D4.3

UI Low Fidelity Prototypes

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This document presents the methodology used and the results of the initial investigations into the types of visualisation that could be used for the USEMP application (named DataBait). A review of visualisation approaches and the overlap with the field of interaction is presented.

The process of design and the tools utilised that led to the choice of three potential DataBait UI visualisations is described. These three approaches, i.e. a ‘bubble’, ‘flower’ and ‘angle’ visualisation, were further analysed via a questionnaire. This led to the selection of the ‘bubble’ visualisation, to be further developed and analysed for the remainder of the project.

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1.Executive Summary

The goal of Work Package 4 is to grow our understanding of how users make use of Online Social Networks (OSN) in their everyday life, motivated by a single research question: “How can we enhance user empowerment in a rising culture of connectivity by identifying, understanding and strengthening the social and technological aspects of user tactics coevolving with platform strategies?”

The previous two deliverables from this work package have successfully reviewed and analysed existing privacy enhancing tools and different privacy strategies employed by real users of social networks. They also provided insights into the underlying mechanisms of the so-called privacy paradox, taking into account issues of awareness and capability. Social requirements were captured and analysed that help refine the subsequent user research in order to discover what users generally disclose on online social networks and in particular how this has evolved from 2005 to 2014. This was done with the aim of enhancing the subsequent quantitative research track using the DataBait Research Tool.

The aim of this document then is to harness these social requirements and use them as part of the design process for the first low fidelity UI prototype wireframes that will form the basis for this early research. The main factors influencing this process are described as well as how this relates to the work done in other work packages in the project and the tools used to reach our initial set of visualisations. We present three sample visualisations of a user’s privacy profile, including a ‘bubble’ visualisation, a ‘flower’ visualisation and an ‘angles’ visualisation. We finish by describing an initial examination of user preference for the three developed visualisations.

2. Introduction

One of the main aims of the DataBait tool is to provide a user of online social networks with the ability to rapidly and efficiently judge the state of their online 'privacy profile'. The privacy profile that we refer to in this case consists of a number of pre-determined 'privacy dimensions', including, amongst others, a user's demographic information, consumer profile or psychological characteristics as described in D6.1. The full range of privacy dimensions and their implications for the design of visualisations is discussed in D6.3 and in slightly less detail in section 3.2 below.

This provision of a rapid and efficient judgment of a privacy profile is the main challenge of the work in D4.3, which requires the design and development of a number of visualisations with this aim in mind. The outcome will provide a user with an overview of the varying levels of exposure of each of her privacy dimensions in a rapid and efficient manner and in a way that does not require the user to understand complex lists of numbers or tables containing the relevant information. To this end, we investigate the different possibilities for the kinds of visualisations that could achieve these goals, which necessitates the use of the full User Centered Design process (Norman & Draper, 1986) and the various tools associated, such as use cases, storyboards, scenarios and brainstorming sessions.

While this work is a natural progression of the work already conducted within Work Package 4, there are a number of influences from several other deliverables from other work packages that must be acknowledged.

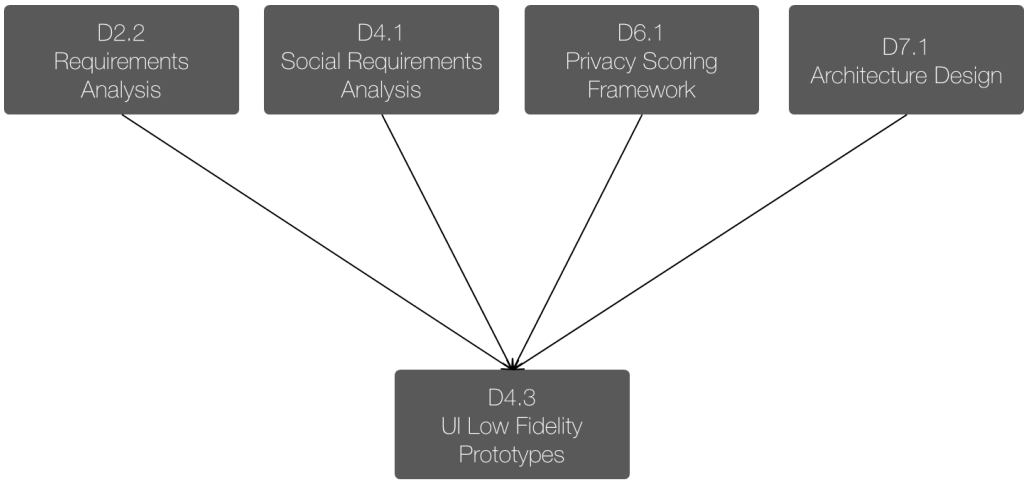

Figure 1: The work conducted in T4.3 is directly influenced by work already conducted in three other work packages.

Deliverable 2.2 discussed the general requirements of the USEMP project and, together with D2.1, it introduced the use cases that shape the direction of the work. These two use cases, the requirements they elicit, and their influence on the work conducted here will be discussed in more detail below. Another important aspect of the DataBait system that was introduced by Deliverable 2.2 is the potential functionalities of the system. Requirement 16(b) states:

"SR16(b)- to easily navigate among USEMP platform enabled features such as: 'Profile', 'Personal Data control', 'Future Control', 'Settings'…"

Three of the four features mentioned relate directly to the development of visualisation tools. These three modes of functionality are **Profile**, which we can consider as a pure visualisation feature designed to provide the user with an overview of her privacy profile, **Personal Data Control**, which we can consider as the interactive part of this work as the user must have some sense of control over the visualisation, and **Future Control**, which we can consider to be a combination of both visualisation and interaction that enables a user to visualise the potential consequences of their actions, such as uploading a photo or updating a status, for example. These different 'modes' will help to shape the visualisation designs during the course of this work, which will subsequently be investigated in depth during the course of T6.3 of WP6.

Deliverable 7.1 introduced the general architecture of the USEMP platform that will have a direct influence on the user interface prototypes, via the definition of the specific client side tools to be implemented. The design of these tools will be guided by work done in this deliverable and in D6.3. The work conducted thus far in WP6 has had the largest influence on this early prototype development. The aim of D6.1, conducted in parallel with D4.3, is to produce a privacy scoring framework for a number of so-called 'privacy dimensions' gleaned from existing literature. This framework was provided early in the process and is discussed in more detail below. The developed visualisation interfaces will be based on this framework while at the same time taking into account the requirements set out in the other work packages.

3. Background

The kind of prototype interface development we describe here requires knowledge from several different areas. The principal inputs come from the fields of human-computer interaction and interaction design but these are complimented by knowledge of human-factors research. Below we provide some of the background that is most relevant to this work, which includes a brief review of important trends visualisation research. A deeper review of interaction, how this links to visualisation. The crossover between these two areas and the field of privacy research will be discussed more deeply in D6.3.

3.1. Visualisation

Data visualisation has emerged in recent years as a powerful way of representing potentially complex data in a way that is both clear and interesting to the viewer and in a way that exploits the human visual system's ability to recognize spatial structure and patterns (Robertson, 1990). This then aids the subsequent analysis of those data by a user and hence their decision making process, which in the case of USEMP should aid users of social networks when confronted with a visual representation of their privacy profile.

In their book on the quantitative display of information, (Tufte & Graves-Morris, 1983) explain that the use of graphics can "reveal" data that wasn't otherwise evident. They describe some basic rules of visualisation that include the rather fundamental rule that the visualisation should "show the data" but also that it should induce the viewer to think about the substance of what they are seeing rather than the visualisation itself. It is these rather fundamental ideas that we must incorporate into the DataBait overview of a privacy profile and this is one very important goal of the work in D4.3.

To achieve this goal it is important to describe what constitutes an overview in this context. (Hornbæk & Hertzum, 2011) present an extensive review arguing that the notion of overview has consistently been focal to information visualisation research and specifically mention a number of definitions such as Card's "visual representations of information spaces to amplify users' cognition" (Card, Mackinlay, & Shneiderman, 1999). (Greene & Marchionini, 2000) argued that a good overview "provides users with an immediate appreciation for the size and extent of the collection of objects the overview represents, how objects in the collection relate to each other, and, importantly, what kinds of objects are not in the collection". Overviews support interaction with information spaces in general and may support specific tasks like monitoring, exploring, refining and browsing.

3.2. Privacy Factors

The provision of an overview of the user's privacy profile is the fundamental aim of this work so it is important to consider our own design space and the dimensionality it can offer for the design of an informative visualisation. Here we briefly introduce our privacy factors framework and discuss how this provides us with a design space that will aid the generation of an overview of a DataBait user's privacy profile.

Work conducted in WP6 focuses on the derivation of a privacy scoring model with the hypothesis that it is possible to infer values of specific aspects of a user's privacy profile by monitoring their online behaviour. In order to show this, a set of specific privacy variables that are considered to be important to the user's overall privacy profile is constructed. It is this set

of ‘privacy dimensions’ that provides us with the necessary design space for our initial visualisation work.

This work, described in detail in D6.1, focusses on two broad groups of study; those that infer private information based on users’ inputs (for example their likes and other OSN behaviour) and those that refer to the attitudes of users towards privacy aspects within online social networks. Via a study of the literature in these two areas a list of eight different privacy dimensions were produced as illustrated in Figure 2.

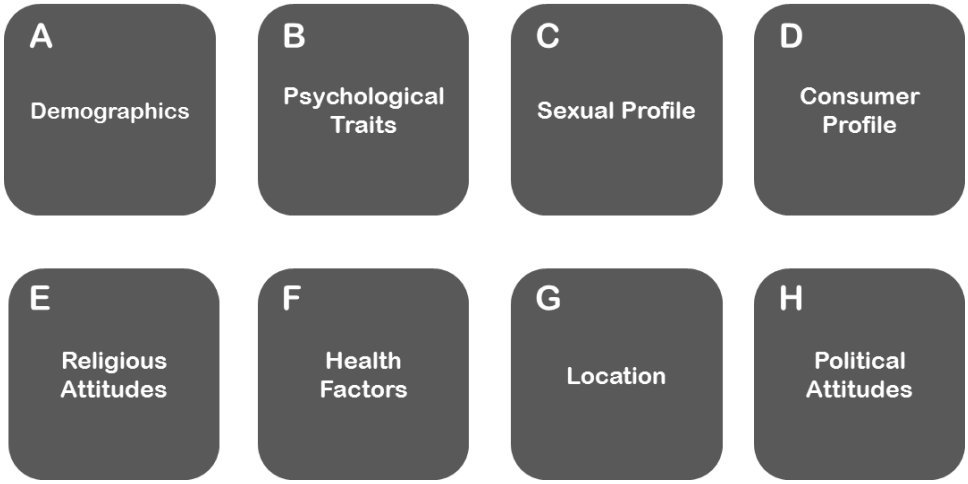

Figure 2: The privacy dimensions derived in WP6.

Each dimension is derived from a complex set of algorithms that take inputs from the user’s photos, text and other general social network activity to compute a score that we might think of as a level of ‘exposure’ of a specific privacy factor on a scale from 0 to 1.0. This score should provide the user with the ability to quantify the risk entailed by the disclosure of different parts of their privacy profile and should ultimately inspire them to take greater control of this risk. Each of these privacy dimensions can also be further sub-divided into a number of specific attributes, meaning that; overall, we are presented with a potentially rich design space for the subsequent visualisation work. In the next section we describe the design process and the tools used that led to the first set of visualisation of these privacy dimensions.

4. The Design Process

4.1. User Centered Design

User-Centered Design (UCD) (Norman & Draper, 1986) is a process in which the needs, wants, and limitations of potential users of a product or service are given specific attention at all stages of the overall design cycle. As has been demonstrated for the two previous deliverables from this work package, this process begins with the most basic needs of the user and evolves into a multi-stage problem-solving process that requires designers to both analyse and foresee how users are likely to use the DataBait tool. This process then finishes with a test of the validity of the designer's assumptions and with an examination of user behaviour in real world settings. Such testing is necessary in order to fully understand what first-time users of a product experience, which helps with the subsequent improvement of the product. The full process is illustrated in Figure 3, which also demonstrates the iterative nature of the cycle.

