Comparing Two Interface Tools in Performing Visual Analytics Tasks

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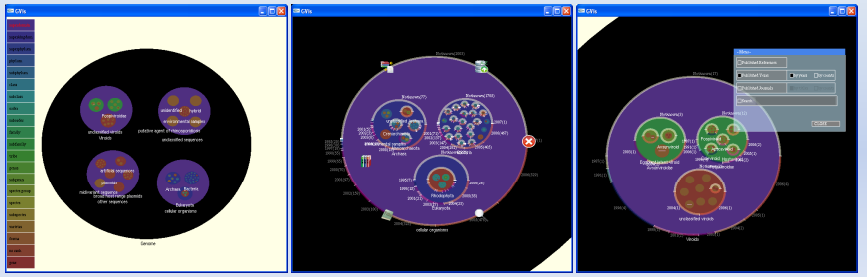
Introduction

In visual analytics, menu systems are commonly adopted as supporting tools because of the complex nature of data. However, it is still unknown how much the interaction implicit to the interface impacts the performance of visual analysis. To show the effectiveness of two interface tools, one a Floating text-based menu (Floating-Menu) and the other a more Interactive iconic tool (Interactive-Icon), we evaluated the use and human performance of both tools within one highly interactive visual analytics system. We asked participants to answer similarly constructed, straightforward questions in a genomic visualization, first with one tool, and then the other. During task performance we tracked completion times, task errors, and captured coarse-grained interactive behaviors. Based on the participants' accuracy, speed, behaviors and post-task qualitative feedback, we observed that although the Interactive-icon tool supports continuous interactions, task-oriented user evaluation did not find a greater difference between the two tools because there is a familiarity effect on the performance of solving the task questions with using Floating-menu interface tool.



System Overview | Interactive-Icon | Floating-Menu

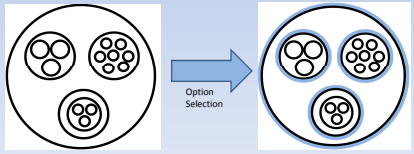
Gvis (Gemonic Visualization)

GVis [2] is an expert visualization system (a zoomable interface) that helps bioinformaticians to support the visual analysis of large-scale phylogeny hierarchies populated with the genomic data of various organisms. It uses a publicly available biological database (Gen-Bank) hosted by the National Center for Biotechnology Information (http://www.ncbi.nlm.nih.gov/) to picture the phylogeny hierarchies of organisms and allows the user to quickly browse the hierarchy from the highest-level, base categorization down to the level of individual genome for the desired organism of interest. On top of GVis, two menu tools were designed: Floating-Menu and Interactive-Icon.

Commonly used menu systems in visual analytics

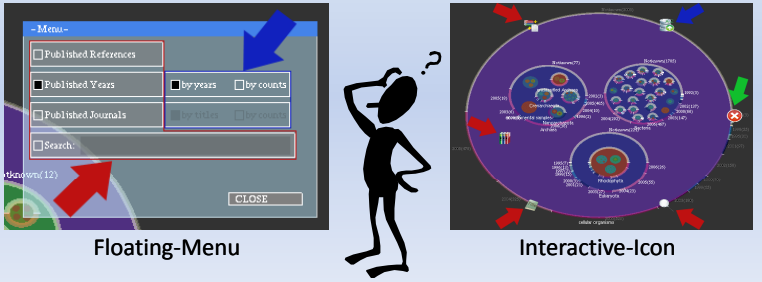
Pull-down menu | Internally positioned | Externally positioned | Floating menu

Representing Information



Organism A | Organism A

What interface tool is good for solving a complex problem in visual analytics?



Floating-Menu | Interactive-Icon

Comparative Study

31 participants (twelve males and nineteen females) performed a total six performance tasks, 3 with each interface. The study includes a tutorial (a general explanation), a training (a detail explanation about how to use each tool), and a main evaluation study (accuracy, speed of the analysis are quantitatively measured, and qualitative feedback on ease of use, ease of learning, preference, and effectiveness are also evaluated.)

