Wayfinder: Presenting Recognizable Open Data in its Related Context

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ABSTRACT
A feeling of connection to nature is commonly regarded as beneficial to overall well-being. Cities, where the feeling of connectedness to nature is not always present, do collect a lot of data regarding the environment. Traditionally, humans construct their opinions based on their personal experiences rather than what is actually true. Presenting nature-related open data in an understandable way could raise the perception of nature where nature otherwise would not be noticed. In order to find an effective approach to portray open data, a wayfinder was designed with a variety of ways to depict open data. The results from the study indicate that designers should, among other recommendations, balance between how literal and abstract the open data is portrayed. This paper discusses the effects of different open data depictions and draws suggestions for future designers.

Author Keywords
Open data; health; vitality; valorisation; interaction design; nature.

INTRODUCTION
The trend of improving technological capabilities and its use in everyday life suggests an increase in the amount of data collected by technology. This publicly available data, called open data, requires skilled statisticians and graphic designers in order to be expressed in understandable pieces of information for the everyday citizen. The accessibility of open data is limited as well, as data is usually displayed in magazines or websites, with little opportunities for immediate impact on citizens. In cities, data is already being analyzed and presented to citizens to assist with their daily life and subsequent decision-making (Pousman et al., 2007). In this paper, we explore the ways to express open data in its direct context, so that citizens not only understand and can interpret it, but are able to relate it to their current situations and act upon them.

When looking at the open data sources we were surprised by the density and the number of natural elements in Eindhoven. Through a quick experiment we validated our hypothesis that nature is often unnoticed. In the experiment, participants had to color a black and white map of Eindhoven with green where they remembered nature. The experiment showed that the participants mostly remembered parks, while a combination of natural elements and an urban environment are noticed less often, and are even less memorable.

The experiment gave us the direction of raising the perception of nature in city environments. Connection to nature in such environments could be nurtured by introducing elements of open data. However, the way people interpret data is shaped by the way it is presented (Groff et al., 2005). This highlights an opportunity to evoke a feeling of connection to nature, through open data itself and the way it is presented.

In this paper, we propose a wayfinder as a platform to test different ways of portraying open data in public spaces. Using varying levels of abstractions such as numbers, images, and sentences, we explore the different mediums to display nature-related open data in the wayfinder platform.

Therefore, our research question is:

- *How should open data be presented to enhance its interpretation and sense-making?*

THEORETICAL BACKGROUND
In this section we discuss prior work on *the everyday life context* of *information sharing and open data*, and synthesize studies on *nature and vitality*.

Open Data and Visualisation
In our everyday lives, we interpret streams of data presented to us, using a combination of perceptual and cognitive skills. An efficient way of sharing knowledge is through *Information Visualization (InfoViz)*. InfoViz suits human perception, amplifying cognition through the faster visual processing speeds (Fekete et al., 2008). Using InfoViz, broad aggregations of abstract data are transformed into graphics that increase the cognitive processing speed and the comprehension of the topic at hand.

InfoViz is implemented in sharing insights on crime data and has a definite impact on society: fear of crime impacts

the quality of life of a city's citizens. Viewing crime maps has been shown to be less fear-inducing than the same data in the form of tabular statistics (Groff et al., 2005). The impact of the displayed data can vary: it can be displayed to minimize negative effects yet also to maximize positive effects. Gurstein highlights that finding an effective use for open data is a separate process from the interpretation and making sense of the data (Gurstein, 2011). Based on Gurstein, applying open data should be split into three parts: *'access'*, *'interpretation'* and *'use'*.

In summary, we have reviewed data interpretation in everyday life. Knowledge-sharing and decision-making can be aided by optimal information visualizations: creating representations that suit the human perception better.

Vitality and Nature
Vitality is the subjective feeling of physical health and a sense of energy. This means that vital people feel fit and function well physically and psychologically (de Jong-Bouwmeester, 2016).

A feeling of connection to nature is commonly regarded as beneficial to the overall well-being, including energy levels (Ryan, 2010), physical health (Keniger, 2013) and emotional health (Roszak, 1995). A connection to nature often brings people a feeling of calmness. For this effect to occur, even an artificial display such as a fake plant or a photograph of nature is shown to be enough (Beukeboom, 2012).

Nature and health are concepts that are connected and in itself shaped by how they are perceived. Applying the practices of knowledge-sharing to the perception of nature bridges the gap and corrects misconceptions between reality and experiences.

Field Research Methodology
In field research, an ethnographic-style observation is widely used. Rather than just observing, researchers actively partake in field research activities to find novel insights on people and their culture. This kind of research can gain an understanding of what goes on in people's minds and also go beyond mere analysis (Koskinen et al., 2011).

