Statistics for children

Professor Yvonne Eriksson, Professor Lennart Strand, Lecturer Jan Frohm
and Lecturer Sven Holmberg.
School of Innovation, Design and Engineering,
Mälardalen University, Eskilstuna, Sweden, 2009.

Abstract

This paper discusses the ability to present statistics to children and suggests that visualizations facilitate interpretations of complex numerical data. Statistics are often a basis for decisions, and children are able to make their own decisions to some extent. Therefore it is necessary to discuss how statistics for children can be designed. Three different examples will be discussed in relation to the role of visual representations in making abstract numbers concrete.

Introduction

The aim of this project is to figure out if and how numerical data can be made accessible to children. Statistics is an elusive subject for many people, especially children. Our research questions are: To what extent is it possible to visualize statistics in a simplified way without losing too many facts? And is it likely that picture narrations will help children to identify themselves with the message?

Children between 10 and12 are often very open-minded and curious about new information and phenomena. They are to some extent able to make decisions on their own, even if they are still dependent on parents and other adults. One's lifestyle when young will have effects later in life. Routines such as exercising and food habits are grounded in childhood. It is therefore surprising that so little attention has been given to how to present numerical data for children.

Studies of textbooks for grades 4-6 indicate that graphic presentations of data are not a priority (Eriksson, 2009). Subjects such as nutrition only briefly discuss the relation between diet, exercise, weight control and health in the long run. However, research indicates that producers of cornflakes make great efforts by directly talking to the children via the package (Sparrman, 2007). One trick is to put plastic figures for collection into the package (Sparrman, 2007). No serious discussions about environmental problems with reference to decision-making have been found in textbooks (Eriksson, 2009). Therefore we want to address the need for further research of how to present statistics to children in a way that will help them make their decisions.

The purpose of this paper is to discuss the first step of a design process in visualization of statistics for children from a theoretical perspective. We also consider visualization as crucial for understanding abstract phenomena such as numerical data. This paper will work as a starting-point for further research in the area.

State of the art

The definition of statistics is data presented in numerical form, often in tables or in diagrams. Statistics is a way of analyzing numerical data. In a naïve sense it is collected data that is presented in numbers and percentages. How these are interpreted largely depends on the quality of the graphic design. Quality is per see a relative concept and has to be evaluated in connection to the target group or the aim of the statistical presentation. For a layman, statistical data are difficult to interpret, since it requires specific knowledge of the actual subject and of statistics as such. However, many daily decisions are based on statistics, from more trivial ones connected to the private sphere to complex political or industrial decisions. Accordingly, decision theory is one part of the academic field of statistics. It is a multidisciplinary field associated with engineering design and activities by human beings. Decision-making is about realistic or ideal statements for an optimal result, and therefore it is linked to philosophy (Daily et.al., 2003.)

Many decisions and choices made in childhood will have consequences for the future, not the least questions related to lifestyle. Although children are dependent on parent's selections, there are still some things that are left to the children themselves.

2.1 Multimodal processes

Multimodal information increases the ability to target larger groups, since it offers a combination of text, pictures and in some cases auditory information. Visualizations often support the physical experience of a phenomenon, since they refer to earlier lived experiences.

Maurice Merleau-Ponty described perception as a bodily experience (Merleau-Ponty, 1945/1965). He emphasized that the lived body is not merely an object in the world, it is also a subject in the world; and the lived body, according to Merleau-Ponty, establishes a concrete ground (Ibid.). This theory has been summarized by Vivian Schobchak (1992).

We must know ourselves as a body-subject living a perceptual encounter with the world and others that is always already communicative, always already expressive and semiotic in nature. This perceptual encounter with world, self, and others occurs prior to and provides the ground upon which we can then live a perceptual semiotic encounter what we call a film the latter itself a perceptual and semiotic encounter with a world, self and others (p. 54).

Schobchak discusses Merleau-Ponty's theories in relation to film, but his theories are also relevant for interpretations of pictures and sculpture (Krauss, 1986). In the following quotation, Schobchak continues the discussion in the context of film, but it is appropriate for visual representations in general.

To see a film, we must match our immediate and living view of the visible with reflexive and reflective knowledge of our subjective acts of vision through which the visible appears to us in its particular significance as an objective form. We must reflexively and reflectively take possession of our vision and make it visible. We must "say what we and seeing are" before we can understand the nature and function, the structure and genesis […]film – as a visible figure of both a world and an act of seeing (p. 54).

To be able to identify oneself with a visual representation, no matter whether it is a film or a picture, the viewer must find necessary references. In Metaphors We Live By, Lakoff and Johnson (1980) have pointed out that metaphors are related to our bodily experience. That means that both visual representations as such and metaphors are linked to bodily experiences.

