Playing with Data: an Experience in Creative Infovis

(Article begins on next page)

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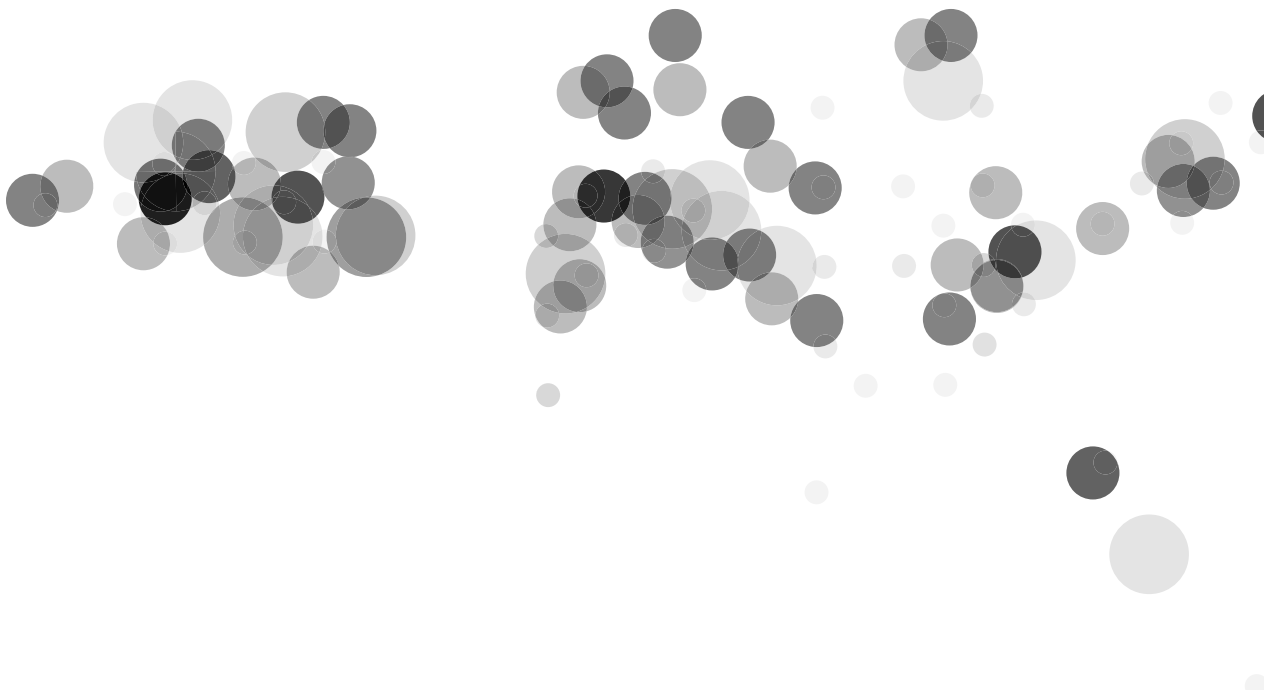Planning, Alghero, Italy

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Playing with Data:
an Experience in Creative Infovis

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Abstract. Information Visualization (Infovis) methods provide an effective way to make sense of the vast amount of data flowing around our everyday experience. Using creative Infovis designs is possible to convey the meaning and enhance the understanding of complex topics. The purpose of this paper is to present the design method adopted in a collaboration between Polytechnic of Turin and Telecom Italia, whose goal is to devise novel and useful Infovis concepts to deal with data. Powered by the sharing of different skills and experiences, this method led to the first results presented in the paper.

Keywords: complex systems design, information visualization

1 Introduction

We are living in an era of exponential increase in data production, collection and usage in every sector of human life, about people, ideas and object. Nowadays more data is produced in a single second than the entire content of the Internet of twenty years ago.[1] As a result data, seen as a complex system, provide an important opportunity to enhance the cognition of our environment. For this reason the ability to collect, understands, communicate and make sense of information is going to be a very important skill in the next decades [3], in the professional field as well as in the educational and research field [4][5]. Under this premise, a collaboration has been established between the Department of Architecture and Design (DAD) of the Polytechnic of Turin and the Innovation and Re-

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[1] An ordinary person today could generate more data in one afternoon's trip to the market than a person born in 1912 would produce in a lifetime. [1] Considering the Internet's content generation rate today, a growth of 44 times in the digital data generation rate in the next ten years could be a reasonable expectation [2].

search Projects department of Telecom Italia S.p.A. This collaboration, involving the authors of this paper (DAD and TI researchers) and a selected group of students from DAD, pointed out, shared and explored new creative design and Infovis methods coming from the experience matured in DAD and TI. Main insights gained in this phase are presented in sections 2,3 and 4 of this paper. In the unfolding of the research activity a pair of case studies, coming from recent Infovis projects in TI and described in section 5, were presented and analyzed by the research group in order to inspire and support the Infovis concept proposals of the students presented in section 6.

