: to emphasize the two different thematic groups (schools <100 pupils and schools <23 pupils), the grouped points appear in a random order and blink before they stay settled.

Visual appearance techniques like blinking are also applied to show points that are visited along a route (Figure 4-19). For example, when in the milk animation the moments a farm is visited by a truck are emphasized by a blinking dot. The dots are also used to mark the end and start point. For example, in the animation about honey buzzards, the routes of the birds fly are very chaotic. It is hard to discern the location of the nest. In the animation the location of the nest is emphasized at the moments the bird visits its nest.

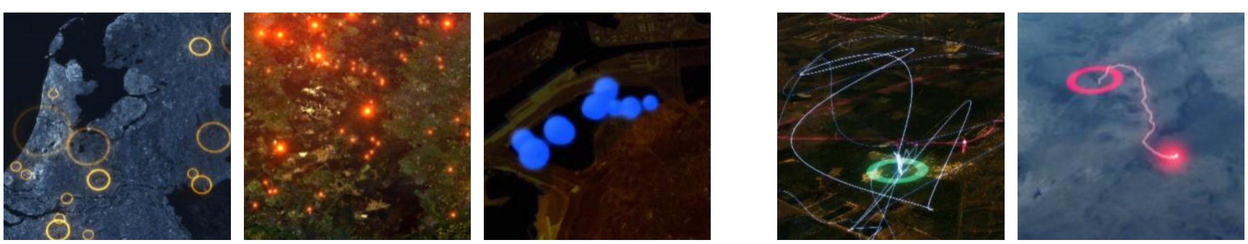


Figure 4-18 Emphasizing the appearance of points (left), emphasizing locations along route (right)

When appearance is used to show difference in intensities the appearance of the entities is not emphasized: entities just appear or disappear. To accentuate the (dis)appearance, a 'wipe' movement can be used (see Figure 4-19).

Figure 4-19 Using a 'swipe' to emphasize difference in intensity (disappearance of points)

Mutation is about the change of the thematic values of the data. The location doesn't change. The thematic change is visualized by change of the graphic variable that represents the values. Literature about geo-data animations is often about especially one type of animation: animated maps. Animated maps are a sequence of cholorpleth maps. During a map animation the thematic values of the different entities (polygons) change over time. Although it is a common animation type, animated maps are not present in our animations. One of the reasons is the low level of detail these kind of animations can show: in animated maps mostly administrative boundaries are used. In our animations, instead, follow change of individual points or tracks . Another reason for not using animated maps is that differences are hard to perceive. People are likely to miss changes that occur in the animation when values change at different locations (Goldsberry & Batterby, 2009).

In the animations, mutation was only used for showing change in the values of fields. These fields are natural processes and are represented by raster data. In the oystercatcher animation, the presence or absence of water (low and high tide) was visualized. This can be regarded as mutation at nominal level (left). In another animation the change of the thickness of the cloud cover (represented by the transparency value) was visualized. This I classified as mutation at higher level (right).

Figure 4-20 Mutation: nominal (left), higher level (middle and right)

4.3.2.1 Contrast foreground / background

To distinguish the foreground object from the background color contrast is used. The background that is used in all the animations is an aerial photograph of the location where the story takes place. The overall color of the background is dark green. In most animations the water bodies are black. When the action takes place in the water, dark blue is used. The background colors are neutral. The objects are represented in bright and high saturated colors, often with a glow effect.

4.3.3 Cinematography

4.3.3.1 Camera distance

As most data only have two dimensions, most animations use primary a top view shot. 80% of the animations starts with an overview shot where the total area where the action will take place is visible. When it is hard to understand where the location of the story is situated when the animation just starts there, the animation will start with an overview of the whole country before 'flying' to the specific location. By doing so, the camera guides the viewer to the story location. An animation can also start from a short camera distance, with a focus on a selection of the whole action. The information about the relation to the whole action (what are we looking at) is thus delayed. This can create curiosity by the viewer. Animations that start with a focus on the action by the narrator are accompanied by a high zoom level framing.

4.3.3.2 Camera angle

Two thirds of the animations also use lower camera angles. When using a lower camera angle a larger area can be captured while keeping the foreground objects in greater detail. A low camera angle if often used to follow the routes of objects that move towards the camera. In a low perspective you can observe the coming objects already from a far distance (Figure 4-21). For example when following the movement of an organ to Brussels, the low perspective allow us to observe the whole route that has been followed. The same is true for the approaching snow storm or the flow of onions. The closer to the Earth the camera is, the higher the experienced velocity of the objects.

Figure 4-21 Low camera angles to observe objects coming from a far distance

A low camera perspective is also used to present an overview of the objects (Figure 4-22). This is done in the beginning of the wrecks animation to show an overview of the large amount of wrecks on the bottom of the sea. In some animations it leads to surprise when by tilting the camera to a lower camera angle the overall situation is revealed. In the waste animation for example there is zoomed in into Roozenburg. Then the camera tilts and the ships that arrive from England become visible. The result is an effect of surprise. Also, low camera angle can be used to follow an object from its point of view. This will create a spectacular perspective (Figure 4-23)

Figure 4-22 (left) Low angles to show an overview of the situation (from left to right: Wrecks, Deer, Waste animation)

Figure 4-23 (right) Extreme low camera angle to create exciting effect (Honeybuzzard animation)

The difference between zoom levels indicates for the different levels of detail of the data that are communicated. An animation that only takes place at one zoom level only give insight in the overall process that is visualized. Viewing the data on other scale levels apparently not give any new insight or interesting new perspectives of the phenomenon it is about. The data is low in story depth. For example in the animation about export flows the relation between the flows can only be viewed at international level. Presenting the data at other levels makes no sense. The same is true for the national trend of the decrease of the number of schools. In other animations differences in scale offer different perspectives on the phenomenon that is visualized. For example, the animation about the transportation of organs shows the overall pattern on national level of all the routes that are followed but also follows the individual routes in detail. Both aspects of the data are interesting in itself. This is also observed in the home sales animation: on the national level the overall trend of decreasing house values is visible, on local level the impact of this trend on individual houses. Showing the local level adds more depth to the story and also makes it more personal.



Figure 4-24 Low zoom level vs high zoom level: multi layered story

Panning is used to follow an action or to move to another location where a new action is followed. Panning is used in every animation. The speed of the characters determines for a great part the duration of the speed of the panning. In two animations extremely fast panning is used to move from one location to the other. The time between the two locations is less than 2 second for distances of around 100 km. It is impossible to orient the locations are no reference to other locations or route to the location is presented. This fast panning can be seen as an editing technique (see section 4.3.3) as it actually functions as a cut between two scenes.

4.3.4 Editing

In general the setting of the animation is always the same during the animations. The background of the actions is an aerial image of the Netherlands which doesn't change. A visual platform that is the same in the different scenes is a matching technique that that helps the viewer in following the story.

The only transitions that I identified are between scenes that happen at different locations or between different actions that happen at the same location. The cutting between two locations is performed by a fast panning movement as described in the previous section or by zooming to the next location.
Figure 4-25 shows how zooming and panning are used to move to the next story scene. As been described in section 4.1.1 a story often starts with an introduction of the setting that is accompanied by an overview shot. Next the action starts and is followed in more detail. In the end a re-establishing shot can be used to conclude the story. As we have seen, a plot can also directly start with an overview but doesn't end with an overview. A third common plot structure starts with a focus on the action and end with an overview (
Figure 4-25).

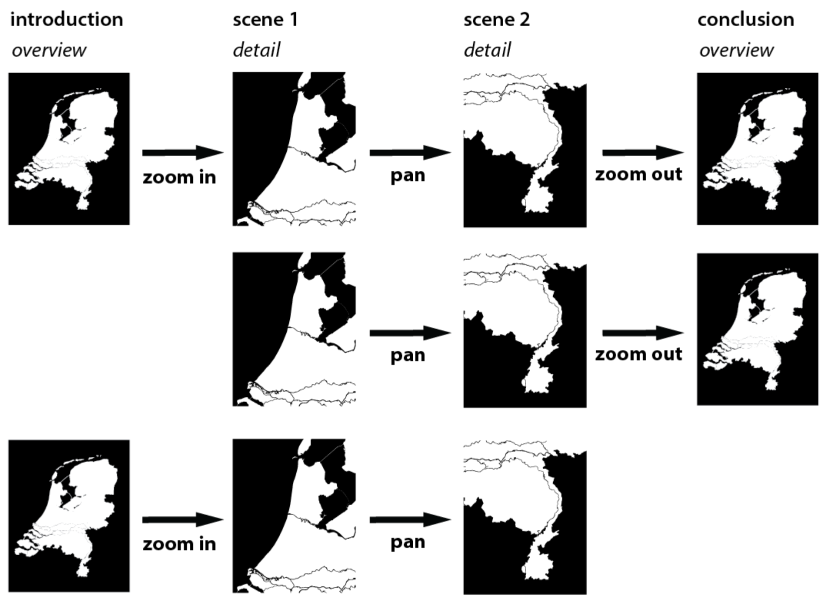


Figure 4-25 Zooming and panning as editing techniques, different plot structures

Cutting between two different actions is often performed by a fade out of the 1st dataset before the 2nd datasets starts playing. When the dataset is about a different subject and is playing at a the same location a clean sweep of the foreground items can be performed before the new dataset starts. For example after the visualization of the decrease of the number of sold houses the area is empty for a while before the new dataset is started. In the animation of wrecks first ship wrecks are shown and later on airplane wrecks. While in the airplane wreck scene the ship wrecks are still visible.

