

# What To Do About Those Pesky Users?

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## ABSTRACT

Most InfoVis/Visual Analytics researchers want users to enthusiastically adopt new visualizations and workflows, but engaging users is often a daunting challenge for researchers who are unfamiliar with the methods and techniques of user-oriented design. This workshop will provide an opportunity for social, behavioral, and computer scientists to articulate, discuss, and document methods and frameworks for gathering design-relevant information from end-user communities who can benefit from well-designed InfoVis/Visual Analytics systems. Engaging potential users may feel more pesky than rewarding, but with some guidance on how to approach a user community, the experience can be great fun – and beneficial to one’s software development goals. The organizers are an interdisciplinary group of researchers who share a passion for understanding “what works” in visualization; more importantly, we want to understand *why* particular affordances, features, and processes distinguish a good tool from those that are not so good. In this workshop, we will engage participants in a day-long discussion about the practicalities of user-oriented design for InfoVis/Visual Analytics projects. Participants will be encouraged to bring questions and challenges for discussion; in addition, the organizers will identify the questions that every visualization researcher *should* have about visualizations, workflows, and end user outcomes.

**Keywords:** Design Methods, User Interactions, Evaluation, Usability, Utility.

## 1 INTRODUCTION

Despite a collective commitment to engaging end-users in the design and evaluation of analytic tools, the Information Visualization/Visual Analytics (InfoVis/VA) community is not very consistent in articulating and applying methodological principles for system design and end-user evaluation of InfoVis/VA systems. This workshop will provide an opportunity for social, behavioral, and computer scientists to articulate, discuss, and document methods and frameworks for gathering design-relevant information from end-user communities who can benefit from well-designed InfoVis/VA systems. The organizers are an interdisciplinary group of researchers who share a passion for understanding “what works” in visualization; more importantly, we want to understand why particular affordances, features, and processes distinguish a good tool from those that are not so good. In this workshop, we will discuss the questions that researchers and developers *should* have about how their technologies can support the work of their intended end users. We are particularly interested in teasing out the challenges of user studies: problems with methods, data collection, or determining how to integrate user study findings into InfoVis/VA research and development activities; then helping participants locate resources and expertise to address these challenges in their work.

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We will advertise the workshop on a webpage and invite potential participant to develop a one-page case study for discussion at the workshop. We will solicit questions from participants about end user issues, from requirements elicitation to conducting utility and usability evaluations. Participants will be asked to submit any methods that they used along with issues they had using the methods or determining how to integrate the results into their research. We will provide an initial framework for these questions and adapt it as necessary given input from participants.

We will provide participants with an initial checklist of questions and ways to address them. In the workshop the organizers and others speakers will introduce participants to various methods and techniques that can be used to answer various questions. Participants will also be asked to present their questions and various issues they had in obtaining answers to them. After the workshop, the organizers will combine these discussions and produce a checklist of common user-oriented research questions, along with methods and techniques that support answering those questions, as well as an extensive annotated reference list. These will be shared with participants along with the request to provide feedback on their future experience using these. If there is sufficient interest, we will hold another workshop or perhaps a special interest group in 2016 to discuss changes that should be made to the checklist.

## 2 PROPOSED APPROACH AND LOGISTICS

The goal of this workshop is to provide researchers and developers with a good understanding of the types of user evaluations that can be conducted, the resources needed to conduct these different evaluations, and the questions that can be answered using each of these different evaluations. We envision a workshop that engages participants in discussing the practicalities of user-oriented research, as discussed below.

### 2.1 Proposed Content

We envision a full-day interactive workshop comprising methodological overviews, problem-focused case study presentations, and collaborative discussions. We realize that VisWeek/VAST workshops are open to all conference participants. However, we would like to cap attendance at about 30 people, so that participants can engage domain experts in discussing their specific user community challenges.

Prior to the workshop we will design a web page that will list a set of initial questions and techniques formulated by the committee. Participants will be asked to comment on the usefulness of those questions to their work, propose other questions, and provide details on the questions and provide a description of what they have done to resolve these questions if appropriate. We will then develop our workshop materials to provide attendees with methods to answer the questions they have about their systems.

