D6.6

Visualisation and Interaction Recommendations – v2

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Steven Strachan (CEA), Sabrina Panëels (CEA), Andreas Drakos (VELTI)

The work presented here represents the culmination of a process of design and evaluation which commenced in T4.3 with an investigation of the purely visual aspects of the DataBait disclosure framework visualisations. This was then progressed to T6.3 where more emphasis was placed on the design of interaction with the disclosure scoring framework and its visualisation. The second phase of D6.3 presented here in D6.6 describes the further iterative development of the chosen 'bubble' visualisation and how this was altered based on feedback from the evaluation process and other influences elsewhere in the project. Using knowledge from this process and experience gained from the evaluation process, a set of guidelines were produced both for the design of such visualisations in the context of disclosure scoring on online social networks and to aid the further development of the technical components of the DataBait system.

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Authors	Steven Strachan (CEA) Sabrina Panëels (CEA) Andreas Drakos (VELTI)
Reviewers	Tom Seymoens (IMINDS) Georgios Petkos (CERTH)
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1.0	Initial Release
1.1	Suggested Changes from CERTH
1.2	Added user study results - CEA
1.3	Changes made for section 6.4 - VELTI
1.4	Improvements based on reviewers' recommendations - CEA

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1.Introduction

The USEMP disclosure scoring framework (see D6.1 and D6.4) aims to quantify different aspects of the disclosure of users' information. It effectively organizes the different attributes of users in a set of "disclosure dimensions" and utilizes a number of scores that are related to e.g. the perceived sensitivity of different dimensions or attributes, the visibility of the information to other users, etc. The scoring framework plays a central role in raising the awareness of users' OSN presence. The development of an adequate front-end visualization for the USEMP disclosure scoring framework is an important development as it will aid the most effective communication of the results produced by the DataBait system. For this reason, great care and attention must be given to the development of this visualization and to its evaluation.

In D4.3 we described the process of choosing the best visualisation that was designed to help users of the DataBait system better understand the disclosure scoring framework and how this relates to their own privacy concerns. This was a purely visual process. In D6.3 we described the further development of this visualization with more emphasis placed on the design of interaction with the visualisation as well as the visual components. This 'bubble visualisation', chosen from a number of possibilities, was also designed to encourage users to explore and take control of their online privacy profiles. D6.6 represents the next stages of this interaction design, development and evaluation process with the eventual goal of providing a number of different interaction guidelines and recommendations that could help other practitioners in this field. This process was iterative, meaning that significant effort was given to designing, evaluating and redesigning the developed visualizations and corresponding prototypes.

In the rest of this report we first recap the planned evaluation process from D6.3 and any slight changes to this initial plan. We then describe the development of high-fidelity prototypes to be used in the evaluation process, including an expert evaluation and a more general study with potential users of the system. The results from these evaluations then enable the refinement and improvement of the bubble visualization, which is then re-evaluated in subsequent iterations. We finish by describing some of the lessons learned from this process, as well as the set of guidelines/recommendation which were generated for the visualisation of the disclosure scoring framework and how these might relate to the other sections of the DataBait application.

2.USEMP Web Application

To re-cap, the USEMP web application takes the form indicated in Figure 1 and is described in detail in D7.2. An initial version of this web application was developed and has been tested in a pre-pilot detailed in D8.2. The version of the web application used for the pre-pilot is slightly different to that which will be used for final deployment. This was due to the fact that a number of required components were still under development and could not be included in the web application at this stage. The details of how this web application differs from that described in D7.2 and how this affects the work described here are given below.

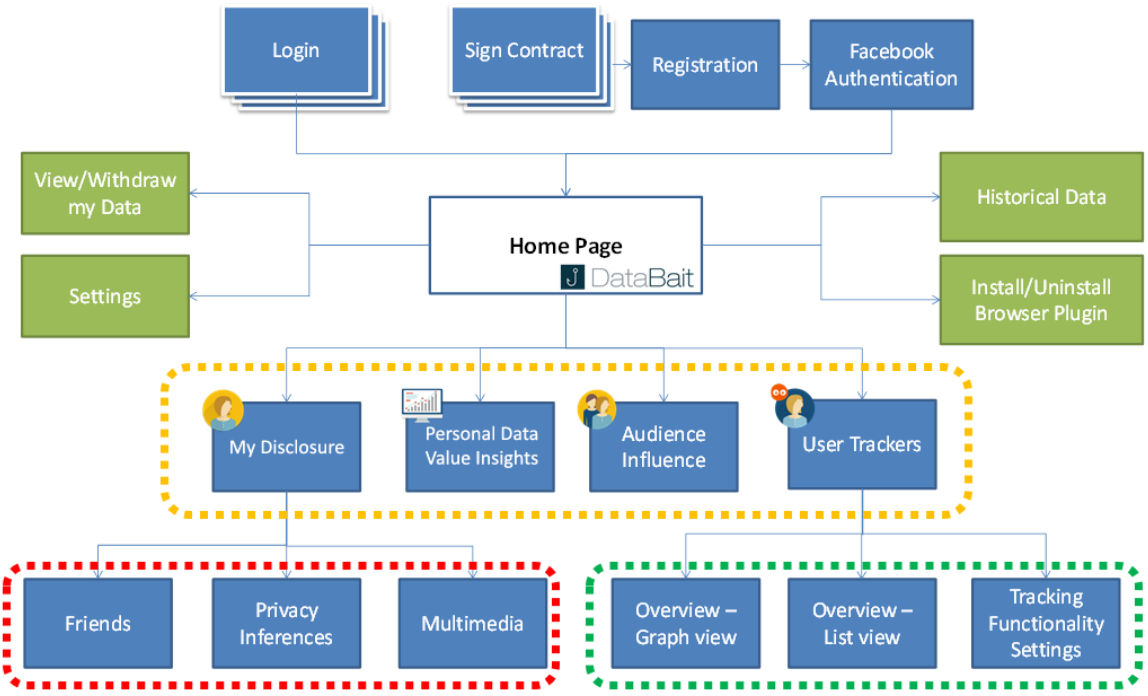


Figure 1: DataBait High-Level UX Flow. From D7.2

The version of the web application that is shown in *Figure 1* is based around a central home page, which has four different sets of functionality as circled in orange. There are two main sections that concern the work conducted in D6.3 and D6.6. The first is 'My Disclosure', circled in red, and contains three subsections, each of which will require a separate visualisation development. The second set of functionalities is 'User Trackers', circled in green, which provides different views of how a user is being tracked online. Both sections are described in more detail in D6.3.

The 'My Disclosure' section is the focus of the visualisation development and evaluation described here. The three subsections of this application are the 'privacy inferences', 'friends' and 'multimedia'. The privacy profile is the main focus of this work since it is this which will provide a direct visualisation of the privacy scoring framework. The other two sections, 'friends' and 'multimedia' aim to provide information to the users on how their friends affect their privacy profiles and how their multimedia (images) affect their privacy profile respectively. It should be noted that due to the fact that relevant data are difficult to obtain in the case of Facebook, the friends section is rather unlikely to be actually integrated as part of the DataBait application. Nevertheless, as the inclusion of additional OSNs is being considered, the friends section is likely to be included if it is possible for that particular OSN. Development of this section could also aid the subsequent user experience development for other sections of the DataBait application, including the Audience Influence section and the user trackers section.

As part of the final web application there will also be a disclosure settings functionality, which is designed to provide the user with some control over their privacy profile. This is a feature that has also been asked for by the users that took part in the studies that will be presented later in this document. Details on the disclosure settings framework can be found in D6.2 and D6.4.

2.1. Pre-pilot web application

For the pre-pilot work conducted in WP8, a test website was produced with a set-up that deviated slightly from that described above, in order to better reflect the maturity of the technologies available at that point in the project's development. The implemented web-app is illustrated in Figure 2 and Figure 3, which show the two sections of the 'My Disclosure' application, namely 'Image Leaks' and an additional tab called 'Location Leaks'.

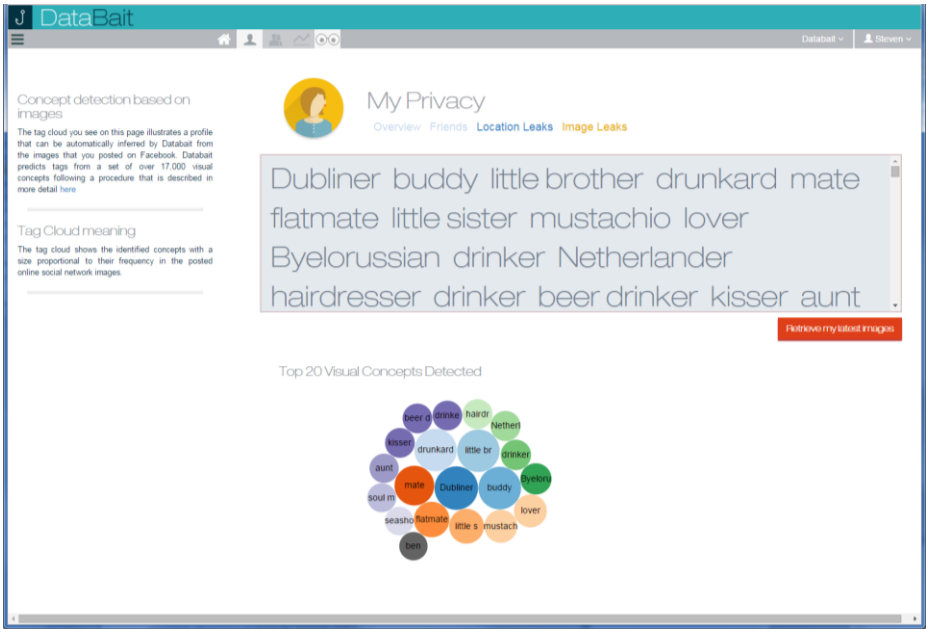


Figure 2 : The image leaks section of the web application implemented for the pre-pilot. The presented words indicate the concepts extracted from the users photos.

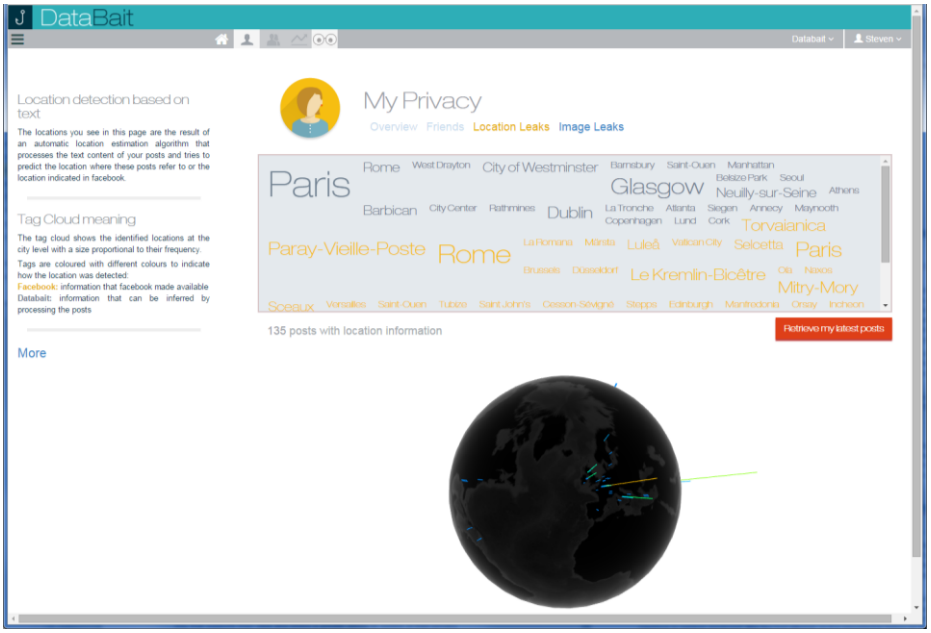


Figure 3 : The location leaks section of the web application implemented for the pre-pilot version. The displayed places indicate the locations that were extracted from the user's photos. These locations are also plotted on a map.

Location leaks was added due to the maturity of the technology, which was at a level where it could be used for such testing but will not be included as a separate section in the final deployment of the web application. Both the 'Overview' (privacy inferences) and 'Friends' tabs weren't implemented for the pre-pilot version of the web application. These were, however, implemented for the purposes of the high fidelity prototype (described below) since one of the main aims of the studies conducted in this deliverable was the further development and refinement of the visualisation for the overview of a user's privacy profile.

3. Evaluation Process (recap)

In D6.3 section 7 the planned evaluation process was described. This process has been designed to be iterative meaning that a repeated set of tools and techniques will be employed in order to refine and improve our scenarios at each step of the iteration process. The principal tools used and the reasons behind using them were described in D6.3. Below we describe these tools in more detail.

3.1. Expert Evaluations

Expert reviews of an interface, carried out with usability experts, enable us to apply a number of standard inspection methods in a clear and methodical way. An expert has the ability to provide feedback and evaluate the heuristic and components of both the interface and the scenario at hand. The recommendations picked up at this phase are then integrated to the current interface design before the next tool is applied. The experts in this case were exclusively usability and ergonomic experts from CEA. In total 5 experts were consulted, 1 male and 4 female, with ages ranging from 23 to 51 years.

According to Forsell (Forsell & Johansson, 2010), evaluation has long been a key research challenge within the Information Visualization (InfoVis) community. Heuristic Evaluation, i.e. a usability inspection method for computer software that helps to identify usability problems in the user interface, is a recognized method but there has been little consensus as to which heuristics should be used as standard. Forsell empirically determined 10 heuristics that could be used for general information visualisation problems and it is those that we used for our expert evaluations.

The heuristics used were as follows:

- **Information coding -** Perception of information is directly dependent on the mapping of data elements to visual objects. The use of additional symbols or realistic characteristics can be used either for building alternative representations (like groups of elements in clustered representations) or to aid in the perception of information elements.
- **Minimal actions** – The number of actions required to achieve a task can have an effect on the perception of a visualisation/interface. This 'workload' with respect to the number of actions necessary to accomplish a goal or a task is a valuable measure of the usability of an interface/visualisation. **Flexibility -** Flexibility is reflected in the number of possible ways of achieving a given goal. It refers to the means available for customization in order to take into account working strategies, habits and task requirements.

- **Orientation and help –** Support functions that help the user to control the level of detail, redo/undo certain actions can have an effect on the user's perception.
- **Spatial organization -** Concerns users' orientation in the information space, the distribution of elements in the layout, precision and legibility, efficiency in space usage and distortion of visual elements.
- **Consistency / Homogeneity -** Refers to the way design choices are maintained in similar contexts, and are different when applied to different contexts.
- **Recognition rather than recall -** The user should not have to memorize a lot of information to carry out tasks.**Prompting / Incitation -** Refers to all means that help users to understand all alternatives when several actions are possible depending on the context.
- **Remove the extraneous -** Concerns whether any extra information can be a distraction and take the eye away from seeing the data or making comparisons.
- **Data set reduction -** Concerns provided features for reducing a data set, e.g. filtering, clustering and pruning, their efficiency and ease of use. Filtering allows reduction of information shown at a certain moment, leading more rapidly to adjustment of the focus of interest, and clustering allows the representation of a subset of data elements by means of special symbols, while pruning simply cuts off information irrelevant for the understanding of a visual representation.

In total five expert participants were asked to evaluate the prototype before commenting for each heuristic. The expert studies were conducted in two iterations meaning that the interface could be updated two times before a study was conducted with potential DataBait users. A full version of the questionnaire presented to the expert users is shown in Section 9.1.

3.2. User Study

For the second part of the evaluation a study was conducted with 11 potential users of the DataBait system. They were each asked to familiarize themselves with the prototype before answering a questionnaire. This questionnaire is detailed in D6.3 and presented here in section 9.

To summarise, the questionnaire consisted of five questions and two evaluations designed to draw out information in a way that would help the subsequent improvement of the design and the generating of recommendations and guidelines after the initial evaluation with expert users. The five questions presented were as follows:

- **Question 1** asked the user to rank the disclosure dimensions that are most important to them with the aim of possibly re-focusing the attention on specific dimensions if there is a clear tendency towards this.
- **Question 2** focused on the colouring and the size of the bubbles. Interviewees were asked how they feel about these two coding aspects and how they might be improved.
- **Question 3** is an attempt to understand whether the interviewee had understood the visualisation by asking them to state which media has caused the increased exposure level of the location dimension.
- **Question 4** focused on the 'Friends' and 'Media Leaks' visualisations and was a simple attempt to see whether the interviewee had understood the visualisation presented to them. The interviewee described their understanding while the interviewer noted any interesting comments.

- **Question 5** related to the media tab of the 'My Privacy' interface. The participant was asked to describe what he understood from the presented visualisation. Any useful comments or insights were noted by the interviewer and used for subsequent improvements to the design.

The two evaluations presented to the participants were designed to evaluate first the user interface and second the actual bubble visualisation:

- **User Interface Evaluation**: This section was designed to directly measure the interviewee's feelings towards each of the visualisations. They were presented with questions pertaining to the ease of use of the interface, the quality of the graphical interface and the system reactivity. Each question was marked on a scale of 1 to 7.
- **Benefit of Visualisation Elements Evaluation**: This section was again designed to measure the participants' feelings, this time about the visualisation elements themselves. This included the motivational impact of the elements, the adaptability of the application to the user's needs and the added value of the visualisation elements.

4.DataBait – High Fidelity Prototyping

Following the structure set out in section 2 with modifications enabling us to more closely reflect the website used in the pre-pilot, a semi-functional prototype was produced using PowerPoint that enabled potential users of the DataBait tool to interact with the designed bubble visualisations.