2   Data, Complex Systems and Systemic Design approach

Complex systems are those systems and phenomena made of many components or agents interacting with each other in countless possible ways, where the overall behavior is not given by the simple sum of the behaviors of their constituent elements, but depends strongly by their interactions [6]. Therefore, our capability to understand complex systems is not only due to our knowledge about the single system's components and features, but especially to the ability to recognize and validate the overall relations among these components and features. This is the case of the analysis and visualization of complex data sets, especially when the number of data is very large (the so called "big data"). In order to reach the Infovis project's goal, we establish a design process methodology starting from the Systemic Design Approach able to organize, optimize and understand all the actors and parties involved in the phenomenon under consideration.

The Systemic Design approach is a new way to face the design activity in complex systems, used and taught in design courses at the DAD. Defined and verified in different design fields as a way to create innovation by the research group, it is focused on designing the relationships between people, activities and contextual features to enhance knowledge about complex systems. It begins with the collecting of broad and tangential information in order to examine the vast array of issues and features surrounding any given complex topic. The study of this overall picture guides the designer into a deep understanding of the topic outlining the real role of all the actors involved within their scope, their development and their relations in their operational context [7]. As a result, using this approach is possible, in one hand, to become aware of the value of the relationships, expressed in the system's behavior, creating the given topic's identity, while in the other hand, the interaction between this identity and the operational context creates the culture of the considered topic. Operating in this iterative process, innovation can be driven using awareness, information and behavior within the system itself [8].

Paolo Tamborrini, Andrea Gaiardo, Luca Bardone and Luca Buriano
Playing with Data: an Experience in Creative Infovis

279

3 Information Visualization

While Infovis can be simply defined as the representation of information in visual form, it is nevertheless a complex multidisciplinary field, ranging from data mining to visual art, from psychology of perception to graphic design. This is because effective Infovis projects try to exploit the great power of human visual perception, creating visual data representations allowing the navigation, understanding and useful pattern discovery in data sets [9]. In other words, the quite ambitious goal of Infovis is cognitive augmentation, i.e. the extension of the capabilities of the human mind with respect to data, allowing to make sense of complex data-driven concepts [10][11][13].

In the collaboration between DAD and TI described in this paper, we've been strongly oriented to the creation of information visualization methods and concepts where one can "play with data", i.e. where aesthetic, creative design and interaction factors [12] are an essential part of the understanding of complex data, in a way that, quoting Andrew Vande Moere, "should appeal both the mind and the soul"[13].

4 Infovis design process methodology

The Infovis design process can be thought as composed of three main phases: analysis phase, encoding phase and display/testing phase. According to the Systemic Design approach, in the analysis phase the designer considers the overall picture of the topic to be visualized, taking into account the different data and elements involved and their relationships in the domain context. In order for the Infovis project to be effective, an important aspect is also the individuation of the target audience and the related communication style. An important design choice is the selection of the actual data to display in the visualization [10]. In this analysis phase is also important to assess data retrieval / extraction / structuring techniques needed in order to actually build the data flow needed by the intended visualization.

In the encoding phase, the most important aspect and design choice is the envisioning and definition of the mapping from data to visual elements, such as shapes, colours, animation, typography, and so on. Effective Infovis projects often make use of creative metaphors in order to convey meaning in an immediate way. The display/testing phase closes a single cycle of the Infovis design process, providing feedbacks and insight for the assessment of the visualization project.