4.3.5 Sound

Every animation is accompanied with sound. In the first place background music and voice. In some animations sound effects are used. Background music that is used is often light, minimal music. The music supports the story as it creates a general atmosphere.

Sound effects are used while zooming in or out. The effect emphasizes the zoom, which in turn is the transition to another scene. Also, sound effects are used to announce dramatic events. For example in the oystercatcher animation rain and thunder effects are used to emphasize the thunderstorm that leads to an extreme high tide. It supports the visual presentation which on its own doesn't communicate the seriousness of the impact of the storm. Thirdly, sound effects are used to just embellish. For example, in the animation where the behavior of surfers is shown the sound effect of fluttering sail cloths is heard. In the migration animation sound effects are used to emphasize the moments of spatio-temporal change of the data. The sound effect is not related to reality. In this animation not only 3D information and movement is added in the visualization of the data, also sound is used to emphasize dynamics of the phenomenon.

4.4 User experience results

4.4.1 Scores: narrative understanding

To answer the question to what degree the viewer was able to understand the animation (narrative understanding (Busselle & Bilandzic, 2009) two Likert scale questions (question a and b, see Appendix B) are asked and a cross-reference study is performed. The scores on the Likert questions is listed in Table 4-3

Table 4-4. It appears however that both questions are not measuring the same. Cronbach`s alpha (measurement of internal consistency) of both questions is lower than 0.5. Therefore I choose to use question a. (whether people are able to follow the story) as a measure for narrative understanding and to not take into account question b (whether people think the structure is logic). Narrative understanding is also measured by submitting statements to the viewers about the animations (question i, Appendix B). When the right statements are judged as right and the wrong statements as wrong the viewer has a good understanding of the message of the animation. When false answers are given, this is an indication of misunderstanding. If people only give one good answer instead of all, it is hard to conclude that the viewer has not fully understood the story. Therefore I only take into account wrong answers. The more wrong answers the lower the degree of narrative understanding.

Table 4-3 shows that the animation are well followed by the viewer (scores around 4). The migration animation scores least. The message of the animations is understood well in general (high scores on question i.). Most wrong answers were given for the migration animation (16%). This is an indication that the message of this animation was less clear.

Table 4-3 Scores on the survey questions a, b and i.

	{a} follow	Logic {b}	Message {i}	
Organs	4.1	~~4.2~~	~~54%~~	2%
Schools	4.2	~~4.1~~	~~66%~~	0%
Home sales	4.2	~~4.3~~	~~73%~~	0%
Migration	**3.9**	~~4.0~~	~~82%~~	**16%**

Cross-reference study: In

Table 4-4 the themes are presented that people have mentioned when answering the question (f): "*what did you remember most?"* The themes that the respondents mentioned are compared to the themes mentioned by the author of the stories. When the themes mentioned by the respondents and the author match they are indicated as bold-underlined. What can be noticed is the great variation of themes that are mentioned. It seems that the themes that are mentioned by the author are also mentioned by at least one of the respondents. Also other themes than the themes the authors thinks as most interesting are mentioned. It is remarkable that after watching the migration animation the theme "Almere" is mentioned most of the times (28x). Apparently Almere invokes a certain feeling of recognition. The answers on question G, (Appendix B) where the respondents were asked to summarize the story, and question H, where the respondents were asked about the meaning of certain entities, no wrong understandings were discovered.

Table 4-4 Themes that people remembered most (Question f)

ORGANS		SCHOOLS		HOME SALES		MIGRATION	
Speed	16	Closing schools	15	**Decrease of prices**	15	**Almere**	28
No. of people	12	**Closing in shrink areas**	8	Decrease of sold houses	7	Difference between low and high spread	6
Distances	6	**Spread of shrink areas**	7	**Increase of cheap houses**	6	Movement patterns	6
Spread	6	Open vs closing schools	7	**Impact of crisis**	5	**Staphorst**	5
International	6	Style	4	**Decrease of expensive houses**	5	Style	2
Coordination	4	Shrink areas	3	Existence of cheap houses	4	Sedentism	2
Lungs	4	Small schools	2	Chance for poor people	4	**Mining areas**	1
Style	4	Closing school in Randstad	2	Existence of expensive houses	3		
Plane	4			Extreme case	3		
Routes	3						
Urgency	3						

4.4.2 Scores: emotional engagement

Likert question c, e and j show an internal consistency (Cronbachs alpha > 0.6) and thus can be regarded as a measurement of the same variable: emotional engagement (Busselle & Bilandzic, 2009; Reeve (2006)). The scores on the separate questions are listed in Table 4-5.

It is apparent that the schools animation evokes that least emotional engagement.

Table 4-5 Scores on survey question c, e and J.

	Interest {c}	Involved {e}	Engage {j}
Organs	4.4	3.8	55%
Schools	**3.7**	**3.3**	**41%**
Home sales	4.3	3.8	45%
Migration	4.3	3.7	48%

Answers on the question: *´The animation has: surprised, enjoyed, learned, surprises, curious or bored me'* is summarized in Table 4-6. High scores are indicated in grey rectangles, low scores as blank rectangles. There can be noticed that all the animations mostly taught people something. The schools and home sales animations are experienced as most educative (score of 50 / 51%). The animation people enjoyed most is the migration animation. The school animation is least entertaining and bored people most. This corresponds with low scores on the other questions regarding emotional engagement (see above). People are most surprised by the organ animation and least by the migration patterns. The migration animation in turn made people most curious.

Table 4-6 Engagement scores

ORGANS			SCHOOLS			HOME SALES			MIGRATION		
Learned	**37**	42%	Learned	**38**	50%	Learned	**43**	51%	Learned	**37**	39%
Enjoyed	**22**	25%	Enjoyed	**12**	16%	Enjoyed	**23**	27%	Enjoyed	**34**	35%
Surprised	**17**	19%	Surprised	**11**	14%	Surprised	**11**	13%	Surprised	**9**	9%
Curious	**10**	11%	Curious	**9**	12%	Curious	**8**	9%	Curious	**15**	16%
Bored	**3**	3%	Bored	**6**	8%	Bored	**0**	0%	Bored	**1**	1%

4.4.3 Evaluation of general remarks

The answers on the question: "*have you other general remarks"* are all presented in appendix C. After a text analysis a number of themes are distinguished per animation. I divided the answers in positive and negative values. The list of themes is shown below (Table 4-7). Some general remarks can be made. For the organs, home sales and migration animation there were more positive answers than negative. The percentage negative and positive answers are indicated in the table. The school animation is perceived more negative than positive. This corresponds with low values on the other questions regarding *emotional engagement* (see section 4.4.2).

What people found positive in the animations was the clearness, attractiveness, educational value, interestingness and completeness. Further, some respondents came up with additional questions after watching the animation. The animation made them curious for more in depth information about the subject.

Negative points that are mentioned are related to several aspects of the animation. At first the use of sound can negatively influence the feel of the animation. Other negative points that are mentioned are the overload of information and the speed at which the information is presented. People mention it might help if additional information was presented on screen like location names, time or values. Further, people question why certain selections are made. They found no explanation in the animation why the selections that are shown are more important than other values. For two animations the choice for data-animation as a medium to present the information is seen as inappropriate. According to them a data animation doesn't have added value for bringing the story. A negative point mentioned about the migration animation was that the graphics doesn't resemble the action that is mentioned by the voice over.

Table 4-7 Identified themes after text analysis

x mentioned	*+ / -*	*themes*	*%*
ORGANS			
11	+	clear / attractive / educational	70%
3	+	curious: new questions arise	
3	-	voice over: monotne / ditactic / propaganda	
2	-	speed: hard to follow	30%
1	-	animation as form no added value	
SCHOOLS			
5	+	clear / attractive	27%
2	+	curious: new questions	
1	-	sound	
14	-	speed / information overload / missed time indication	
2	-	animation as form no added value	63%
1	-	choice for selections unclear	
1	-	not complete: locations are missed	
HOME SALES			
11	+	clear / attractive / interesting	61%
2	-	sound: too dramatic	
2	-	missed indication of locations / percentages	
1	-	not complete: missed subject rent	39%
1	-	unclear how values are determined	
1	-	missed focus on regions instead of cities	
MIGRATION			
13	+	clear / attractive / interesting / complete	62%
2	-	speed / infomation overload (too much levels)	
1	-	missed indication of locations	
2	-	choice for selections are unclear	38%
1	-	graphic doesn`t show the pattern that is mentioned	
2	-	lack of depth	

5 Conclusions & discussion

5.1 Conclusions and discussion per research question

5.1.1 Narrative structure [Q1]

In the animations that I analyzed a dramatic plot development with an arc of suspense (exposure, inciting incident, climax, resolution) is hardly found. Instead, in most animations the events are presented in a chronological order. The sequence of events just takes place as expected. However, within the plot techniques are used to create effects of surprise and curiosity. Curiosity is used in the beginning. To create curiosity, story information is withheld for a short period. Surprise created by presenting unexpected events (twist). Surprise is often applied in the end of an animation.