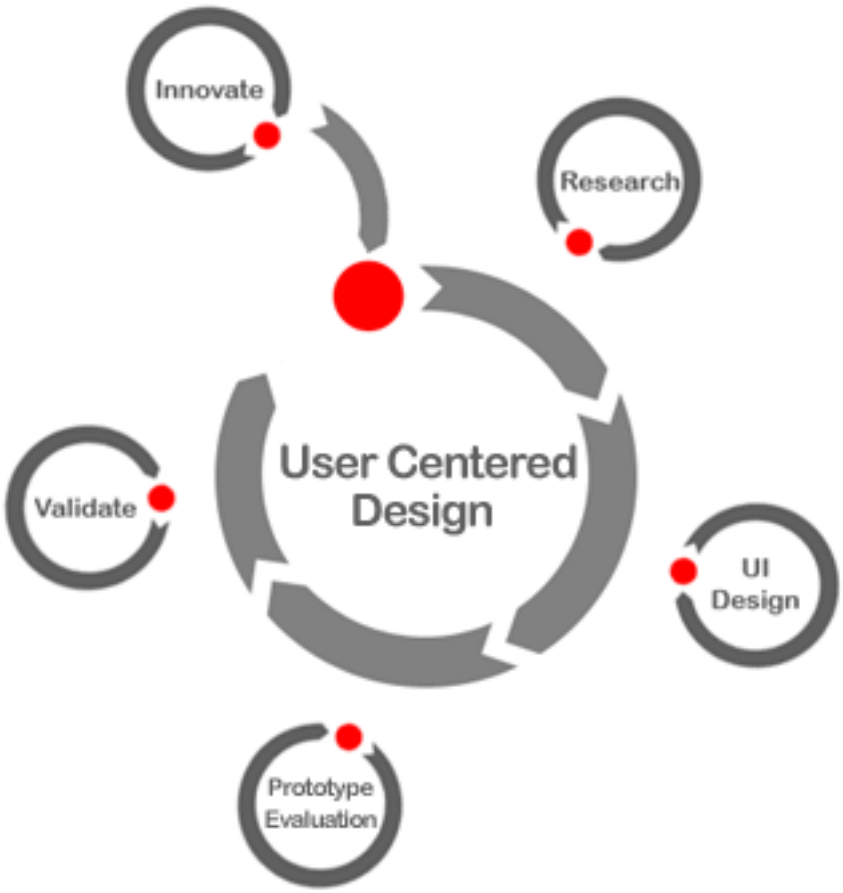

Figure 3: The User Centered Design process

The UCD process demands that potential requirements are considered at the beginning and included into the whole product cycle. These requirements are noted and can be further

distilled through the use of investigative methods such as ethnographic studies, prototype testing or usability testing amongst others. Others include the so called 'generative methods' such as participatory design sessions that actively involve all stakeholders in the design process to help ensure the result meets their needs. To enhance our understanding of the user perspective in WP4, we applied a mixed method approach, applying both quantitative and qualitative techniques. More specifically, we conducted a survey, several focus group sessions and 15 interviews to analyse what personal data users are generally more worried about and what data should be included in the visualisations.

The full process is enshrined by an ISO standard for Human-Centered design ("ISO 9241-210:2010 - Ergonomics of human-system interaction -- Part 210: Human-centred design for interactive systems," 2010), which describes the following six key principles:

- The design is based upon an explicit understanding of users, tasks and environments.
- Users are involved throughout design and development.
- The design is driven and refined by user-centered evaluation.
- The process is iterative.
- The design addresses the whole user experience.
- The design team includes multidisciplinary skills and perspectives.

The specific visualisation design work conducted here consisted of two phases of design with users. The first, described in section 4.4, was conducted with a small number of users in order to explore the design possibilities and inform the potential visualisation development. The second phase, described in section 5.2 involved a larger number of users and was conducted with the goal of validating those initial investigative visualisation ideas. Before describing these two phases in more detail we first describe the more general design phases and tools used in work package 4 and how these shape the work performed in D4.3.

4.2. Visualisation Design Process

The work presented here focuses on the early stage design process that makes use of a number of different tools that are commonly used in user centered design. These tools include scenarios, use cases and personas amongst others, described in D2.1. A short description of each tool employed here and how we took advantage of those is described below.

Use Cases

A use case is a method used to describe an event that may occur during the use of a system, which describes a typical interaction between an individual and the rest of the world. This interaction could be brief but may consist of subtle details, interactions and illustrations of what takes place between a user and a system that are not evident in initial stages of design. The interaction between a user and the system is an act that takes place in everyday use. This interaction system should be thought about in detail, and hence use cases are created to understand how these tiny interactions occur.

Use cases are useful because they enable the identification of useful levels of the design work. They enable designers to experience the lower level details that make the problem easier to work with, since the specific steps and details the user makes are exposed,

enabling the reconstruction of a task via many smaller tasks and enabling the focusing of design resources on the most important micro-tasks identified.

As USEMP is a multidisciplinary research project, it is extremely important to maintain a clear view throughout the project on the needs and challenges of the different stakeholders involved, acting as a mechanism for keeping the practitioners from the multiple disciplines aligned for the whole duration of the project. To this end, two separate use cases were developed. The developed use cases focus on the two main aspects of the DataBait system, i.e. the OSN empowerment tool and the Personal Data Value Awareness Tool. These two use cases are described below with emphasis placed on the parts that are specifically relevant to this work.

Use Case 1: OSN presence awareness and control

Our first use case deals with the creation of tools that empower online social network users toward the content and information they share online be it volunteered, observed or inferred information. These tools should give the user the means for correctly assessing which of her personal information is visible to the online social network site or via connected profiles and other third parties. In order to effectively do this, the USEMP platform must hold two major functionalities: real-time OSN presence management and long-term OSN presence management.

The real-time OSN presence management functionalities have to give the user the means to indicate what type of information she prefers to keep private and what she wants that would happen when the USEMP system detects that she is about to disclose parts of this sensitive information. This will raise the users' awareness towards the unintended sharing of sensitive information and the invisible processes tracking and structuring her online behaviour.

- This means that **visualisations** should be created that warn the user in **real-time** when releasing data that oppose her previous stated privacy-level

The long-term OSN presence management tools have to give the user feedback about his overall privacy level for the different dimensions of his privacy.

- Effective **visualisations** need to be created that help the user to rapidly recognize how much information she is revealing with respect to the privacy scoring framework developed in WP6.

Extracted requirements from the first use case from D2.1

SR03 - The system shall provide an interface such that newly created content or feedback (e.g. photos, texts, likes, ratings, etc.) can be vetted prior to upload. This interface should provide options to block the post, or offer alternatives to which the implications to the profile can be determined (see next point).

SR05 - The system may be able to provide suggestions for alterations regarding the visibility of parts of the posted content in order to allow the user to make informed changes on how the profile will be outwardly perceived. This is directly related to the development of visualisation tools.

Use Case 2: Personal data value awarness

Through implementing the features of this second use case, we want to raise users' awareness concerning the value of their personal data. The business models of online social network sites are currently based on the monetization of the users' personal information they

disclose when making use of their services. An interface needs to be created that raises users' awareness on the value of their personal data and in what way the OSN operators are exploiting it.

- **Visualisations** should clarify which third parties collect user data on the Internet and how and by whom ths data is being used.

Extracted requirements from the second use case from D2.1

SR07 - The system shall enable the visualisation of end-users digital trails and thus, the estimations of profiles (and/or profile segments/categories) she placed into by different actors in the network. Thus, the system should provide information from profiling in order to show the user which entities have the greatest interest in their data.

SR08 - The system shall enable to provide end-users useful insights on the value of their digital data and social footprint that are either directly shared in social networks (e.g., likes on Facebook) or are indirectly collected by various network actors that track their activities on web browsers.

Scenarios and personas

In the context of User Centered Design a scenario is a fictional story, designed to aid the thought processes and extract potentially useful information about small details of, as in this case, an interface design. The scenario should usually involve one of the main stakeholder groups or personas from the previously described use cases and will generally follow a specific sequence of events that are relevant to the research question we are trying to answer. The scenario can take several different paths, for example, the 'best case', 'worst case' or simple the 'average case' scenarios may involve the same sequence of events but with different outcomes that eventually help the designer to imagine the full set of interactions possible. Scenarios also work by providing a social context that is more easily understood by potential users of a system, which helps those users to more easily grasp the system they are involved in evaluating.

Stemming from the two previously described use cases, two different potential future scenarios were created with the goal of leaving behind the abstract, technical descriptions provided by the use cases and to come to more concrete situations that can both link directly to the work conducted here and help define sector specific challenges that may arise in a day-to-day use of DataBait.

First Scenario: OSN presence control (Empowerment) tool

For this scenario we created a basic story in which a married director of a Christian school has a lesbian relationship with a colleague of the school. Several potential privacy threats could be extracted: the risk to get fired from the job, the end of the marriage, etc. We show how the personas struggle with this new reality and how they adopt several strategies to keep their personal information as private as possible: they start making use of privacy ensuring technologies (such as Snapchat, Confide), they withold themselves from posting certain (sensitive) information, they consciously start managing their online audiences and eventually they come into contact with DataBait.

- Main personas of the OSN Presence control scenario:
    - Sofia Moore: A 36-year old woman, who is married and is a mother of two children (Anna and Trixie). She would use DataBait to gain control over her

children's privacy, conceal her medical situation and keep her lesbian extra-marital relationship with Caro hidden. This means that DataBait should present her with nice visualisations of how far her personal data reaches and warn her when she's about to release sensitive information.

- Caro Edgerton: A 33-year old single woman, who is an intense Facebook user and has a big interest in Japanese culture.
- Stephan Zimmer: A 35-year old man, married with Sofia, who makes a lot of use of different applications to track his behaviour, e.g. Runkeeper to track his sportive performances.

Second Scenario: Information Value

A second future scenario was created about a 25-year old student with a passion for whisky, photography, sailing and the designer clothes of Henry Lloyd. He is interested in getting more control on his online data and decides to use the USEMP platform to become a brand ambassador for the products of his choosing. Potential problems are identified such as poor audience management, which results in his father, who recently quit the habit of drinking, receiving tailored advertisement for whisky. A third character was introduced as the technology savvy friend, but he needed further elaboration.

- Main personas of the Information Value scenario
  - Karl Vrijders: Karl is a 25-year-old man, who is a freelance photographer and whiskey enthusiast. He would make use of DataBait to become a brand ambassador for the products of his choice and to keep track of his digital traits. He would want the tool to help him manage awareness of his personal data value and give him more control over which audience he reaches with his activity.
  - Etienne Vrijders: Etienne is a 51 year old, married man and father of Karl. He recently had some heart problems and since then tries to quit drinking. He wants DataBait to help him get more control over who has access to his medical information.
  - Victor Segers: Victor is a 25-year-old man and friend of Karl, he is highly involved with new media technologies. He also creates his own applications for android phones in his spare time.

4.3. Common Visualisation Approaches

While work in the academic field is wide ranging and abundant, so-called **infographics** have emerged in recent years as a popular method for displaying data that might otherwise be considered too complicated or uninteresting. This method of visualisation has long been used for the illustration and interpretation of scientific data (Cressey, 2014), and it has more recently begun to be used in the classroom (Davidson, 2014) or for public outreach (Saavedra & Lozano, 2013).

A main aim of this work is to produce a visual representation of a user's privacy profile that is both interesting and full of information for the user. One "mass market" visualisation system that has shown some success in recent years is the so-called **traffic light system** for nutritional information on food products as illustrated in Figure 4. As a response to the widely-accepted need to improve consumer health and awareness of their nutritional intake

and as a way to help consumers to make more informed choices about their food, the UK food standards agency recommended that the nutritional value of food products should be displayed on the front of packages.

A number of possible ways of displaying nutritional information were investigated. (Grunert & Wills, 2007) conducted a review of the different systems of displaying nutritional information finding that in general there was a widespread interest for nutritional information on food packages and that consumers like the idea of simplified front of pack information. In 2006 the food standards agency in the UK dictated that nutritional labelling should take the form of four colour-coded lights indicating the level of fat, saturated fat, sugar and salt in the product. A red circle, for example indicated that there is high level of that particular nutrient. Amber is a medium level and green in a low level.