The contextual interview is commonly used in field research, incorporating other data-gathering techniques including observation. In an unstructured and informal form, the interviewer does not stick to a set list of questions, and even can be guided by the interviewee (Preece et al., 2015).

Prototypes, which involve design activities, may embody various roles within research processes. At first, prototypes can serve as a *vehicle for inquiry*, with the process of

prototyping being documented, analyzed, critically assessed and written up (Wensveen et al., 2015). The research contribution is tied to how the artifact is crafted, instead of the artifact itself.

Apart from focusing on the process of prototyping, the research can also be conducted through the prototype, which functions as a *means of inquiry*. In this case, the prototype is designed and crafted to collect, record and measure phenomena. As instruments of inquiry, prototypes can also provoke reactions and insights, although this mainly leads to a open-ended explorations rather than specific results (Wensveen et al., 2015).

In conclusion, we seek to explore the different methods to present open data by applying field research methodology, fitting for this context as it encourages an observant and user-centered approach. This is relevant for us because we intend to find out the perception of nature in people and its context in their everyday life.

RELATED WORK
The *'Cyclist Counter Pole'* (De Greef, 2015) by *OnsBrabantFietst* counts and displays the real-time amount of cyclists who have passed by the installation (Figure 1). This system uses a very literal way of portraying data and displays that data in a related context — where it is being collected. It is a good example of a platform to display data and make it accessible for citizens, however, not a good example of presenting the use and value of the data.

Figure 1: 'Goed Dat Je Fietst', an interactive installation by OnsBrabantFietst. This installation keeps track of how often it is passed by cyclists, and visualizes this data. Screenshot taken from (de Greef, 2015).

On the other hand, traditional wayfinder installations are a successful and widely accepted method of sharing information. Its sole purpose is presenting useful navigational information, in a way that is impossible to misinterpret.

By being aware of what existing designs are good for, we can position them and new designs in relation to their accessibility, interpretability and usability (Gurstein, 2011).

CASE STUDY — A

Map 1: Elements Affecting the Perception of Nature

In order for designers to be able to increase the perception of nature in city environments, they must first understand what nature is to citizens. In the theoretical background we have showcased the positive correlation between the perception of nature and vitality (De Jong-Bouwmeester, 2016). We hypothesized that there are natural elements, or a combination of elements, that are perceived by people the most, thus impacting the vitality the most.

> *Research question: Which elements of nature influence the perception of nature/vitality?*

A custom map of Eindhoven was created where all colour markings of nature were blanked out. This prototype acted as a vehicle for inquiry: participants of the research were asked to mark green spots where they remembered nature (Figure 2). As the participants were colouring in the maps, the researchers stimulated them to reflect on what natural elements they valued most, using the think-aloud protocol (Van Someren, 1994).

Figure 2: Case Study A impression: Participant 'A4' is marking previously memorized parts of nature on a blanked map.

Results: Elements Affecting the Perception of Nature

From the way the participants coloured the map we found that every person could best remember the locations of bigger strands of nature, such as parks. Overall, they had little memory of locations where nature blends in with the city. In fact, many participants highlighted the difference between nature in parks and the nature in cities:

- *"City nature is different from nature."*
  — participant A2

- *"I love when there is absence of cars and infrastructure, but I can also appreciate the stark contrast of nature and concrete in Strijp."*
  — participant A5

- *"[... to me, nature is ...] running across non-paved paths when going for a long walk, seeing a red deer."*
  — participant A1

Figure 3: Showcase of some of the collected maps of Eindhoven, created by participants in case study A.

Being aware of the distinct gap between the perceptions of nature in city nature and real nature could lead designers to look for ways to bridge this gap. By bringing the attention of the citizens to natural elements in cities, designers could evoke a higher degree of connectedness to nature.

Participants themselves hinted at possible ways to bring the feeling of nature connected to the city. They mentioned their confusion in how nature is expressed on a map:

- *"I know there's more green on the map, but not all green is nature" — participant A3*

- *"Why isn't this part of the map green if there are only cyclists and pedestrians?" — participant A4*

Although data in Google Maps is being displayed in a very straightforward way (using the colour green), when digging deeper into the question of what nature is for the participants, they were not so sure what that green represents. This seems obvious, as the interpretation of green is not vital for Google Maps.

While a superficial awareness of nature's location is formed, no specific data is presented. This brought us to look for a platform to display nature open data in, so it has an impact on the decisions that citizens can make.

CASE STUDY — B

Wayfinder 1: Variations of Data Visualisation

For Case Study B, a physical object that can portray open data in a public space was created. The prototype was shaped as a wayfinder, portraying open data on its direction boards. This wayfinder was put in its related context, with opportunities for people to act upon the data.