Two animations show a perfect dramatic plot structure. Apparently it is very well possible to tell real stories with geo-data. It might be concluded that finding a real story in data is simply a hard task. Most datasets contain interesting facts and trends that might be exceptional and worth telling. But telling a real story that follows a dramatic story structure is only possible when the data contains a change that disrupts the status quo (inciting incident) and a climactic moment. In most data-sets this is just not found. That most animations don't tell a real dramatic story doesn't mean they are not interesting or that they don`t effectively communicate information. What makes them interesting is not as much the overall feeling of suspense but rather the experience of the data itself. Geo-data in itself reveals patterns that are otherwise hard to discern and are often invisible. Visualizing geo-data gives us new insights and let us discover human behavior and natural processes in a new way.

Most animations are aimed at showing us routes that a certain character has followed, connection patterns, differences in intensities and spatial patterns. Also, animations are distinguished that emphasize aspects of a non-temporal dataset. In half of the animations, the narrative is based on a single phenomenon. In the other animations relations *between* different phenomena (that are not interesting when presented separately) are the inputs for the story. In these animations the focus is to show us a causal relationship between events, correlations between spatial patterns or compare different behavior. Also, an animation can be based on multiple phenomena that are not directly related but together communicate a complete story. As been mentioned in section 2.1, stories are about causal relationship between events. Animations that present a single phenomenon only visually present *effects*. Causes of the effects are often mentioned in the voice over or are just not communicated. In animations where the focus is to show correlations or comparisons, are only about effects. Only in animations where different phenomena are shown that are causally related, both cause and effect are visually presented.

Themes that are mostly found are: transport, species and infrastructure. In general one can state that the animations are mostly based on human and animal *movement* or human geographic subjects. For telling a story it is important, according to the chief-editor, to find data that tells 'something about us' and is about a subject we can identify ourselves with. Even in animations about animal behavior, people are attached to the story because they can relate the behavior from their own human behavior. When natural phenomena are used in the animations, they mostly are the cause for certain human behavior. The animations mostly take place in the present or a range of years ending in the present. The viewer might be more attached to the story when events are presented that have recently happened and that can be remembered by the viewer. Also, when events are visualized that have recently happened, this might give the viewer the imagination that the phenomena that are shown are actually happening at this moment too. It will give the viewer a sense of actuality. Animations that take place at a single scale only communicate the general trend of the phenomenon. When the story is told by making use of selections of locations this gives the story more depth.

The most important requirement for telling a good story is having data that is interesting. The reason for being interesting can be that the phenomenon itself is exceptional or unexpected. Another reason for being interesting is that the representation of the phenomenon by a data-visualization is surprising, spectacular or beautiful in itself. It reveals patterns that are otherwise not possible to. Next, there is often looked for remarkable manifestations of the phenomenon at certain locations, moments in time or within certain thematic categories of the data. These extremes will often determine the events of the story. In the animation the viewer is guided through these selections of remarkable events or extreme values.

To answer this first research question the data-matrices as presented in chapter 3 were used. By watching the animations the scores on the variables were filled in. The process can be described as iterative. Classes were shaped along the route. As I am not an expert in narrative studies I might have missed certain important storytelling variables. It might have been wise to include journalist and other actual storytellers in the process of selecting the variables that are of importance for storytelling. Most literature about narrative data-visualization is about static visualization and do not take geo-data into account as a special data type. Therefore the conclusion that just showing a process already can be a narrative was surprising.

5.1.2 Narrative storytelling techniques [Q2]

Narrative storytelling techniques are used to support the structure of the story. As described above a story often shows a phenomenon in its totality followed by focusing on specific selections in time, locations and thematic values. Overview scenes and selection scenes are the building blocks of the plot. Dynamic variables are used to put these scenes in order, isolate selections, and emphasize certain scenes by expanding their duration or let people experience different views by repeating the story time. By narration the story information is communicated. A voice-over guides the viewer through the different scenes. On the one hand the voice-over communicates what happens in the visual display, he tells what you see. On the other hand the voice over adds context to the events that are shown, introduces the viewer to the story and ends the story by concluding remarks. To support the story the data is often simplified to a single category.

In analyzing narrative storytelling techniques the framework of dynamic variables of Blok (2005) seemed useful. Thereby I might conclude that storytelling at some points share the same principles as monitoring information. To identify narration techniques I transcribed all the voice-over texts. This seemed a useful method. The classes I identified were not related to literature but were my own observations. The style of the voice-over in the animations is very specific. I therefore didn't take into account tempo and language but just described the general function of the voice-over sentences. I described narrative and visual techniques as apart from each other. In reality they are closely related in the animations. I might have missed interesting conclusions about their mutual influence.

5.1.3 Visual storytelling techniques [Q3]

Mostly routes, connections and differences in intensity are visualized. Mostly the actions are visualized in high detail: individual routes are followed, difference in intensity is visualized by showing the appearance of individual points and connections are visualized as movements of points along a path. Aggregations of the data that performs the action are seldom made (no chloropleth maps are used for example). Moreover, detail is even *created* when it is not present in the original geo-dataset. Normally, connections only contain information about the start time, start location and end location. In the animations however, connections are visualized as points that follow a path from A to B in a certain time. So, the duration of the connection (the speed of the point) is devised by the author of the story to let the viewer imagine more detail. Even a third dimension is added to experience the connection as a trajectory. I might conclude that (for the author) more detail means more spectacular visualizations.

Although detailed information is used, to support the viewer in following the story the data entities are mostly not differentiated based on thematic values in the animations. Mostly the thematic information that is available in the data is neglected. The data is presented in the most basic level. Not the differences between the data entities are of importance but rather their movements, appearance or relations with other entities. When differentiations between nominal classes or numerical values are used, these are only used to show that there are different classes or values. The viewer is not assumed to perceive the meaning of the classification or the magnitude of the values. When differentiations between categories or values are visualized, only the graphic variables color and size are used. When size is used, extreme differences between the smallest and largest value are used to emphasize the difference (big versus small rings).

During the animations no additional visual information (like legend information) is presented that helps the viewer in understanding what the entities mean. As the data is often representing one or two nominal categories this is not needed. Often the narrator tells what the entities represent. Keeping the information simple appears to be the main tactic when creating a narrative data-animation. Besides, visualizing the data in bright colors on a dark background make them easy to focus on. Also adding 3D effects and glowing emphasizes the data and make the entities more attractive.

Spatio-temporal changes that are used most in the animations are movement along a path and appearance. As been mentioned, the entities that perform this type of change are mostly points. Phenomena that show mutation are mostly natural phenomena that are represented by raster data. Movement along a path is visualized by a moving bright point. Its trajectory is visible. The length of the trajectory is proportional to the speed of the movement. To show the pattern of all the movements of the different individual entities together, the trajectories often stay visible after the action. In fact, this redundant information helps the viewer to recapitulate what they just saw or the put events that follow into context. To emphasize appearance expanding and contracting (blinking) is used. Blinking is also use to emphasize entities in non-temporal datasets. In non-temporal animations, animation time is used to let the entities appear in a random order (not at once). In this way the viewer has time to point his eye to the right location. Contrast between foreground items and background is used to emphasize the foreground items. Bright colors are used for the foreground items, dark color for the background.

Mostly high camera angles are used: top down view as most of the data only have 2 spatial dimensions. When z values are present in the data low angles can be used to experience three-dimensionality. Experiencing three-dimensionality seems to be more attractive for lower scales. In the animations three-dimensionality is even created when it is not present in the data. For example points are visualized as spheres and connection lines are visualized as 3D arcs. Low camera angles are not only used to experience 3D. When tilting the camera from a high angle to a low angle, a vaster area becomes visible. By tilting to a lower angle new information can be revealed; it can be applied as an effect to create surprise. In many animations it is used to observe approaching entities. By filming in low perspective the whole dataset will be visible while the camera is closer to the object. Zooming-in is used to guide the viewer to certain selections of location. Zooms are often the transition between scenes. To accentuate the zoom a sound effect is used. A zoomed out shot is used to generate an overview of the setting. It is often used in the beginning of an animation. Zooming out can also be used at the end to summarize what has been presented. When following a route that follows different scale levels, zooming is used to keep the route in focus.

In most animations the scenes are not divided by cuts. The scenes may differ in their location or scale level. Then zooming is used to move from one scene to the other. As been mentioned, often these zooms are accentuated by a sound effect. Also, fast panning from one location to the other is used to switch between scenes. Background music is used in every animation and is used as a unifying element. Next, background music is used to dramatize. Sound effects are used to embellish certain events or to announce change.

The data used to analyze the visual techniques I derived from watching the animations and filling in the data matrices as described in chapter 3. Thereby the fact that I contributed myself to the realization of the animations and therefore knew the structure of the underlying datasets helped me in this process. The animations are made for the same television series. They all share a similar graphical style. Different techniques might be discovered when analyzing different animations. Still, I think the principles that were identified are generally applicable, but are not complete. Further research that takes into account a wider range of animations is needed to come to a complete investigation of successful visual (and narrative) storytelling techniques.

