User perception of 4 hierarchical layouts

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ABSTRACT
Information visualization offers an opportunity to provide quick overviews and support exploration of the information landscape. However, there are many visualization techniques and layouts to choose from and some designs work better than others. The poster presents four hierarchical layouts developed in our FrbrVis prototype to display bibliographic work families and looks at user’s perceptions of the layouts gathered through a usability study. The results of reaction cards and interviews show that the radial layout was perceived least favorably while sunburst received the highest number of positive comments.

Keywords
information visualization, hierarchical technique, user perception, user studies

IMPLEMENTATION DESIGN
Using information visualization techniques, we designed a user interface for exploring not only expressions and manifestations of a literary work, but also works related to the work and other works by and about the author. Based on the predominant data structures and the desired functionality of the FrbrVis prototype, hierarchical technique was chosen for implementation (for more details see Merčun et al., 2012). Four common hierarchical representations identified by Zhao et al. (2005) were used as the basis (Figure 1), as for each of the four types, one of the possible 2D visualization layouts has been implemented and tested in the final prototype (Figure 2):

A. indented hierarchical list (H; hierarchy),
B. radial tree (R),
C. circlepack (C),
D. sunburst (S).

INTRODUCTION
In its early days, the field of information visualization has mostly focused on the development of innovative information visualization techniques and there were relatively few studies analysing the effectiveness of visualizations (Stasko et al., 2000). As the area matured and became more widespread, the need for more critical and empirical studies emerged to help better understand the strengths and weaknesses of visualizations, the tasks they are most appropriate for and the features that need to be improved. This study tries to enrich the body of knowledge on different visualization designs by looking at user experience and user perceptions of four hierarchical layout techniques.

Figure 1. A. indented outline, B. node-link graph, C. nested containment, D. alignment and adjacency.

A and B belong to a node-link representation while C and D present a space-filling tree representation scheme. Node-link representation can be oriented top-down, left-right, or radially. It is most familiar to users and better at showing the depth of the tree, but fails to scale to large datasets (Zhao et al., 2005) and is less efficient in its use of screen space (Plaisant et al., 2002). Space-filling representations, on the other hand, can be characterized by their compactness and effectiveness at showing the properties of nodes in a hierarchy through size or colour (Shi et al., 2005). Child nodes can be placed inside (case C) or outside (case D) the parent node and can take rectangular or radial/circular form.
STUDY DESIGN

Between December 2011 and January 2012, a usability study with 152 undergraduate and postgraduate students was carried out to test the proposed model for presenting work families as well as to examine which of the four layouts would be most appropriate for further development. While the formal and observational experiment provided also a number of quantitative measures and compared FrbrVis to a baseline interface, this poster focuses on user perceptions of the four visual designs.

Figure 3 illustrates the factorial design of our two experiments. Due to the large number of experimental conditions, each of the 120 participants in the formal experiment worked with 3 out of 5 prototype designs which meant that a prototype design was tested 72-times (18-times with each of the four work family examples). In the observational experiment each visualization was tested 8-times as 32 participants worked with a baseline system and only one of the four visual designs. In both cases, experimental conditions as well as tasks were randomly counterbalanced to avoid order effect. While the observational experiment asked users to freely explore the interface and describe what they have learned about the work and how the system worked, the formal experiment provided participants with 10 lookup tasks within each prototype (for example: “Find the newest edition of an audio book Little Women. When was it published?” or “Find different versions and editions of the work Little Women and describe the main differences between them.”).

USER PERCEPTION OF THE FOUR DESIGNS

The overall results of reaction cards from the two experiments (Figure 4) show that out of the four layouts, radial design received the largest number of negative and the smallest number of positive comments. Interviews revealed that participants found the lines and dots confusing; they often described that it took them a long time to get an overview of what was presented, how it made their eyes dart around and how each time they clicked on a node, the change in the visualization was distracting:

- “…when you click on something, the positions change and you have to read everything once more to get a sense of where you are”
- “I really did not like this system, the way the dots move around…everything seems too scattered…”
- “it is interesting and unusual, but with the dots and lines it confuses you and it takes time to click on the node”

Circlepack received the second largest number of negative comments, but also the second largest number of positive ones. On the positive side participants thought it was interesting and fun, but still found it somewhat difficult to understand at times:

- “there were too many circles, I did not find my way around very well, or see connections”
- “it is something really new, so when you first get into the system, it is difficult to understand, but when you get to know it, it is quick to understand”

Out of the four layouts, hierarchical list and sunburst were seen most favourably. Interestingly, hierarchy got very few
negative remarks, but it was the sunburst design that received the largest number of positive comments. For hierarchy most participants pointed out that it is organised, systematic and easy to use. With the sunburst layout, on the other hand, many participants noted that it was innovative, quick to understand and very logical after the first few clicks. They also particularly liked that it did not change too much (compared to others) and that they always knew their position in the hierarchy.

Comparing the user perceptions from reaction cards to user performance data also collected in the study, we can observe that both approaches gave similar results. Measuring task times, task success, use of navigation, and ease of use namely showed that participants performed best using hierarchical indented list and sunburst and significantly worst using the radial layout.

CONCLUSION
Based on our study, we cannot conclude that space-filling representations have, for example, been in general received better than node-link ones. However, despite having the same underlying data structures, the four visualizations were seen differently. This tells us that it is important to explore also user perceptions as they provide a better insight into which elements users find useful and pleasing and which they see as confusing, distracting, and complex. While some reactions may be the reflection of our particular implementation, many of the users’ comments also help us understand more general principles of different layouts and information visualization dynamics.

REFERENCES