In D6.3 it was found that there is a large range of attitudes towards the sharing of personal information online that have some impact on the visualisation design process. It was decided that in order to allow the DataBait application to appeal to all kinds of users, we must provide a simple representation of a user's disclosure profile, which appeals both to users who are less concerned about their disclosure profiles and to users who wish to investigate their disclosure profiles further.

Another of the main goals of this visualisation development is to provide users with a sense of understanding and eventually of fine-grained control over the disclosure of their information. It is clear from the literature that this can be achieved if the user is made to enjoy the interaction. The sense of interaction with our visualisations is one of the most important aspects of this design task and to render the interaction enjoyable to the user will create a sense of engagement that hopefully leads to a greater sense of control that lets users expose different layers of detail. Achieving this will act as a catalyst for the users dialog with the data and eventually their understanding of it.

The first iteration of our high fidelity prototype, created using PowerPoint, implemented the four sections of the web application described above, i.e. the privacy overview, friends, location leaks and multimedia leaks sections.

4.1. Interaction and Visualisation

As a basis for the high-fidelity prototype a number of guidelines taken from the literature and detailed in section 2.4 of D6.3 were used. After an extensive review of the information visualisation literature, (Yi & Kang, 2007) describe seven generally used interaction techniques:

- **Select**: users can mark something as interesting in a potentially large set of data, making it stand out from the rest.
- **Explore**: users can see 'something else' by interacting or moving around within the data in order to expose other views of the data that may otherwise have been hidden.
- **Reconfigure**: Again, based around providing different perspectives of the data, other views/arrangements are generated according to the interaction.
- **Encode**: different representations can be displayed to the user. The user is provided with the ability to change the colour coding or overall representation of the data.
- **Abstract/Elaborate**: Reveal more or less detail from visualisation via simple controls, for example via simple mouse hovers over areas of interest or zooming.
- **Filter**: show something based on certain filtering conditions. Users have the ability to specify different criteria that alter the visualisation in some way.
- **Connect**: users can highlight associations and relationships between different data items via clicking etc.

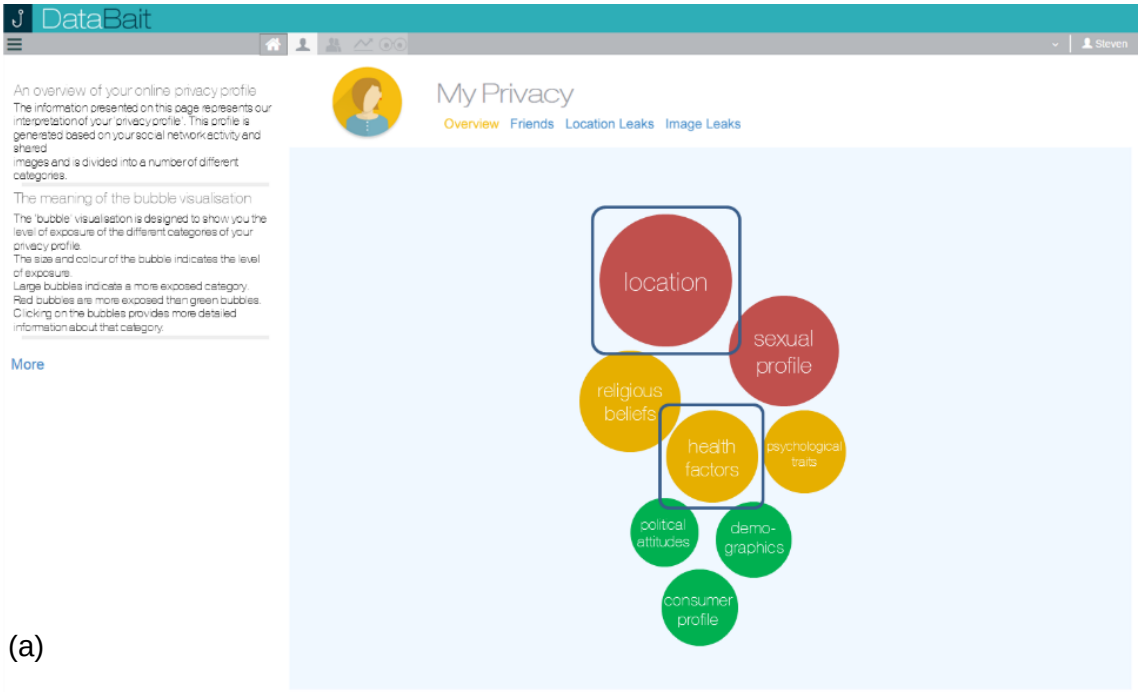
Similarly, (Elmqvist et al., 2011) described a number of guidelines for the design of interactive visualisations:

- DG1: Use smooth animated transitions between states.
- DG2: Provide immediate visual feedback on interaction.
- DG3: Minimize indirection in the interface. For example, avoid control panels that are separated in a way that takes the user's attention away from the visualisation.
- DG4: Integrate user interface components in the visual representation
- DG5: Reward interaction. For example, provide visual or audio queues to indicate that something has changed.
- DG6: Ensure that interaction never 'ends.' i.e. the user should never reach a dead-end with nowhere else to go.
- DG7: Reinforce a clear conceptual model. The user should always have a clear idea of their current state and position within the interaction.
- DG8: Avoid explicit mode changes. I.e. avoid drastic interaction changes from one mode to another.

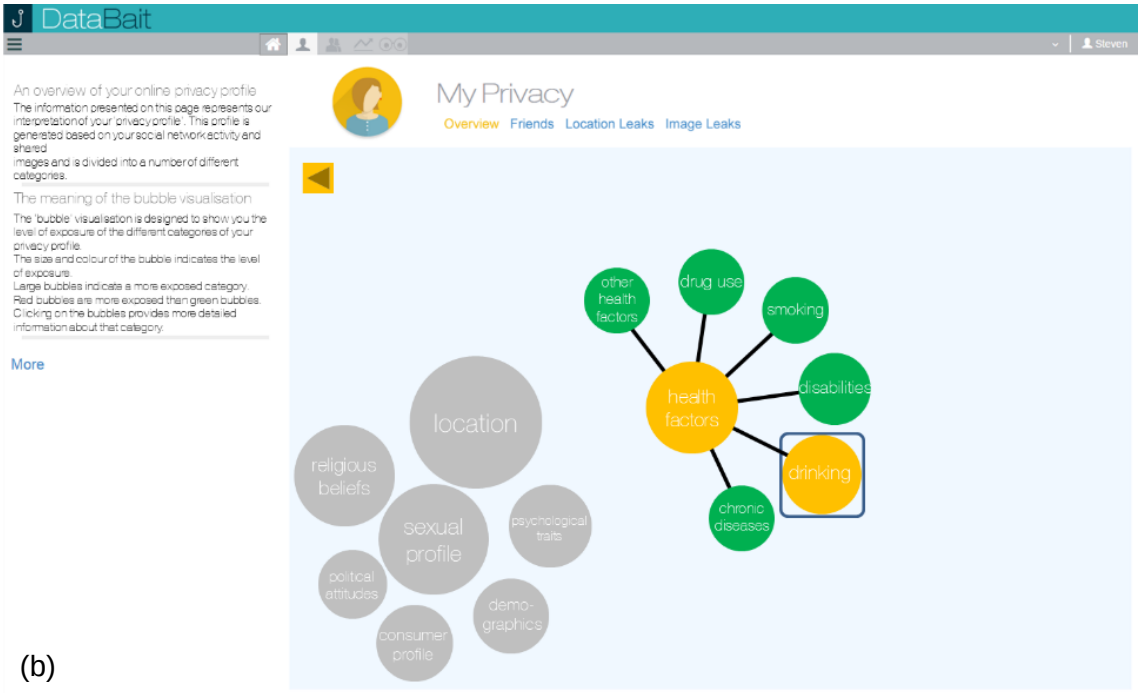
For the design of our high fidelity prototype we take several of these guidelines into account. The initial prototype design was based around Yi and Kang's 'explore' and 'connect' techniques. Users were provided with the ability to explore their disclosure profiles and reveal more information about specific disclosure dimensions by simply interacting with them. This provides a basis for our iterative evaluation and development process by following the design guidelines for fluid interaction set out above, whilst at the same time attempting to create other guidelines more directly related to the field of information disclosure.

4.2. Prototype – Iteration 1

The first version of our semi functional high-fidelity prototype is illustrated in Figure 4 to Figure 7. Figure 4 provides a run through of what a user would see after clicking the 'Overview' tab of the main interface. In this semi-functional prototype the user could only click on the bubbles outlined with a rectangle, in this case the 'Location' and the 'Health Factors' bubbles, in order to discover more information about what is exposing these disclosure dimensions.



(a)



(b)

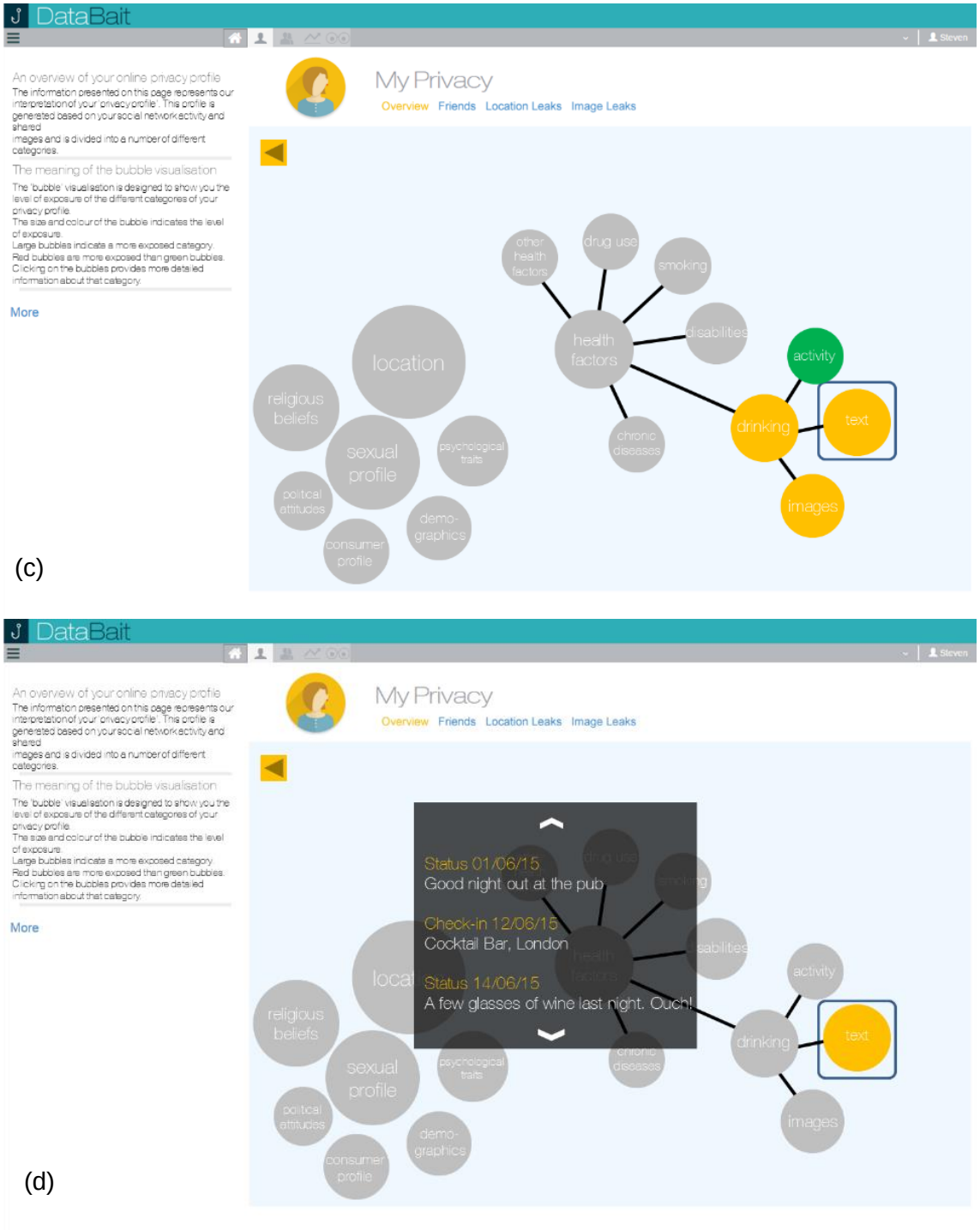
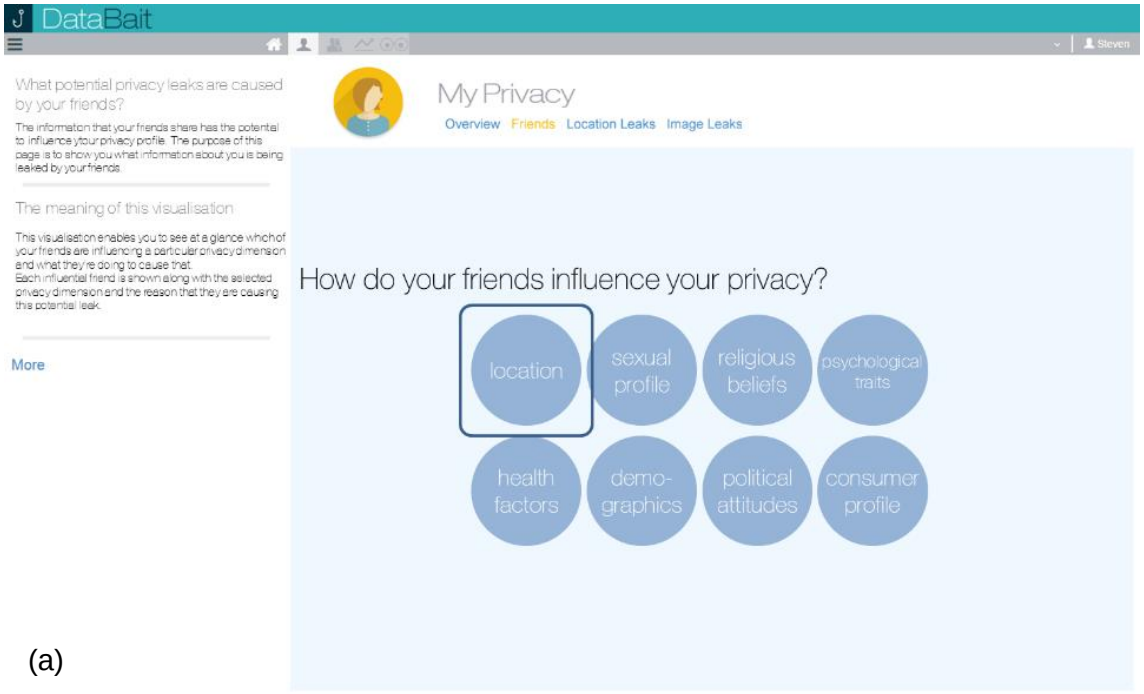


Figure 4 : The user is initially presented with an overview of their disclosure profile (a). They are then able to click or touch the elements surrounded by a box. The user clicks 'health factors' (b) then 'drinking' (c) and then 'text' (d). From this they find out which text caused their health factors dimension to become over exposed.

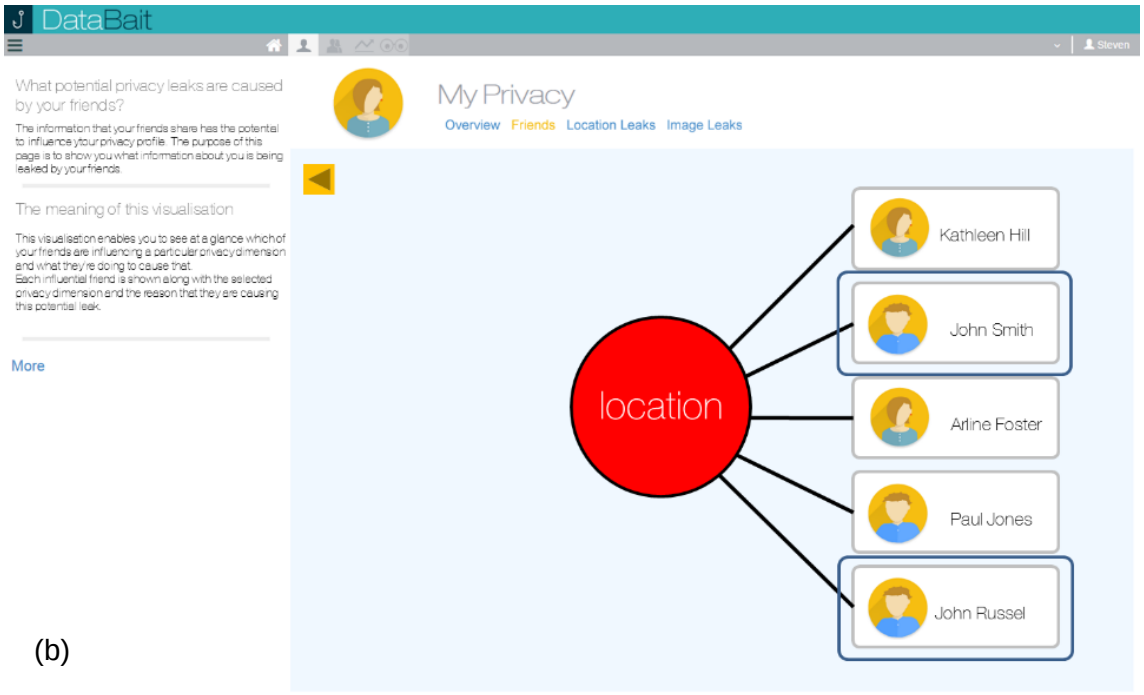
As the user clicks through, they are exposed to new levels of information about the exposure. Eventually in the example provided in Figure 4 the user discovers that some text from their online social networks has been exposing their health factors dimension. Examples of the text that is causing this exposure is provided to the user. In other scenarios it is also possible to see which images or which activities (likes, check-ins etc.) have contributed to the exposure of a specific disclosure dimension.