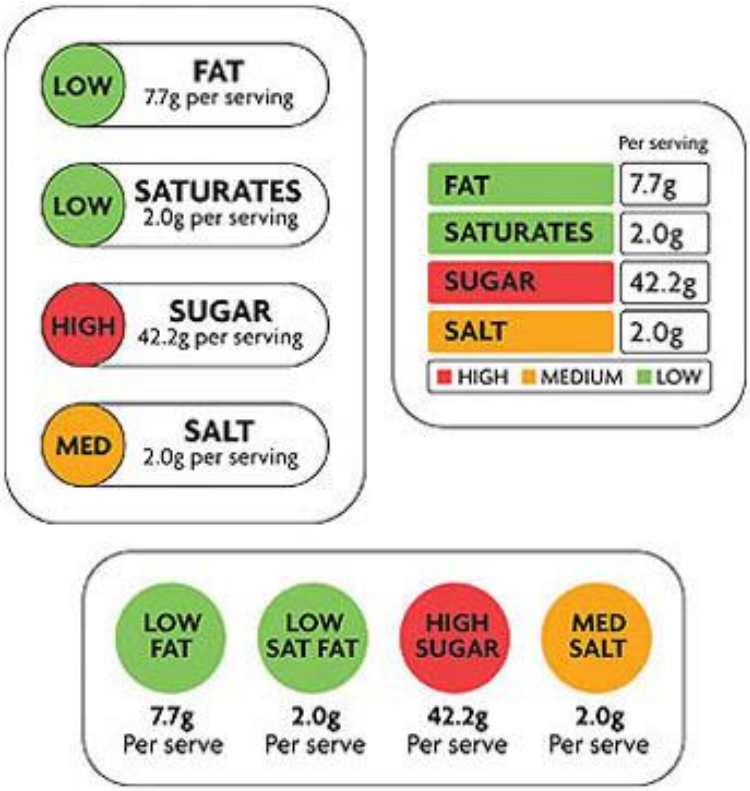

Figure 4: Examples of the nutritional traffic light system.

(Sacks, Rayner, & Swinburn, 2009) investigated the use of the traffic light system finding that they did have an effect on 'energy-intake' overall. The authors conclude that this system of nutritional labelling does have an effect and is likely to offer good 'value for money' as it indirectly reduces the effects of obesity and the subsequent cost to society.

As a first attempt at visualising our privacy dimensions this method was tested. Each privacy dimension was represented as a traffic light with a corresponding colour indicating its level of exposure in red, amber and green as indicated in Figure 5, formed from a mocked up sample of privacy dimension data as shown in Table 1, which was formed based on the persona of Sofia Moore, described above, who's privacy profile may look like that described in Table 1, in the scenario where her sexual profile has been exposed by some OSN activity.

Demographics	Psychological	Sexual	Political	Religious	Health	Location	Consumer

	Traits	Profile	Attitudes	Beliefs	Factors		Profile
0.6	0.4	0.9	0.3	0.3	0.6	0.1	0.4

Table 1: List of mock privacy dimension values used for initial sketching.

The colour of each traffic light, one for each privacy dimension was designed to reflect the level of exposure indicated in Table 1. A score of 0.0-0.4 is represented with green, 0.5-0.7 is represented with yellow and 0.8-1.0 is represented with red. This provides a quick indicator as to the level of exposure but it is not possible to measure the relative differences between the dimensions with the same colour.

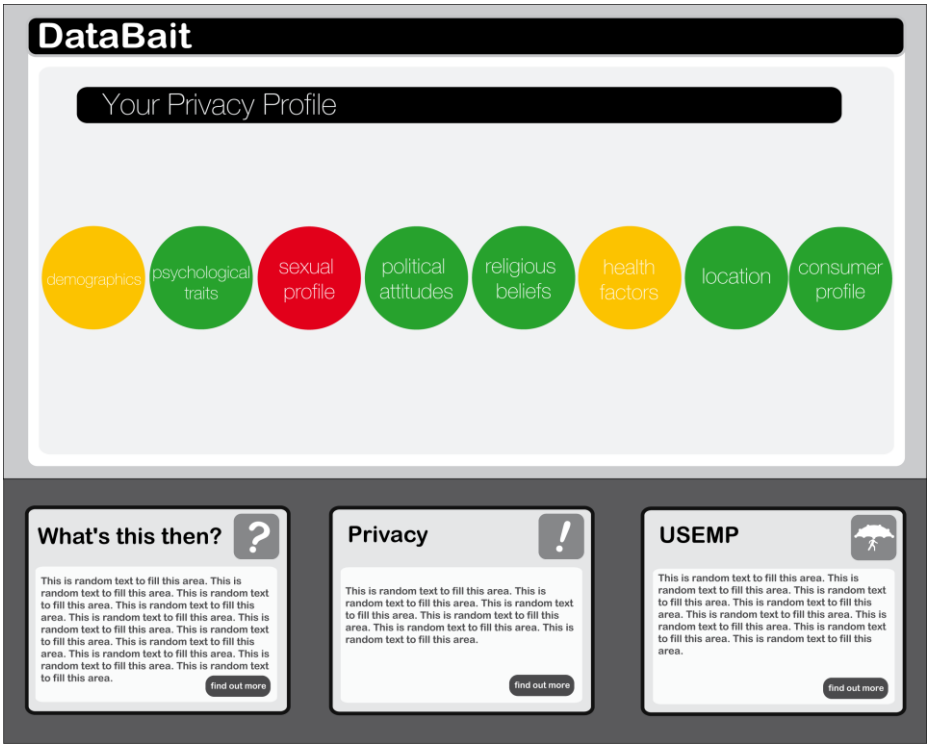

Figure 5 : Our privacy dimensions are represented using the traffic light system.

For this reason, additional experimentation with the size of the traffic lights was also investigated in an effort to potentially enhance the granularity of the information portrayed to the user.

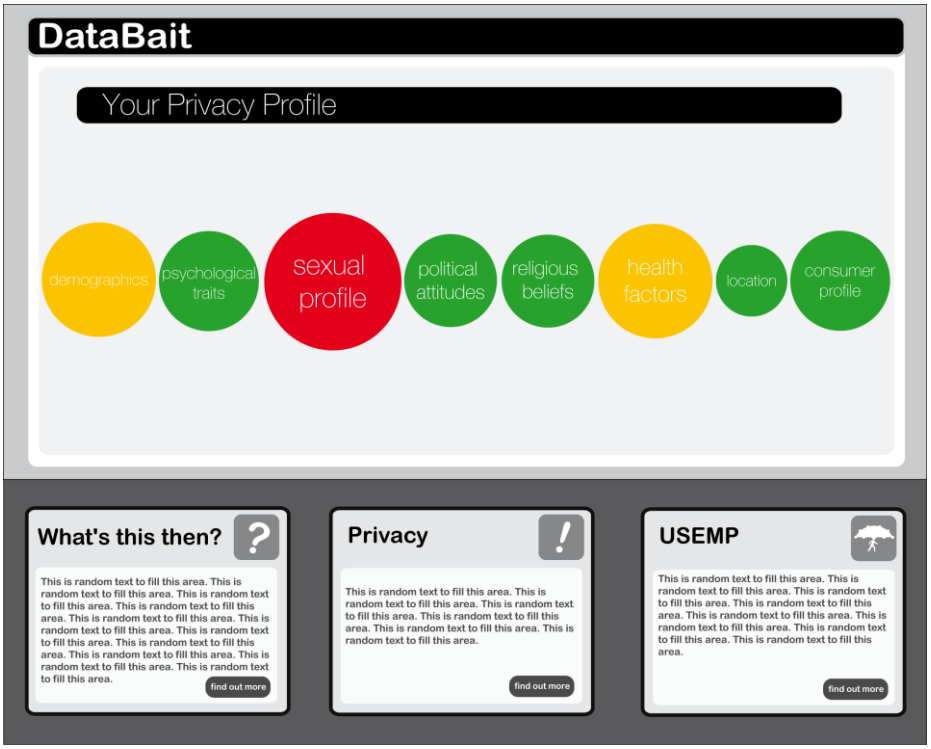

Figure 6: The level of exposure is further highlighted by varying the size of the traffic lights.

Based on this initial investigation it was decided to conduct a brain storming session in order to investigate the range of potential ideas for further visualisation development.

4.4. Brain Storming and Design Session

Brainstorming sessions, introduced by Osborn in 1953 (Osborn, 1953), are one of the most widely used techniques for the enhancement of creativity in a group. The group discusses a specific topic with the goal of gathering as many ideas as possible. To make the most out of the two sides of the mind, the creative and the judicial, Osborn suggests dividing a conference into two phases. During the first, the storming phase, participants share any idea that comes to mind to get the maximum number of ideas. In the second, the norming phase, they categorize and evaluate the ideas produced, with the aim of reaching a conclusion to the question asked. With this in mind and as part of the initial creative investigation of other potential visualisations of our privacy dimensions, a session was held with eight potential users of the DataBait system, all of which were social network users aged between 22 and 33.

The Session

Our brainstorming session started with an introduction and explanation of the USEMP project. The main goals were explained to the participants, including the need to make users more aware of their online privacy and the fact that this could eventually be used as a means of understanding the value of personal information.

At this point, and before any more detailed discussion about the privacy dimensions the participants were asked the question:

“What do you consider to be sensitive information in your social networks?”

They were given some post-it notes and asked to write down what they consider important and what they would like to have more control over. Each participant then presented their ideas and these ideas were grouped together. It was found that they could be grouped in a way that is consistent with the privacy dimensions listed above.

This exercise served as a way of introducing the USEMP privacy dimensions to the participants. An effort was made to find a link between the participants' ideas and the privacy dimensions. By far the more pertinent dimensions were **Location (G)** and **Demographics (A)** but a majority of the other groups were also identified. Only **Health Factors (F)** and **Psychological Traits (B)** did not appear in this initial list.

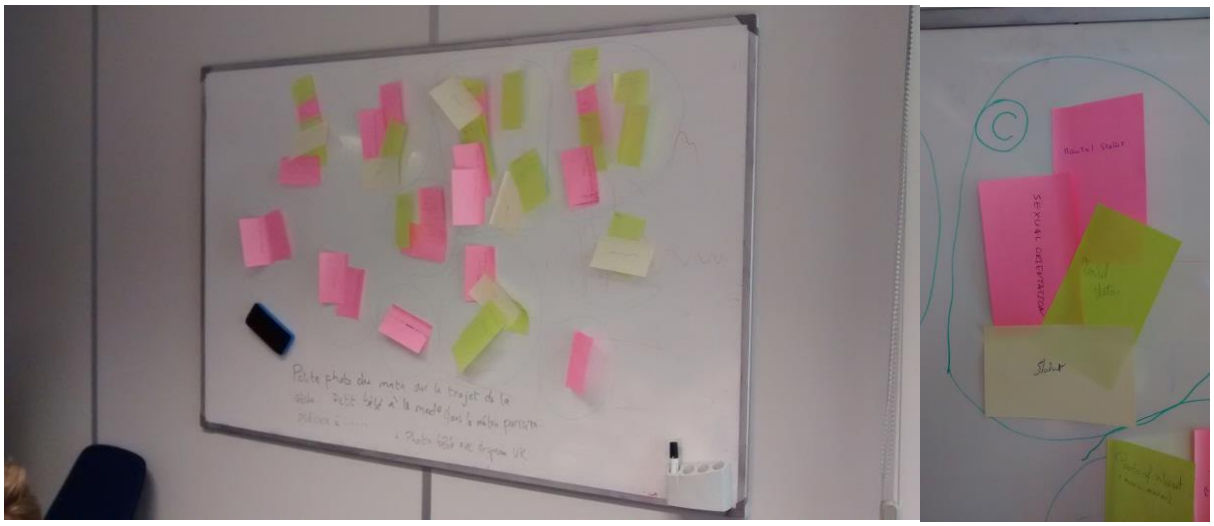

Figure 7: Board with grouped ideas (left). An example of the grouping for category C (right).