Pictures are a two-dimensional representation on a surface. What is unique about pictures is that they are multimodal and that they are spatially organized and do not have any given viewing order. In addition, pictures can look alike, and because of that become iconic. Visualizations are one way to make abstract data concrete and graspable. However, visualizations can be either iconic or abstract. An abstract visualization in a statistical context is a table or a graph; on the other hand it is tangible in relation to numbers. For children a diagram is rarely a source for decision, for it is far too abstract. One purpose of presenting statistical data is to encourage people to change behavior in one way or another. How to succeed depends on many things, and research has suggested several ways to go.

Area of research

Several artists have elaborated visualizations of statistics data. In her China Girl, which consisted of 3 800 small mosaics each with the face of a girl, Maria Ängqvist Klyvare created a debate about the fact that 3 800 girls disappear every day in China. The big mosaic made the abstract numbers real since she transformed them into portraits of real missing girls.

Inspired by Maria Ängqvist Klyvare, we have tried to envision several problems based on statistics. The aim of the project is to investigate to what extent it is possible to make numerical data real for children. We have combined facts with pictures that hopefully attract the children's attention. To attract children it is important that they can identify themselves with the content of the picture and with its appearance. That has raised questions about gender and ethnicity. In pictures one often finds stereotypical gender behavior (Eriksson & Göthlund, 2004; Eriksson, 2009). One of the reasons for that is to be found in a statement by E. H. Gombrich in Art and Illusion (1960), namely, there is no picture that has not had its origin in an earlier picture. That means artists or illustrators are highly influenced by earlier visualizations and often unconsciously repeat stereotypical tropes. Those tropes, or rhetorical figures, could be hard to recognize in illustrations since we are so accustomed to them.

Pictures often work as role models for children and youngsters, since pictures are easy to imitate. Therefore it is important not to replicate fashion model ideals in illustrations discussing food habits and the need for exercising

3.2. Visual working memory

To make a simple visual representation is challenging and demands a lot from the illustrator. A simple representation shows the essential features of an object or individual. The borderline between a simple representation and a simplified one is blurred. Interpretation of complex pictures requires more time than interpretations of uncomplicated pictures that viewers do not have to look at several times, at different details. They can distinguish between details and the whole immediately (Ware, 2008). However, there is a difference between interpreting a single object and interpreting a picture as a meaningful whole (Eriksson, 2009). A picture can look simple but have a complex message. It is common in cartoon strips that details crucial for the content are only indicated, since the readers are expected to get the meaning through context. In semiotics those indications are often defined as indexes.

To create an index that is obvious to the target group will facilitate both interpretation and the visual working memory. The observer does not need to look several times to interpret single picture elements. The interpretative act as such will be facilitated. The design process has been elaborative. Our first step was to find relevant themes for the project.

3.2. Statistical narrations

One way to get someone involved is to make up a story. Stories can be mediated via novels, short stories, movies,

cartoons or pictures. Picture stories that lack accompanying texts are complicated because pictures are ambiguous and can be interpreted in several ways.

In the current study we have used a simple cartoon style to present statistics about the effects in Sweden of using palm oil in food and cosmetics. In *Your skateboard is burning* a girl with her skateboard is the central figure in the picture. The skateboard is burning and so is the palmoil tree she stands beside; in the background a row of palm oil trees are visible. In the picture strip on the next line a boy is depicted with an ice cream cone in his hand and the text says: "Do we need ice cream? Yes, but ice cream can be made without palm oil." This illustration is followed by one in which the boy is eating potato chips. The accompanying text is: "Do we need chips? Yes, but chips can be made without palm oil." A third image illustrates the same boy washing his hands with soap. The text reads, "Do we need soap? Yes, but soap can be made without palm oil." At the bottom of the picture the girl and an orangutan covered in paper from a butter wrapper with the text "Smör" (butter) are trying to stop the fire. The visual rhetoric in the illustrations is obvious, and the aim of the visualizations is to convince children that it is possible to save rainforests by making alternative choices: buying products without palm oil. The pages contain texts with facts about the threatened rainforests.

What would you say if your skateboard was burning?

During the last 50 years, millions of hectares of rainforests have been burned down or cut down for production of palm oil.

Do we need rainforests?

If we cut down the rainforests, orangutans, one of our nearest biological relatives, are at high risk of extinction in the wild.
Orangutans survive only in the dwindling tropical rainforests of Borneo and Sumatra, where they depend on the forest for food and nesting sites.