5.1.4 Effectiveness of animations [Q4]

A user study is performed to test the narrative understanding (Busselle & Bilandzic) and emotional engagement (Busselle & Bilandzic, 2009; Reeve, 2006) of narrative geo-data animations. From the user study it can be concluded that the narrative understanding of the animation was high. The study shows high scores on the question whether the user was able to follow the animations, the meaning of entities was well understood and in summarizing the animations no false statements were made. In general the animations evoked a medium level of emotional engagement by the respondents. Respondents indicated that they were above average interested in the animations (average score of 4.2 on a scale from 1 to 5). Respondent to a lesser degree felt involved in the subject (average score of 3.6), but still above average. Half of the respondents showed a high level of engagement based on measuring their intended behavior after watching the animations (they at least wanted to see the animation again). Half of the respondents showed a low level of engagement as they indicated that they didn't want to see the animation again. The schools animation scored relative low on all the questions that measured the emotional engagement (least interested, involved and engaged). The reason for this low engagement might be related to the subject which is well known by most people and might be perceived as boring. In their general remarks respondents evaluated the schools animations mostly as negative (63 % of the remarks were negative). The other animations were in contrary evaluated mostly as positive (> 60% positive remarks). What people experienced as negative regarding the schools animation was mainly related to the chaotic character of the animation (too many points, too many numbers mentioned), the lack of focus, the speed of the animation (too fast) and the lack of interesting correlations (only the general pattern is shown).

The animations mostly were evaluated as educative and entertaining rather than surprising, curious or boring. The animation that surprised most respondents was the organs animation. What remained most by the respondents were the high speed, far distances and the large number of people that were helped by this operation; surprising facts. The animation that made the respondents most curious was the migration animation. It might be that people were curious how the migration pattern in their own city would look like. The animation that least enjoyed people and most bored people was the schools animation; also the animation that showed the lowest scores on interest, involvement and engagement.

Positive values that were mentioned by the respondents were: clearness, attractiveness, educational value and interestingness. Negative themes that were mentioned were related to sound (perceived as too dramatic), the amount of information that was communicated (too much), the lack of additional information on screen (like time stamps, data values or location names), or the choice for data-visualization (some respondents had the opinion that a data visualization is not always needed to tell the story).

With only a four animations that were tested it was hard to draw explicit conclusions about the relationship between the type of the animation and effectiveness. The choice for testing only four animations was prompted by the fear for impatience of the respondents. The selection of the animations was based on the type of temporal change that was visualized. I made the selections before I had a clear classification of the animations. Afterwards, I realized that I should have based the selection on the narrative structure types I identified after answering research question 1. In total 65 people responded. The age distribution of my respondents and the actual viewers was different at two points. I missed people under the age of 19 and between 35 and 49. Relating age group to the scores on the variables of effectiveness might have resulted in interesting conclusions. This however, is not the scope of this thesis. In principle, to be effective, the animations should be understood and evoke emotions by everyone, no matter what their age is. The data was collected via an online survey. Therefore most questions were closed. The reasons behind the answers could not be identified, what have led to a lack of nuance in the conclusions. I found it hard to analyze questions with multiple choice answers. Calculating scores for these questions was less straightforward than for single answers questions. In future research I should avoid multiple choice questions. In analyzing the open questions I used a qualitative approach of identifying themes. Also here, asking supplementary questions would be a valuable addition. Afterwards, I conclude that an online survey made it easy to reach a vast number of respondents in a short time, but also resulted in more superficial insights.

5.1 General conclusion

In this thesis I conducted an analysis to classify narrative geo-data animations that are broadcasted on television. I therefore analyzed 21 animations that were created for the Dutch television series “The Netherlands from Above”. I concluded that narrative geo-data animations often don`t need a dramatic structure to be interesting and to generate emotional engagement. Often events are presented in chronological order without an inciting incident or climax. Often the fact that the data animations are showing us human behavior or natural processes in a way we have never experienced before already evoke positive emotions. Although most animations don’t have a dramatic plot structure and thus doesn’t show an overall arc of suspense, techniques to evoke surprise and curiosity are applied. I concluded that the authors of geo-data animations used data about phenomena that are exceptional or unexpected in itself. Also, they combined different phenomena to reveal interesting correlations or causal relationships. Next, the authors often focused on selections of locations, moments in time or thematic aspects of the data that are remarkable. It has been investigated that the animations are mainly about human behavior or animal behavior that happened in the present. Animations can focus on routes that are followed, connections, differences in intensity, patterns or emphasize aspects of non-temporal data. I classified animations based on the structure of events. Animations can present the behavior of a single phenomenon, or combine different phenomena to reveal correlations or causal relationships or to stress different aspects of a story.

Narrative techniques that support the story are the use of isolation of visual aspects of the data (moment of display), ordering of events, duration and frequency. Voice-over helps in annotating, introducing and concluding the sequence of events. Next, data simplification techniques are used support the story. Visual techniques are aimed at structuring the focus of the viewer. Mostly data is visualized in a single class. When differentiation in the data *is* visualized this is only done to emphasize that there *are* different categories or values, not *how much* they differ. Next, visualization techniques are aimed at making the animations visual appealing and attractive. Therefore a high level of detail is used. Even when this detail is not present in the original dataset detail is created. Other techniques that are used to attract the viewer are the use of bright colors and 3D effects. Trajectories are used to let the viewer observe speed proportional to reality and to see the other routes in context. Cinematographic techniques were used to isolate details (zooming), creating overviews, or creating 3D imagination and perspective (angle). By naming the techniques that are used in these animations and identify successful combinations of techniques I think that I have equipped journalists, scientists, or educators with a toolset for narrative presentation.

The user study gave insight in the narrative understand and emotional engagement of the animation and thereby about their effectiveness. The general conclusion is that the animations had a high degree of narrative understanding and scored average on emotional engagement. The animations mostly were perceived as educational rather than evoking emotions as surprise, curiosity or suspense. This can be explained by the lack of a dramatic plot structure. The one animation that was perceived as consequently less emotionally engaging than the others showed changes of a high number of points in a short period (chaotic), lacked focus and lacked interesting correlations according to the respondents. Identifying these aspects and preventing them in the future might help in the creation of good geo-data animations.

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7 Appendix

7.1 Appendix A1: data matrices research question 1

Animation nr.	Animation name	type of action	inc. Incident	climax	resolution	curiosity	surprise	type	Begin	End	single / multiple phenomena	aspects / causal / pattern / comp.	single / sub-processes	Relation Type (see table 4.2)
4	shrink	spatial pattern / non-temporal	n	n	n	0	0	A	setting	extreme	multiple	aspects	single - values/ causal	B1
9	homesales	intensity	n	n	n	0	0	A	action	no	multiple	aspects	single - values (2x)	B1
5	organs	follow route	n	n	n	0	0	A	action	conclusion	single		single - sub-sim	A2
16	sedentism	connection	n	n	n	0	0	A	summary	no	single		single - sub-select	A4
10	wrecks	non temporal	n	n	n	0	0	A	setting	no	multiple	aspects	single	B1
12	oystercatcher	follow route	y	y	y			E	setting	resolution	multiple			B3
19	newland	follow route	n	n	n	0	0	A	action	resolution	multiple	causal		B3
8	roadassist	follow route	n	n	n	0	0	A	setting	extreme	multiple	causal		B3
11	snowplow	follow route / intensity	n	n	n	1	1	D	action	surprise	multiple	causal		B3
13	surf	follow route	n	n	n	1	0	C	summary	no	multiple	causal		B3
6	crossroads	follow route	n	n	n	0	1	B	setting	surprise	multiple	comparison		B2
20	fate	spatial pattern	n	n	n	0	0	A	summary	conclusion	multiple	comparison		B4
7	deer	spatial pattern	n	n	n	1	1	D	action	surprise	multiple	comparison		B4
2	export	connection	n	n	n	1	0	C	action	no	single		single - sub-select	A4
14	lambs	follow route	n	n	n	0	0	A	setting	no	single		single	A1
15	honeybuzz	follow route	y	y	y			E	setting	climax	single		single	A1
18	roses	follow route	n	n	n	0	1	B	summary	surprise	single		single - sub-sim	A2
1	milkyway	follow route	n	n	n	0	0	A	summary	conclusion	single		single - sub-seq	A3
3	urban	intensity	n	n	n	0	0	A	summary	no	single		single	A1
17	waste	follow route	n	n	n	0	1	B	action	surprise	single		single - sub-sim	A2
21	logistics	connection	n	n	n	0	0	A	setting	conclusion	single		single - sub-sim	A2