A variety of open data visualisations was printed on paper (Figure 4) and could easily be stuck onto/removed from the wayfinder to experiment with different visualisations of data. Multiple visualisation strategies were implemented, including graphical representations and abstractions of the word 'nature'.

Both sides of the direction boards were used to stick the data visualisation on, meaning that people coming from opposite direction are able to see the wayfinder and data. The wayfinder was located at the 'T-section' between Vertigo, de Zwarte Doos and Auditorium on the campus of the TU/e (Figure 5).

Research question: Which data visualisation is able to cause an immediate moment of reflection in people who pass by the wayfinder?

We expected that some people that walked past the wayfinder, would stop walking and compare the presented data with reality we call a moment of reflection. Resulting social behaviour could include small group discussions and gestures that communicate their opinion, drawing the attention of other passers-by.

The prototype was utilized as a means of inquiry: it was used as a tool to aid in an open-ended exploration consisting of observations and interviews. The resulting qualitative data was evaluated using a thematic analysis.
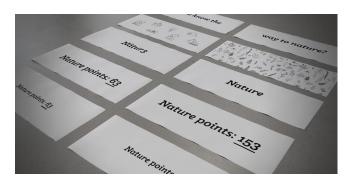

Figure 4. Data visualisation methods in Wayfinder 1. The 'paper prototyping' format allowed for rapid iteration and evaluation of hypotheses.

Figure 5. Field Scene of Wayfinder 1 on the TU/e campus. In this instance, a graphical visualisation strategy was chosen: the side with a better 'nature' score was decorated with elements of nature.

Results: Variations of Data Visualisation

By observing the wayfinder we noticed that most passers-by simply glance at the wayfinder, but show no noticeable change in their walking direction or way of observing their environment. A large number of people were looking at their phone while walking past the wayfinder, therefore not noticing anything at all. The majority of people walking by would simply glance at the wayfinder and look back at where they were going. Some people displayed clear signs of confusion and snuck another look when passing by the wayfinder.

From the interviews we synthesized themes about the perception of the presented open data:

Abstraction and understanding

Although interviewees described their troubles in making sense of the meaning of the *"nature points"*, we found this data visualisation to inspire conversations about nature the most. Relevant quotes include:

- *"I have no idea what it means, I don't know."* — participant B6

- *"Maybe it's a score. Hmmm."* — participant B7

- *"I don't know what nature points are."* — participant B8

Participants of this research focused more on what could be the meaning of the points and were unable to relate that to the nature around them.

Clear distinctions

One participant noted that it was difficult to make a distinction between the two directions:

- *"This feels too much like one area. I still feel the environment when I'm on the other side." — participant B7*

- *"It's difficult because it isn't really separating." — participant B7*

They would like the distinction of the areas to be clearer or to be communicated more explicitly. This would help them in reasoning whether they agrees with the wayfinder or not.

Appreciation of nature

During the interviews, participants were asked questions that allowed us to get a better understanding of their attachment to nature. The responses were mostly about their appreciation of the nature found on-campus:

- *"The Dommel rivel is okay, but a bit trashy" — participant B3*

- *"The nature in general is good here." — participant B5*

- *"There's better nature on the right (side) than the left." — participant B7*

However, there was some indifference to the use of the wayfinder. Some participants questioned the relevance of the data.

- *"No I just walk to my building and mind my own business. If I want to be in nature I'd go to a forest."— participant B11*

- *"I want to take the more natural route based on the wayfinder" — participant B12*

Furthermore we observed that a lot of people would just glance at it without doing something with it. No noticeable change could be seen in their actions upon noticing the wayfinder: almost all passers-by would just continue their way.

In conclusion, this experiment resulted in a better understanding on visualizing data on a public display. Out of the tested visualisation methods, the approach of 'quantifying' nature *('nature points')* had responses relating to nature the most.

CASE STUDY — C

Wayfinder 2: An Interactive Wayfinder

Research question: Do the interactive elements of the wayfinder help in getting people to think about nature?

Figure 6. Field Scene of Wayfinder 2 on the TU/e campus. In this case, a tangible button was chosen to trigger the numbers on screens, illustrating the *'nature level'* of both directions.

