

# GLOBAL ENGINE – A MULTIMODAL INSTALLATION SHOWING GLOBAL GREENHOUSE GAS EMISSIONS DATA

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**ABSTRACT:** Due to the dominance of human’s visual sensation, information visualization is widely used in exhibition design. In this paper, we present Global Engine, an installation that does not only use vision, but additional multimodal sensation, like smell, to present big data to exhibition visitors in an intuitive, understandable and clear manner. The installation was presented at the Berlin Climate Day 2016 to a wide audience showing global greenhouse gas emissions data. Feedback of the audience has been gathered by conducting qualitative interviews, and the answers were analyzed using the open coding approach. Our results allowed us for deriving design recommendations for big data visualization using multimodal installations. We hope this work inspires curators and exhibition designers considering multimodal information representation, especially for communicating complex big data in an intuitive way to a broad audience.



*Fig. 1: Installation of a global map and smoke appearing above countries representing the greenhouse gas emission footprint for each nation*

## 1. INTRODUCTION

The global greenhouse gas emissions are known to be a serious danger for the earth. However, companies, governments, and individuals mainly do not feel responsible for the problem, which might be caused by a lack of awareness and understandable information presentation.

While information visualization already allows for data presentation showing data values and trends, it is widely accepted that as more modalities are used as better information can be transmitted. Consequently, this work explores the multimodal presentation of big datasets showing the emissions footprint of the countries

on a global map installation and its benefits for giving a broad audience the ability to join a sound discussion about complex problems, through a multisensory installation.

## 2. METHOD

By choosing the global greenhouse gas emission per nation during the year 2012[1], we made a decision for a dataset, that is relevant for the problem of accelerated global warming.

We have put the data in relation to each country population, with the intention to give the spectator a personal reference to the presented numbers.

We take advantage of effects of multimodal communication, which has been classified as promising for the improvement of brand building communication by marketing experts [2]. We adapted the method to evaluate its usefulness for the presentation of complex information. We chose the format of an installation for our project to study the reactions of its spectators and the effects the project during an exhibition.



*Fig. 2: Final Installation Setup*

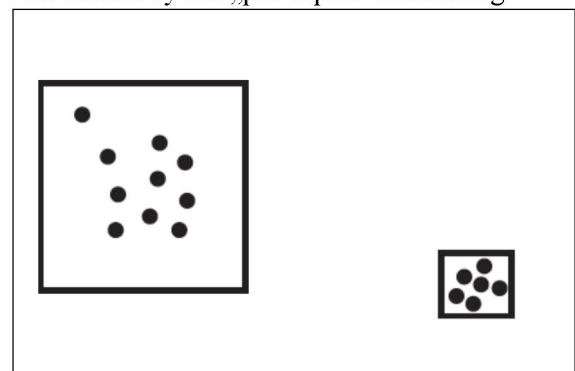
As a basis for the visual presentation we chose a world map on which every nation has a number of miniature smokestacks coding for its amount of greenhouse gas emission per capita. To present the information in a comprehensible way, we made the decision to exhaust real smoke through the smokestacks as a highly associative symbol for greenhouse gas emission. The miniaturization of the presented dataset was our approach to achieve an intuitive understanding of the topic and the quantitative information, being communicated.

Using the Java Framework Processing, we wrote a program, which automatically collected the emission data from the servers of the World

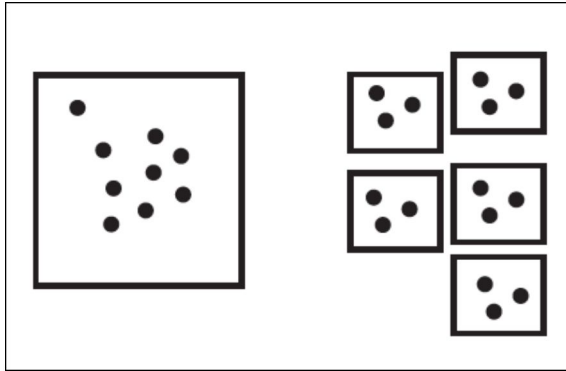
Resource Institute through their API, to subsequently validate, save and process the collected data. On a 300cm x 150cm wooden table, we mounted the world map. Within the borders of each nation, we drilled an amount of holes, representing the greenhouse gas emission per capita during the year 2012 as miniature smokestacks. The body of the table was closed airtight with transparent foil. Internally a fogger was installed to fill it with smoke like fog, produced out of fluid (Propylenglycol). Through the smokestacks on the world map, the steady smoke is now being exhausted according to each countries emission data, polluting the air of the room like a wall of smog. To study the perception of our work, we chose an exhibition during the „Berliner Klimatag“ on 24.4.2016 that several hundred visitors attended (<http://www.berliner-klimatag.de/?p=753>). We gathered feedback on our work during the exhibition by interviewing visitors. Moreover, we collected observations of visitors by taking notes.

## 2.1 RESULTS

During the exhibition, we observed visitors' reactions during a period of 8 hours. We also conducted interviews with over 30 visitors about the installation, the topic and the information. It was clearly visible, that the interest for the installation, was much higher, during the phases in which smoke was exhausted, than during the phases in which we had stopped the exhaustion. While the fogger was exhausting, almost every visitor stopped to take a look at the installation. Almost no one stopped while no smoke was being exhausted. Many questions regarding the uncommon appearance of the distribution of the amount of exhaustion throughout the world arised, which was caused by the „per capita“ relationing.



*Fig. 3: Density within countries*



*Fig. 4: Country density.*

We learnt that spectators had problems with understanding the presented information caused by the neglect of the relation between each country's exhaustion amount and size of territory. The resulting impression of smokestack density was always perceived intuitively as the carrier of the quantitative information. While smoke was exhausted, there were no questions regarding the topic or type of data being visualized. While no smoke was exhausted, people weren't clear about the presented theme. Most visitors used the installation to search for different countries, the largest or smallest exhauster, or compared countries with each other and came up with different opinions and understandings.

### 3. DISCUSSION

The significantly higher amount of shown interest for the installation during the smoke exhaustion demonstrates that non-visual modalities, like smoke, have an impact on the success of information presentation by effecting its perception. We want to highlight that using under-presented modalities in data visualization has potential for bringing complex topics closer to a broader audience. The uncommon image of distribution of exhaustion differences, caused by the „per capita“ relationing of the data has in amplified the amount of critical discussions about the data and the topic. The neglect of the individual territory sizes in mapping the exhaustion was adverse for the intuitive understanding of the presented information. It is also not only the density of smokestacks within the countries, but also the density of countries, which leads to an unwanted perception of a „per capita“ representation. An additional relationing to each country's territory size would have been more qualified for an intuitive perception. The exhaustion of smoke, clearly amplified the intuitive understanding of the

topic. The physical similarity of the symbol reduced the scope for deviation of interpretation through individual imprinting and associations, significantly.

### 4. CONCLUSION

With our work we have examined methods for preferably easy, interesting and quickly understandable ways to present big data. From our experience, we draw the following conclusions: The form of presentation added value to the process of fast and intuitive understanding of the presented information through miniaturization and physical similarity of the symbol, which led to the possibility to easily search, filter, compare and work with the huge data set. The multimodal communication approach appeared to be beneficial for generation of a broad interest in the presented information and has the ability to provide with an intuitive understanding of a context or topic possible. Density can be considered as a stronger visual signal than amount, seclusion and even proximity, which is an interesting finding that can be used in further exploration.

### 5. ACKNOWLEDGMENTS

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### 5. REFERENCES

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