Animation nr.	Animation name	Themes	Human / physical	Year	Story Period - class	Period - class - code
4	shrink	education / population / urbanization	human	1995-2012	1 - 15 years	E
9	homesales	economy / human settlements	human	2006, 2008, 2012	1 - 15 years	E
5	organs	health / transport	human	2012	1 - 7 days	B
16	sedentism	human settlements / urbanization / population	human	1900-2012	1 century	F
10	wrecks	rivers and lakes / coastal areas /	human	1700, 1940, 2012	> 1 century	G
12	oystercatcher	species / coastal areas	nature	2012	1 month - 4 months	C
19	newland	landuse	human	2008-2013	1 - 15 years	E
8	roadassist	infrastructure / tourism / transport	human	2012	1 - 7 days	B
11	snowplow	climate / infrastructure / private consumption	human vs nature	2012	< 1 day	A
13	surf	climate / tourism / coastal areas / species	human vs nature	2012	1 - 7 days	B
6	crossroads	transport / education / food supply	human	2012	1 - 7 days	B
20	fate	climate /	human vs nature	2012	1 year	D
7	deer	species / infrastructure	human vs nature	2012	1 year	D
2	export	transport / food supply / agricultural production	human	2012	1 year	D
14	lambs	vegetation / species / infrastructure	nature	2012	< 1 day	A
15	honeybuzz	species	nature	2012	1 month - 4 months	C
18	roses	transport / agricultural production	human	2012	1 month - 4 months	C
1	milkyway	transport / food supply / agricultural production	human	2012	1 - 7 days	B
3	urban	urbanization / population / human settlements	human	1900-2012	1 century	F
17	waste	transport / energy production / waste management	human	2012	< 1 day	A
21	logistics	transport / private consumption	human	2012	< 1 day	A

scale max	scale min	scale max-min	scale diff	Aspects of interest
national	local	nationallocal	2	Extremes
national	local	nationallocal	2	Extremes
national	local	nationallocal	2	Phenomenon exceptional in its own
national	national	nationalnational	0	Phenomenon interesting in its own
national	regional	nationalregional	1	Extremes
regional	local	regionallocal	1	Phenomenon interesting in its own
local	local	locallocal	0	Phenomenon interesting in its own
national	local	nationallocal	2	Phenomenon exceptional in its own
national	national	nationalnational	0	Phenomenon exceptional in its own
national	local	nationallocal	2	Extremes
regional	local	regionallocal	1	Combination
national	national	nationalnational	0	Extremes
regional	regional	regionalregional	0	Phenomenon interesting in its own
international	national	internationalnational	1	Extremes
regional	regional	regionalregional	0	Phenomenon exceptional in its own
international	local	internationallocal	3	Phenomenon exceptional in its own
international	regional	internationalregional	2	Combination
regional	regional	regionalregional	0	Extremes
national	local	nationallocal	2	Extremes
national	local	nationallocal	2	Combination
national	local	nationallocal	2	Extremes

7.2 *Appendix A2: data matrix research question 2*

Animation nr.	Animation name	selection of subsets of time	selection of location / object	selection of thematic attributes	Order	expanded	compressed	Frequency	annation direct	annotation indirect	context	summary
4	shrink	0	1	1	AB	0	0	0	1	1	1	1
9	homesales	1	1	1	AB	0	0	location	0	1	1	0
5	organs	0	1	0	AB	0	1	0	0	1	1	1
16	sedentism	0	0	0	AB	0	0	sub-pr	0	1	0	1
10	wrecks	0	1	0	AB	0	0	0	0	1	1	1
12	oystercatcher	1	1	0	AB	1	1	0	0	1	1	1
19	newland	0	1	0	AB	0	0	0	0	1	1	0
8	roadassist	0	1	0	AB	0	0	0	0	1	0	1
11	snowplow	0	1	0	AB	0	1	0	0	1	1	0
13	surf	1	1	1	AB	0	0	location	1	1	1	1
6	crossroads	0	1	0	AB	0	0	0	0	1	1	1
20	fate	0	0	0	AB	1	0	0	1	1	0	1
7	deer	0	1	0	AB	0	0	0	0	1	1	1
2	export	0	1	1	AB	0	0	sub-pr	0	1	1	0
14	lambs	0	0	0	AB	0	1	0	1	1	1	1
15	honeybuzz	0	1	0	AB	1	0	0	0	1	1	0
18	roses	0	1	0	AB	0	0	0	0	1	0	1
1	milkyway	0	0	0	BA	0	0	0	1	1	1	1
3	urban	0	1	0	BA AB	0	0	location	0	1	0	0
17	waste	1	1	1	AB	0	0	sub-pr	0	1	1	0
21	logistics	0	1	0	AB	0	0	0	1	1	1	1

7.3 Appendix A3: data matrices research question 3

Animation nr.	Animation name	Differentiation		Measurement scale	Perception	Graphic variable	no. of classes
4	shrink	1	points	nominal	associative	color	
9	homesales	0	points				
5	organs	0	lines				
16	sedentism	0	lines				
10	wrecks	0	points				
12	oystercatcher	1	lines	nominal	selective	color	
19	newland	1	lines	nominal	selective	color	
8	roadassist	0	lines / points				
11	snowplow	0	lines / points				
13	surf	0	lines				
6	crossroads	1	lines	nominal	associative	color	
20	fate	1	points	numerical		size	
7	deer	0	points				
2	export	1	lines	numerical		size	
14	lambs	1	lines	nominal	selective	color	
15	honeybuzz	1	lines	nominal	selective	color	
18	roses	1	lines	nominal	selective	color	
1	milkyway	0	lines / points				
3	urban	0	polygons				
17	waste	0	lines / points				
21	logistics	0	lines				

Animation nr.	Animation name	movement traject		appearance	visual effects	boundary shift	visual effects	mutation nominal	mutatin higher	connection change	non-temperal	visual effects
4	shrink	0		1	appear / short	0		0	0	0	1	random / expand
9	homesales	0		1	appear	0		0	0	0	0	
5	organs	1	trajectory	0		0		0	0	0	1	pulsating
16	sedentism	0		0		0		0	0	1	0	
10	wrecks	0		0		0		0	0	0	1	random / expand
12	oystercatcher	1	trajectory	0		0		1	0	0	1	fade
19	newland	1	trajectory	0		1	fade	0	0	0	0	
8	roadassist	1	trajectory	1	appear	0		0	0	0	1	glow
11	snowplow	1	trajectory	1	appear	0		0	1	0	0	
13	surf	1	trajectory	1	appear	0		0	0	0	0	
6	crossroads	1	trajectory	0		0		0	0	0	0	
20	fate	0		1	appear	0		0	0	0	0	
7	deer	1	trajectory	1	expand	0		0	0	0	1	slowly appear
2	export	0		0		0		0	0	0	1	movement
14	lambs	1	trajectory	0		0		0	0	0	0	
15	honeybuzz	1	trajectory	1	ring	0		0	0	0	0	
18	roses	1	trajectory	0		0		0	0	0	0	
1	milkyway	1	trajectory	1	expand	0		0	0	0	1	fade
3	urban	0		1	appear	0		0	0	0	0	
17	waste	1	trajectory	0		0		0	0	0	1	random / expand
21	logistics	1	trajectory	0		0		0	0	1	0	

Animation nr.	Animation name	zoom out	zoom in	zoom difference		sound effects		Tilting
4	shrink	5	7	2				1
9	homesales	4	12	8				1
5	organs	3	13	10				1
16	sedentism	4	9	5		fireworks		1
10	wrecks	4	10	6		thunder		1
12	oystercatcher	6	12	6				0
19	newland	8	11	3				0
8	roadassist	6	12	6				1
11	snowplow	4	10	6				1
13	surf	5	11	6				0
6	crossroads	6	12	6				1
20	fate	5	6	1				1
7	deer	8	11	3		wind in sail		0
2	export	1	3	2				1
14	lambs	9	13	4				1
15	honeybuzz	2	11	9				1
18	roses	1	11	10				1
1	milkyway	6	10	4				0
3	urban	5	11	6				0
17	waste	4	11	7				1
21	logistics	5	12	7				0

7.4 Appendix B: survey

a. Het was moeilijk om de gebeurtenissen in de animatie van begin tot eind te volgen*

	1	2	3	4	5	
helemaal mee oneens	○	○	○	○	○	helemaal mee eens

b. Het verhaal van de animatie heeft een logische opbouw*

	1	2	3	4	5	
helemaal mee oneens	○	○	○	○	○	helemaal mee eens

c. Ik vind de animatie interessant*

	1	2	3	4	5	
helemaal mee oneens	○	○	○	○	○	helemaal mee eens

d. Ik vind de gebeurtenissen in de animatie geloofwaardig*

	1	2	3	4	5	
helemaal mee oneens	○	○	○	○	○	helemaal mee eens

e. Ik voel me betrokken bij het onderwerp van de animatie*

	1	2	3	4	5	
helemaal mee oneens	○	○	○	○	○	helemaal mee eens

f. Wat uit de animatie is u het meest bijgebleven?*

g. Kunt u het verhaal dat de animatie vertelt samenvatten in 1 of 2 zinnen?*

h. Wat stelden de rode punten die aan het eind oplichten voor?*

1i. Deze animatie gaat over (meerdere antwoorden mogelijk)*

- ☐ Orgaandonoren
- ☐ Vervoer van patienten
- ☐ Ontvangende patienten in Nederland
- ☐ Vervoer van organen

2i. De animatie gaat over (meerdere antwoorden mogelijk)*

- ☐ Scholen die zijn gesloten
- ☐ Scholen in krimpgebieden
- ☐ Scholen die moeten sluiten
- ☐ Kwaliteit van het onderwijs

3i. Deze animatie gaat over (meerdere antwoorden mogelijk)*

- Afname van het aantal verkochte woningen na de crisis
- Waardedaling van woningen na de crisis
- Toename van het aantal goedkope woningen
- Stijging van de wachttijd om een woning te verkopen na de crisis