4.3. Friends

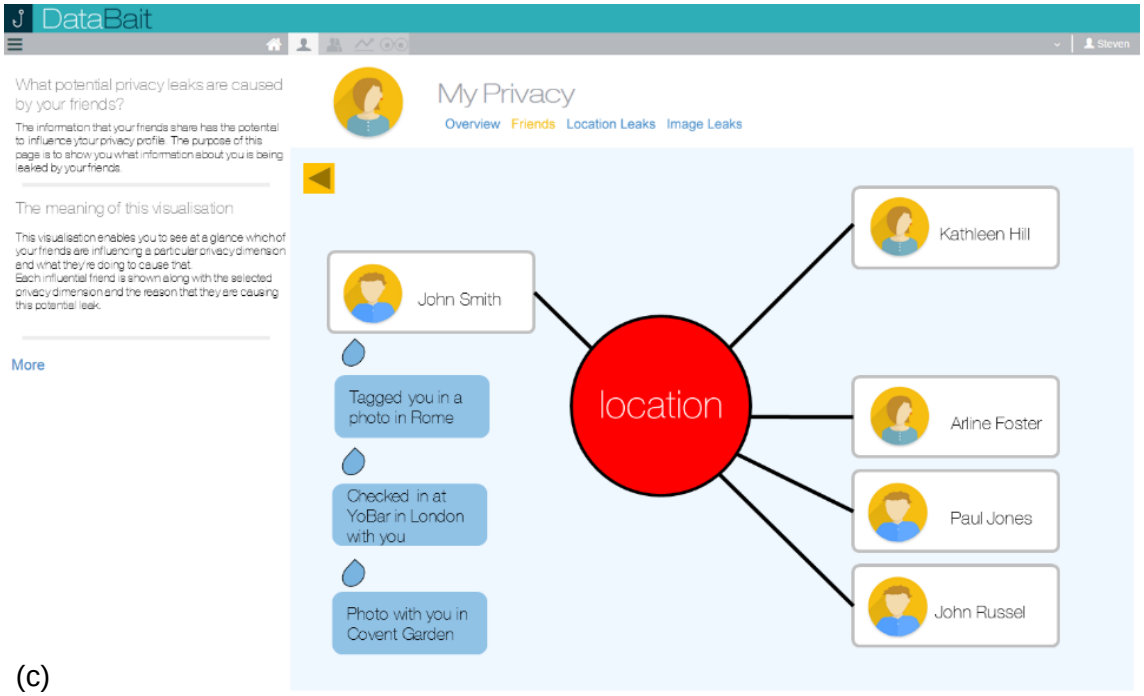
The friends tab of the interface, while – as mentioned – is not very likely to be integrated in the first versions of the DataBait system (but is likely to be integrated at a later version that also handles additional OSNs), is designed to enable users to gain some insight as to which friends are contributing to the exposure of their disclosure dimensions. Figure 5 provides an initial example of how this process might evolve.



(a)



(b)



(c)

Figure 5 : On clicking the friends tab the user is presented with a list of dimensions (a). On clicking a particular dimension the user is presented with a list of friends that have contributed to the exposure of this dimension (b). Finally the user clicks a particular friend to discover how that friend has contributed to the exposure (c).

4.4. Location Leaks

The location leaks tab of the web application provides users with an insight as to which locations are being extracted from their OSN data, in initial versions of the system, using only the users published text.

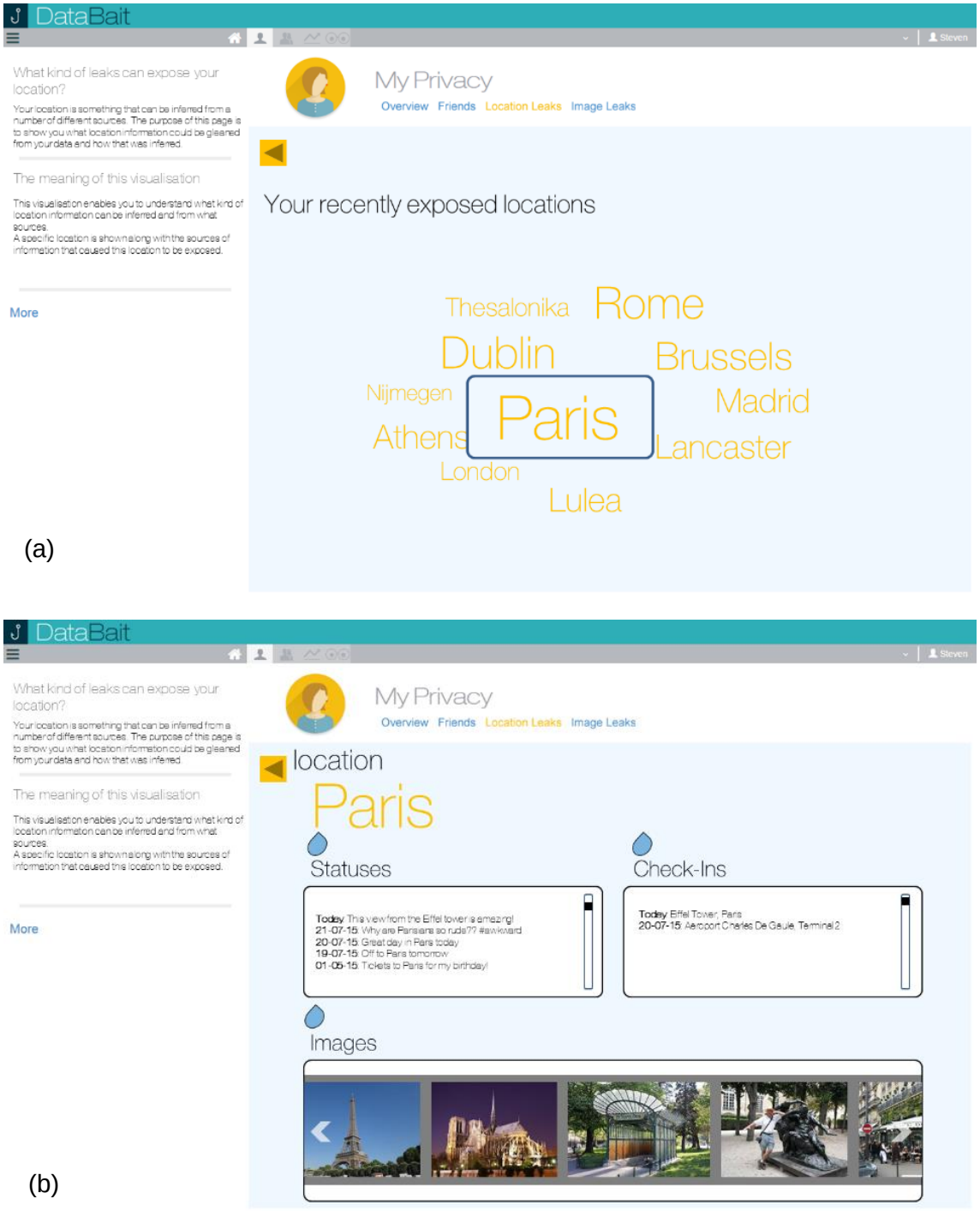
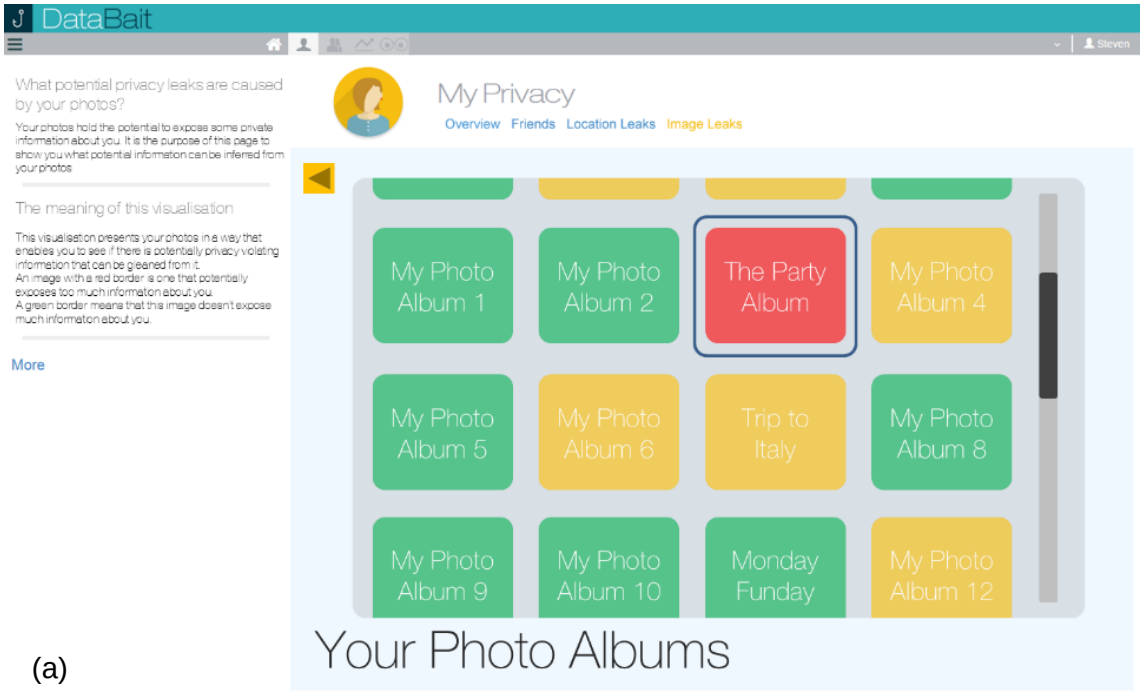


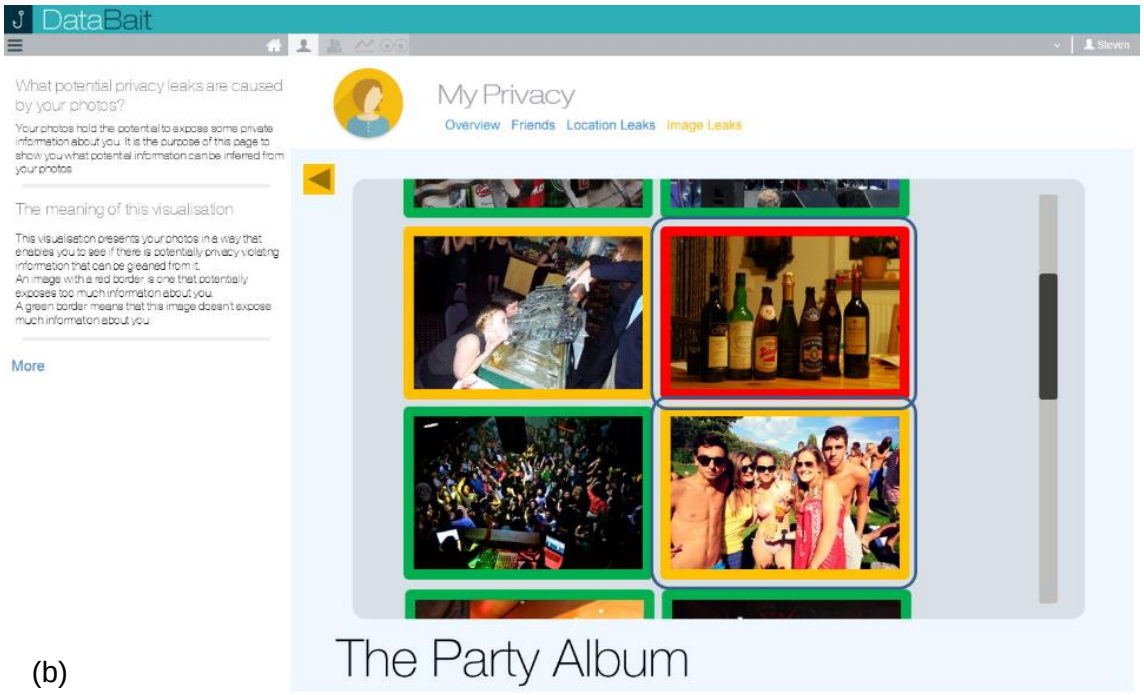
Figure 6 : On clicking the location leaks tab the user is presented with a word cloud of the locations that were extracted from their OSN data (a). When a particular location is clicked some of the reasons for this exposure are presented (b).

4.5. Image Leaks

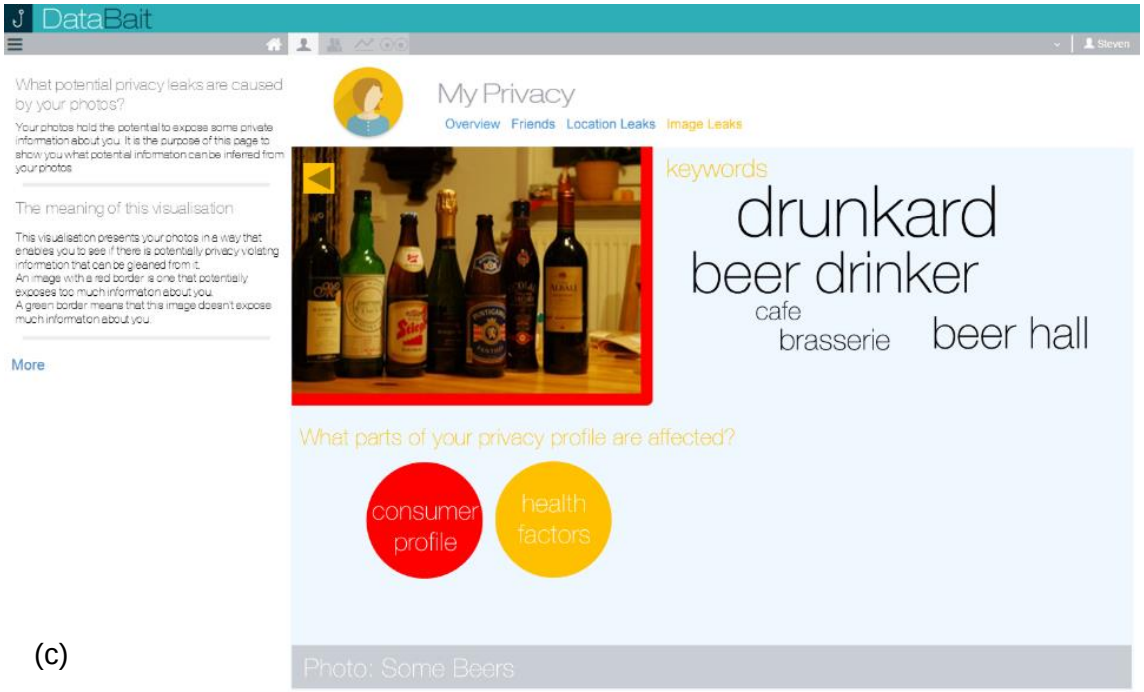
The image leaks tab provides users with a view of how their photos are exposing particular aspects of their disclosure profile. Figure 7 illustrates the flow of interaction. The user is presented with their list of albums, each of which is colour coded to provide a sense of how that album is exposing the disclosure profile.



(a)



(b)



(c)

Figure 7 : The image leaks tab provides information to users on their specific images that are contributing to the exposure of their disclosure profiles. The user is presented with a list of their photo albums, coloured depending the level of exposure of the photos in that album (a). After clicking on an album individual photos are displayed, again with a corresponding colour (b). Clicking on a photo then shows which concepts have been extracted from that photo and which disclosure dimensions are being affected (c).

Within each album the user can see how each photo is affecting their disclosure profile and by clicking on a photo they can see what visual concepts are being extracted from that photo.

5.User Studies

5.1. Expert Interview Results

Results from the expert interviews showed that for the first iteration of the high fidelity prototype, there were some improvements to make to each component of the web application visualization. A number of points were recorded for each heuristic in the questionnaire described in section 3.1. The most interesting points are described below.

Information Coding

In general, the participants were positive about the information coding. In particular, they liked the size and colour choices for the bubble visualization; the choice of colours used was complimented. However, there was some criticism of the inconsistency between the different tabs of the application. It was commented that the size of the bubble was not always consistent with the colour used. It was also commented that the use of greyed out bubbles wasn't a very appealing feature.

For the overview tab it was commented that there was no real consistency in the exploitation of the axes, since the "expansion" direction of the tree slightly randomized. One expert would

have preferred to see a more horizontal expansion of the ‘disclosure tree’ as is common in other visualisations.

For the friends tab users were far less positive overall and commented that the initial visualization should be consistent with the visualization used for the overview. Some would have preferred that this part of the application showed us which friends were exposing our disclosure profile.

Minimal Actions

Comments in this section were slightly less positive. In general it was commented that the navigation in the overview was difficult since it wasn’t possible to easily return to a previous state without a back button. Instead of disabling each of the ‘inactive’ bubbles it should be possible to click on them again to return to a previous state or change to another.

For the friends tab it was again mentioned that this should have the same representation as the overview since “we are interested in the content posted by friends and if it bothers us then who are the friends responsible?”

Flexibility

In terms of flexibility a number of comments were noted regarding the lack of possibility for customization and positioning of the bubbles and their colours in the overview. However, it was also noted that this was not a major issue for the usability of the visualization.

Orientation & Help

Comments for this category focused on the lack of an undo/redo functionality and a lack of explanation for what each category meant. Although there was a text explanation at the side for each sub application, users would have preferred a more contextual help. A popup with an explanation for each category, for example.