From this point, participants were given a little more detail on the functionality of the project including the fact that the principal inputs would be **images**, **text** and **activity**. It was explained to the participants that the main goal of this session was to produce a visualisation of the privacy profile of a social network user.

The task then for the second part of the session involved taking a status update and and asking the participants to imagine how the potential consequences of this update might look if they were visualised. Another example taken from the traffic lights representation was shown (Figure 8) to help the participants understand the task.

Figure 8: An example of how the 'privacy consequences' of a status update might be visualised.

An example of a status update taken from facebook was then chosen and as a group it was decided how this update may be interpreted in terms of our privacy dimensions. A score was assigned for each of our privacy dimensions (shown in Figure 9).

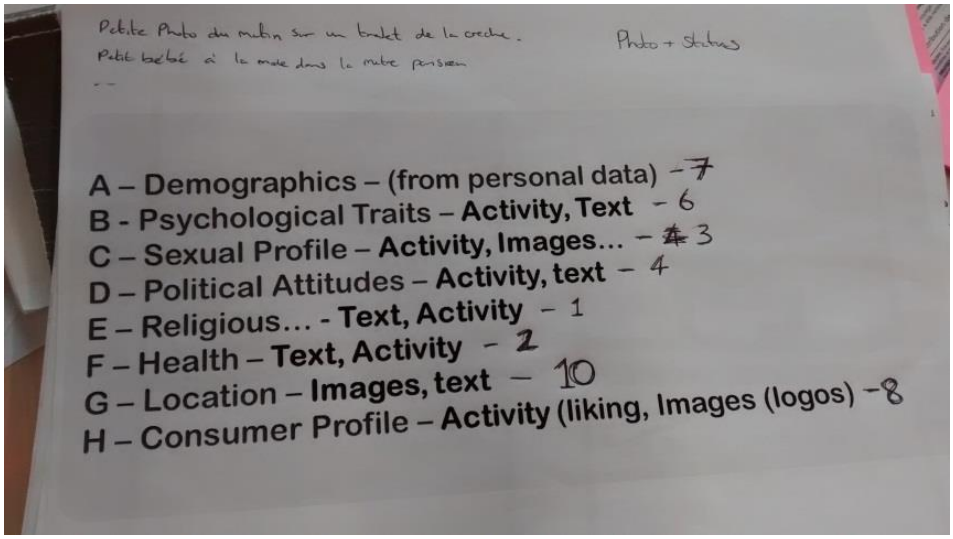

Figure 9: Assigning a score for each of the privacy dimensions for our status update.

The participants were then asked to decide how they might represent this visually. They were given a template for a website as shown above and asked to draw their ideas. Some of these ideas are shown below.

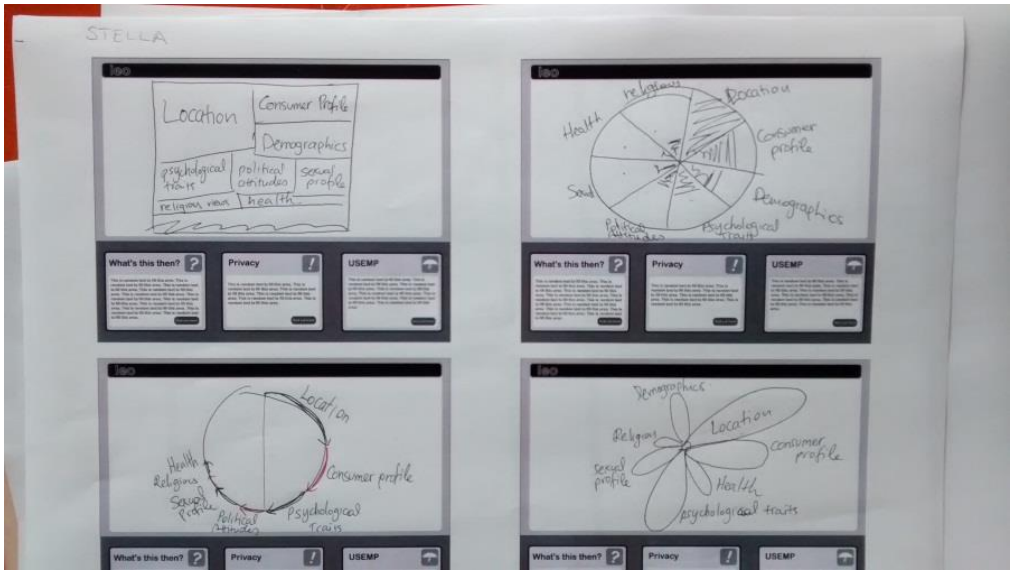

Figure 10: Ideas for another kind of visualisation. Block/tree representation (upper left). Angles representation (lower left). Pie chart style (upper right). Flower visualisation (lower right).

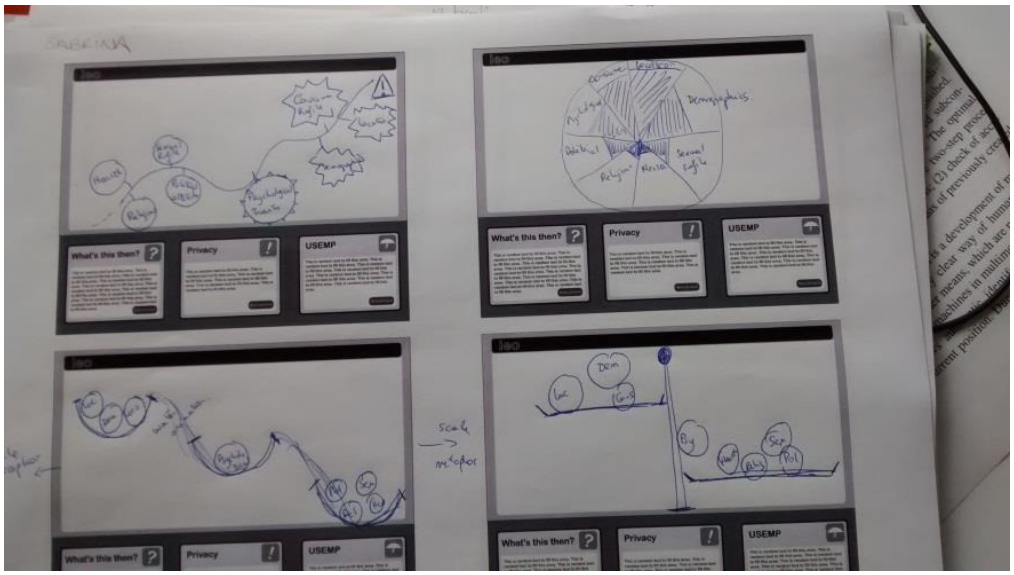

Figure 11: Trail (upper left). Cascading water (lower left). Pie chart (upper right). Weighing scales (lower right).

A number of interesting ideas were produced. One thing that appeared from four of the eight participants was the use of a direct link from the status update to the privacy dimension and its exposure level. A number of the ideas obtained in this session were retained for further development, which is described below.

5. Visualisation Wireframes

Visualisation of the privacy dimensions discussed above is one of the main design challenges of the USEMP project and, following this discussion,, three main visualisations were chosen for further development. These visualisations will be referred to as ‘Bubbles’, ‘Flowers’ and ‘Angles’. The Bubbles method, a further iteration of the traffic lights visualisation shown in Figure 5, was chosen for further development both due to the success of the traffic lights metaphor described in the literature and because it offers the opportunity to confirm its utility in the online social networking domain. The Flowers visualisation was chosen due to its recent success as a visualisation mechanism for the OECD Better Life Index[1], where its use as a visual representation of GDP and economics statistics has received critical acclaim. The Angles representation was chosen both due to its presence in more general data visualisation literature, its resemblance to the classic and well understood pie chart and because it appeared a number of times in our brain storming session, meaning that it is likely to be well understood by users. The details of how these visualisations were further developed and tested are described below.

5.1. Visualisations Development

Each of our sample visualisations was recreated based on a privacy profile that consisted of the ‘privacy scores’ detailed in Table 2. Figure 12 shows the basic ‘overview’ representation of the user’s privacy profile.

Demographics	Psychological Traits	Sexual Profile	Political Attitudes	Religious Beliefs	Health Factors	Location	Consumer Profile
0.5	0.4	0.8	0.2	0.7	0.9	1.0	0.3

Table 2: The ‘privacy-vector’ to be visualised. The exposure of each privacy dimension is rated on a scale from 0 to 1.0. This table itself represents a form of visualisation of the privacy profile data.

[1] www.**oecd**betterlifeindex.org

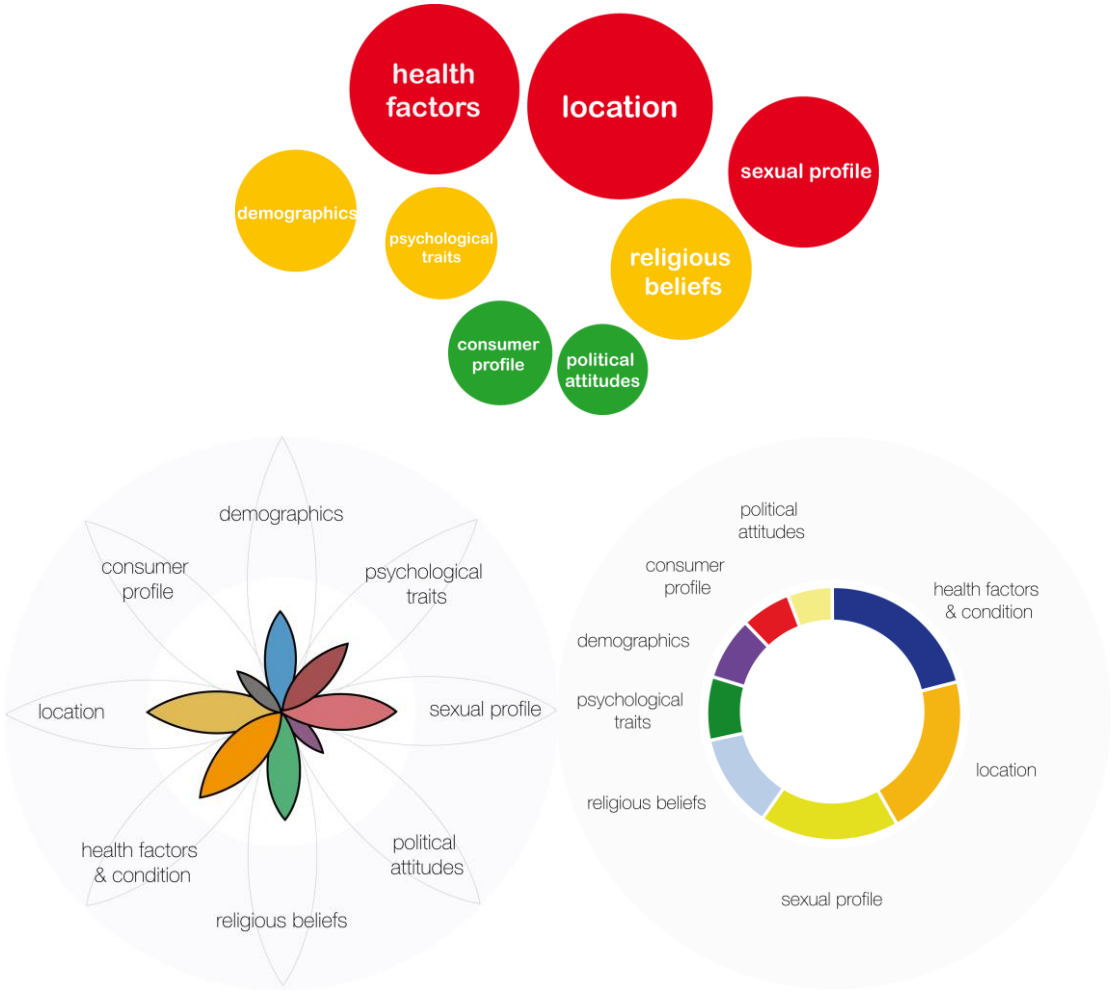

Figure 12: Top: 'bubbles' overview, Bottom-Left: 'Flower' overview, Bottom-Right: 'Angles' overview.