Two sets of task questions are used:

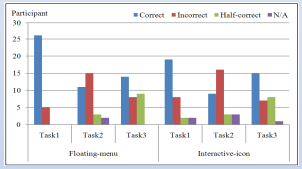
[SET-1]
- Count how many papers were A) published and B) not published about the group Bacteria.
- Find the organism whose one research paper was published in 2007.
- This question has three parts.

1. First, count how many publications were published about group Rhizobiales.
2. Secondly, count the number of publication(s) for Rhizobiales in 1995.
3. Thirdly, name the journal that published 7 papers in total about Rhizobiales.

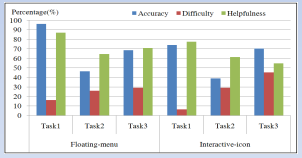
[SET-2]
- How many papers in total were published about the Apscaviroid group?
- Name the organism whose research paper(s) were published in 1987.
- There were multiple papers published in 2006 about the Micrococcineae (This questions has 2 parts).

1. First, how many papers are published in 2006?
2. And what is name of the journal that published 11 of those papers?

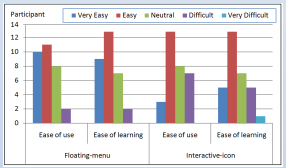
Evaluation Results



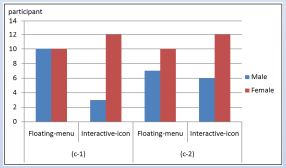
Accuracy with (p=0.23) and without (p=0.24) a half point given.



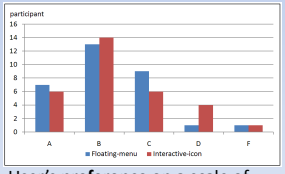
With a easy and helpful interface, the participants solved the tasks more accurately ($p < .0001$ for easiness and $p < .0001$ for helpfulness).



From the post-study questionnaire, we found that about 67% (21) and 51% (16) of the participants rated that Floating-Menu and Interactive-Icon were **easy to use**, respectively (see Figure 1(e)). A positive significant correlation was found between **ease of use** and task accuracy ($r(185) = .21$; $p = .0035$), as well as between **ease of learning** and task accuracy ($r(185) = .28$; $p = .0001$)).



Which interface did you like **better** (c-1)? and Which interface did you feel more **comfortable** (c-2)?



User's **preference** on a scale of 'A' to 'F'.

Conclusion and Future work

Green et al. [1] claim that menus cause considerable interruption to the analysis process. Lim et al. [3] reports that menus and direct manipulation icons are not comparable in performance. Our traditional task-oriented evaluation tends to support the no-difference claim by Lim et al. However, we did not find evidence to support the interruptive-menu claim made by Green et al.

What is really necessary to be considered?
- Cognitive flow (How does the user's analysis process get interrupted?)
- Familiarity (How much does the user get familiar with each interface tool?)
-Reasoning process (How does the user build his reasoning process easily with what interface tool?)

What we need to do for future work?
We and others can now undertake deeper and more careful studies on the relationships between interaction, cognitive flow, and the reasoning process. This is a central research issue for visual analytics.

References
[1] T. Green, W. Ribarsky, and B. Fisher. Visual analytics for complex concepts using a human cognition model. pages 91–98, VAST 2008, Oct. 2008.
[2] J. Hong, D. H. Jeong, C. D. Shaw, W. Ribarsky, M. Borodovsky, and C. G. Song. GVis: A scalable visualization framework for genomic data. In K. Brodlie, D. J. Duke, and K. I. Joy, editors, EuroVis, pages 191–198. Eurographics Association, 2005.
[3] K. H. Lim, I. Benbasat, and P. A. Todd. An experimental investigation of the interactive effects of interface style, instructions, and task familiarity on user performance. ACM Trans. Comput.-Hum. Interact., 3(1):1–37, 1996.