Comments here also pertained to the orientation within the ‘disclosure tree’. While it was noted that for the disclosure overview, there was a ‘breadcrumb trail’, this was less evident for the other sub-applications where the user’s orientation was quickly lost. This was particularly true for the friends and media leaks tabs.

Spatial Organization

The spatial organization for the disclosure overview was generally well received, however, it was again commented that the use of grey colour for the inactive bubbles was not pleasant for the look and feel of the interface. For the other tabs, in particular the media leaks tab, it was commented that much more could be done in terms of spatial organization with more use of size and colour as with the other tabs.

Another comment here was that there was a lack of dynamism in the form of movements and sounds that would have made things more fun for the user.

Consistency

In terms of consistency the main criticism of the interface was that the representations between different tabs were providing two different types of visualization, which impacts directly on consistency. In particular it was commented that there was no consistency between the sizes of the bubbles in the friends tab in the overview tab.

The friends tab received most criticism since a different approach to the visualization was used that impacted on the performance of the overall application as users were required to understand multiple representations of what were essentially the same concepts. It was advised to change this visualization to resemble the overview visualization.

For the media leaks tab it was commented that again the representations were different to that presented in the overview tab meaning that a lot of confusion was needlessly inserted into the visualization.

It was also commented here that the location leaks tab seemed superfluous since the location aspect of disclosure was already treated in the overview tab.

Recognition rather than recall

The comments for this section were rather positive. The experts could generally recall the category labels. One minor comment was that when it came to memorizing the content of each category there was more of a problem.

Prompting

The main comments for this category were related to the lack of dynamism in the animation of the visualization. Since the visualization was introduced as a ‘bubble’ visualization, the users expected more bubble like movement. It was commented that the static visualisations implemented for this version of the PowerPoint prototype detracted from the interactive feel of the prototype. It was commented that making the bubbles more ‘clickable’, i.e. inciting users to click on the bubbles or simply making the bubbles look more clickable could help for the ‘interactiveness’ of the interface.

Remove the extraneous

For this category the overwhelming message was that the location leaks tab was superfluous to the overall application and should be removed due to its redundancy. For the overview section it was again commented that the grey bubbles should be changed.

Data set reduction

The main comments received here were that there could be some kind of clustering features, i.e. clustering of similar photos for the media leaks or clustering of similar friends in terms of how much of your disclosure profile they’re exposing. It was also commented that some kind of filtering would be useful since there are some categories which are more interesting than others. It would be good to only show the interesting categories or the categories which rise above a certain level of exposure.

Overall View

Overall, the first iteration of the prototype was well received by the expert users. It was commented that it was easy to learn and that it will become a useful tool for management of social network content. Especially when the content from multiple social networks is aggregated.

In terms of missing aspects it was commented that interactivity was lacking due to the lack of animation and customization. Data reduction (filtering) was also mentioned as something that would add to the overall usefulness of the application.

5.2. Prototype Update – Iteration 2

Based on the feedback from the expert user study it was decided to update the interface.

Updated Interface

Overview Tab

Main Changes:

- A more ordered and informative view of the inactive bubbles.
- More movement, animation and responsiveness of the bubbles.
- Greater consistency between the bubble sizes and colours.
- Improvement of navigation between levels
- Removal of all grey (replace with colours).

The initial overview screen with the bubble representation was unchanged. A simple animation involving the bubbles floating up to the top of the screen was implemented in order to add some dynamism to the process as illustrated in Figure 8. A simple animation was added to a number of different screens in order to answer the demands of the expert users.

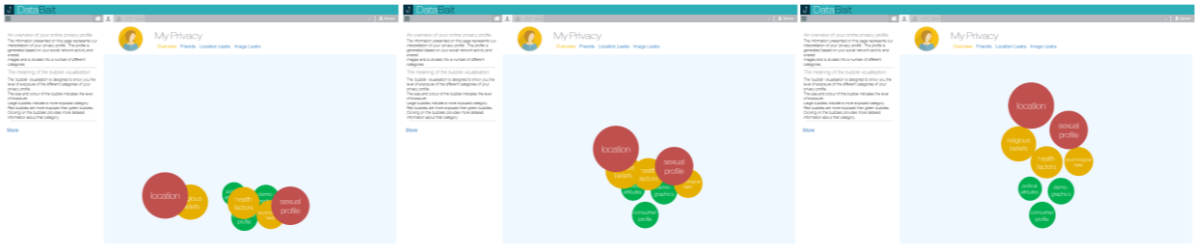


Figure 8: The bubble overview representation with added animation (from left to right).

Figure 9 now shows a comparison between v1 and v2 of the prototype after a user clicks on the health factors bubble. In line with the suggested changes from the expert users, the grey bubbles were abandoned and replaced by a more structured menu.

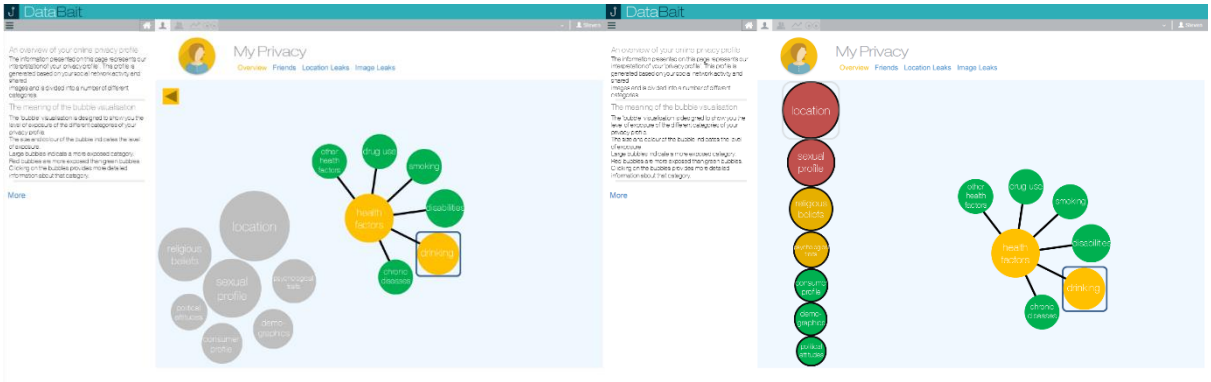


Figure 9: Left: The v1 representation for comparison. Right: The v2 representation of what is displayed after a user clicks on a specific disclosure dimension.

Figure 10 shows another example of how the grey bubbles were removed and replaced with a lighter coloured version.

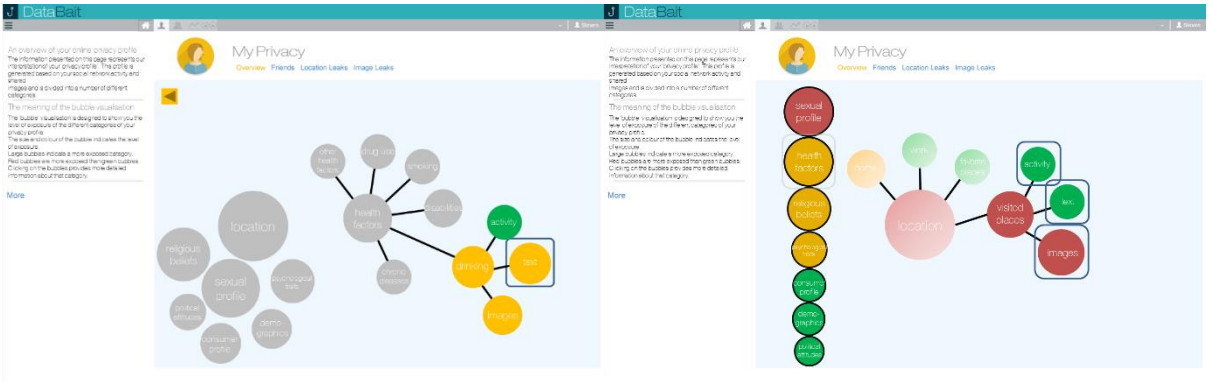


Figure 10: Greying of the inactive bubbles was changed for a less bright coloured representation. Left: old representation. Right: new representation.

The friends tab

Main Changes:

- Complete redesign of the main view to better reflect the overview style
- More focus on the list of friends and “their effect on me”

While the overview sub application was largely unchanged, the friends tab, on the other hand, was completely redesigned. Expert reviewers preferred to see which friends were exposing their profile first as opposed to the original version where a disclosure dimension was chosen. Figure 11 shows the new layout whereby a list of friends is shown to the user. Each friend has a coloured outline indicating the level of their influence on the user’s disclosure profile.

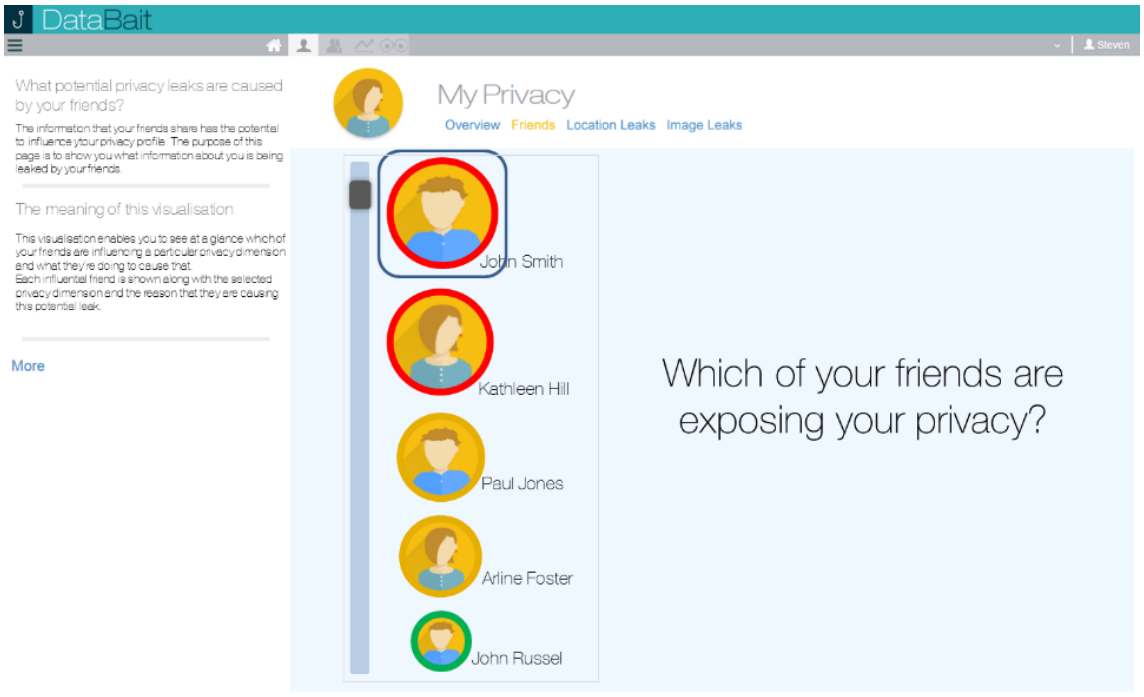


Figure 11 : The list of friends who have an effect on the user’s disclosure profile.

Figure 12 shows that when the user clicks on the chosen friend, a new overview of the exposure of all disclosure dimensions related to that friend is displayed.

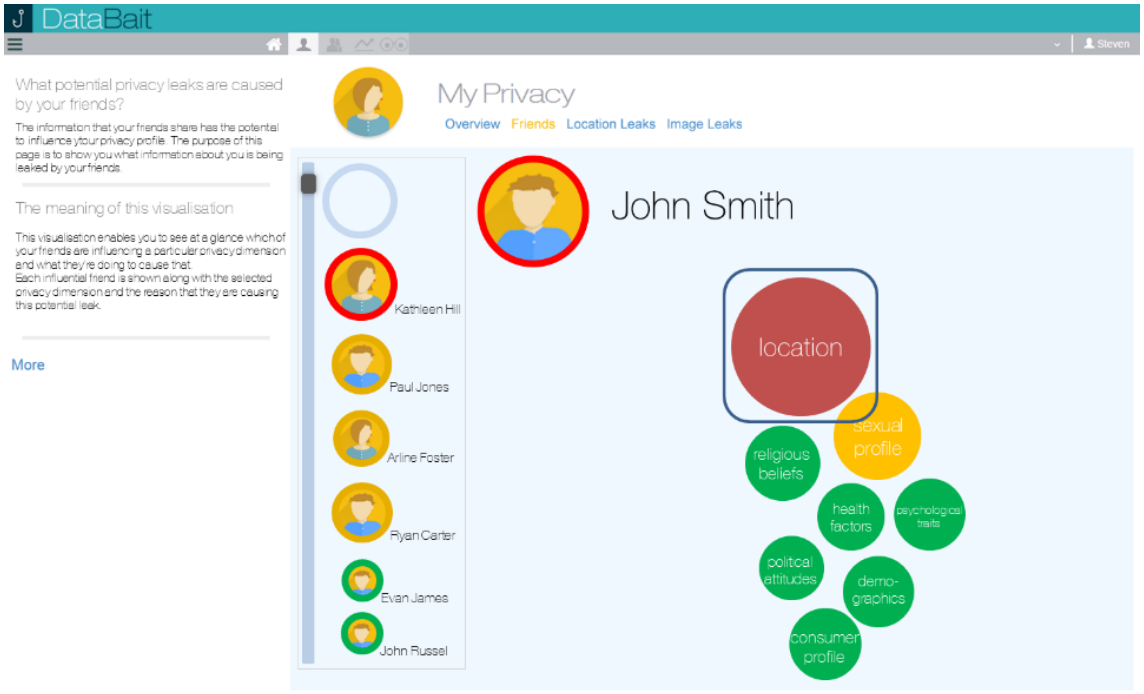


Figure 12 : A bubble overview of that friend's influence on your disclosure profile is displayed.

A user may then click on the bubbles in the same was as for the overview tab in order to gain more information about why this friend is influencing a particular disclosure dimension, illustrated in Figure 13.

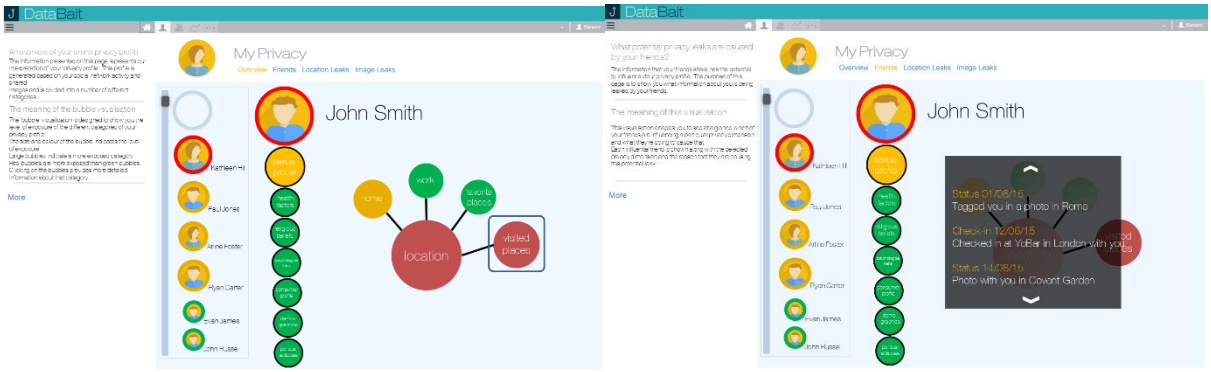


Figure 13 : If a user wishes to investigate how a particular friend is influencing their disclosure profile they can click on the 'overexposed' dimensions to find out why.

The location leaks tab

Main Changes:

- Colouring of the words in-line with their size.

Given the lack of importance of the location leaks tab for any final application, very little was changed. The only substantial change to be made was to the color of the locations, which are now related to the size of the word, in line with the bubble representation. This is illustrated in Figure 14.

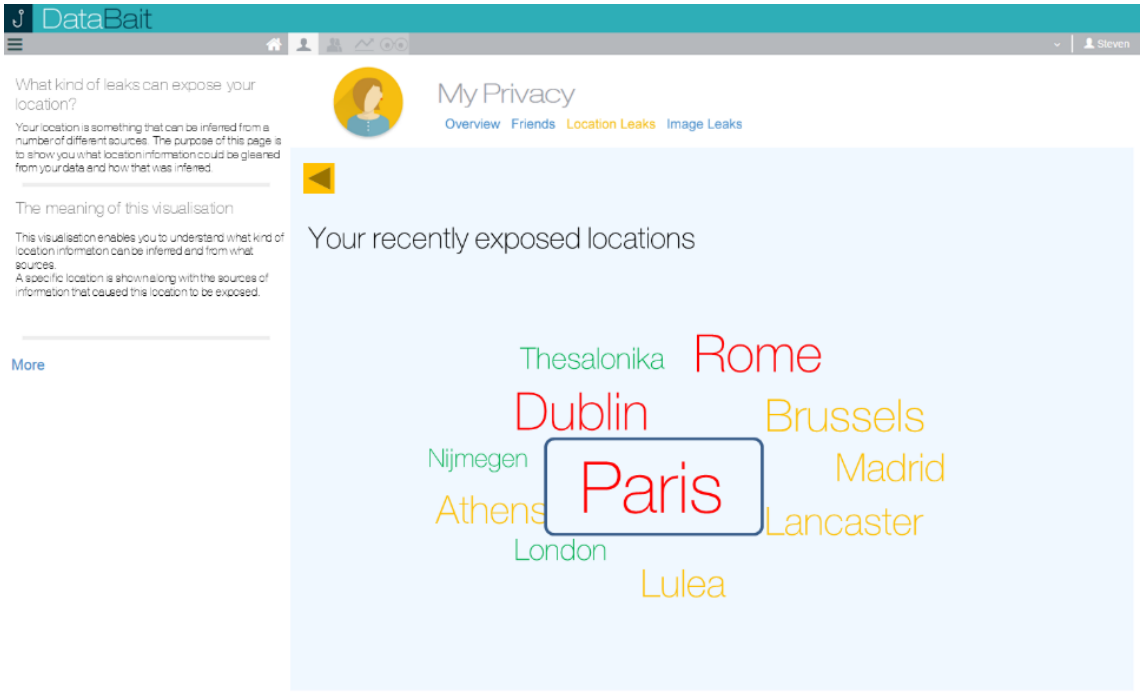


Figure 14 : The colour of the words was changed in proportion to their size. This was in order to be more consistent with the bubble representation of size and colour.