The 'Bubbles' visualisation overview in Figure 5, based on the classic traffic lights visualisation, consists of a series of simple circles with the name of the privacy dimension indicated within. The size and the colour of the bubble are designed to indicate the 'exposure level' of that dimension and the larger bubbles are placed above the smaller ones to give the 'bubble effect'. The flower overview follows the same sequence as that for the bubble visualisation. Each 'petal' of the flower inflates to reflect the relative exposure level of each privacy dimension. The angles overview varies the width of each segment depending on the level of exposure of the privacy dimension. For both the angles and the flowers visualisations the colour was chosen at random.

In order to help develop the potential interactions with these visualisations, a scenario was developed whereby a user with this privacy profile notices that his location privacy dimension is over exposed compared to the others and wants to find further information about why this is the case. Below we illustrate the potential interaction flow for each of the three cases.

Bubbles Interaction

Interaction Expansion 1

In our scenario the user wishes to find out why their location privacy dimension is so over exposed. They achieve this by simply tapping on that bubble as indicated in Figure 13 to reveal a new level of detail.

Figure 13 : A user can expand the available information by simply clicking/tapping on the privacy dimension of interest.

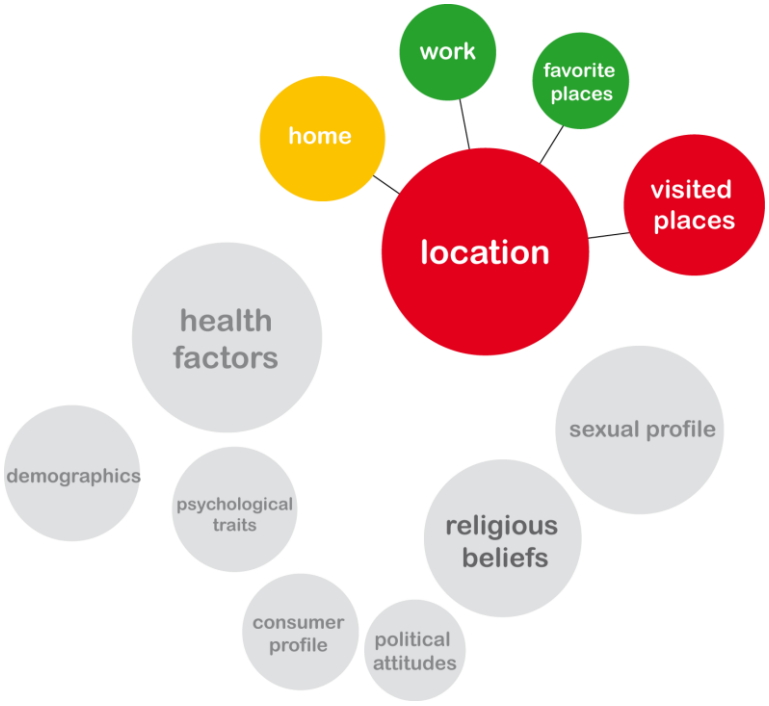

Figure 14 : An expanded view of what is causing the location dimension to be over-exposed. Four location-specific attributes are exposed.

Interaction Expansion 2

The user performs the same action again with the 'visited places' bubble to reveal even more detail.

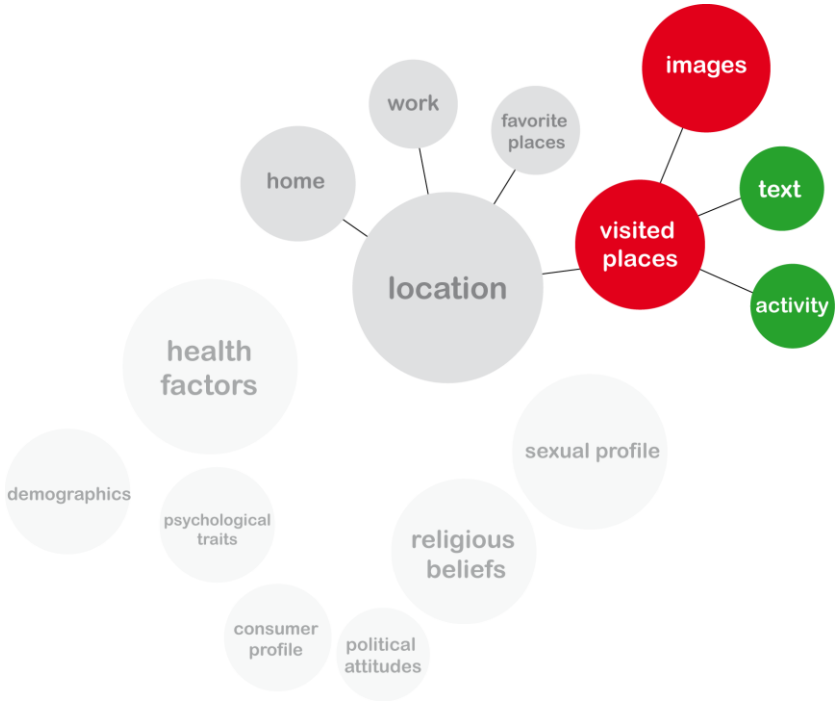

Figure 15 : Further interaction reveals more detail. It is now clear that the user's images are the cause of this over exposure of the location dimension.

Interaction Expansion 3

The images bubble is further expanded to reveal some of the support (in this case photos) that have been used to directly identify the user's location. The user can now choose to remove these photos or share them with less people in a way that will reduce the overall impact on the user's privacy profile.

Figure 16 : Finally the photos that are principally responsible for the over-exposure of the user's location privacy dimension are displayed.

Flowers

The flower visualisation follows the same sequence as that for the bubble visualisation to enable a direct comparison. After each interaction 'click' a new flower is generated.

Overview

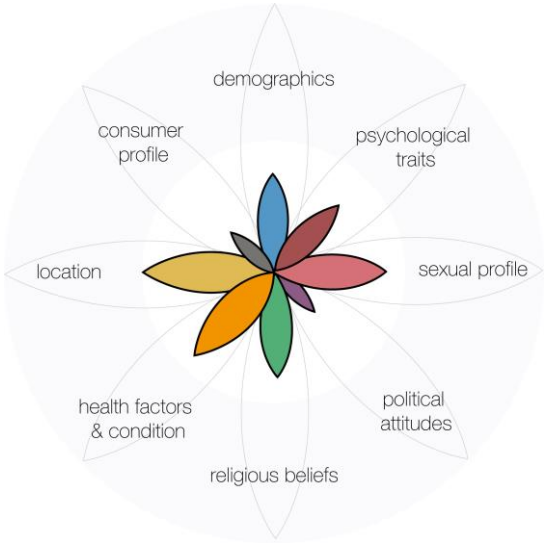

Figure 17 : The general overview of a user's privacy profile using the flower representation.

Interaction Expansion 1

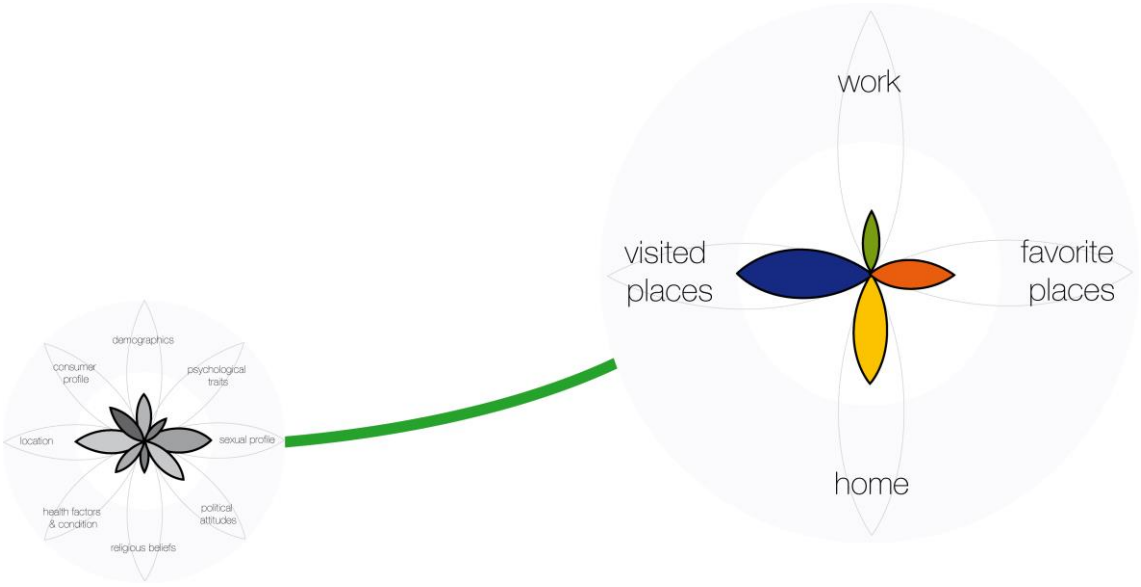

Figure 18 : Interacting with the flower causes another flower to grow from it with more information.

Interaction Expansion 2

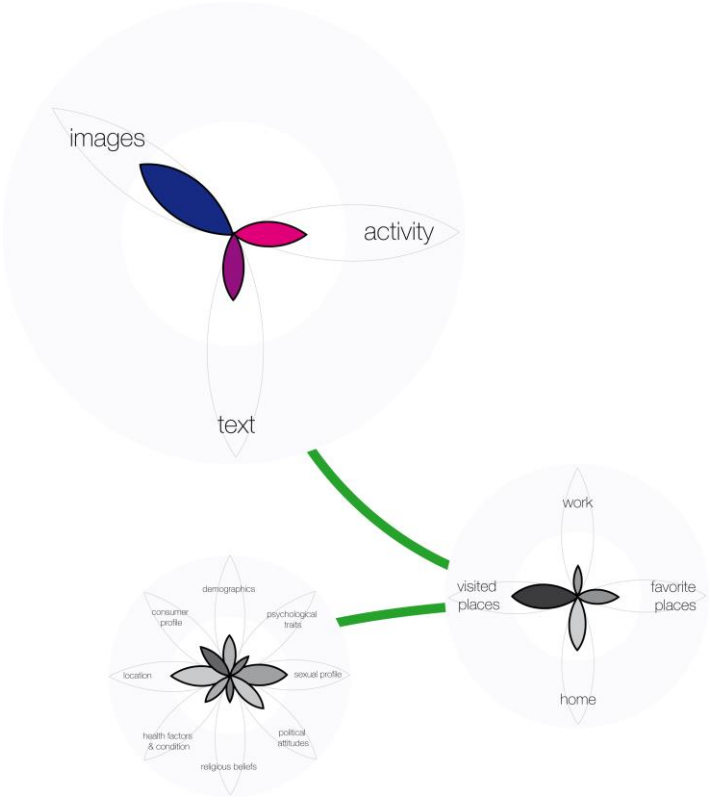

Figure 19 : Clicking/Tapping on the 'visited places' leaf shows that the images are principally responsible.

Interaction Expansion 3

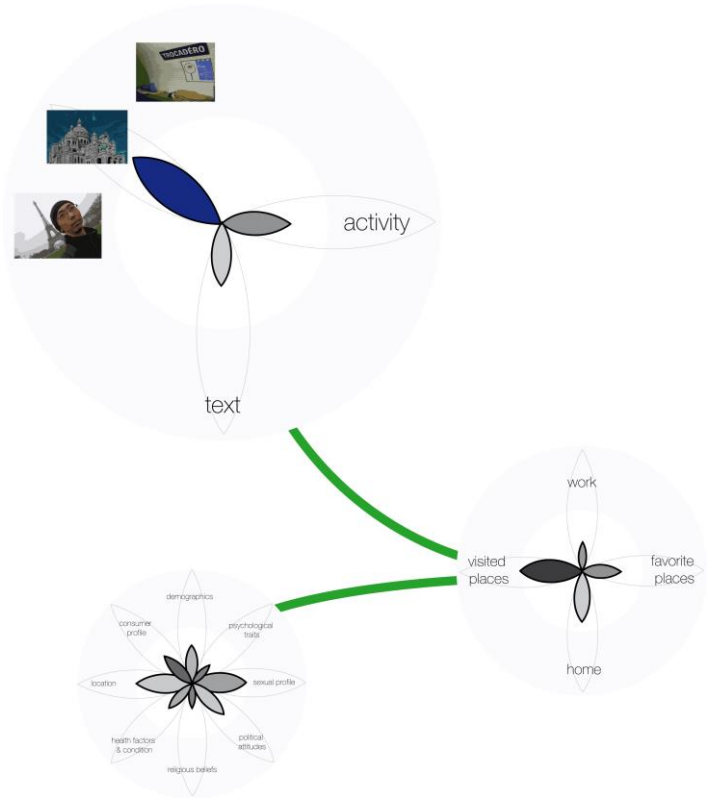

Figure 20 : The responsible images are displayed.