The Sumatran orangutan, especially, has an extremely high risk of extinction in the wild in the near future. Since 1900, the number of Sumatran orangutans is thought to have fallen by about 91%, with a rapidly accelerating loss towards the end of the twentieth century. Other threatened animals are the Sumatran tiger, the Sumatran rhinoceros, and the Asian elephant.

And the second text is:
In Sweden alone we import 44.000 tons of palm oil every year. 99 million square meters
of rainforest are being used for this production. According to World Bank
estimates, in just 12 years – between 1985 and 1997 – 60% of the lowland rainforest
of Borneo and Sumatra was destroyed. The United Nations Environment Program (UNEP) estimates that 98% of Indonesia's lowland forest may be destroyed by 2022.

There are two oil palms: the African Oil Palm (Elaeis guineensis) is native to west Africa, and the American Oil Palm (Elaeis oleifera) is native to tropical Central America and South America. In the 19th century the African oil palm was taken to South East Asia. Here two countries are responsible for over 80% of world oil palm production, Indonesia and Malaysia.

The texts with information about the current situation are not directly linked to the pictures or vice versa. The aim of the pictures is to attract children's attention, to make them curious about why the girl's skateboard is burning and why the girl and the orangutan are trying to put out the fire. The next step will be to read the texts. There are other ways to interest a presumptive reader. To be able to make comparisons, we have presented the same data by using more traditional graphic design.

3.3 Spatial organization

In this version the issue (environmental effects of the use of palm oil) is not represented as a narration. It is a spatially organized visualization of numerical data with only one pictorial element, the palm. First of all the spectator will observe the distinct large numbers 99 and 0 that

flank the three palm oil treas. The numbers are connected to the information that we use 99 million square meters of rainforest when we use palm oil as an ingredient in a variety of products. If we produce products without palm oil, we use zero square meters of rainforest. The organization of the page shows two opposite choices: we can either choose products made with palm oil or the same products without palm oil.

The information text in this example is as follows:

> We use palm oil in ice cream, soap, margarine, chips, cosmetics, chocolate
> and in many other products. To make these, Sweden imports 44.000 tons of
> palm oil every year, made from oil palms planted on rainforest land.
>
> There are two oil palms: the African oil palm (Elaeis guineensis) and the American oil palm (Elaeis oleifera). In the 19th century the African oil palm was taken to South East Asia where the rainforest is being cut down and replaced by oil palm plantations.
> Two countries, Indonesia and Malaysia, are responsible for over 80% of world palm oil production.
>
> /…/
> We use palm oil in ice cream, soap, margarine, chips, cosmetics, chocolate
> and in many other products. To make these, Sweden imports 44.000 tons of
> palm oil every year, made from oil palms planted on rainforest land.
>
> There are two oil palms: the African oil palm (Elaeis guineensis) and the American oil palm (Elaeis oleifera). In the 19th century the African oil palm was taken to South East Asia where the rainforest is being cut down and replaced by oil palm plantations.
> Two countries, Indonesia and Malaysia, are responsible for over 80% of world palm oil production.
>
> Sources: WWF, Greenpeace, SNF, UNEP, World Bank, Wikipedia

The graphic design supports the message, and the enlarged numbers dramatize the huge difference if we use palm oil or not in different products; 99 million square meters or 0 square meters. The layout emphasizes that this is a question of our own choices.

The former example is more playful and addressed directly to children, and the level of the information text is adapted for children. The picture story is meant to stimulate children´s imaginations and could work as a source for discussion with other children and adults, such as parents and teachers. In the second case the presentation of the message is more direct and less visual working memory is used than in the first example. On the other hand, it does probably not appeal to children's curiosity or imagination.