The image leaks tab

Main Changes:

- Change the size of the album items in line with their colour.
- Change the size of the photos within the album in line with their colours.

The main criticism of the image leaks tab was that it didn't follow the same size/color conventions of the bubble representation. For this reason it was decided to vary the size of the photo albums in-line with their colour. The same change was also made for the photos within the album whereby the photos which exposed more of the user's disclosure dimensions were larger in size. These changes are illustrated in Figure 15.

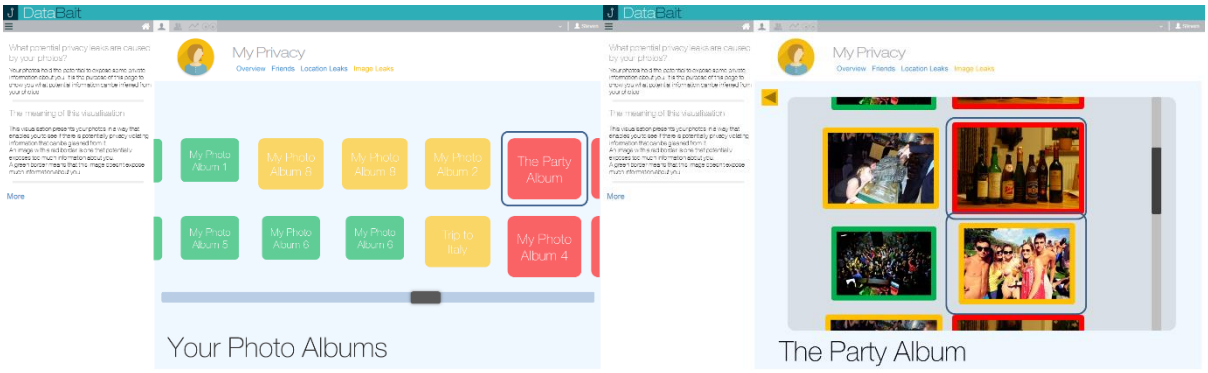


Figure 15 : The size of the album icons and the images was now varied depending on the amount of exposure/colour, in-line with the bubble representation elsewhere in the application.

5.3. Expert Interview Results – Round 2

A second iteration of expert reviews was conducted using the updated prototype. This time only two experts were interviewed. Overall, both experts thought the interface had much

improved. Consequently, the reviewers focused more on the details of the interface that were missing. It was noted in particular that there were still some important improvements in terms of filtering and interactivity that could be made. The same heuristics that were used for the first iteration were used again, with the main points described below:

Information Coding

It was commented that in fact there is an inter-dependency with some disclosure dimensions that is not made very clear with the current visualisations. For example, the location of a person can have an indirect effect on other dimensions. While this is a complex issue, in later versions of the system it should be possible to observe the effect on certain disclosure dimensions as data is added or removed from other dimensions. The bubble visualization lends itself well to this as it should be possible to animate slight movements in one bubble as changes are made to another via the disclosure settings framework, for example.

Minimal Actions

The tree structure of the expanded bubble view was complimented as it enhances the breadcrumb trail; an important issue for the user's comprehension of the interaction. It was commented that the dimension attributes could be exposed at the first level in a more subtle way, i.e. in a way that lets the user directly interact with the dimension attributes form the first view as this would reduce the required number of actions. This could be achieved with more subtle rendering of the dimensions, whereby the size of the bubble reacts to mouse over events, for example.

Flexibility

The flexibility of the interface was improved slightly, especially with the redesign of the 'friends' sub-application but it was still commented that it would be good to filter out irrelevant categories, change font sizes, etc.

Orientation & Help

The lack of an 'undo' functionality was again commented on. It was remarked that the presence of a back button wasn't consistent enough. It was also suggested that icons might be used instead of text for the disclosure overview bubbles.

Spatial Organisation

It was commented that the help text at the side wasn't really needed after the first few interactions with the interface due to its intuitiveness and simplicity. This indicates that any help in a future version of the system should only need to be displayed for the first use before it can be hidden. Both experts preferred the more organized layout of the unused bubbles on the left (as opposed to the previous grey bubbles) but it was commented that it would be better to keep the space for the currently active bubble in the list (consistent with the redesigned friends app) to maintain the link between all of the dimensions.

Consistency

For version 2 of the prototype black circles were placed around the inactive dimensions but this was criticized by both of the expert users as being unnecessary. It was also commented

that the friends sub-app still wasn't consistent with the overview and should probably have the friends represented in a cloud, as with the disclosure dimensions overview.

Recognition rather than recall

Some minor comments were made regarding the positioning of the names of the photos in the media leaks section that need to be changed. The lack of audio feedback was also criticized since it has potential for aiding the user's navigation and appreciation of the interface.

Prompting

The main comment here pertained to the media leaks section. It was noted that the influenced disclosure dimensions displayed with the photo prompted the user to interact with them even though in this case they were static. It may be better here to have another kind of representation, such as a bar.

It was also noted that the dynamism of the bubbles was still used too little and that there was more potential here for better use of the metaphor. It was commented that the bubbles were still too flat and needed to be more pronounced in order to let the user want to click them.

Remove the extraneous

For this section the only suggestion was that the help section be removed.

Data set reduction

The main comment received here was again about the lack of a filtering option that could reduce the amount of extra information on the screen or would enable the user to display different configurations of data related to specific dimensions, for example.

Overall

The prototype was well received by both experts who considered it much improved from the first iteration.

5.4. Prototype Update – Iteration 3

Based on the feedback from the second round of expert interviews it was decided to make the following changes

Updated Interface

Overview Tab

Main Changes:

- Removed black outlines from dimensions menu.
- Space left in dimensions menu for currently active dimension to return to.

The significant change to the overview tab, as illustrated in Figure 16, was a change in style of the disclosure dimensions menu on the left where the black outlines were removed. A space was also left in this menu for the 'currently active' dimension to create a connection between the menu and the currently expanded dimension.

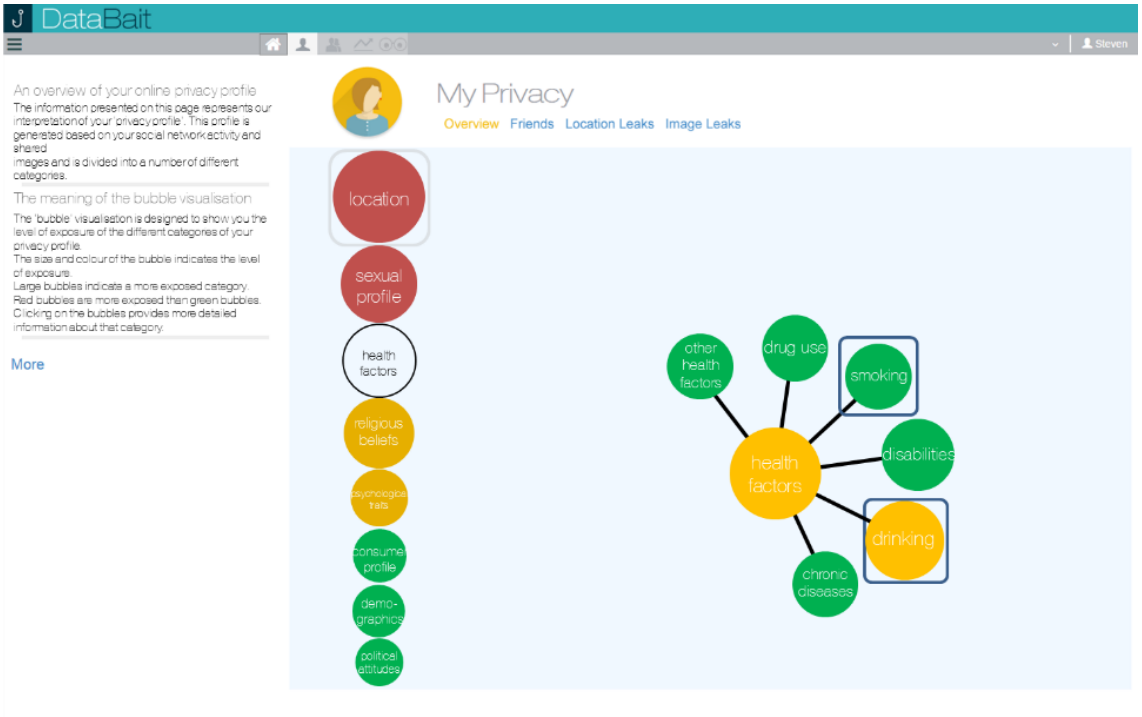


Figure 16: The disclosure dimensions menu was restyled and modified to leave a space for the currently active disclosure dimension.

Friends Tab

Main Changes:

- List of friends exchanged for a 'bubble view' in line with the overview
- Filtering functionality added. Filter by overall exposure level or by a specific dimension.

The friends tab saw the most significant changes since the main view was changed to a bubble representation more in line with the disclosure overview. This is illustrated in Figure 17.

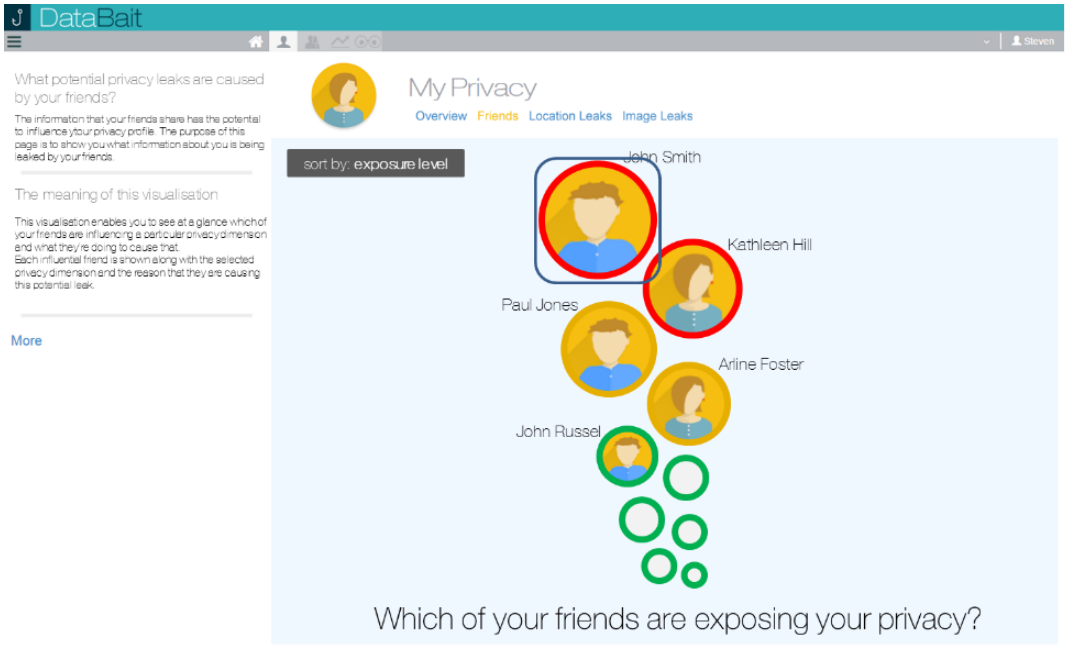


Figure 17 : A friend's influence on a user's disclosure profile is now represented with the same bubble view as for the overview.

A filtering functionality was also added to the friend's interface, which enables a user to display their friends based either on the overall exposure or exposure from a specific disclosure dimension. Figure 18 shows this menu. Users may select the dimension that they are most concerned about and have a list of friends displayed who have an influence on that disclosure dimension.

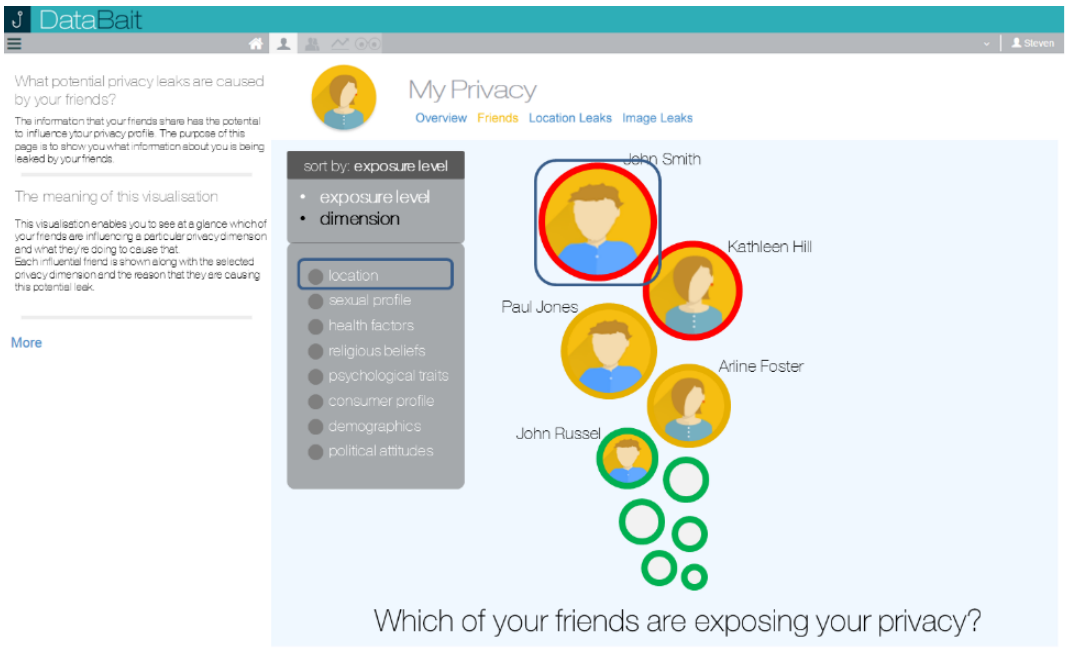


Figure 18 : The user has the ability to filter depending on a specific dimension or by an overall exposure level. A list of friends who influence these dimensions is then displayed.

Location Leaks Tab

Main Changes:

- No changes implemented for this version

No changes were implemented for this iteration.

Media Leaks Tab

Main Changes:

- From the photo details page the bubbles were exchanged for bars.
- The title of the photo was moved to the top as is more standard.
- Several font colours were changed after comments from the expert users.
- A back button was fully implemented for the media leaks tab.

The main visual changes to this sub-application were implemented only on the photo page, as illustrated in Figure 19

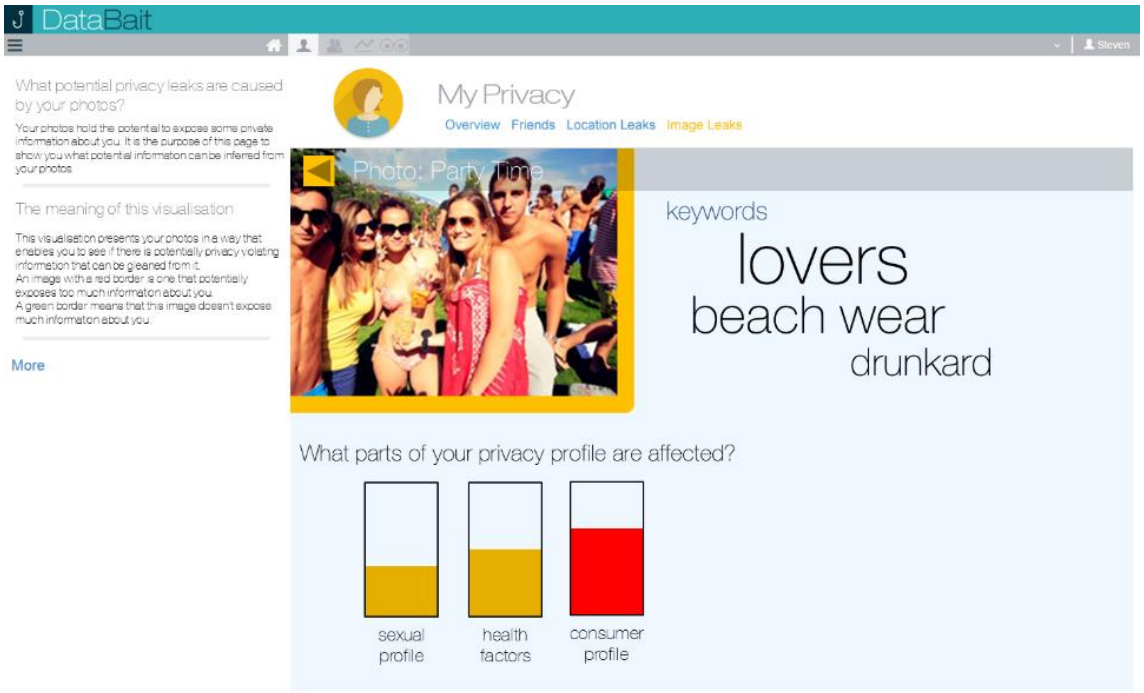


Figure 19 : The influence of this photo on a user's disclosure dimensions is now represented by bars as the previously used bubbles caused some confusion. Other minor details were also changed such as the positioning of the photo title and the color of the fonts.