4i. Deze animatie gaat over (meerdere antwoorden mogelijk)*

- De trek van mensen van het platteland naar de stad
- De terugkeer van mensen naar hun oorspronkelijke woonplaats
- De verhuisgeneigdheid van mensen
- De afstand waarover mensen verhuizen

j. Na het zien van de animatie zou ik (meerdere antwoorden mogelijk)*

- hem nog een keer willen zien
- erover willen vertellen aan anderen
- hem niet nog een keer willen zien
- meer informatie willen opzoeken over het onderwerp
- Anders:

k. De animatie heeft me vooral (meerdere antwoorden mogelijk)*

- Vermaakt
- Verrast
- Iets geleerd
- Verveeld
- Nieuwsgierig gemaakt
- Anders:

L. Wat wilt u verder nog kwijt over deze animatie?

7.5 Appendix C: Full text survey answers

ORGANS – GENERAL REMARKS

Leuk dat buitenland in dit verhaal ook voorkomt. Het was een coole animatie. ik was onder de indruk door hoe dat allemaal gaat als een orgaandonor overlijd. Duidelijk en mooi om te zien. De animatie is duidelijk en leerzaam. Dat er ook organen naar het buitenland gaan. Orgaandonatie beleid is immers op nationaal niveau geregeld. Ik vraag me af hoe dat zit. Ik ben benieuwd hoeveel van dit soort transplantaties dagelijks worden uitgevoerd. knap gemaakt. Mooi in beeld gebracht mooie vormgeving. Animatie was totaal onnodig bij dit onderwerp. overzichtelijk en instructief Ik vond de stem en de geluiden een beetje schokkend klinken, overdreven waardoor de sfeer van een propaganda film werd opgeroepen. Ik ben al donor maar ik verwachtte dat de kijken gevraagd werd om donor te worden. Het ging snel ik had niet meteen door welk orgaan waar heen ging en welk lijntje de invliegende dokter was. Maar zo snel gaat orgaan donatie in t echt ook, dus dat klopt wel. In het eindoverzicht mistte ik de twee organen die naar het buitenland (Duitsland en Kroatië) zijn gegaan. combinatie van animatie en voice-over heel goed de animatie en de voice-over leken soms niet synchroon te lopen, waardoor het soms wat onduidelijk was waar welk orgaan heen ging of juist nergens heen ging. De opbouw klopte ergens niet helemaal. De verteller vertelde te monotoon en te langzaam. Vervelende stem commentator. Langzaam en te belerend.

ORGANS-REMEMBERED MOST

De mooie animatie. De lever is in een uur in Groningen. Vervolgens is een route over de snelweg te zien. Dat is pakweg 180 kilometer. Dan kom ik dus op een gemiddelde snelheid van 180 km/h. Lijkt me zelfs voor een Medisch transport wat snel, zeker weten dat dit geen helikopter transport was? Het transport van de organen in beeld gebracht. Door twee overledenen zijn 6 mensen geholpen. Dat donoren levens redden. De spectaculaire snelle lijnen die flitsen over het landschap. Het feit dat er zoveel gebeurt. Actie / reactie, A zorgt voor B etc. de snelheid waarmee de longen nieren etc. worden getransporteerd en de urgentie (in rood). De hoeveelheid mensen die geholpen wordt (Veel!) en de afstanden (Ver!). Dus w.b.t. de animatie het eindbeeld. En ik vond de vliegtuigen leuk weergegeven. Dat het verhaal in Utrecht begint en dat de organen door heel Europa gaan. Verschillende snelheden van beweging. De vlucht naar Duitsland en Kroatië. De veelvuldig gebruikte kleur rood. Dat er veel gereisd wordt om de lichaamsdelen op de plek van bestemming te krijgen. De routes. Dat een mens letterlijk verdeeld word over de wereld. Dat de organen snel vervoerd moeten worden anders zijn ze niet meer bruikbaar zoals de longen. Het zien van de weg die de organen afleggen. Dat er 6 mensen aan een beter leven geholpen worden. Eén overledene kan meerdere patiënten helpen. Dat het transporteren van donor organen redelijk snel gaat, en dat de organen zelfs zo ver als Kroatië vervoerd worden. De terugreis van de artsen vanuit Schiphol nadat de (ik dacht) longen niet geschikt bleken te zijn. De longen die niet bruikbaar zijn Dat de animatie het verhaal verduidelijkt. Het eindbeeld geeft duidelijk aan welke route de organen afleggen en dat organen van twee overleden personen zes andere mensen helpt. De afstanden die de verschillende organen afleggen. Dat er een nier met het vliegtuig naar Kroatië werd vervoerd. Helder hoe de auto's hun eigen lijn met een helder punt hebben op het beeld. Mooi hoe het wegen net wordt gebruikt in de animatie. Overzichtelijk met de overzicht beelden van boven. Goed hoe de auto en vliegtuig verschillende kleuren hebben in de animatie. Dat diverse organen van één patiënt worden gebruikt op diverse plaatsen. De lijn Utrecht-Groningen loopt volgens de wegen en dat duurt maar 1 uur. De snelheid waarmee de lever in Groningen is vanuit Amsterdam. Per helikopter vervoerd? De verdeeldheid over het land. Binnen 48 uur worden er op verschillende plekken verschillende mensen aan een nieuw orgaan geholpen. Dat er veel gebruikt kan worden van een overladen mens. De manier waarop wordt aangegeven waar de verschillende organen overal terecht komen. De snelheid van transport. Dat vele organen nuttig zijn na de dood maar dat er ook veel tijd en transportmiddelen ervoor nodig zijn. Dat 6 mensen gered zijn door 2 donoren. De snelheid. Duidelijk overzicht van de verspreiding en de toepassing van donororganen. De verdeling van iemands organen over Europa. Stem + beeld van boven van vliegtuigen en auto's. De loop van de rode lijnen. De verscheidenheid aan waar organen heen gaan en de snelheid. Dat organen binnen een korte tijd een lange afstand kunnen afleggen. dat de longen niet meer bruikbaar waren. Verspreiding Dat Belgische longspecialisten een vergeefse reis maakten. Dat er 6 mensen worden geholpen door 2 donoren. 6 personen. De soms lange route die organen moeten afleggen en hoe belangrijk afstemming is. Dat het goed georganiseerd is. 2 verschillende auto's voor de nieren, want onderweg kan de bestemming aangepast worden. De lange afstanden en verschillende bestemmingen van de organen. Het tijdsbestek wat beschreven wordt binnen deze animatie, hierdoor voelt de data die gebruikt is zeer accuraat. De snelheid van zaken. De logistiek van de orgaan donatie. De kleurverschillen wegverkeer/vliegverkeer en de realistische contouren van wegen

SCHOOLS– GENERAL REMARKS

ik lees het liever in de krant. Duidelijk en mooi om te zien. Het gaat meer over aantallen dan over locatie. De verspreiding is zo groot dat de locatie minder toevoegt. Ik ben wel nieuwsgierig naar meer verdieping binnen dit onderwerp. Wat zorgt voor deze tendensen. "Ik zou dan ook graag willen weten waarom er zoveel nieuwe scholen bij sluitende scholen zijn gebouwd. (waarschijnlijk door de diversiteit van de religie/ openbaarheid van de scholen?) Het is jammer dat er alleen ingezoomd wordt op Zeeland. Een vlucht lang de periferie was ook leuk geweest denk ik, of de Bible-belt ofzo." Ik zou bij het opsommen va. De aantallen die ergens met cijfers in beeld hebben gebracht. mooie vormgeving "Mijn antwoord bij 2k. (dat is vermaakt werd) heeft vooral te maken met de mooie beelden, niet zozeer met de inhoud. Ik begrijp niet goed waarom het camerastandpunt zich een tijd lang ten zuidwesten van Zeeland bevindt. Hierdoor wordt het overzicht over het hele land minder helder. En los van het even inzoomen (daarvoor) op het gebied rond de grote steden, had het volgens mij geen functie. Bij het inzoomen op de grote steden had ik het plezierig gevonden als deze grote steden even werden gemarkeerd, zodat de informatie die de voice-over geeft ('ook rondom grote steden veel scholen gesloten') beter zichtbaar is." Mooi gedaan. "De muziek was irritant. Het geheel was te kort om in een keer begrepen te worden, teveel informatie te snel verteld en die knipperende puntjes waren verwarrend" Er was teveel informatie met te veel puntjes op teveel plekken, waardoor het onoverzichtelijk en daardoor oninteressant werd. kwam rommelig over qua onderwerpen, te veel getallen en door het draaien van Nederland niet heel duidelijk. dit is eigenlijk slecht nieuws, dus je wordt er niet blij van. Het is net niet echt boeiend, want wat maakt het uit? Het overzicht is te groot en gaat te snel, daardoor kan ik geen verbanden ontdekken of even kijken hoe het is in mijn buurt. De animatie geeft te weinig interessante verbanden of echt inzicht. Waar komen bijvoorbeeld die nieuwe scholen dan? en waarom daar wel? En waardoor komt dat? Het hoofdthema is krimpgebieden, een gevolg daarvan de scholen die weggaan, niet andersom. erg kort, maar één soort data. Het verhaal wilde ik wel volgen maar eigenlijk ligt het gegeven te veel voor de hand en was ik er wel van op de hoogte. Te langzaam.