5 Infovis case studies

The case study called "Politics" (fig.1) is focused on gathering, processing and visualizing data and information from Italian newspapers' articles and Italian po-

litical structure. Data are obtained by analyzing articles using Natural Language Processing (NLP) tools, by extracting useful concepts and matching them to structured information (using semantic web techniques) and by classifying articles on a pre-built taxonomy of arguments. That set of tools produces additional information (annotations) for every article: date of publication, people, organizations, places mentioned into the article, and relations between annotations based on their co-occurrences into articles. All of the annotations generated is our dataset, which can be continuously updated. Our visualization design approach is to use simple visual forms and different visual modules to show data at different
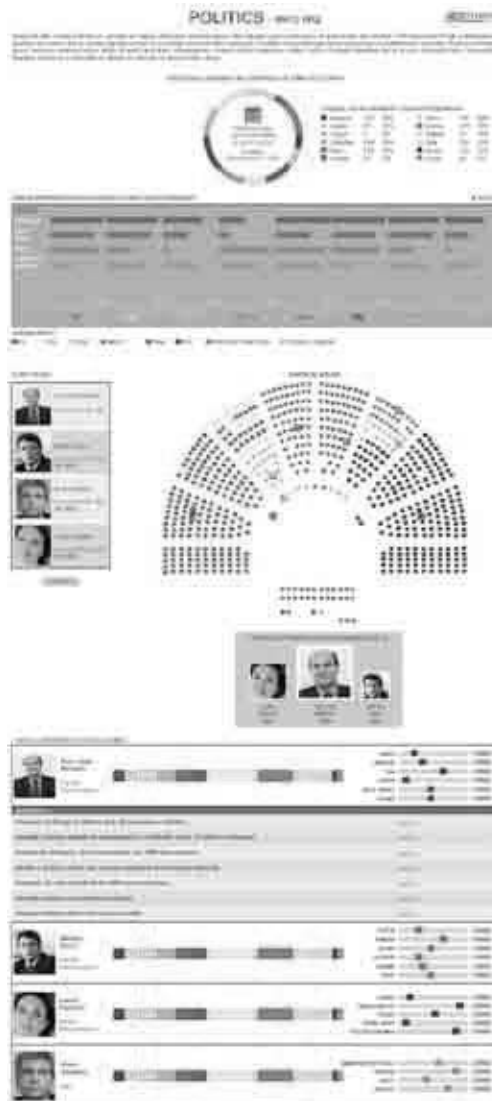

Fig. 1. Screenshot of the "Politics" Infovis project.

Paolo Tamborrini, Andrea Gaiardo, Luca Bardone and Luca Buriano
Playing with Data: an Experience in Creative Infovis

281

levels of aggregation. At the higher level of aggregation we use a donut chart to represent articles by argument. For more detailed information on deputies and their mentions in articles we use still images of the deputy to identify him. Moreover, to represent all the politicians whose information we deal with, we use the metaphor of the Italian Parliament drawn as a circular sector composed of tiny circles, one for every deputy; the colour of the circles can be arbitrary or the one traditionally associated to the party.

The "Colours of the Vineyard" (fig. 2) is a visual recommender system on the domain of Italian wines from the Piemonte region, based on a database of these wines and their properties related to smell, taste, grapes and production locations. When the user chooses a wine from the list, the system extracts from the database a set of wines with similar properties and creates an interactive visualization of this set, allowing visual exploration of wines' properties. Visual layout creation is driven by a fitness function taking into account not only data relationships, but also aesthetic, perceptual and graphic design factors. This method follows the approach of generative visual art and generative graphic design, where the artist/designer, after envisioning a set of aesthetic, functional and semantic criteria, models them as a process and lets the resulting system organize into the actual, emergent visual patterns [14]. The flexibility and modularity of the fitness function allows the designer to experiment with different aesthetic criteria and styles. Moreover, the generative approach naturally leads to the creation of a diverse set of visual solutions for a given data set, enriching the user's experience with a source of visual novelty. A detailed description of the project can be found in [15].

Fig. 2. Screenshot of the "Colours of the Vineyard" Infovis project.

6 Playing with data: Infovis design concepts

The design concepts produced by students follow the systemic design methodology explained before and embrace a range of different domains.
Every concept is briefly exposed hereafter:

Realtime Communication (authors: Pallaro Agnese, Rudà Elisabetta, Schioppetti Marzia, Tron Valentina). This work presents (fig.3) the concept of a system for realtime, interactive visualization of data flows in worldwide telecommunication networks. The key metaphor used is the sea, evoked by the color palette (also in line with the "control room" overall layout of the visualization) and by the wave-like shapes of several graphical elements. This, jointly with the envisioned advanced navigation features in (geographical) space and time of the visualization, effectively addresses the current need of surfing the ocean of data in a way that allows awareness and understanding.