This workshop is aimed at InfoVis/Visual Analytics researchers who have recently performed, are currently performing, or are planning an end-user research engagement. Organizers and participants will address methodological topics

and questions that frequently crop up when computer scientists are working with end users of visualizations and visual analytics environments. The following research frameworks are well-suited to addressing various types of user-oriented design and evaluation questions:

- *Cognitive Work Analysis (CWA)*: What elements constitute this work domain? What are the major activities, resources, tools, goals, and expected outcomes? What are the keystone tasks that must be completed for the group to accomplish its work? How can work domain decomposition reveal critical requirements for analytic system design?
- *Cognitive Task Analysis (CTA)*: How do people perform keystone tasks? What are the principal sources of variation in task approach and performance? How can task analyses help developers identify system requirements?
- *Enactive Distributed Cognition (D-Cog)*: Does interaction with the visualization support domain professionals in reasoning about the problem? Can it be used to propose and evaluate alternative hypotheses and explanations?
- *Visual Cognition*: Can users see the important patterns in the data? Does the interface support the acquisition and utilization of visual expertise (i.e. visualization literacy)? Are the users confused or misled by the visualization?

Other frameworks, approaches, and methods to be discussed include observational study design and implementation, contextual inquiry, activity theory and distributed cognition, basic usability evaluation, including heuristic reviews; qualitative usability methods, quantitative usability testing, and new user training approaches.

## 2.2 Time Line

As submission acceptance for workshops will be announced on May 15, we propose to have our initial framework of methods and questions developed and published on a web site no later than June 1. We will advertise this web site at this point and ask potential participants to submit questions and issues they may have had with trying to answer questions about their systems. We will ask that these submissions reach us by August 1. We will review these submissions and revise our framework accordingly. We will select participants to present based on the generalizability of their question or issues to the community. Based on the revised framework for the workshop, we will invite additional speakers. At this point if we have not received 30 applications, we will advertise again with the clarification that while additional participants will be added, any additional framework revisions will only occur during the workshop.

We will develop an electronic checklist during the workshop that will be available on the workshop web site for participants. This will include the ability to look by question to determine various methods that can be used or to look at the techniques and determine the types of questions that can be answered using a given technique. We will give the participants some time to try using this checklist and provide feedback. Once we have incorporated feedback, we will provide this information in some published form to the VisWeek community.

## 2.3 Suggested Workshop Participants/Presenters

In discussing this workshop, the organizers identified a preliminary set of InfoVis/VA experts who have demonstrated leadership in human-focused visualization design and evaluation. If the proposed workshop is accepted, we will invite some of these individuals to give a brief “lessons learned” based on their user experiences and/or participate as discussants for participant case studies.

- **Simon Attfield**, Middlesex University, London
- **Sheeghagh Carpendale**, Innovative Visualizations, University of Calgary
- **Tamara Munzner**, Visual Analysis and Design, University of British Columbia
- **Margit Pohl**, Human-Computer Interaction Group, Vienna University of Technology
- **Bill Ribarsky**, Charlotte Visualization Center, UNC Charlotte
- **Colin Ware**, Visual Design, University of New Hampshire
- **Krist Wongzuphasawat**, Visual Analytics Researcher, Twitter

In addition, as we learn more about our participants’ challenges for engaging user communities, we plan to identify other domain experts who can help workshop participants with specific questions about user engagement strategies. We will ask domain experts who may not be able to attend to provide a short write-up and references to distribute along with our final checklist.

## 2.4 Workshop Room Arrangement

The workshop should be setup with tables and chairs in a lecture format. We will need two projectors as we will allow speakers and participants to show slides to enhance their presentations. We will also be taking notes that will be displayed in real-time on a second screen. We also need a room that will accommodate breaking into discussion groups during the workshop.

## 3 ORGANIZERS’ BACKGROUND AND SELECTED PUBLICATIONS

The organizers’ background and selected publications are summarized below.

**Brian Fisher** ([brianfisher@ieee.org](mailto:brianfisher@ieee.org)) is an Associate Professor at Simon Fraser University and Associate Director of the Media And Graphics Interdisciplinary Centre at the University of British Columbia. His research focuses on human perception, cognition and collaboration with visual information systems. Dr. Fisher serves on the VAST Steering Committee and VIS Executive Committee. He chaired VAST 2010, ISCRAM 2012, and the International Symposium on Smart Graphics in 2004 and 2006. He publishes in computing and cognitive science journals and conference proceedings. Selected publications are listed below.