The main change implemented was the removal of the bubble representation since these were being confused with the bubble representation elsewhere in the application, i.e. users expected to see an expanded view after clicking on them. A bar chart was viewed as a suitable alternative although this may change again as the design matures. Other changes here involved minor alterations to the aesthetic aspects.

5.5. Testing with Potential DataBait Users

The 3rd iteration of the prototype was tested again, now with potential DataBait users. In total there were 11 participants; 9 male and 2 female, aged between 23 and 53 years old

participated. Their backgrounds were mostly in mechanical engineering, with one computer scientist, 7 of which were PhD students and the rest research engineers.

All of the participants were social network users. All used Facebook, 10 also use Linkedin, 4 use Twitter and 3 Viadeo. Leisure was the most important social network use for 7 participants, with two stating that they were strictly only for leisure. The remaining 4 used both for professional reasons and for leisure. Seven participants check their social networks several times a day, 3 once a day and 1 once a week.

The average time spent using social networks is 6 min for professional reasons (e.g. on LinkedIn, ranging from 0 to 15min) and 26 min for leisure (ranging from 1 min to 1h30), see Figure 20.

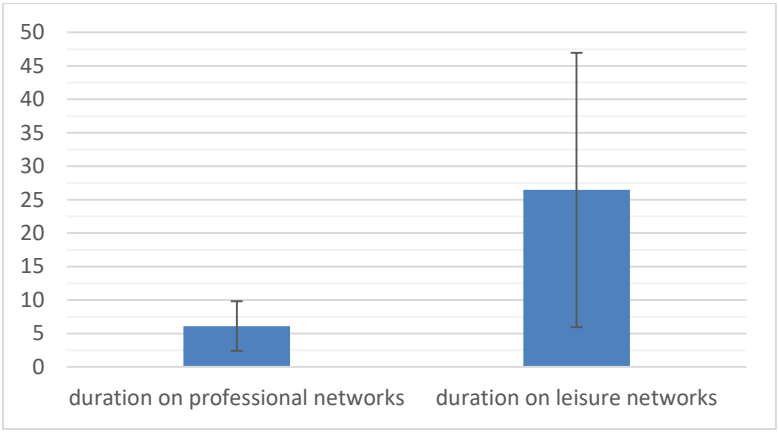


Figure 20: Duration spent on social networks on average per visit (in minutes)

All participants said that they were concerned about their information disclosure. When asked to declare their level of concern, all stated that it was 'medium to high'. All participants except one said that they prefer not to share much data in order to limit their exposure. The other participant said that they share false data. Nine of the participants do not want to willingly share their private information for marketing purposes, not even in exchange of monetary benefits. Overall, their main activity on social networks consists in writing private messages, reading posts, and sharing and watching pictures and videos (but for most not personal pictures or videos).

Protocol

The study lasted for approximately one hour and was divided in two stages. First, the participants were briefly introduced with the USEMP project goal and the specific goal of evaluating the prototype visualizations about their exposure on social networks. They would then freely explore the PowerPoint prototype. Second, they were asked a few questions about their understanding of the visualizations in order to validate it and then asked to fill out a usability questionnaire evaluating the impact of the visualizations in addition to some questions about their profile and use of social networks.

Results

General Understanding

In terms of the users understanding of the size and colour coding, 9 participants fully understood and 2 reported some ambiguity where either the color or size were indicators of the importance of the dimensions according to their own preference. For example, one

participant saw red bubbles as an indication that a particular dimension was important to them, with the size indicating how exposed this dimension is. Another commented that the user's personal importance of a particular dimension is crucial as the exposure of this dimension can have very different effects depending on culture, country, religion, e.g. exposing that you are a gay in a very conservative country can be dangerous. Indeed, one of the scores included in the scoring framework - "sensitivity" - expresses the importance that different attributes or dimensions have for the user. Importantly, the sensitivity can be set directly by the user and is taken into account for computing overall disclosure scores.

This is an interesting ambiguity that could be solved by displaying a legend explaining the coding or having an interactive tutorial at the first use. Moreover, offering some filtering mechanisms on the dimensions of interest to the user could tackle that need to represent the dimensions the user is particularly preoccupied with. Through the questionnaire, the 3 dimensions participants were most concerned about were: health (9pp), sexual profile (7pp) and psychological traits (5 pp). None of the participants considered demographics to be important. Conversely, the 3 least important dimensions were demographics (8pp), religious beliefs (6pp) and location (6pp). The consumer profile dimension was considered the least important by 5 participants. This shows that the dimensions that are considered the most personal and which exposure would be considered harmful are the health status, information about sexual behaviour and personality traits. On the other hand, demographics data is considered least important, most likely because it is frequently shared for various reasons (administrative procedures, subscription for websites, etc.) as for location, perhaps the general tendency to be geotagged minimizes the importance of its exposition. Finally, the participants recruited were not very religious people, hence the religious beliefs being one of the least important dimensions.

Interface Evaluation

The participants were asked to evaluate the prototype visualizations in terms of its usability and 'achieved informative goal' using a 7-point Likert scale questionnaire where the answers range from 'completely disagree' to 'completely agree'.

The detailed results to the questionnaire are displayed in Figure 21and Figure 22. In general all participants were rather satisfied with the visualizations; this can be seen with the large proportion of positive answers to positively phrased affirmations (in green) and the negative answers (in red/orange) to negatively phrased affirmations. This is particularly visible in Figure 22 where many items concerning the benefits of the visualizations are fully agreed upon, such as the motivated interest for disclosure management, motivating support to understand the exposure and better understanding. During the evaluation, most participants commented that this was a really good idea and that it would be a 'cool' tool to use.

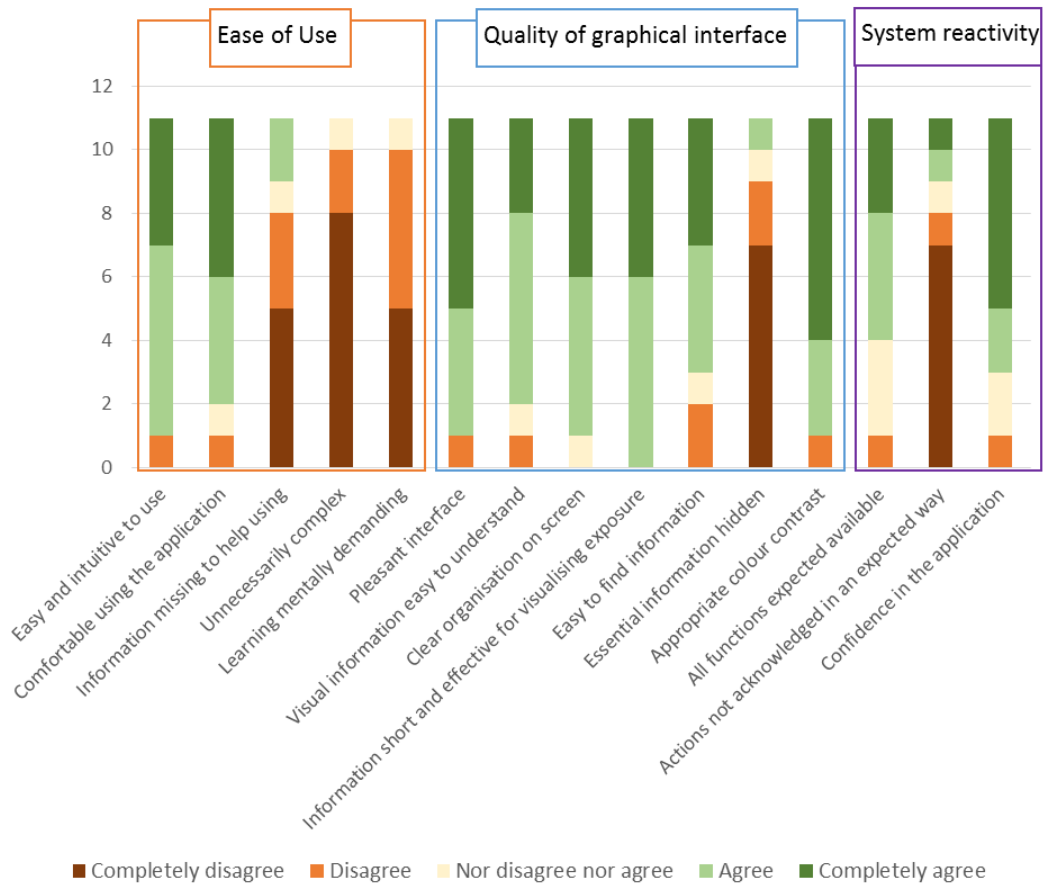


Figure 21: First part of results to usability questionnaire

The only questions that obtained negative answers (8pp) concerned the good support for correcting and reducing the exposure level (see Figure 22) and to some extent the ones relating to the effective and quick management of exposure (4 and 6 pp). This was explained by the lack of features that enable a correction of the exposure level from the “My privacy” application, e.g. either a “delete” button next to a compromising picture, or some tooltips informing the user on how to remove this content from the related social network.

Overall, participants really appreciated the visualizations for the purpose of being informed about the exposure, but all participants thought it needed some action features, either through advice on how to change parameters - many commented that the settings in Facebook are complicated - or action to take to correct the exposure, or through more direct control within the application. When asked about it, some thought a mere visualization without these correction features would not be useful or would not be used regularly, but most agreed that even without, the “My privacy application was still a powerful tool”. This result is interesting as it supports the inclusion of a disclosure settings framework, described in D6.2 and D6.4. This feature of the application was not explained to the participants during the evaluation, however, it is clear from this evaluation that users feel the need for such a feature.

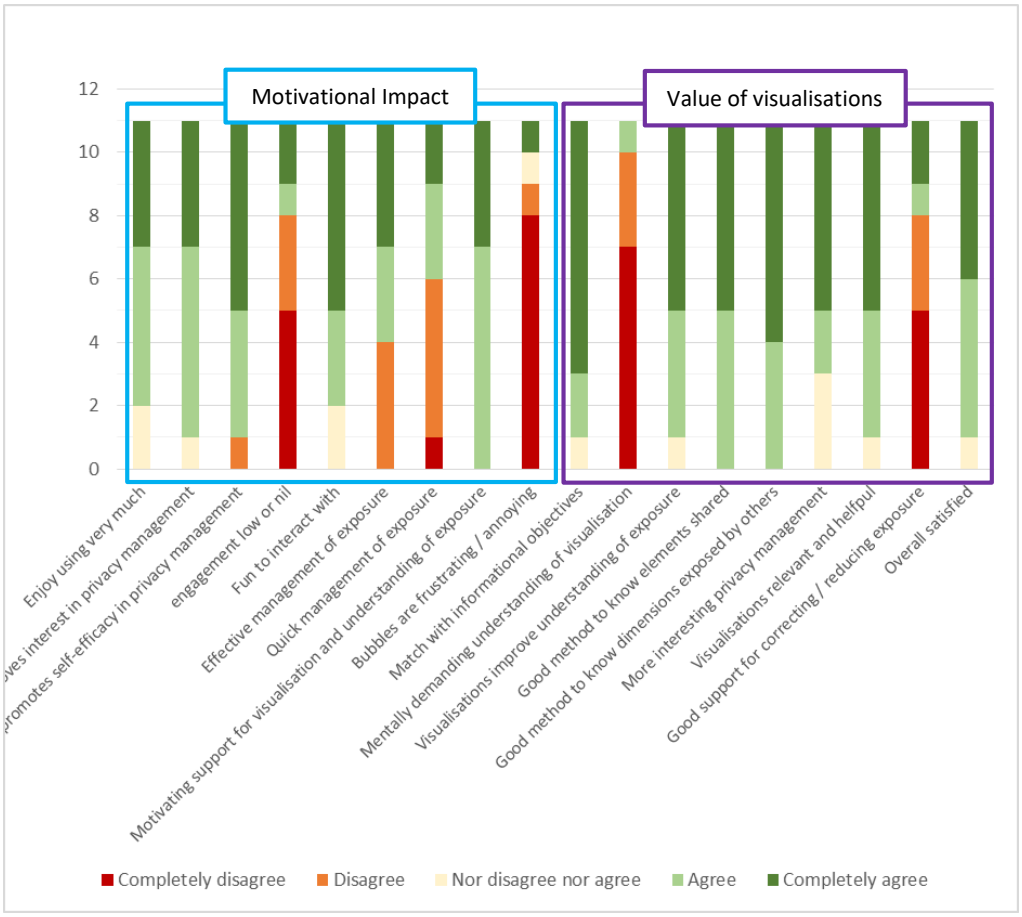


Figure 22: Part 2 of usability questionnaire

Suggestions

When asked about missing features, two main types of information were reported as missing:

- **Information about the source of the exposure** (*which social network?*) (4pp suggested it directly): for instance in the overview, the location is exposed by a number of media, however the origin of these media is lacking (i.e. coming from Facebook, or Instagram, etc.). When enquired about it, 5 other participants confirmed it is needed. Generally participants preferred it to be displayed at the lowest level, directly for the media concerned (4pp), one participant wanted to also have a top-level filter in addition and one even suggested to have a bubble view per social network. It should be mentioned that the disclosure scoring framework explicitly handles pointers to data related to specific user attributes and therefore the source of the exposure can indeed be shown, it has just not been shown in the prototype that has been used for the tests.
- **Information about the target seeing that exposure** (*who can see that?*) (5pp suggested it directly): for instance, depending on the privacy settings on the social networks, the public or your friends do not have the same access to the information posted. Thus one information is not exposed the same way according to different targets. When enquired about it, 3 other participants confirmed it would be interesting. Generally participants preferred it to be selected through a top level filter or at the lowest level, i.e. with the information “seen by…”. One participant was worried that it could desensitize people to the risks of exposure if they thought the exposition is only to an acknowledged group of people, while two others considered that as long one person has access to the information, then it can be shared with anyone so they did not care for this information. Importantly, the disclosure scoring framework also has a

score – “visibility” – that quantifies the audience to which some attribute or dimension is accessible. Nevertheless, this is a feature of the scoring framework that was chosen not to be shown in the prototype that has been used in these tests.

Overall, most participants thought that the visualizations were good as they are. Some improvements were suggested and discussed:

- Add **more interactivity** to the visualizations (4pp): for instance with more physical and dynamic effects relating more to the bubble representation.
- **Change the layout of the Image leaks** (9pp): rather than horizontal, have a vertical display classifying the red albums/images on top similarly to the bubbles or even filter on the most critical items and display only these (3 suggested having the picture level only, no albums). Some participants also preferred that the same bubble view is kept across menus (6pp) for instance with a representative picture of the album as the thumbnail in the bubble. 2 participants preferred it remained as it is liking the metaphor of a film of pictures.
- Some participants did not see the value of having **location leaks** in a separate menu (4pp), as it is a dimension itself. They proposed to include it in the main bubble view, perhaps even using a globe for more visual effects (which already exists in a later version of the site used for the pilot study).
- 2 participants also suggested to show the **cross-impact on other dimensions**; e.g. in the location leaks menu the statuses also reveal some information about the consumer profile (e.g. “Disneyland”) or demographics (e.g. “my birthday”).
- In the same respect, one participant suggested that in addition to the image leaks, there should be **menus specifically for the other types of media covered**, such as text, activity and even videos if these are not included in image leaks. This also emerged during the expert studies.
- 3 participants were interested in **more quantitative data** to complement and better understand the visualizations and the computational model behind, either in the form of tables or specific numeric data that appears on mouse over. 3 other participants specifically asked questions about this model when answering the question about the confidence in the application. This implies that the actual numerical scores should also be accessible, to this end we consider to show the actual scores of each attribute of dimension, when a user hovers over some bubble.
- A few participants also got a bit confused about what the **main view** was actually showing (2pp), due to the inappropriate use of the word “overview”, they thought it was combining both their own exposure and the one from friends. In that respect, they suggested that a proper overview was missing (4pp). It could be provided either by: having different menus, namely an overview combining the two views (2pp) or just the most critical aspects (1p) and then “my exposure” and “my exposing friends” (2pp); or by including their own exposure in the view with friends (2pp), to also get a possible comparison to friends (whether my friends are exposing me more than myself).
- Also some participants (5pp) wondered exactly **how the exposure was computed** and thought the explanation of that measure was missing to fully have confidence in the application. For instance for the image leaks, one participant wondered if the exposure depended on the number of times the image was published and commented.

5.6. Prototype Update – Iteration 4

Based on this feedback the prototype was updated again for its final iteration. Changes for this iteration were minor and serve mainly as suggestions for any future developments.