Fig. 3. Screenshot of the "Realtime Communication" Infovis concept. Authors: Pallaro Agnese, Rudà Elisabetta, Schioppetti Marzia, Tron Valentina

Paolo Tamborrini, Andrea Gaiardo, Luca Bardone and Luca Buriano
Playing with Data: an Experience in Creative Infovis

283

My Energy Consumption (author: Altobelli Claudia). This work presents (fig.4) the concept of a system for the monitoring and visualization of home energy consumption. The metaphor and key graphical element used in the visualization is a little plant, whose different leaves represent different days, while the degree of filling of each leaf is proportional to the energy consumption in the associated day (in alternative visualizations, the leafs can represent different dimensions, e.g. the consumption of different household devices). This results in an intuitive and immediate method for becoming aware of the often quite elusive data about personal energy consumption.
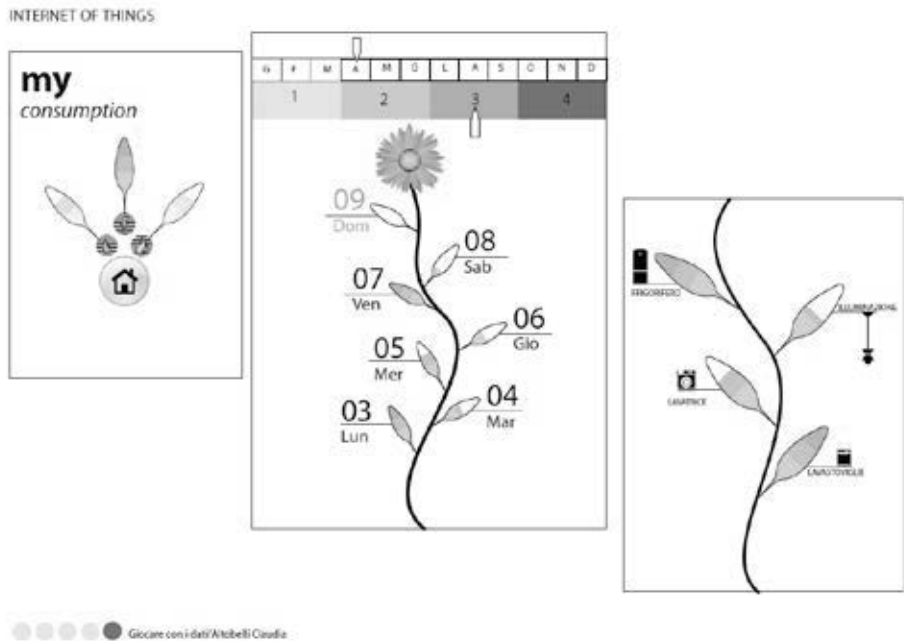

Fig. 4. Screenshot of the "My Energy Consumption" Infovis concept. Authors: Altobelli Claudia

Data to Think About (author: Altobelli Claudia). This work focuses (fig.5) on the goal of raising the awareness about the problem of violence against women. Key design factors are the navigation of statistical data in an interactive way, a clean, stylized graphic layout and the use of evocative shapes metaphorically related to the problem analyzed (e.g. the pointer indicating a particular statistics about feminicide has the shape of a gun). This results in a work having a strong emotional impact while allowing a clear understanding of actual facts and social factors related to the analyzed problem.
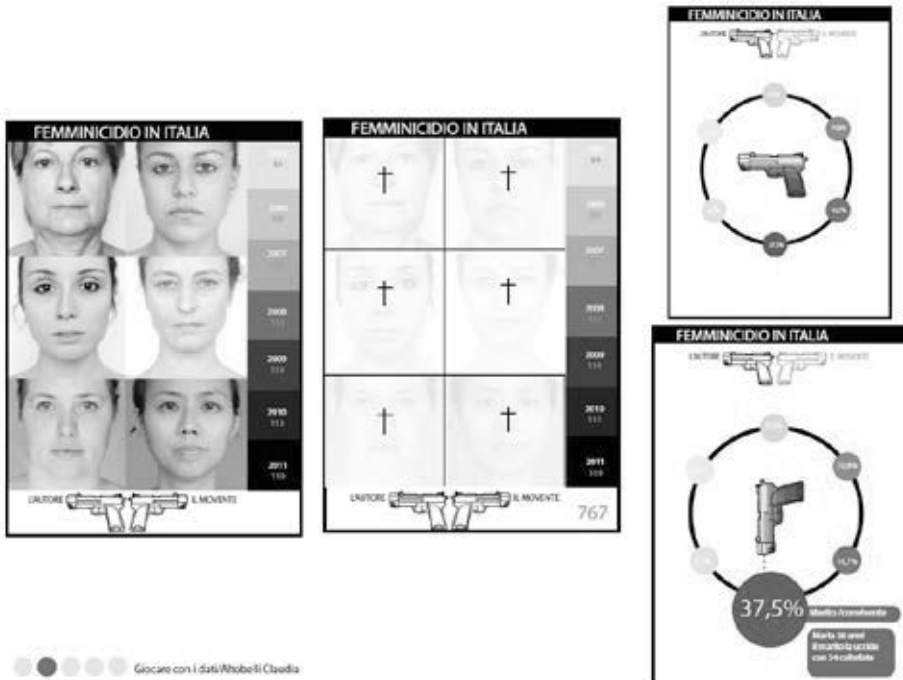
Fig. 5. Screenshot of the "Data to Think About" Infovis concept. Author: Altobelli Claudia