Angles

The angles visualisation represents the most standard way of visualising data within our three chosen visualisations. Interacting with a privacy dimension exposes another layer.

Overview

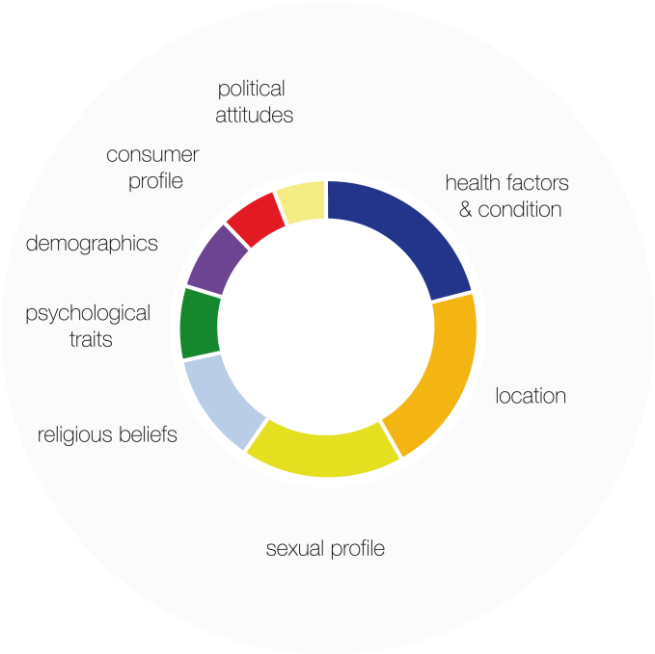

Figure 21 : The general overview of a user's privacy profile using the angles visualisation method.

Interaction Expansion 1

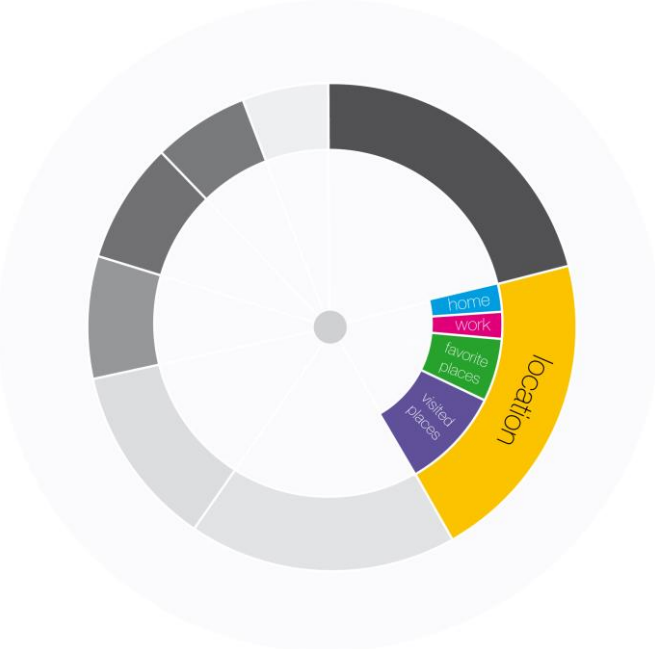

Figure 22 : Interacting with this visualisation again involves a simple click or tap on the section of interest.

Interaction Expansion 2

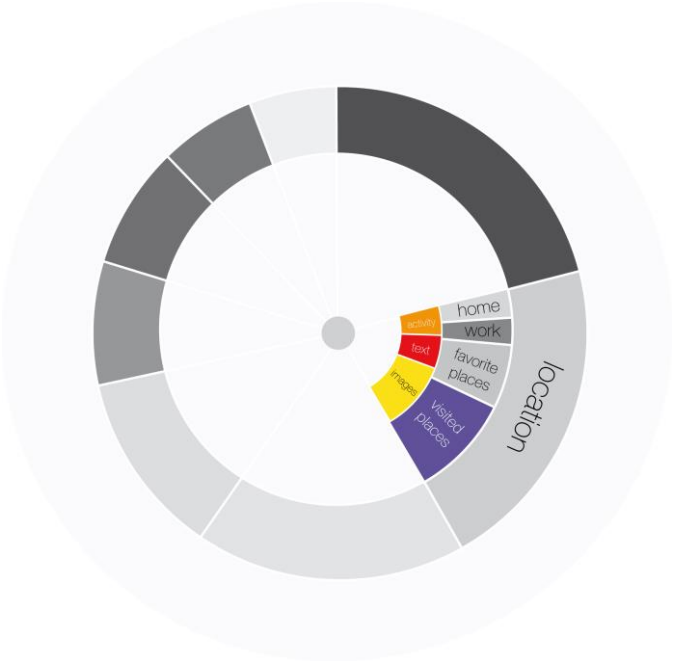

Figure 23 : Further interaction reveals more detail.

Interaction Expansion 3

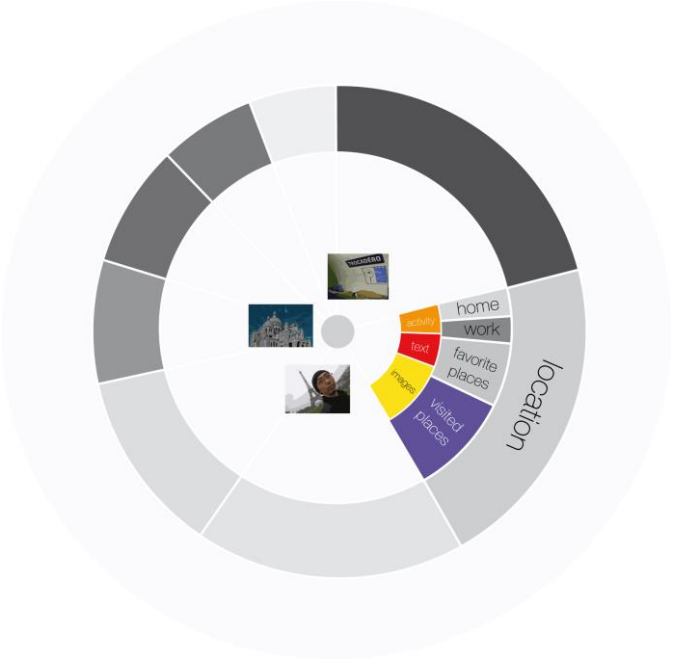

Figure 24 : The responsible photos are eventually exposed.

5.2. Questionnaire

As an initial insight to the effectiveness of the three selected visualisations, a questionnaire was designed, with the aim of both informally gathering users' feelings about privacy (also as an effort to make the respondents think about their own privacy profiles before thinking about the visualisation) and to choose a visualisation to be further developed for the remainder of the project and for the work in WP6.

General Results

The questionnaire consisted of 30 questions in total and was divided into three distinct sections. The first part involved collection of information on the user's profile. The second part was about social network usage and the third part was about the analysis of the three privacy profile visualisations.

The questionnaire took 15 minutes to complete on average and received 44 responses (19 female and 25 male). The respondents were aged from 19 to 76. All of the participants had experience with social networking. 24% with 1 to 5 years' experience, 61% with 5 to 10 years' experience and 15% with over 10 years' experience. 96% of the respondents were users of Facebook. These statistics are illustrated in Figure 25.

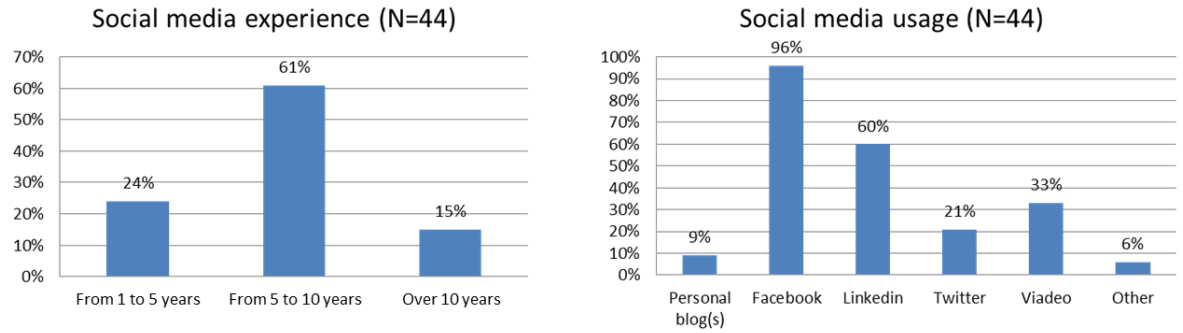

Figure 25 : Summary of the questionnaire respondents' experience with social media.

In terms of the frequency and duration of social network usage, almost half of the participants used OSN's five times or more per day. For those used for professional purposes people tended to use them for less than 10 minutes per day. For personal use, most people used them for 10 to 30 minutes per day. These results are summarized in Figure 26.

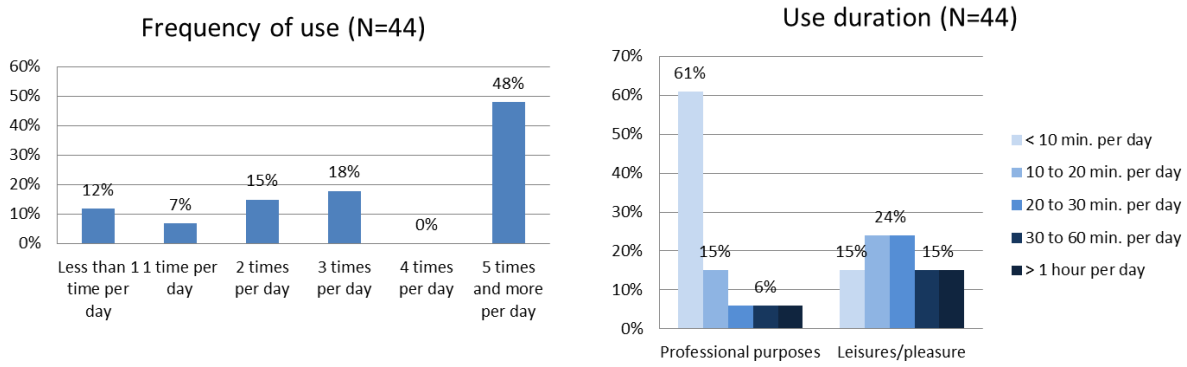

Figure 26 : A summary of the respondents' frequency and duration of use of social media.

Visualisation Analysis

The respondents were asked to rate the visualisations on eight different criteria, listed below with the corresponding statement that they were asked to rate from **1- completely disagree** to **4-completely agree,** a standard scale in usability research.

- ***Impact on behaviour*** *– "This visualisation could cause me to change my behaviour on social networks."*
- ***Control tool*** *– "This visualisation could help me to control the exposure of my private life on social networks."*

- ***Perception tool*** *– "This visualisation improves my perception of my degree of exposure of my private life on social media"*
- ***Utility*** *– "This visualisation is useful"*
- ***Attractiveness*** *– "This visualisation is attractive"*
- ***Intuitiveness*** *– "This mode of visualisation is intuitive"*
- ***Relevance*** *– "The information is short and relevant"*
- ***Readability and Understanding*** *– "The visualisation is readable and easy to understand"*

The results for these eight criteria are summarized in Figure 27. It is clear that the least satisfactory visualisation for the participants was the flower representation for all categories. Between the Angles and Bubbles visualisations users slightly preferred the bubbles for all of the eight categories.