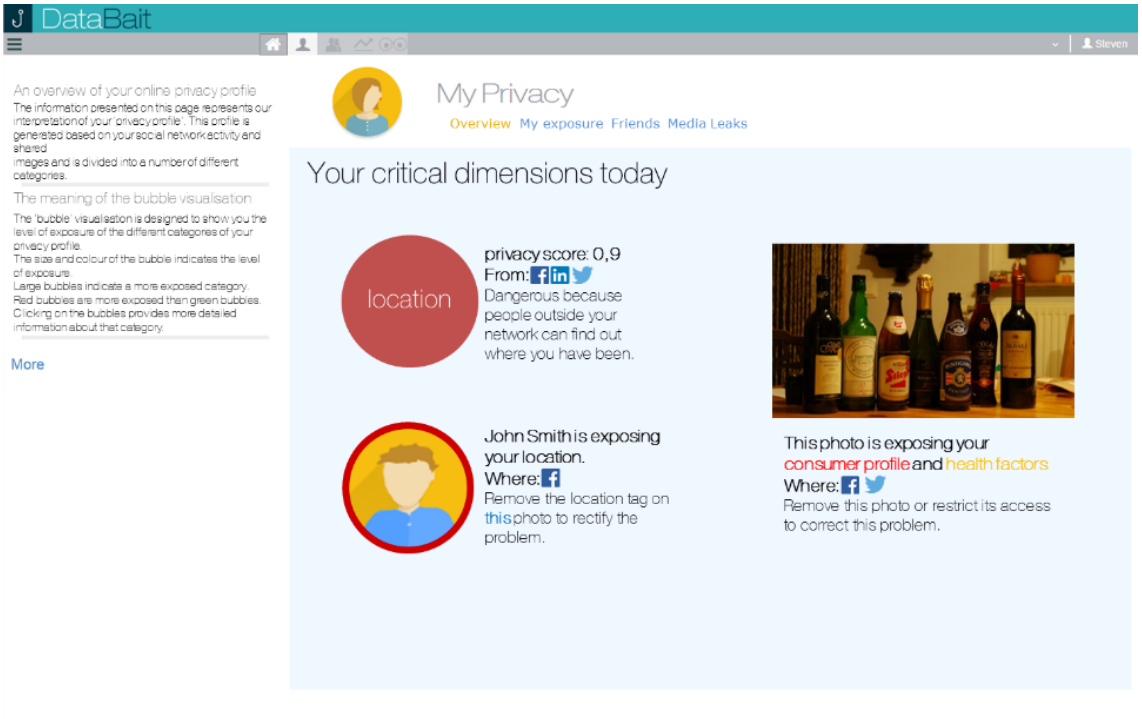


Figure 23:The inclusion of a 'true' overview which summarizes the different parts of the application was suggested by a number of users.

The first change, as illustrated in Figure 23, involved the conclusion of a 'true' overview of the different aspects of the DataBait application. The previous overview was changed to 'my exposure' due to the confusion caused for a number of participants.

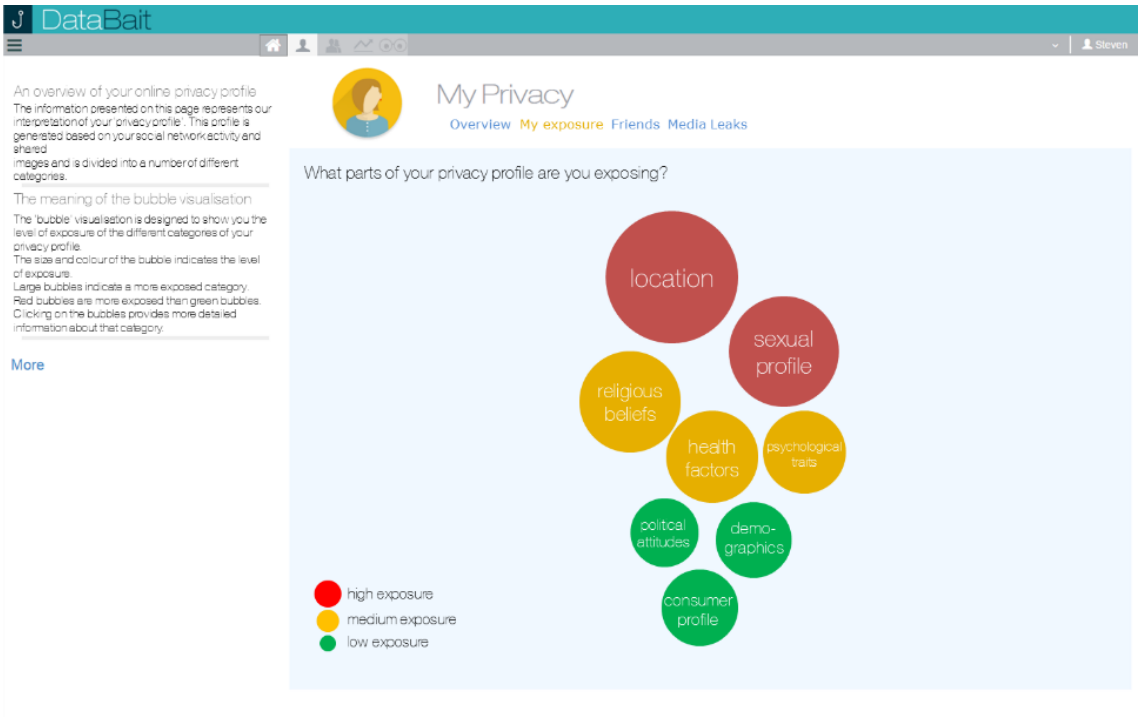


Figure 24 : The name of the overview was changes to 'my exposure' and a legend was added to aid the interpretation of the different colours and sizes of the bubbles.

The second change involved the addition of a legend to the main overview, now called 'my exposure', as illustrated in Figure 24. This legend was designed to aid the user's interpretation

of the size and colour of the bubble representation in the case where there was any confusion. This legend also enables the possibility for including different encodings for the size and the colour, potentially enabling a richer visualization.

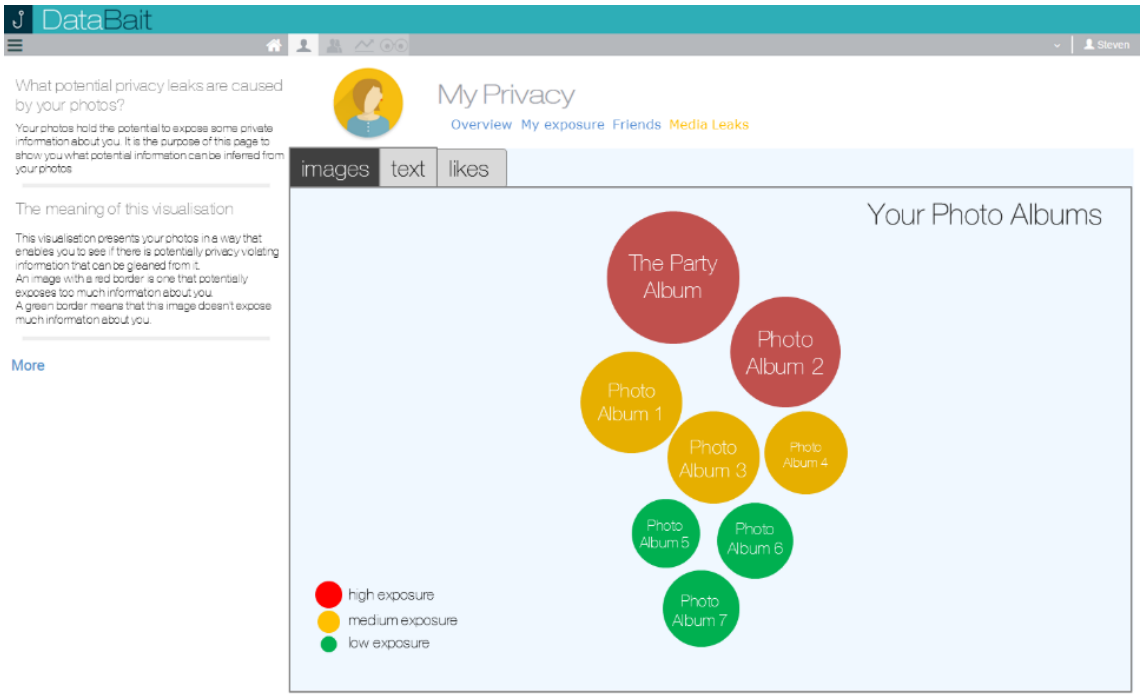


Figure 25 : The final change to the media leaks section involved the addition of a choice between different kinds of media and a change to a bubble representation to keep the overall application consistent.

The final change was made to the image leaks section, whose name was changed to ‘media leaks’ in order to include other kinds of media, such as text. The main change made was to the representation of the photo albums. This was changed to a bubble representation in order to increase consistency between the different sections of the application, as this was noted as an issue during the user study.

5.7. Recommendations

From the combination of both the expert interviews and the user study a number of different recommendations were extracted, which are designed to help both the technical implementation of the DataBait system and, more generally, other practitioners working in the field of visualisation for disclosure applications.

Interaction design guidelines

These recommendations refer to the prototype application presented above but relate more generally to the design of applications that deal with information disclosure.

- **Provide a global overview**: When providing several different views (in our case the ‘overview’, ‘friends’, ‘location leaks’ and ‘multimedia leaks’) within an application we must make it extremely clear what each view is supposed to convey without ambiguity between them. ”. In the “My privacy” application, each view was designed to provide an overview of each sub application, but the study revealed the need for a “meta-overview” that focuses only on the dangerous aspects and which provides them at a glance. This avoids the need for the user to navigate between the different views in

order to gain a global idea of their disclosure profile. This is supported by the visualization mantra from Schneiderman “Overview, zoom & filter, then details on demand.

- **Provide help/explanation**: Successfully raising awareness of threats imposed by the disclosure of personal information is the goal of these applications. The threats posed by each of the dimensions should be explicitly provided in the views not only in terms of relative impact but also complemented with explanations about the risks themselves, how the measures were calculated and with precise numeric values that help to quantify this exposure in the mind of the user. Even a simple visualisation is not always self-evident and can cause ambiguities with the meaning: provide either a legend for the coding or interactive tutorials.

- **Make the model used as transparent as possible to increase confidence in the system**: Data explaining the computations and the quantification of the exposure are not only needed to better understand the visualization but also consequently to increase the confidence in the application. On a topic as sensitive as information disclosure, keeping the users confidence is of upmost importance, without it, people will not use the application. A facility for the provision of this data should be provided. Indeed, as mentioned, the scoring framework includes pointers to the data that is related to each dimension / attribute and therefore these pointers can be shown to the user to increase the transparency and confidence of the user in the system.

- **Provide the ability to change something:** Providing a user with the power to change or alter their disclosure profile or with instructions about how this may be achieved is the key to empowering the user to take control of their online disclosure profile. A simple view of their profile is interesting but engagement is limited when nothing can be done to change it. The disclosure settings framework that is under development should cover this requirement.

- **Take into account the user’s preferences**: Users assign different importance to different dimensions and this is something that should be accommodated. Some participants actively thought this should be taken into account in the display, either by encoding it (e.g. with color) or by providing relevant filtering mechanisms. As discussed before, the sensitivity score of the different dimensions and attributes encodes the importance of different dimensions and can be set by the user. Although not not examined in the prototype that was used for the presented tests, the framework and the final visualization / interface will full support it.

- **For successful evaluation, even for low-fidelity prototypes, try to provide a glance of everything to support the understanding of visualizations**: provide not only the visualizations, but the means to understand them and be clear about the goal and the coverage of each view.

DataBait ‘My Disclosure’ Technical Implementation

These recommendations are designed to provide some guidance for the technical implementation of the DataBait front-end interface and follow from those presented above. These recommendations pertain in particular to the disclosure overview visualization (the principle goal of this deliverable) and provide recommendations for both the current implementation of the DataBait application and any future implementations.

- **Provide a consistent visualisation between sub-applications:** The initial prototype designs had very different representations for each sub-application (overview, friends, location leaks, image leaks) but after several iterations it was found that a more consistent bubble overview between the sub-applications was preferred. This rule must also apply to the design of visualisations for the User Trackers and Audience Influence aub-applications.

- **A more dynamic use of bubble metaphor will increase engagement with the data**: A consistent point that participants raised was that they would have liked to see more dynamism in the visualisation. It's widely accepted that this form of physical simulation increases user engagement with systems and this bubble metaphor was something that appealed to potential users of the system.

- **Provide a legend for users, especially if using more than one encoding**: most participants understood the colour and size encoding but some of them assumed that size and colour were not coupled. This indicates that it is possible to include separate encodings for the size and the colour if necessary. However, in this case a legend must be provided.

- **The provision of filtering options is a plus**: It was noted that both the expert users and the study participants desired some kind of filter control for the bubbles since they assigned different importance to different dimensions. A facility that enables users to give more or less prominence to certain dimensions would be a plus point.

- **Assure a consistent breadcrumb trail**: One aspect that is true for applications that involve a level of searching or zooming is that they need to assure a consistent trail through the different levels of the application. It was found that users could lose their orientation quickly. This is likely to increase the number of users abandoning the application.

- **Provide access to raw data for the interested user**: While most users were satisfied with the simple bubble visualisation and encoding, a number of users were intrigued about the raw data that was being used to display this. For this reason it's important to provide these users with the ability to see data if they wish. This should increase trust in the application for these users.

- **Show the source of the data**: Most participants were intrigued to know where the data that was being displayed was coming from. Any future implementation of the application should show clearly where each source of data is coming from.

6.Implications for other DataBait features

While these recommendations were developed for the 'my disclosure' application in mind, there are also implications for other parts of the DataBait application. Notably the Audience Influences and the User Trackers sub-applications, as illustrated in Figure 1.

While the initial designs of these sections were influenced by early versions of the bubble visualisation presented in D4.3, some effort needs to be made to render the user experiences more consistent between the different sub-applications.

This consistency could be achieved by generally following the guidelines described above but some of the more specific changes that could be implemented for each section are described below.

6.1. Audience Influence

This section currently uses a graph representation with the current user being represented by the central node and their most influenced friends spread around and connected by ‘springs’ to him/her, as illustrated in Figure 26-left.

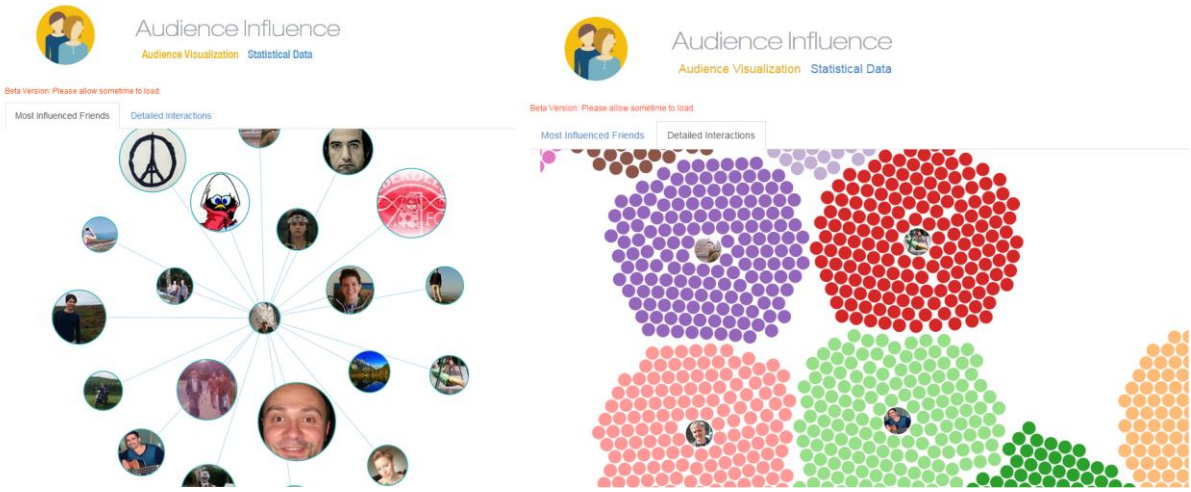


Figure 26 : Left: The current Audience Influence visualisaiton. A graph representation with the main user at the center and the most influenced friends around. The size of the friend indicates the level of influence. Right: A display of individual actions for each friend. A click on each action takes the user to the appropriate action on the facebook website.

While this view offers some form of information by varying the size of the circle in line with the number of ‘actions’, this view could benefit from some of the work on the ‘friends’ section described above.

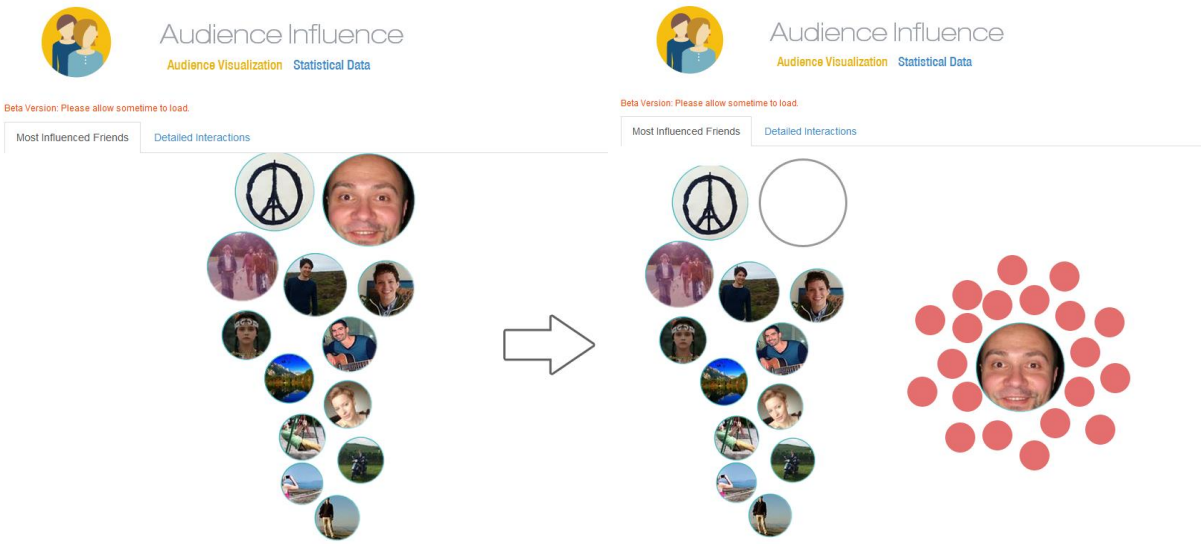


Figure 27 : The possible 'bubble' representation of the Audience Influence sub-application. The most influenced friends float to the top. Clicking on a friend's bubble provides more detailed information on individual actions.