SCHOOLS-REMEMBERED MOST

Dat er scholen dicht gaan in dunbevolkte gebieden. Dat de krimpgebieden niet alleen in de uithoeken van het land liggen. Dat uit de krimpgebieden veel scholen dicht moeten Veel basisscholen moeten sluiten in de krimpgebieden. Dat er best veel scholen zijn die op de nominatie staan om te worden gesloten. Niet iets bijzonders. Ik mis het verband tussen de gesloten scholen en de nieuw geopende. Lijkt dast er in dezelfde regio zowel scholen openen als sluiten. Hoe kan dat? De ligging van de locaties van sluitende scholen in krimpgebieden. Het overzicht van de krimpgebieden. Dat er gebieden zijn waar mensen wegtrekken. Scholen gaan dicht. Dat er basisscholen sluiten en pal ernaast nieuwe geopend worden. Geen namen van de locaties. De omvang en het grote aantal gebieden met krimp. Dat er zoveel scholen moeten sluiten. Dat er enerzijds veel scholen zijn gesloten maar anderzijds ook een hoop zijn bijgekomen.
Dat veel kleine basisscholen moeten sluiten. Waar gaan al die kinderen dan heen? Dat veel basisscholen verdwijnen in krimpgebieden waar veel gezinnen met kinderen wegtrekken. Het kunnen zien van het minder worden van scholen. Het viel mij op dat er ook scholen in de Randstad staan, die in de gevarenzone zitten. Het grote aantal scholen dat sluit. Ook rond de grote steden. Dat er geen bredere boodschap aan de data verbonden werd. Is het erg dat scholen sluiten doordat mensen wegtrekken. Wat is de impact hiervan? Dat zou het eventueel interessant kunnen maken. De oplichting van de krimpgebieden in geel nadat daarvoor de scholen met minder dan 100 leerlingen al in het geel waren aangegeven. Dat scholen met minder dan 23 kinderen gesloten moeten worden. Dat scholen die gesloten worden vooral in krimpgebieden liggen waar jonge gezinnen wegtrekken. Eigenlijk niet zoveel. Wellicht komt dat omdat het onderwerp me (zonder context) niet zo pakt. Dat er sinds 1997 meer basisscholen zijn gesloten dan geopend. De hoeveelheid scholen die sluiten. Dat er een marge is tussen scholen met een grote krimp en scholen die werkelijk moeten sluiten. Dat bijna heel Nederland als geel gebied wordt gezien, dus iedereen naar hele kleine oppervlaktes trekt met z'n allen. Dat er veel nieuwe scholen vlakbij sluitende scholen gebouwd zijn. Scholen die dicht moeten. dat er scholen dicht gaan als er niet genoeg ll. zijn. Dat er toch nog nieuwe basisscholen zijn geopend. De rode en witte lichtjes vind ik een beetje vaag. Dat in een betrekkelijke korte periode nieuwe scholen zijn geopend en oude scholen, met minder dan 100 leerlingen, moeten binnenkort sluiten. Hoe, bijna, gelijk gedeeld de krimp gebied is over Nederland. Heel veel puntjes. Een overzicht van de krimpgebieden. Er moeten veel kleine scholen sluiten. Scholen die dicht moeten als gevolg van teruglopende bevolking (krimp). De gele vlekken op de kaart van de scholen die moeten sluiten. De informatie over het aantal gesloten scholen. Dat er door heel het land kleine scholen zijn in de gevarenzone. Dat er veel scholen weg moeten de laatste jaren, omdat veel jongere gezinnen wegtrekken uit bepaalde gebieden in Nederland. te kleine scholen. De sluiting van meer scholen dan er nieuw geopend worden. Dat er zoveel basisscholen sluiten. In welke gebieden de meest oplichtende punten zich bevinden. Dat op plekken waar scholen verdwijnen in de vuurt nieuwe verschijnen. veel basisscholen moeten sluiten als jonge gezinnen wegtrekken. Eigenlijk best schokkend dat er zoveel scholen sluiten. De scholen die moeten sluiten. Kleine basisscholen.

HOME SALES– GENERAL REMARKS

Noodzakelijke prijscorrectie van (te) dure huizen. Geeft duidelijk beeld waar de knelpunten zitten. Dit was goed te volgen, misschien mede doordat de huizenprijzen al jaren steeds onder de aandacht zijn gebracht. "Ik vond de informatie over het huis dat 800.000 euro minder waard was geworden niet relevant. Als er meer specifieke gevallen werden benoemd was het wellicht beter. De dreigende muziek bepaalt erg de sfeer van het filmpje. Dit is natuurlijk logisch, maar in dit geval sluit de muziek voor mij niet aan bij mijn beleving van het onderwerp. Een goed beeld van de huidige huizenmarkt. Heldere info. Het onderwerp huizenprijzen interesseerde veel mensen dus sluit snel bij hun interesse gebied. ik vond de animatie een beetje ingewikkeld, omdat het over 2 dingen ging nl. minder huizen verkocht en waardevermindering interessant Jammer dat er niet meer is ingegaan op de diverse gebieden in ons land en het niet noemen van percentages. Volgende keer ook huur. Het zou interessant zijn om in het wisselen tussen de plaatsen wel te laten zien waar ze in NL liggen. Dit heeft immers alles met de prijs te maken. (onder 100.000 allemaal in krimpregio's etc.). Mooi en duidelijk om te zien. Mooie duidelijke beelden. De muziek is steeds wel heel dramatisch voor het onderwerp. Het is niet duidelijk of de genoemde waarde een vraag- of verkoopprijs is of dat deze waarde ergens anders op is bepaald. Leuk om te weten en vooral ook waar wat gebeurt. Ik begrijp niet waarom Epe enz. uit worden gelicht. Ik vond het over zicht van NL het leukste. Dan kan je nadenken over waar je zou willen gaan wonen in de toekomst. bouwen en woningbouw is mijn vak, ik had er weinig aan. Er ligt teveel nadruk op de extremen. Woningen boven de 1.000.000 en onder de 100.000.

HOME SALES-REMEMBERED MOST

De animatie laat op een gegeven moment het verschil zien tussen 2008 en 2012, maar het gebied verplaatst daartussen wel enigszins, waardoor de verschillen aan de randen niet goed te zien zij. Dat er een toename is van woningen met een waarde onder de 100.000 en een afname van woningen met een waarde van 1.000.000. De crisis biedt ook kansen. Woningprijzen. Dat huizenprijzen enorm zijn gedaald. De waardedaling van de huizen. Dat er veel woningen voor minder dan een ton zijn bijgekomen. Het overzicht van heel NL met de afname van dure en toename van goedkope huizen. Het spannende muziekje.. wat is er zo spannend aan? Ik vind het toch wel spannend die huizenmarkt. Dat er huizen onder een ton zijn. Huizen zijn in waarde gedaald in 4 jaar tijd. maar voordeel is dat er meer goedkopere huizen zijn bijgekomen. Extra huizen clusters onder een ton. Het verrassend grote aantal dure huizen in Nederland. Dat er zoveel huizen minder worden verkocht en dat ze minder waard worden. Aantal huizen dat per dag minder wordt verkocht. Wat zijn er veel huizen die minder waard zijn. Dat er een huis met 800.000 is gedaald. Het kunnen zien van de verkochte huizen voor en tijdens de crisis. Er zijn veel huizen die meer dan een miljoen kosten. Dat de uitersten in de prijsklassen zo sterk reageren. Dat het effect van de crisis op huizenprijzen zo ontzettend groot is geweest. De enorme prijsdaling van het huis in Bloemendaal. Locaties waar prijzen van boven de miljoen naar minder dan een miljoen zijn gedaald. Dat de crisis een grote invloed heeft gehad op de huizenprijzen. De vele verkochte huizen per dag voor de crisis. Daling van de huizenprijzen. De animatie van het aantal huizen dat voor de crises werdt verkocht en daarna. De groei van het aantal woningen< € 100.000 en dat er niets over de geografische spreiding werd gezegd. Het aantal toenemende goedkopere en afnemende dure woningen. Er zijn veel huizen te koop voor minder dan een ton. De huizen markt is zeer verasnderd sinds 2008. Het aanbod van goedkope woningen in volgens mij minder populaire gebieden van Nederland. Het effect van de crisis op zowel rijk (negatief) als op arm / minder vermogend (positief). Vooral waar de goedkope huizen zijn. Snelle verandering in zo korte tijd. Duidelijk overzicht van de waardevermindering in de huizenmarkt in vier jaar tijd. Verspreid over Nederland. De huizenmarkt verandert. Crisis biedt ook kansen. De huizenprijzen van voor en tijdens de crisis. wijziging in verkoop en prijs van huizen. Grote afname van woningen die te koop stonden. De crisis in de huizenmarkt. prijsdaling en daling aantal verkopen. Dat in sommige plaatsen of wijken het aantal 'dure' huizen enorm is afgenomen. Dat de huizen nu minder duur zijn. Dure woningen Dat woningen door de crisis enorm kunnen dalen in vraagprijs. Hoe snel de prijzen dalen. Huizencrisis maakt huizen goedkoper. De vermindering van het aantal huizen dat te koop stond. Huizenprijzen. Kansen voor goedkope huizen. Huizen minder dan een ton enorm toegenomen.