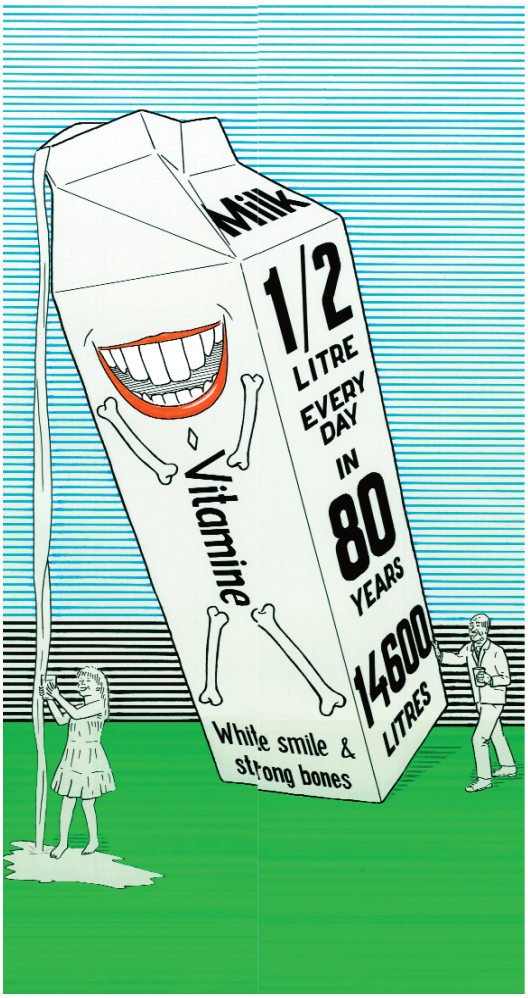
3.5 Playful presentation of statistics

What to eat and drink, and what we should avoid concerning our health, is difficult to visualize precisely. The theme as such is complex and could easily be misinterpreted, since eating disturbances are common – some people suffer from anorexia or bulimia, and others are overweight or obese. To initiate a discussion in Sweden about food and healthcare in the long run, we created an illustration about milk. It is recommended that we should drink half a liter of milk every day. If we drink half a liter every day for 80 years, we will consume 14.600 liters. The picture shows a milk carton, and has the following text on the front: "1/2 liter of milk every day for 80 years = 14.600 liters." On the other side a smiling mouth shapes the letter D followed by –Vitamin, and "White smile & strong bones". An elderly man is pushing the carton so the milk is spilling over, and a young girl standing on the other side of the carton is catching the spilling milk into a glass. The picture can be interpreted in different ways; one explanation is that milk makes you so strong that you can move a carton containing nearly fifteen thousand liters.

This example does not discuss a problem, but it illustrates a number. It is a visual representation of the sum of all the milk that the child will drink in the future. Hopefully the illustration itself will stimulate a discussion about the need of Vitamin D and calcium. Calcium is not represented in the picture, but the teeth and the text "strong bones" work as an index for calcium.

4. Concluding remarks

Messages can be mediated via pictures or text, and in a combination. They are, however, diverse symbolic systems and allow different ways of representations. Text symbols are abstract and are built on conventions, which are roles for spelling and grammatical roles. In single words and in short text lines it is possible to give a statement or information. Pictures could look alike or be non-figurative, even if a visual representation looks as though it could symbolize something else. Another characteristic of pictures is their ability to show relations, in both space and size. That quality makes illustrations suitable for numerical data. Visual representations of statistics facilitate interpretation of complex relations. In this project we have gone a step further by making visual narrations to draw attention to a problem.



It is risky, however, to simplify complex relations or to make up stories from numerical data, since the focus on the actual problem could change. Statistics raise many ethical dilemmas for the producer and for the receiver: how to present numerical data in an accurate way and at the same time make it accessible for children? The child, on the other hand, has to make a decision based on the information. Even if she or he ignores the information, that also has to be interpreted as a decision.

Since presentations of statistics are an important foundation for decisions within politics, economics, health, environment, etc. it is important to develop different ways of presenting statistics in pictures, text, graphs and presentations.

Reference

Daily, C. Gretchen et.al.(2003). The Value of Nature and the Nature of Value. Science Magazine, 289(5478):395.

Eriksson, Yvonne & Göthlund, Anette (2004). Möten med bilder. Att analysera visuella uttryck. Lund: Studentlitteratur.

Eriksson, Yvonne (2009). Bildens tysta budskap. Interaktion mellan bild och text. Stockholm: Norstedts Akademiska Förlag.

Gombrich, E. H. (1960). Art and Illusion.A Study in

the Psychology of Pictorial Representation. Princeton New Jersey: Princeton University Press.

Krauss, Rosalind (1986). The Originality of the Avant-Garde and Other Modernist Myth. Cambridge Mass.: MIT Press.

Lakoff, George & Johnson, Mark (1980). Metaphors We Live By. Chicago: University of Chicago Press.

Merleau-Ponty, Maurice (1945/1962). The Phenomenolgoy of Perception. London: Routledge.

Sobchack, Vivian (1992). The Address of the Eye. A Phenomenology of Film Experience. Princeton New Jersey: Princeton University Press.

Sparrman, Anna (2007). Up the walls! Children's talk about visuality in their own rooms. In: Karin Ekström & Birgitte Tufte (eds.) Children, media and consumption: on the front edge, pp. 301-317. Göteborg: NORDICOM/Göteborg Univ.

Ware, Collin (2008). Visual Thinking for Design. San Fransisco: Morgan Kaufman Publishers.