More particularly, we could more to a more bubble like visualisation whereby each friend is represented as a bubble with the size of the bubble related to the number of actions would provide a greater level of consistency with the rest of the application and would provide at least the same level of information. This view could also be coupled to the detailed interactions tab whereby a click on a particular friend then displays the individual actions as in Figure 26-right. A mock-up of these suggestions is shown in Figure 27.

6.2. User Trackers

The User Trackers sub-application is designed to provide a user with information about the sites they have visited and any trackers or cookies which are associated with them. Users have the ability to enable or disable various cookies and trackers directly from the interface. Two views are provided, a graph view and a list view as illustrated in Figure 28.

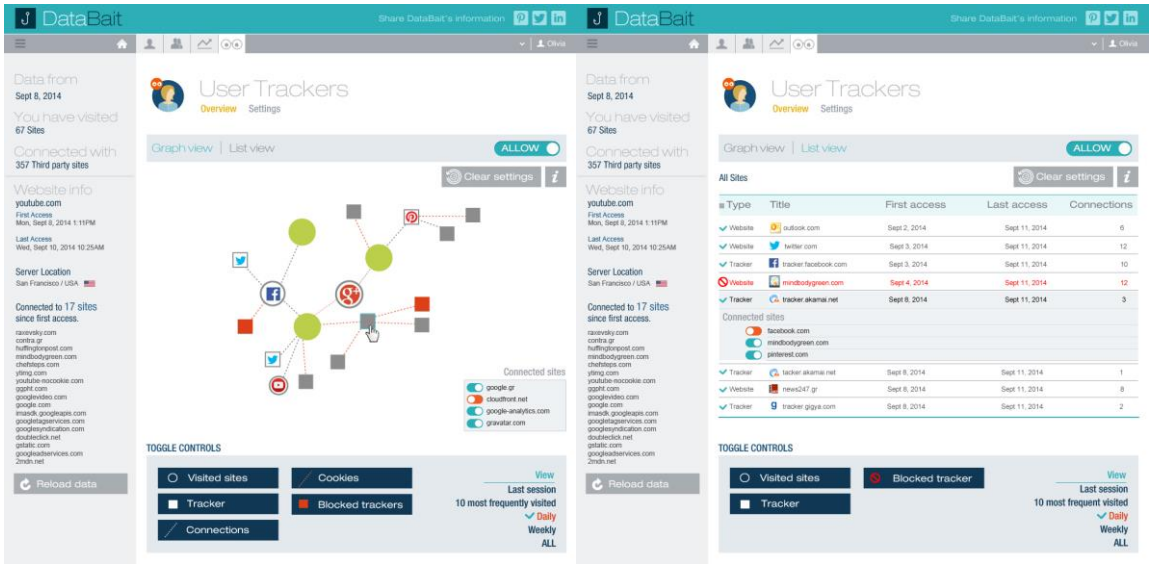


Figure 28 : Left : Graph view of trackers connected to websites visited by the DataBait application user. Right : List view of the same information.

Given the very different nature of the information being provided here when compared to the more personal nature of the ‘My Disclosure’ and ‘Audience Influence’ sub applications, both the graph and the list view represent the optimal visualisation in this case. However, some effort could still be made to better conform to the recommendations listed above. A final evaluation of this sub-application during the pilot studies will confirm its utility.

7.Conclusions

The work presented here is the culmination of a long process that has progressed from basic ideas through a series of iterations, refinements and improvements. This document has presented the final stages of that process. Moving beyond the low-fidelity prototypes of D6.3 we have now presented the results of a high-fidelity prototyping approach that has enabled the chosen ‘bubble visualisation’ to be refined to the point where it is ready to be deployed to users and also to aid other practitioners in the field.

The expert user studies have shown that while the initial prototype conveyed the basic ideas, it still contained some fundamental design flaws that risked to disrupt the overall user experience of the interaction design. By taking into account some of the comments of the expert reviewers, via two iterations, we were able to refine the interface to the point where it could be evaluated with potential users of the DataBait system.

This final round of testing showed that in general the idea of a DataBait application was well received, as was the visualisation of a user’s disclosure profile and the make-up of that profile. The only negative evaluation of the interface pertained to the lack of ability to make any changes or to alter an exposed disclosure dimension. This functionality is however a planned part of the final version of the DataBait platform. This criticism only serves to reinforce the choice to include it in the platform design.

A list of recommendations was provided that are designed to help other practitioners in this field. Their generality relates principally to the display of a ‘disclosure profile’ to users and how this should be displayed. The principle message from this list is to reduce ambiguity whenever possible by simplifying the application and to provide the ability to gain more detailed information whenever it is desired by the user.

8.References

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Forsell, C., & Johansson, J. (2010). An heuristic set for evaluation in information visualization. *Proceedings of the International Conference on …*. Retrieved from http://dl.acm.org/citation.cfm?id=1843029

Yi, J., & Kang, Y. ah. (2007). Toward a deeper understanding of the role of interaction in information visualization. *… and Computer Graphics, …*. Retrieved from http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=4376144

9.Annex I: The study materials

9.1. Expert Interviews

Heuristic Evaluation

Objective: The purpose of this evaluation is a systematic inspection of the usability of the DataBait system. Your feedback on potential issues will help the redesign of the system in the subsequent phases of our iterative design process. The system aims at providing the user with a sense of control and perception of their profile, the means to set their privacy policies while lessening the configuration burden and make the interaction enjoyable for a sense of engagement.

Instructions: Please familiarize yourself with the interface before starting to apply the guidelines listed in this questionnaire. You can do this by first testing the interface major functions. After this familiarization, you can start the systematic inspection of the interface. Please apply the guidelines listed below to all the interface's elements and functionalities and provide suggestions for improvements if any.

Typical usage scenario: Jessica is a heavy Facebook user and yet has concerns about her privacy. She has posted a few things on Facebook lately as well as some friends of her. As she wants to be careful about the information she discloses about her activities, she has installed the DataBait system which provides various visualisations that analyse the content of her posts and the ones of her friends which can influence her privacy. Today, she wants to check that she hasn't disclosed too much on her latest travels using DataBait.

1. Information coding	**Not good 0 1 2 3 4 5 6 7 8 9 10 Very good**
Perception of information is directly dependent on the mapping of data elements to visual objects. The use of additional symbols or realistic characteristics can be used either for building alternative representations (like groups of elements in clustered representations) or to aid in the perception of information elements. Encodage de l'information pour sa représentation et compréhension : mapping entre les données et les objets visuels, utilisation de symboles additionnels ou de caractéristiques réalistes.	
2. Minimal actions	**Not good 0 1 2 3 4 5 6 7 8 9 10 Very good**

(Concerns workload with respect to the number of actions necessary to accomplish a goal or a task) Le critère d'actions minimales concerne la réalisation d'une procédure, d'une suite d'actions. Pour satisfaire à ce critère, on doit éviter de solliciter une action inutile et fournir des raccourcis. Le nombre d'étapes d'une procédure doit être limité pour que l'utilisateur puisse accomplir sa tâche le plus rapidement possible.	
3. Flexibility	**Not good 0 1 2 3 4 5 6 7 8 9 10 Very good**
(Flexibility is reflected in the number of possible ways of achieving a given goal. It refers to the means available to customization in order to take into account working strategies, habits and task requirements.) La flexibilité d'un système concerne sa capacité à être adapté en fonction des besoins de l'utilisateur. Ce dernier doit pouvoir choisir de "personnaliser" l'interface selon sa façon de travailler, les commandes qu'il utilise fréquemment, etc. On doit donc prévoir plusieurs façons d'obtenir le même résultat.	
4. Orientation and help	**Not good 0 1 2 3 4 5 6 7 8 9 10 Very good**
(Functions like support for the user to control level of details, redo/undo of user actions and representation of additional information (for example, the path a user followed while navigating in a complex structure) define help and user orientation features.) Fonctionnalités telles que le contrôle du niveau de détails, annuler/rétablir, et information additionnelles de guidage.	

5. Spatial organization	**Not good 0 1 2 3 4 5 6 7 8 9 10 Very good**
(Concerns users' orientation in the information space, the distribution of elements in the layout, precision and legibility, efficiency in space usage and distortion of visual elements.) Spatial organization is related to the overall layout of a visual representation, which comprises analyzing how easy it is to locate an information element in the display and to be aware of the overall distribution of information elements in the representation. Locating an information element can be hard if some objects are occluded by others, and if the layout does not follow a "logical" organization depending on some characteristics of the data elements. So, degree of object occlusion and logical order are characteristics to be measured in the visual representation. The spatial orientation, which contributes for the user being aware of the distribution of information elements, is dependent on the display of the reference context while showing a specific element in detail. Distribution spatiale de la représentation visuelle (localiser facilement une information/un détail, avoir une vue d'ensemble, ordre logique / organisation)	
6. Consistency / Homogénéité	**Not good 0 1 2 3 4 5 6 7 8 9 10 Very good**
(Refers to the way design choices are maintained in similar contexts, and are different when applied to different contexts.) Juger de l'homogénéité d'une interface c'est donc s'intéresser à tous les aspects de cette interface, du global au particulier. Les choix réalisés pour les éléments de l'interface doivent être respectés	

dans la totalité de l'application. Cet aspect touche à la fois le visuel des éléments, leur appellation, les réactions du système, les procédures… Le revers de ce critère est que les éléments qui ne se ressemblent pas doivent être différenciés visuellement et dans leur terminologie. L'utilisateur ne doit pas confondre deux éléments parce qu'ils se ressemblent.	
7. Recognition rather than recall	**Not good 0 1 2 3 4 5 6 7 8 9 10 Very good**
The user should not have to memorize a lot of information to carry out tasks. Eviter nécessiter de mémoriser des choses pour réaliser les tâches	
8. Prompting / Incitation	**Not good 0 1 2 3 4 5 6 7 8 9 10 Very good**
(Refers to all means that help to know all alternatives when several actions are possible depending on the contexts) Le critère d'incitation permet de juger des moyens mis en œuvre pour faire connaître à l'utilisateur le contexte dans lequel il se trouve et les actions qu'il peut effectuer. E.g. Dans le domaine du web, il s'agit par exemple d'indiquer à l'utilisateur où il se trouve dans le site web et quels éléments sont cliquables. Les éléments propres à la page sont aussi des indicateurs intéressants pour optimiser le guidage.	
9. Remove the extraneous	**Not good 0 1 2 3 4 5 6 7 8 9 10 Very good**
(Concerns whether any extra information can be a distraction and take the eye away from seeing the data or making comparisons.) Présence d'éléments superflus créant une distraction.	

10. Data set reduction	**Not good 0 1 2 3 4 5 6 7 8 9 10 Very good**
(Concerns provided features for reducing a data set, e.g. filtering, clustering and prunning, their efficiency and ease of use. Filtering allows reduction of information shown at a certain moment, leading more rapidly to adjustment of the focus of interest, and clustering allows representing a subset of data elements by means of special symbols, while pruning simply cuts off information irrelevant for the understanding of a visual representation.) Mécanismes de réduction des données et leur efficacité et simplicité d'utilisation : par exemple les opérations de filtrages, de regroupement et de sélection de données.	
At this stage, how successful do you consider the system in accomplishing its goals?	**Not successful 0 1 2 3 4 5 6 7 8 9 10 Very successful**
Why? Which goals are achieved/not achieved?	

9.2. User Studies

Application "My Privacy"

Part 1. User's description

☐ Male ☐ Female

Year of birth: _____

Educational background: _____

Educational level: _____

Job title: _____

Years of experience in the current job title: _____

Years of experience in your field: _____

Use of social networks

1. How long have you been using social networks?
☐ less than a month ☐ 1 to 6 months ☐ 6 to 12 months ☐ 1 to 5 years ☐ 5 to 10 years ☐ More than 10 years

2. Frequency of use of social networks on average :
☐ never ☐ rarely ☐ several times a year ☐ several times a month ☐ once a week ☐ several times a week ☐ once a day ☐ several times a day

3. In general, your use of social networks is :
☐ Strictly Professional ☐ Mainly professional ☐ Professional and for leisure
☐ Mostly for leisure ☐ Strictly for leisure

4. Which social networks do you use :
☐ Blog(s)
☐ Facebook
☐ Linkedin
☐ Twitter
☐ Viadeo
☐ Others. Please specify : _____

5. In general, how long do you spend on social networks for professional reasons: _____

6. In general, how long do you spend on social networks for leisure: _____

7. Amongst the following functionalities, which ones do you use on social networks?
☐ Addition/creation of groups
☐ Blog(s)
☐ Chat
☐ Posts
☐ Private messages / Mails
☐ Online gaming
☐ Reading posts/articles/etc.
☐ photos/vidéos sharing
☐ Radio
☐ Shopping
☐ Watching videos
☐ Other. Please specify: _____

8. Which information do you share on social networks?
☐ Name
☐ Picture
☐ Age
☐ Date of birth
☐ Place of birth

☐ Nationality
☐ Country of origin
☐ Languages spoken
☐ Level of studies
☐ Email
☐ Professional status
☐ Salary
☐ Familial information
☐ Religious beliefs
☐ Technologies used (Smartphone, tablette, laptop, etc.)
☐ Personal traits (shy, anxious, sad, etc.)
☐ Sex
☐ Sexual tendencies
☐ Political opinions
☐ Political party
☐ Health
☐ Illegal product consumption
☐ Alcohol/cigarettes consumption
☐ Place of residency
☐ Place of work
☐ Place of holidays
☐ Visited places
☐ Hobbies/interests
☐ Favorite brands
☐ Other. Please specify: _____

9. Compared to your first usage, would you say that the frequency of your activity on social media today is :
☐ A lot less ☐ A little less ☐ Identical ☐ A little bit more ☐ A lot more important

If the frequency of your activity is less than it used to, please explain briefly why:

Your information on social networks

10. Are you concerned about your privacy on social networks?

☐ Not at all ☐ rather not ☐ rather okay ☐ of course

Level of concern about your privacy: □ Null □ Low □ Medium □ High

11. If you share personal information on social networks, what is the frequency of times you provide false information? _____%

12. Would you be willing to provide voluntarily personal information to social networks so that the advertisement targets your taste and interests?

☐ Not at all ☐ rather not ☐ rather okay ☐ of course

13. Would you be willing to do it if the social networks remunerated for it?

☐ Not at all ☐ Rather not ☐ Rather okay ☐ Of course

Part 2. User tests

Question 1: *Look at the application « My Privacy » and rank the privacy dimensions from 1 to 8 in order of their importance to you.*

☐ Location
☐ Sexual Profile
☐ Religious Attitudes
☐ Psychological traits
☐ Demographics
☐ Political Attitudes
☐ Health Factors
☐ Consumer profile

Question 2: *In your opinion, what is the utility/meaning of the:*

- Bubble color?

- Bubble size?

Question 3: *Which media is responsible for revealing the user's location?*

☐ Activity ☐ Text ☐ Images

Question 4: *Which of the user's friends are influencing the "location" privacy dimension?*

Question 5: *Look at the shared photo albums and select a particular album. The photos are displayed with a coloured outline. In your opinion, what is the utility/meaning of the colours?*

User interface evaluation

1 (Strongly disagree); 5 (Strongly agree); N/A (Not applicable)

Ease of use	1	2	3	4	5
Learning to operate the application “My privacy” is intuitive and easy for me. If it is perceived to be difficult, please explain why:					
I feel comfortable using the application “My privacy”.					
Some information is missing to help using the application. Please specify:					
I find the application “My privacy” unnecessarily complex. Please specify:					
The learning is mentally demanding.					

Quality of the graphical interface	1	2	3	4	5
The interface of the application is pleasant.					
The visual information is easy to understand.					
The organization of information on the screen is clear.					
Information is short and effective in helping me visualize my privacy exposure level.					
It is easy to find the information I need.					
I find some essential information is hidden or filtered out.					
The colour contrast is appropriate.					

System reactivity	1	2	3	4	5
This application has all the functions and capabilities I expect it to have.					
Some actions are not acknowledged the way I expected. Please specify:					
I have confidence in the application.					

Benefit evaluation of visualisation elements

1 (Strongly disagree); 5 (Strongly agree); N/A (Not applicable)

Motivational impact	1	2	3	4	5
I would enjoy using the application very much.					
The application improves my interest in my privacy management.					
The application promotes my self-efficacy in my privacy management.					
The engagement is low or nil.					
Interacting with the application is fun to do.					
I can effectively manage the privacy exposure level using the application.					
I am able to manage the privacy exposure level quickly using the application.					
The application is a motivating support for visualisation and understanding of my privacy exposure level.					
The bubbles are frustrating/annoying elements. Please specify:					

Adaptability of the application to needs	1	2	3	4	5
The application matches with the informational objectives.					
The understanding of the visualisation elements when using the application is mentally demanding.					
The visualisation elements improve the understanding of the privacy exposure level.					
Added value of visualisation elements	**1**	**2**	**3**	**4**	**5**
Using the application is a good method to know the elements that I shared.					
Using the application is a good method to know the dimensions revealed by others (e.g. friends).					
The application makes privacy management more interesting.					
The visualisations elements are relevant and helpful.					
A good support is provided for correcting/reducing the privacy exposure level.					
Overall, I am satisfied with the application. If not, please specify:					

Comments or suggestions

Would you like the system to provide other types of information?