The second iteration of the design was different from the first iteration:

- From Case Study B, we realized that most people were not interested enough to start a meaningful interaction with the wayfinder. The introduction of a tangible button was hypothesized to lower the interaction threshold (Figure 6).
- For the different visualizations, *'nature level'* (formerly *'nature points'*) was chosen as the most engaging semantic strategy. When talking about *'nature level'* participants would relate them to their surrounding nature the most.
- Digital screens were added to display the amount of *'nature level'*. The fact that displays do not show the numbers before pushing the button is thought to arouse more interests by providing an element of mystery. We assume that if only glancing at the wayfinder with a blank digital screen, people would be curious about the result of pressing the button.
- We assume that people would be likely to feel confused, look around and compare their own

opinions to the numbers on displays after pressing the button. Under this circumstance, conducting a contextual interview with them becomes a natural progression.

Results: An Interactive Wayfinder
During the observation, we noted that most passers-by spent several seconds gazing at the wayfinder while walking past it, while some even looked over their shoulders as they passed the wayfinder. A minority of the participants stopped near the wayfinder and interacted with it. Those who showed interest in the prototype were interviewed using an semi-structured format.

Generally, the majority of interviewees had no ideas about the wayfinder and misunderstood the nature level when they initially pressed the button and saw the numbers.

- *"I don't know what the nature level means." — participant C1*

- *"I don't really understand what's the implication of the numbers." — participant C6*

- *"Does it mean the temperature?" — participant C3*

Nevertheless, after a brief explanation the participants looked around and compared surroundings with the nature level, trying to figure out the meaning of the numbers. Finally, they were capable of connecting the numbers with some specific elements around them.

- *"I agree with the numbers because there are more trees, and grass on the left." — participant C6*

- *"This way is towards city center with more buildings and crowds." — participant C8*

- *"Nature level may be about grassland, trees and animals." — participant C9*

With our conversation going deeper, only a couple of respondents offered us their opinions and suggestions about our prototype.

- *"I would definitely choose the left way after seeing this wayfinder, because this way with higher a nature level is healthier." — participant C8*

- *"Without technology, it is just like the traditional wayfinder." — participant C5*

- *"Why not put real-time visualizations of the environment on the wayfinder?" — participant C5*

Overall, despite the fact that respondents initially had trouble in comprehending the 'nature level' and numbers,

they could still associate themselves with surrounding environments after thinking for a while and were guided properly.

DISCUSSION
This paper presents three different case studies in which the presentation and interpretation of open data in the context of nature were explored. We examined how people interpreted open data visualizations and how they connected them to their context. Since we are researching how people link nature-related open data to their surroundings (nature), we first have to understand how they define nature.

Nature varies from animals and trees to the lack of visible cars and streets. The results of our case studies illustrate the subjectiveness of interpretation of nature. Some people interpreted the context of the nature level limited to a few meters around the wayfinder, others to the entire campus and some to areas outside of the campus.

Besides, defining *natural elements* is a tough question, as it differs from person to person. Being in an environment with green elements does not necessarily correlate with the feeling of being in nature. For example, some people simply defined natural elements as grass and trees *(participant C9)* while some thought a nature area should be rural and have a low population density *(participant A4)*.

Since the perception of nature is subjective, presenting data about nature so that people can make sense of it, can be challenging. From our research, we found some general *best practices* for presenting recognizable open data in its related context.

Clear Distinctions

Location of the prototype
From our results we found that the location in which the wayfinder were placed left room for different interpretations as to where and what the wayfinders were directing to. The nature that is in their surroundings, based on some participants, includes only the immediate environment around the wayfinder (visible trees and grass). For others it is a long distance in the direction that the wayfinder is pointing (city center in the direction of the arrow (participant C8)).

Therefore, for the ease of open data interpretation, it is important to consider where the open data is being displayed and how people interpret it in relation to its context.

Relevance of the open data
Open data should be useful for the user in its context.

As stated in the results of Case Study B appreciation of nature, some respondents questioned the relevance of the

data presented on the wayfinder. For example, some did not see any use in the knowing which direction has more nature. As stated in the results, a lot of people would just glance at it without doing something with the information provided. The prototype did not aid passers-by with any immediate goals they had, and therefore was not interesting to them.

These results conclude that the usability and relevance of the displayed open data has an effect on how the data is perceived. This should therefore be considered when presenting open data.

Abstraction and Understanding
The introduction of the *'nature points'* and *'nature level'* were both too difficult and abstract for participants of this research to understand. It was only through specifically and repeatedly asking what those nature level points could possibly mean that people started to think about it. *Participant C5* suggested a real time visualizations on the wayfinder instead of 'nature levels', and was asking for something more concrete and linked to the familiar environment.

We suggest considering the level of *abstraction* versus *concreteness,* and *novelty* versus *familiarity* of certain topics and vocabulary. As these elements influence whether the viewer of the open data is able to make sense of it.