Who is the Fastest Sprinter of 2012 in 100 Meters? (authors: Amouzad Khalili Hamid, Khorramian Kaveh). This work presents a visual comparison of the speeds attained by top athletes in different sports, using as metaphors a clock/timer wheel and a virtual "speed contest". The visual comparison is integrated in a video showing the protagonists of this contest in action. This results in an immediate and effective way of explaining the concepts of speed and time (in an educational setting, for example) in different contexts.

Smart Cities (authors: Casale Enrico, Conte Fabio, Lopez Eliana Paola). The focus of this work (fig.6) is on improving the visual presentation of open data about cities. Key design factors are the switch from traditional infographics to a more intuitive and appealing design (like the radial layout proposed) and the improved navigation among the data, in order to easily move between their different levels of aggregation and categorization. This results in a easy-to-use tool allowing rapid understanding of complex data sets about the cities and their inhabitants.
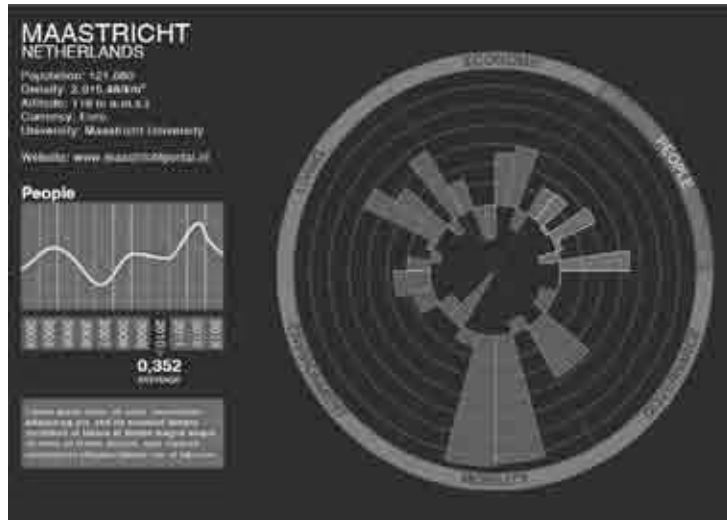
Paolo Tamborrini, Andrea Gaiardo, Luca Bardone and Luca Buriano
Playing with Data: an Experience in Creative Infovis

285

Fig. 6. Screenshot of the "Smart Cities" Infovis concept. Authors: Casale Enrico, Conte Fabio, Lopez Eliana Paola

ToriNoi (authors: Guataquira Sarmiento Nataly Andrea, Rugeles Joya Willmar Ricardo). This work (fig.7) proposes a tool for social networking / information retrieval with the goal of helping people, coming to Torino from foreign countries, to get the right information on travel, healthcare and legal documents required to live in Italy. The key visualization/navigation metaphor is a stylized shape of the Mole, Torino's iconic monument, composed of the stylized shapes of the users' avatars (the name of the concept, "ToriNoi", is the fusion of "Torino" and "Noi", the Italian word for "Us". Hence, the meaning is "Torino for Us" or "Torino are Us"). This design results in a warm welcoming feeling and in a great immediacy in the user experience when looking for information.
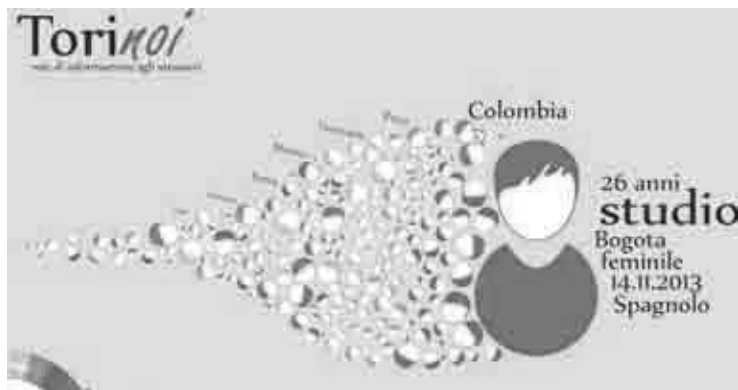

Fig. 7. Screenshot of the "ToriNoi" Infovis concept. Authors: Guataquira Sarmiento Nataly Andrea, Rugeles Joya Willmar Ricardo.