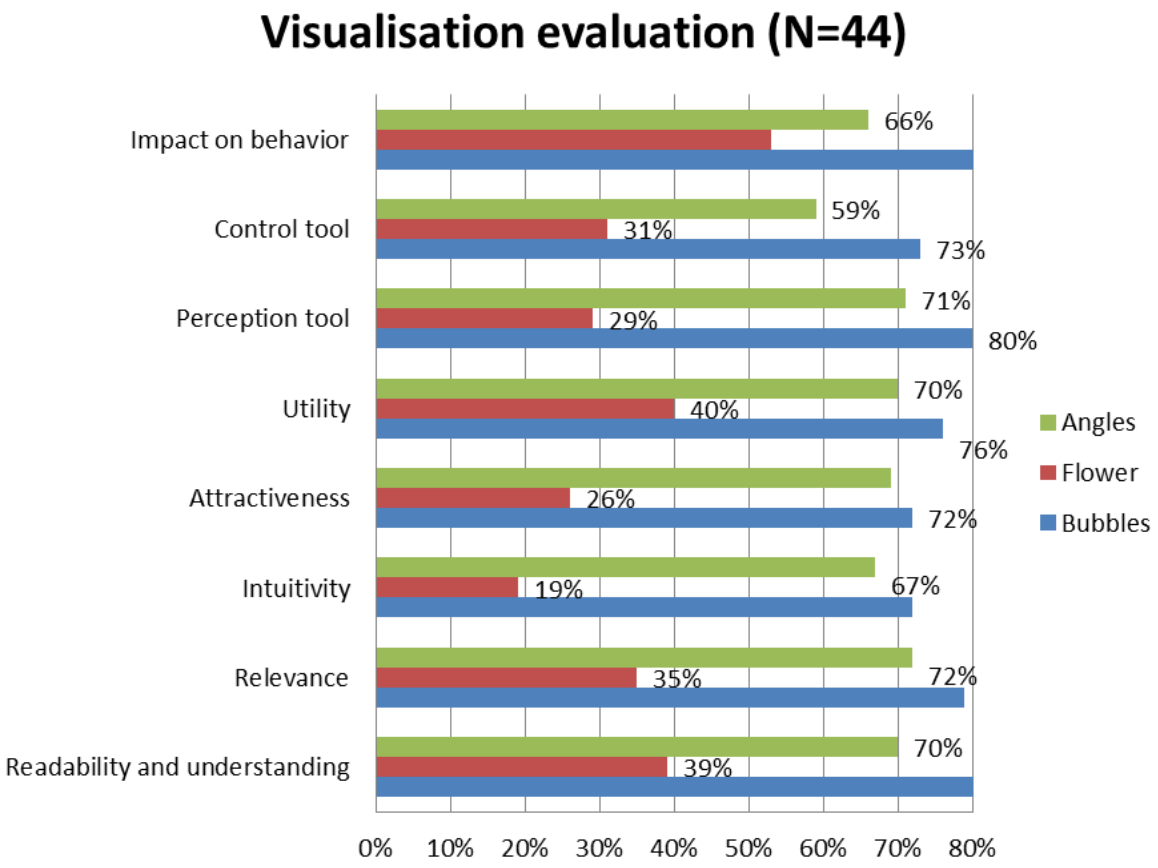

Figure 27 : Results for eight different criteria for the three visualisations. The percentage scores indicate the percentage of participants who positively agreed with the statement (score 3 or 4).

However, when the users were asked to state their overall preference 50% of participants chose the angles visualisation, 20% chose the flower visualisation and 30% chose the bubbles visualisation. This discrepancy is likely due to the users' initial familiarity with the angles visualisation, given its similarity to the traditional pie chart.

In order to further examine the participants' feelings about each visualisation they were asked to state three advantages and three disadvantages for each. For the bubbles visualisation, some advantages included "originality", "clarity/simplicity" and "good comprehension of colours". Some disadvantages were that it took up a lot of space

(especially the expanded versions) and that there was no perceived link between the different elements. For the angles visualisation one advantage noted was that it was “traditional”. Disadvantages included that it was “too mathematical” and that it was “limited in terms of the number of categories that could be included”. For the flower visualisation it was noted that it was “original” but that it was, as with the angles visualisation, “limited in terms of the number of categories”. It was noted that any reduction or increase in the number of categories would change the aesthetics of the visualisation.

6. Conclusions

In the course of this work we have demonstrated the design and development of different kinds of visualisation with the potential to be used as a means for informing a user about the exposure of their 'privacy profile' in online social networks. The overall design process was described and the process of creating three different visualisations was illustrated that led to the selection of three potential visualisations for a DataBait user's privacy profile, the so-called 'bubble' visualisation, a 'flower' visualisation and an 'angle' visualisation.

A questionnaire conducted with 44 potential users of the system found that while there was a preference for the angles visualisation when asked to state their preference directly, the users slightly preferred the bubble visualisation for all 8 individual categories. This discrepancy is likely due to the fact that people tend to have a previous familiarity with mathematical visualisations such as angles, whereas the bubble and flower visualisations were new.

The goal of this early research is to create a visualisation that will help a user to better understand their privacy profile. The bubble visualisation was preferred in the most important categories that will aid the further development of this work in WP6 and help further the goals of the USEMP project, i.e. 'readability and understanding', 'impact on behaviour' and 'control tool'. This combined with the fact that the participants provided more advantages and correspondingly less disadvantages for the bubbles visualisation than they did for the angles visualisation leads us to believe that the bubbles visualisation is the best option to take forward to WP6 for further development.

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8. Annex I: Evaluation Questionnaire

The questionnaire used for this study was presented in French. Below is the original questionnaire with translations where relevant.

-Ce questionnaire a pour objectif de mieux connaître vos besoins d'informations sur le degré d'exposition de votre vie privée sur les réseaux sociaux (Facebook, Twitter, Linkedin, Viadeo, etc.). Il est composé de 30 questions et requiert environ 15 minutes.

Il n'y a pas de bonnes ou de mauvaises réponses. Seul votre avis compte.
Les informations recueillies sont strictement anonymes.

-The goal of this questionnaire is to better understand your requirements for information concerning the degree of exposure of your private life on social (Facebook, Twitter, LinkedIn, Viadeo, etc.). It consists of 30 questions and will require roughly 15 minutes of your time.

There are no right or wrong answers. Only your opinion counts.
The collected information is strictly anonymous.

Votre profil – Your Profile

Veuillez s'il vous plaît cocher la ou les case(s) correspondante(s) à votre choix.
Please check the boxes that apply to you.

1. Vous êtes : ☐ un homme-male ☐ une femme-female

2. Dans quelle tranche d'âge vous situez-vous ? – *Which ages range do you beling to ?*

☐ Moins de 15 ans ☐ De 15 à 24 ans ☐ De 25 à 34 ans ☐ De 35 à 44 ans ☐ De 45 à 54 ans ☐ De 55 à 64 ans ☐ 65 ans et plus

3. Quel est votre niveau d'études le plus élevé ? – *What is your level of education ?*

- ☐ Certificat d'études primaires, aucun diplôme
- ☐ Brevet des collèges, BEPC
- ☐ CAP, BEP ou diplôme de même niveau
- ☐ Baccalauréat général, technologique, professionnel ou équivalent
- ☐ Diplôme du 1er cycle universitaire, BTS, DUT, ou équivalent, niveau BAC+2
- ☐ Diplôme de 2ème cycle universitaire
- ☐ Diplôme de 3ème cycle universitaire, doctorat, grande école, ingénieur
- ☐ Autres. Précisez : _____

4. Vous êtes : - *your marital status*

☐ Célibataire ☐ En couple ☐ Marié(e) ☐ Divorcé(e) ☐ Veuf (ve)

5. Votre région : - *Your region*

☐ Ile de France ☐ Province ☐ Etranger

6. Votre environnement : - *your environment*

☐ Rural ☐ 2000 à 19999 hab. ☐ 20000 à 100000 hab. ☐ 100000 hab. et plus ☐ Agglomération parisienne

7. Quel est votre code postal ? _____ - *your post code*

8. Quelle est votre catégorie socioprofessionnelle (dernière ou actuelle) ? – *what is you social profile ?*

☐ Agriculteurs exploitants
☐ Artisans, commerçants et chefs d'entreprise
☐ Cadres et professions intellectuelles supérieures
☐ Professions intermédiaires
☐ Employés
☐ Ouvriers
☐ Etudiants/Lycéens/Collégiens/Elèves
☐ Sans activité professionnelle
☐ Autre : _____

Votre usage des réseaux sociaux

9. Depuis combien de temps utilisez-vous les réseaux sociaux ? – *for how long have you used social networks ?*
☐ Moins d'1mois ☐ De 1 à 6 mois ☐ De 6 à 12 mois ☐ De 1 à 5 ans ☐ De 5 à 10 ans ☐ Plus de 10 ans

Année de la première inscription : _____

10. Vous vous connectez aux réseaux sociaux depuis : - *you connect to social networks with (smartphone, computer, both)*
☐ un smartphone (BlackBerry, IPhone, etc.) ☐ un ordinateur ☐ les deux

11. Vous vous connectez aux réseaux sociaux en moyenne : - *you connect to social networks on average (1 time per day, 2 times per day, 3 times per day…)*
☐ Moins d'1 fois par jour ☐ 1 fois par jour ☐ 2 fois par jour ☐ 3 fois par jour ☐ 4 fois par jour ☐ 5 fois et plus par jour

12. D'une manière générale, vous vous connectez : - *In general, where do you connect to social networks ? (at home, in work, both)*
☐ De votre domicile ☐ De votre lieu de travail ☐ les deux ☐ Autres. Précisez : _____

13. D'une manière générale, vous diriez que votre utilisation des réseaux sociaux est : -*In general you would say your social network usage is : (strictly professional, principally professional, professional and fun, only for fun)*
☐ Strictement professionnelle ☐ Principalement professionnelle ☐ Professionnelle et ludique
☐ Principalement ludique ☐ Strictement ludique

14. Parmi les réseaux sociaux suivants, quels sont ceux que vous utilisez : - *From the following social networks, which do you use ?*
☐ Blog(s) personnel(s)
☐ Facebook
☐ Linkedin
☐ Twitter
☐ Viadeo
☐ Autres. Précisez : _____

15. En moyenne, vous vous connectez aux réseaux sociaux **<u>à des fins professionnelles</u>**: - *On average you connect to social networks for professional reasons for how long ?*
☐ Moins de 10 minutes par jour ☐ De 10 à 20 minutes par jour ☐ De 20 à 30 minutes par jour ☐ De 30 à 60 minutes par jour ☐ Plus d'1 heure par jour

16. En moyenne, vous vous connectez aux réseaux sociaux **<u>pour vous divertir</u>**:

☐ Moins de 10 minutes par jour ☐ De 10 à 20 minutes par jour ☐ De 20 à 30 minutes par jour ☐ De 30 à 60 minutes par jour ☐ Plus d'1 heure par jour

17. Parmi les fonctionnalités suivantes, quelles sont celles que vous utilisez sur les réseaux? – *Amongst the following functionalities, which do you use on the social networks ?*
☐ Ajout de contacts
☐ Ajout/Création de groupes
☐ Blog(s)
☐ Chat
☐ Messagerie publique (Posts)
☐ Messagerie privée (Mails)
☐ Jeux en ligne
☐ Lecture de posts/articles/etc.
☐ Partage de photos/vidéos
☐ Radio
☐ Shopping
☐ Visionnage de vidéos
☐ Autres. Précisez : _____

18. Parmi les informations suivantes, quelles sont celles que vous partagez sur les réseaux sociaux à **caractère professionnel**? – *Amongst the following information, which do you share on social networks for professional reasons ?*
☐ Nom
☐ Prénom
☐ Photo de profil
☐ Age
☐ Date/Année de naissance
☐ Lieu de naissance
☐ Nationalité
☐ Pays d'origine
☐ Langues parlées
☐ Niveau d'études
☐ Adresse mail
☐ Statut professionnel (salarié, retraité, étudiant, etc.)
☐ Salaire
☐ Informations familiales (statut marital, enfants, etc.)
☐ Croyances religieuses
☐ Technologies utilisées (Smartphone, tablette, laptop, etc.)
☐ Traits de caractère (extraverti, timide, anxieux, etc.)
☐ Sexe
☐ Profil sexuel (hétérosexuel, homosexuel, etc.)
☐ Opinions politiques
☐ Parti politique
☐ Etat/historique de santé
☐ Consommation de produits stupéfiants (cannabis, cocaïne, LSD, etc.)
☐ Consommation d'alcool/cigarettes
☐ Lieu de résidence
☐ Lieu de travail
☐ Lieu de vacances
☐ Lieux visités
☐ Hobbies/centres d'intérêts
☐ Marques préférées
☐ Autres. Précisez : _____