The philosophical concept of *language games* was first discussed by Wittgenstein (Wittgenstein, 1999). He explains them as inside jokes, which people have to be a part of in order to understand them. Applying it to our research, an example of a *language game* would be where people read the text 'nature level' or 'nature points' thinking that there is an event or a competition that they are not a part of. In that case, since they wouldn't consider themselves as part of the group the wayfinder is for, they don't care to try to interpret or understand the way finder. Thus, designers should avoid using terms like 'points'.

User Study Practicalities

Presence of researchers
Throughout each case study, we were present for observations and interviews. Our presence might have influenced how participants interacted with our prototypes and responded in our interviews.

Location
Another factor that could have affected our outcomes is the location in which the case studies took place. The specific

T-section where the wayfinders were placed separated only a road and not two very distinct directions. In addition, the campus of the TU/e might not be the most 'nature like' place to execute a study based on nature; a park or forest would be more obvious.

Target group
Since our case studies took place on a university campus, our audiences were, inevitably, mostly students. Having done these case studies in a city center, for instance, would have had a much different and diverse audience than at a university. This could have given us insights into differences in the interpretation of open data by people from different ages and backgrounds.

Prototype
The two wayfinders were designed to be familiar artifacts in the daily lives of citizens. Yet the design of the wayfinders themselves still resembled a lo-fi quality prototype. Seeing an obvious prototype with a big red button could have made people, especially the students, aware of a possible user test that is going on, which would influence how sincere their responses were.

Research duration
Since this research took part of a class, each case study was specifically made for and executed in one afternoon each. This means that no one on the campus could get used to the presence of our prototypes. The '*Cyclist Counter Pole'* is something that is around for quite a while so that the novelty effect wears off.

Although it is difficult to pinpoint exactly when the novelty effect wears off (Hung et al., 2012; Koch et al., 2018), a period of time surpassing four weeks has a higher probability of producing more reliable results.

Future Implementation
Proceeding from the last iteration from our field study, we have enough insights to make a new iteration. We would make the following changes:

Change the term *'nature levels'*. Although we already changed the term *'nature points'* into *'nature levels'*, it has still shown to be too abstract. A field study would be done to find a term, understandable for everyone and linking natural elements to health. On the other hand, it could simply be a very specific term such as the *'amount of trees'*.

Moreover, the interaction with the wayfinder needs to be reevaluated. In Case Study C, we found that the interaction with the button did not help with the interpretation of the open data. More questions need to be reconsidered and answered, such as does it need to be interactive by the use of a button? Is the prototype required to be interactive at all?

CONCLUSION

In this research we explored how open data can be presented to enhance its interpretation and sense-making. Our aim was to present nature-related data in such a way that passers-by are engaged with it, able to relate to it and understand it before using it. Through field research we have conducted three case studies. The first study was aimed at discovering the definition of *natural elements* and the *context* where open data could be displayed. The second case study was conducted to explore different ways of visualizing open data in-context, and to observe the interpretation of the visualizations. Lastly, we validated our assumptions and tried to aid the interpretation process with the addition of an interactive element.

From these case studies we have extracted a number of considerations for the portrayal of nature-related open data that can be applied to other types of open data. The level of abstraction and familiarity of open data portrayal influences people's ability to interpret the data the most. We also highlight the role that the context plays in data interpretation, as the context influences the goals people have, thus what is relevant to them at that moment.

With the continuation of technological growth, increasingly more data will be collected and available to citizens. This study highlights areas in which improving open data presentation to citizens can be done and provides a set of best practices for other open data pioneers to use in their studies or design.

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APPENDIX

In this section the backgrounds of the different authors are described, alongside their main responsibilities in the research process.

Mitchell Ansems is a master student Industrial with an affinity for Behavioral Design. During the research process Mitchell participated most in concept development, prototype fabrication and data analysis.

Linas Gabrielaitis is a research focused Industrial Designer, who was responsible for framing the research and guiding the team in gaining knowledge through design. Linas participated the most in concept development, background and field research and group discussions.

Arthur Geel is a master student Industrial Design with an affinity for User Experience (UX) Design. Within the research process, Arthur took an enterprising role in the concept development, physical realisation of the prototype and execution of the field research.

Naomi Kool is a master student Industrial Design with an affinity for User Experience (UX) Design. Within the research process, Naomi participated most in concept development, execution of the field research and team communication within and to the coaches of the course.

Jiangxue Xu is a master student Industrial Design with an affinity for product design. Jiangxue participated most in physical realisation of the prototype and execution of field research.

Xiaoyu Yu is a master student Industrial Design with an affinity for Human-Computer Interaction and UX Design. In the research process, Xiaoyu participated most in prototyping and conducting user test.