Italian Political History (authors: Cirillo Letizia, Sorgente Livia, Spagnuolo Anna). This work (fig.8) envisions a visualization tool on the data about the complex domain of Italian political history. Key design elements and metaphors are: 1) a "time wheel", i.e. a timeline with a circular layout organized in circular segments, representing different periods of Italian political history; 2) a schematic drawing of the Italian Parliament, showing the composition of the political forces (overall and in detail) in a interactively selected time period; 3) a graph layout visualizing the links among political actors, their parties, the available information about them, their media appearances, and so on. This results in a powerful, yet easy to use, analysis tool to explore and understand the past and present Italian political situation.

Fig. 8. Screenshot of the "Italian Political History" Infovis concept. Authors: Cirillo Letizia, Sorgente Livia, Spagnuolo Anna

Augmented Journalism (authors: Basile Carmine, Dellalibera Mattia). This work (fig.9) envisions a tool for the spectator of talk shows and similar TV programs, allowing to more easily understand important and complex themes. The key metaphor is the scientific optical instrument (e.g. microscope or telescope), penetrating under the surface of the visible TV show and visualizing in a realtime, accessible way the information linked to persons and themes present in the show, making use of information extraction, information matching and image recognition technologies. This provides the spectator a "augmented view" layer for an improved understanding of what she/he's seeing.

Paolo Tamborrini, Andrea Gaiardo, Luca Bardone and Luca Buriano
Playing with Data: an Experience in Creative Infovis

287

Fig. 9. Screenshot of the "Augmented Journalism" Infovis concept. Authors: Basile Carmine , Dellalibera Mattia

7 Conclusions

First results of the collaboration between our research groups were encouraging, because the students, guided by the systemic design approach and by the insights gained during the projects meetings, were able to produce high-quality visualization designs and "play with data" across the different phases of the design process, giving us a very strong positive feedback.

The future of our collaboration will explore the application of these design methods and insights in other domains, especially focusing on visualizations with strong interactive and aesthetic features.

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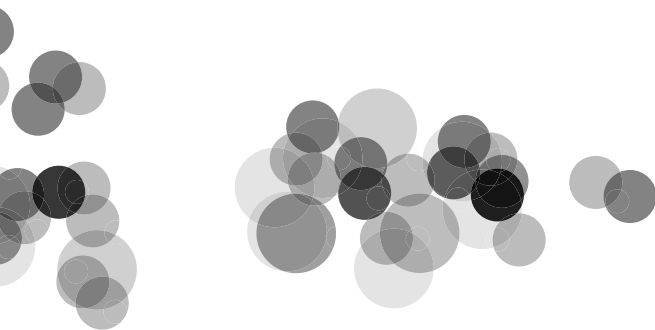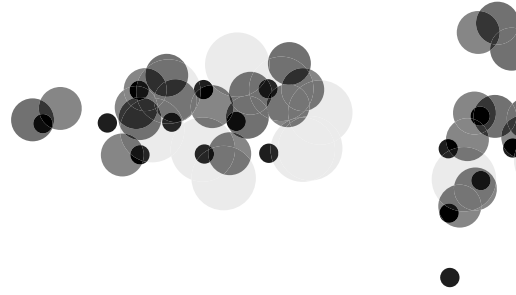
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2CO's first edition (25-26 October 2013, Alghero, Italy) has gathered an international community of professionals and scholars active in this area to share experiences, points of views and methodologies, focusing on three main areas of interest: informative-animation, interactive data visualization, info-graphics.

This volume collects their contributions in the three conference categories: full papers, posters and 'junior track' special session.

Generated by a consortium of European Universities that in 2011 started collaborating on the InformAnimation project, and by fellow Universities active in visual design teaching and research, **COmmunicating COmplexity** aims at becoming an international reference point for research and education in the area off communicating complexity through new media.