19. Parmi les informations suivantes, quelles sont celles que vous partagez sur les réseaux sociaux à **caractère NON-professionnel**? – *Amongst the following information, which do you share for non professional reasons ?*

☐ Nom
☐ Prénom
☐ Photo de profil
☐ Age
☐ Date/Année de naissance
☐ Lieu de naissance
☐ Nationalité
☐ Pays d'origine
☐ Langues parlées
☐ Niveau d'études
☐ Adresse mail
☐ Statut professionnel (salarié, retraité, étudiant, etc.)
☐ Salaire
☐ Informations familiales (statut marital, enfants, etc.)
☐ Croyances religieuses
☐ Technologies utilisées (Smartphone, tablette, laptop, etc.)
☐ Traits de caractère (extraverti, timide, anxieux, etc.)
☐ Sexe
☐ Profil sexuel (hétérosexuel, homosexuel, etc.)
☐ Opinions politiques
☐ Parti politique
☐ Etat/historique de santé
☐ Consommation de produits stupéfiants (cannabis, cocaïne, LSD, etc.)
☐ Consommation d'alcool/cigarettes
☐ Lieu de résidence
☐ Lieu de travail
☐ Lieu de vacances
☐ Lieux visités
☐ Hobbies/centres d'intérêts
☐ Marques préférées
☐ Autres. Précisez : _____

20. Par rapport à votre première utilisation, vous diriez que la fréquence de votre activité sur les réseaux sociaux est aujourd'hui: - *With respect to when you first started using social networks your use now is ? (much less, a little less, the same…)*
☐ Beaucoup plus faible ☐ Un peu plus faible ☐ Identique ☐ Un peu plus importante ☐ Beaucoup plus importante

Si la fréquence de votre activité est plus faible, expliquez rapidement pourquoi: - If your use is less, explain briefly why?

Vos informations sur les réseaux sociaux
Your information on social networks

21. Si vous partagez des renseignements personnels sur les réseaux sociaux, quel est le pourcentage de fois où vous fournissez de fausses informations ? _____% - *If you share personal information on social networks, what is the percentage of that information is false?*

22. Seriez-vous prêt(e) à fournir volontairement des renseignements personnels aux réseaux sociaux afin que les publicités en ligne ciblent vos goûts et vos intérêts? *Would you be ready to voluntarily provide information to help more provide more focussed advertising?*

☐ Pas du tout d'accord ☐ Plutôt pas d'accord ☐ Plutôt d'accord ☐ Tout à fait d'accord

23. Seriez-vous prêt(e) à fournir des renseignements personnels (informations, photos, etc.) à des fins de publicité en ligne si les réseaux sociaux vous offraient une compensation

financière pour ces informations? – *Would you be ready to provide personal information (information, photos etc.) for publicity reasons if the social network provided compensation ?*

☐ Pas du tout d'accord ☐ Plutôt pas d'accord ☐ Plutôt d'accord ☐ Tout à fait d'accord

24. D'une manière générale, diriez-vous qu'un outil de visualisation du degré d'exposition de votre privée sur les réseaux sociaux est : - *In general, would you say that a visualisation tool that shows you the degree of exposure of your private life on social networks is : (completely useless, fairly useless, useful, very useful)*

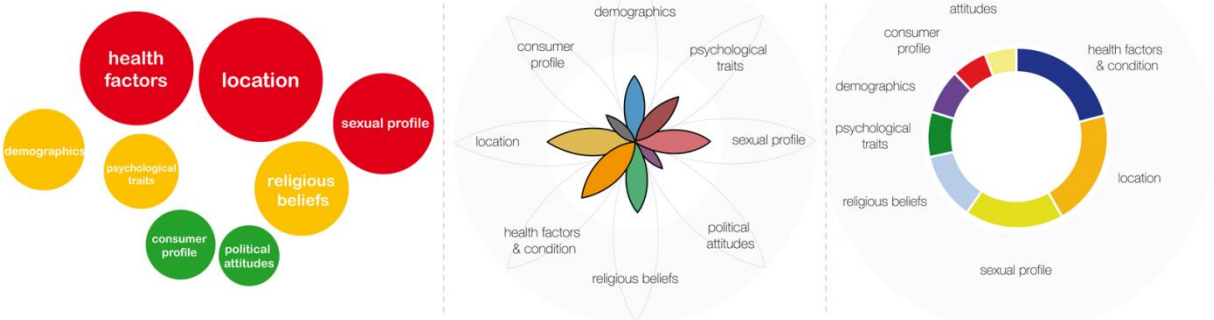
☐ Pas du tout utile ☐ Plutôt inutile ☐ Plutôt utile ☐ Très utile

25. Si un outil permettant d'évaluer le degré d'exposition de votre vie privée sur les réseaux sociaux existait, seriez-vous prêt à l'utiliser ? – *If a tool that enabled the evaluation of the exposure of your private life on social networks existed, would you be ready to use it ?*
☐ Pas du tout d'accord ☐ Plutôt pas d'accord ☐ Plutôt d'accord ☐ Tout à fait d'accord

Evaluation d'un outil de visualisation du degré d'exposition de votre vie privée
Evaluation of a tool that visualises the degree of exposure of your private life

Les questions suivantes ont pour objectif d'évaluer votre niveau de satisfaction concernant trois différents modes de visualisation du degré d'exposition de vos informations personnelles sur les réseaux sociaux. Il n'y a pas de bonnes ou de mauvaises réponses. Seul votre avis compte.
-The following questions are designed to evaluate your level of satisfaction concerning three different visulisation of the degree of exposure of your private information on social networks. There are no right or wrong answers. Only your opinion counts.

Vue générale



a) Bulles b) Fleur c) Sections

26. Parmi les 3 modes de visualisation précédents (i.e. bulles, fleur, sections), quel est celui que vous préférez ? – *From the 3 visualisations above (bubble, flower, sections), which do you prefer ?*
☐ a) Bulles ☐ b) Fleur ☐ c) Sections

27. Pour chaque mode de visualisation, citez au moins **trois avantages**: - *For each visualisation, provide at least three advantages :*

a) « Bulles » :

b) « Fleur » :

c) « Sections » :

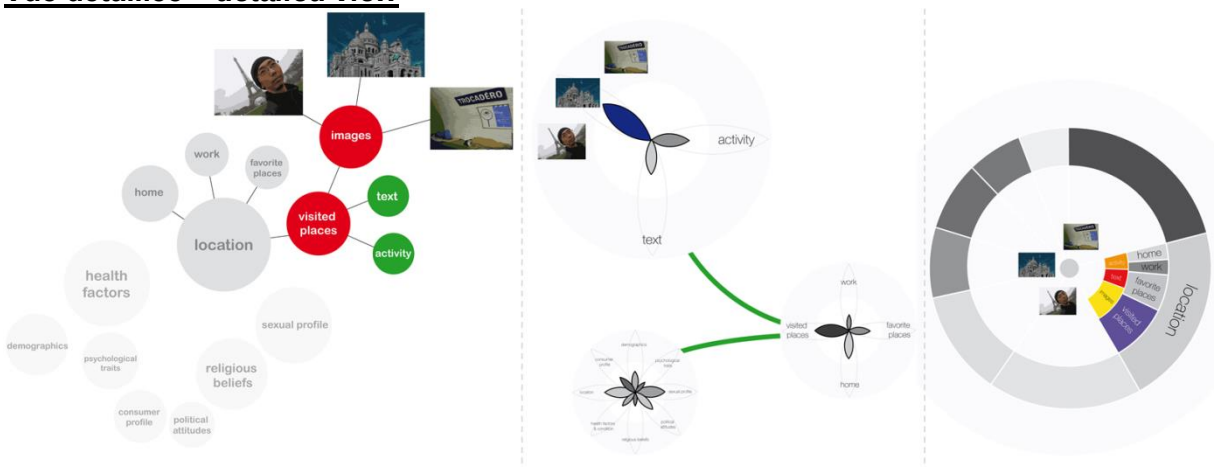
28. Pour chaque mode de visualisation, citez au moins **trois inconvénients**: - *For each visualisation, provide at least three disadvantages*

a) « Bulles » :

b) « Fleur » :

c) « Sections » :

Vue détaillée – *detailed view*



a) Bulles b) Fleur c) Sections

29. Evaluez votre niveau de satisfaction concernant les items suivants : - *Evaluate your level of satisfaction concerning the following items*

- L'information est lisible et facilement compréhensible. – *The information is readable and easy to understand*

	Pas du tout satisfait(e)	Plutôt pas satisfait(e)	Plutôt satisfait(e)	Tout à fait satisfait(e)
a) Bulles	☐	☐	☐	☐
b) Fleur	☐	☐	☐	☐
c) Sections	☐	☐	☐	☐

- L'information est courte et pertinente. – *The information is short and pertinent*

	Pas du tout satisfait(e)	Plutôt pas satisfait(e)	Plutôt satisfait(e)	Tout à fait satisfait(e)

a) Bulles	☐	☐	☐	☐
b) Fleur	☐	☐	☐	☐
c) Sections	☐	☐	☐	☐

- Ce mode de visualisation est intuitif. – This mode of visualisation is intuitive

	Pas du tout satisfait(e)	Plutôt pas satisfait(e)	Plutôt satisfait(e)	Tout à fait satisfait(e)
a) Bulles	☐	☐	☐	☐
b) Fleur	☐	☐	☐	☐
c) Sections	☐	☐	☐	☐

- Ce mode de visualisation est attractif. – *This mode of visualisation is attractive*

	Pas du tout satisfait(e)	Plutôt pas satisfait(e)	Plutôt satisfait(e)	Tout à fait satisfait(e)
d) Bulles	☐	☐	☐	☐
e) Fleur	☐	☐	☐	☐
f) Sections	☐	☐	☐	☐

- Ce mode de visualisation est utile. – *This mode of visualisation is useful*

	Pas du tout satisfait(e)	Plutôt pas satisfait(e)	Plutôt satisfait(e)	Tout à fait satisfait(e)
a) Bulles	☐	☐	☐	☐
b) Fleur	☐	☐	☐	☐
c) Sections	☐	☐	☐	☐

- Ce mode de visualisation améliorerait ma perception du degré d'exposition de ma vie privée sur les réseaux sociaux. – *This mode of visualisation improves my perception of the degree of exposure of my private life on social networks*

	Pas du tout satisfait(e)	Plutôt pas satisfait(e)	Plutôt satisfait(e)	Tout à fait satisfait(e)
a) Bulles	☐	☐	☐	☐
b) Fleur	☐	☐	☐	☐
c) Sections	☐	☐	☐	☐

- Ce mode de visualisation pourrait m'aider à contrôler l'exposition de ma vie privée sur les réseaux sociaux. – *This mode of visualisation could help me to control the exposure of my private life on social networks*

	Pas du tout satisfait(e)	Plutôt pas satisfait(e)	Plutôt satisfait(e)	Tout à fait satisfait(e)
a) Bulles	☐	☐	☐	☐
b) Fleur	☐	☐	☐	☐
c) Sections	☐	☐	☐	☐

- Ce mode de visualisation pourrait m'amener à modifier mon comportement sur les réseaux sociaux. – *This mode of visualisation could encourage me to change my behaviour on social networks.*

	Pas du tout satisfait(e)	Plutôt pas satisfait(e)	Plutôt satisfait(e)	Tout à fait satisfait(e)
a) Bulles	☐	☐	☐	☐

b) Fleur	☐	☐	☐	☐
c) Sections	☐	☐	☐	☐

30. Avez-vous des commentaires ou suggestions ? – *Do you have any comments or suggestions ?*