MIRGRATION– GENERAL REMARKS

Blijkbaar hebben 'oude steden' meer aantrekkingskracht op bewoners. goed dat er steden in het noorden, zuiden én westen als voorbeeld zijn genomen. Het is een beetje onduidelijk te zien aan de graphics hoeveel mensen er verhuizen en waarheen. Het verschil tussen de steden wordt verteld maar komt niet zo duidelijk naar voren in de graphics. Helder neergezet. Interessant. Interessant. M.i. de interessantste van de vier. Goede informatie. Vond hem aantrekkelijk vorm gegeven en een interessant onderwerp. Met verhuizen om verschillende redenen hebben veel mensen persoonlijk ervaring. Ik neem aan dat dit een introductie is van een onderwerp dat nader onderzocht wordt. Zo komen sommige andere animaties ook over. Algemeen: ik vind de technische foefjes en de snelle schakelingen zo irritant dat ik het programma al snel uitzet. Hoewel ik het had aangestreept in de gids. Ben al 40 jaar met planning en bouwen bezig. Het zal met leeftijd 70+ te maken hebben. Ik vind het lastig om niet te horen over welk gebied of plaats het gaat, omdat ik eer veel ken. ik kan / moet dat later opzoeken. Dat lukt me niet , dus weer ergernis. Dat m.i de trek van platteland naar stad niet aan de orde is gekomen. Mooi en duidelijk om te zien. Mooi in beeld gebracht! Ik zou de grote steden ook wel in deze vorm willen zien. Mooie animatie. Mooi weer gegeven. Zijn deze patronen in de tijd aan het veranderen? Rommelig verhaal, wat oppervlakkig. Er wordt volgens mij op meerdere niveaus informatie gegeven waardoor het onduidelijk is denk ik. Eerst over een stad waar gezinnen weggaan. dan over een stad waar gezinnen niet weggaan. dan over een stad waar gezinnen in de stad zelf verhuizen dan opeens over Almere in en uit. Waarom deze steden? Wel leuke selectie, al snap ik Maastricht niet helemaal. Iets van het waarom van die selectie laten zien is wel leuk. Waarom gezinnen? Maar goed de animatie zelf was erg leuk en beeldend. Sloot prima aan bij de info. De stroom naar het westen vond ik minder dan verwacht. de mondelinge informatie was hier nodig om het plaatje te verduidelijken. De verhuisbewegingen, maar deze animatie overtuigde minder, want ik zag weinig verschil tussen grote verhuisbewegingen en minder grote, de animatie heeft in tegenstelling tot de andere drie niet bijzonder veel aan toegevoegd.

MIGRATION-REMEMBERED MOST

De mooie animaties. Dat er veel mensen vanuit Assen naar de mijnstreek gingen. Dat in Almere veel mensen uiteindelijk besluiten weer te vertrekken. De stroom naar het westen vond ik minder dan verwacht. Almere iedereen gaat er graag naartoe... maar iedereen gaat ook even graag weer weg. Het verhuisgedrag van mensen in Nederland grillig is. sommige regio's zijn er minder verhuizingen dan in andere. Almere is een stad waar niemand lang blijft. Mooi beeld met die 'vuurwerkjes'. En Almere is me het meest bijgebleven omdat dat zo'n stad is waar 'niemand wil wonen', maar die bekend staat als betaalbaar.. nou ja, een stad waar je het vaak over hebt mbt dit thema.

dat mensen uit bepaalde steden bijna niet verhuizen en anderen juist wel. Grappig stukje over Almere. Iedereen gaat er graag naar toe. maar gaat net zo makkelijk weer weg. Almere. Almere. De migratiebewegingen omtrent Almere. Dat er zoveel verschillen in Nederland zijn, w.b. het blijven wonen in en het verlaten van sommige steden. Aantal mensen dat weer uit Almere weggaat. Dat Almere een soort tussenstation is en dat Staphorst een zeer honkvaste bevolking heeft. Dat verhuizers uit Maastricht binnen een straal van 10km verhuizen. De verschillen in verhuisbewegingen van plaatsen. Mensen uit Staphorst zijn honkvast. De grote verschillen tussen de verschillend plaatsen. alleen bij Almere werd getoond wie er naar toe kwamen en deze gingen net zo makkelijk weer weg. Hoe traditioneler de bevolking des te kleiner zijn de migratieafstanden. Dat Almere geen families bindt, maar slechts een tijdelijke woonlocatie lijkt te zijn. Op zich wel begrijpelijk natuurlijk. De "honkvastheid" van mensen uit Staphorst. De situatie in Heerlen. Dat mensen net zo makkelijk Almere verlaten als dat ze er gekomen zijn. Interessant onderwerp. Wat is de verklaring? Buurtbinding? Het stukje over Almere. Wellicht dat dit komt doordat dit het laatste wordt benoemd. Dat Almere een migratiegemeente is. Verschil per stad van verhuispercentage. Almere, hoeveel mensen daar heen geen maar ook weer weg. de animatie vind ik mooi weer gegeven. Het feit dat uit Assen de laatste 135 jaar kennelijk weinig mensen naar het buitenland zijn verhuisd. Almere. De verhuizingen van en naar Almere. De mooie weergave , spectaculair. Bijna niemand verhuist uit Staphorst. Dat de mensen in Staphorst honkvast zijn! Dat Almere grote aantrekkingskracht heeft, maar niet vasthoudend is. De verschillen tussen Almere en de overige genoemde plaatsen. Dat de bewoners van Staphorst erg honkvast zijn. De bijzondere positie van Almere. Hoe verspreid over NL de mensen uit Almere ging verhuizen. De mondelinge informatie was hier nodig om het plaatje te verduidelijken. Een beeld van de migratie in Nederland. Dat er veel mensen verhuizen. Voornamelijk naar het westen. Dat mensen zowel naar Almere toegaan als er ook weer weg gaan. De verhuisbewegingen vanuit de verschillende gebieden. Getallen over wegtrekken/honkvastheid in verschillende gemeenten. Dat Almere zowel aantrekt als afstoot over heel Nederland. Dat mensen in sommige plaatsen honkvast zijn, en andere plaatsen meer of sneller verlaten. Honkvaste gebieden. Migratiebewegingen naar en uit Almere: doorgangsgebied. Dat er uit bepaalde dorpen weinig mensen vertrekken en uit andere plaatsen weer veel. Verhuis bewegingen. De vuurwerkachtige uitwerking die de verhuisbewegingen mooi weergeeft en dan met name bij Almere. Waar men blijft wonen en steden waar men vertrekt. Mensen verhuizen veel. Dat Almere populair is om te komen maar blijkbaar geen mensen kan vasthouden. Almere. Mobiliteit groeit nog steeds. Dat minder dan 10% uit Staphorst vertrekt. De situatie in Almere (duiventil)

7.6 Appendix D: results Likert questions A – E

	FOLLOWING			*LOGIC STRUCTURE*			*INTEREST*			*TRUST*			*INVOLVEMENT*		
	SCORE	NO.	TOTAL	SCORE	NO.	TOTAL	SCORE	NO.	TOTAL	SCORE	NO.	TOTAL	SCORE	NO.	TOTAL
	5	**31**	155	1	**1**	1	1	**2**	2	1	**0**	0	1	**2**	2
	4	**19**	76	2	**4**	8	2	**2**	4	2	**3**	6	2	**4**	8
ORGANS	3	**3**	9	3	**3**	9	3	**3**	9	3	**1**	3	3	**17**	51
	2	**7**	14	4	**27**	108	4	**18**	72	4	**18**	72	4	**20**	80
	1	**2**	2	5	**26**	130	5	**36**	180	5	**40**	200	5	**18**	90
		62	256		61	256		61	267		62	281		61	231
			4.1			4.2			4.4			4.5			3.8
	5	**32**	160	1	**1**	1	1	**0**	0	1	**0**	0	1	**5**	5
	4	**14**	56	2	**3**	6	2	**6**	12	2	**2**	4	2	**10**	20
SCHOOLS	3	**11**	33	3	**8**	24	3	**19**	57	3	**2**	6	3	**19**	57
	2	**3**	6	4	**25**	100	4	**23**	92	4	**23**	92	4	**18**	72
	1	**1**	1	5	**24**	120	5	**13**	65	5	**34**	170	5	**10**	50
		61	256		61	251		61	226		61	272		62	204
			4.2			4.1			3.7			4.5			3.3
	5	**32**	160	1	**0**	0	1	**0**	0	1	**1**	1	1	**1**	1
	4	**18**	72	2	**2**	4	2	**2**	4	2	**1**	2	2	**4**	8
HOME SALES	3	**6**	18	3	**6**	18	3	**6**	18	3	**4**	12	3	**20**	60
	2	**3**	6	4	**27**	108	4	**22**	88	4	**15**	60	4	**18**	72
	1	**2**	2	5	**26**	130	5	**31**	155	5	**40**	200	5	**18**	90
		61	258		61	260		61	265		61	275		61	231
			4.2			4.3			4.3			4.5			3.8
	5	**26**	130	1	**1**	1	1	**2**	2	1	**0**	0	1	**3**	3
	4	**17**	68	2	**3**	6	2	**2**	4	2	**2**	4	2	**6**	12
MIRGATION	3	**8**	24	3	**11**	33	3	**5**	15	3	**6**	18	3	**14**	42
	2	**8**	16	4	**24**	96	4	**21**	84	4	**16**	64	4	**22**	88
	1	**2**	2	5	**22**	110	5	**31**	155	5	**37**	185	5	**16**	80
		61	240		61	246		61	260		61	271		61	225
			3.9			4.0			4.3			4.4			3.7