1. Kaastra, L.T., & Fisher, B. (2014) Field Experiment Methodology for Pair Analytics. BELIV 2014: Beyond Time and Errors - Novel Evaluation Methods for Visualization. Visweek 2014, Paris France.
2. Al-Hajj, S., Pike, I., Riecke, B., & Fisher, B. (2013) Visual Analytics for Public Health: Supporting Knowledge Construction and Decision-Making. Proceedings of the 46th Annual Hawaii International Conference on System Sciences. IEEE Digital Library
3. Arias-Hernandez, R., & Fisher, B. (2013) A Qualitative Methodology for the Design of Visual Analytic Tools for Emergency Operation Centers. Proceedings of the 46th Annual Hawaii International Conference on System Sciences. IEEE Digital Library.
4. Kaastra, L.T., Arias-Hernandez, R., & Fisher, B. (2012) Evaluating Analytic Performance. BELIV 2012: Beyond Time and Errors - Novel Evaluation Methods for Visualization. Visweek 2012, Seattle, WA

5. Fisher, B., Green, T.M., Arias-Hernández, R. (2011) "Visual Analytics as a Translational Cognitive Science," Topics in Cognitive Science 3,3 609–625
6. Green, T.M., Jeong, D. H., & Fisher, B. (2010) Using Personality Factors to Predict Interface Learning Performance. Proceedings of the 43th Annual Hawaii International Conference on System Sciences, pg. 1-10. IEEE Digital Library
7. Ribarsky, W., Fisher, B. Pottenger, W. (2009). "Science of Analytical Reasoning," Information Visualization 8(4). 254-262.

**John Alexis Guerra Gomez** ([john.guerra@gmail.com](mailto:john.guerra@gmail.com)) is a recent graduate of the University of Maryland and currently works as an information visualization Researcher at Yahoo Labs. His research focuses on incorporating the user in the data analysis loop. For this, he designs rich and interactive information visualization interfaces that allow users to find insights in their own data. To evaluate such systems, John uses Multi-dimensional In-depth Long-term Case Studies (MILCS), a technique more suitable than controlled experiments and usability studies to validate such complex systems. John conducted 14 case studies to evaluate his PhD Thesis TreeVersity, an information visualization tool to compare changes in datasets over time using hierarchies. In the past he has also work visualizing network structures and currently works on visualizing big photo repositories. Selected publications include:

1. Guerra-Gomez, J. A., Pack, M. L., Plaisant, C., & Shneiderman, B. (2013). Visualizing change over time using dynamic hierarchies: Treeversity2 and the stemview. In *IEEE Transactions on Visualization and Computer Graphics* (Vol. 19, pp. 2566–2575). IEEE. doi:10.1109/TVCG.2013.231
2. Guerra-Gomez, J. A. (2013). *Exploring differences in multivariate datasets using hierarchies, An interactive information visualization Approach*. University of Maryland at College Park, <http://drum.lib.umd.edu/handle/1903/14484>
3. Wongsuphasawat, K., Guerra-Gomez, J. A., Plaisant, C., Wang, T. D., Taieb-Maimon, M., & Shneiderman, B. (2011). LifeFlow: visualizing an overview of event sequences. In *Proceedings of the 2011 annual conference on Human factors in computing systems - CHI '11* (p. 1747). New York, New York, USA: ACM Press. doi:10.1145/1978942.1979196

**Laura A. McNamara** ([lamcnam@sandia.gov](mailto:lamcnam@sandia.gov)) is Principal Member of Technical Staff at Sandia National Laboratories. She is an organizational anthropologist who has spent her career performing design studies with professional technical communities in support of the design, development, deployment and evaluation of analytic software. She is particularly keen on helping computer scientists learn about research methods for engaging users in deconstructing and analyzing work domains, towards the end of developing better tools to support human cognitive work. Recent relevant publications include:

1. McNamara, Laura A., Cole, K.S., Haass, M.J.; Matzen, Laura E.; Morrow, J.D.; Stevens-Adams, S.M.; McMichael, S.N. 2015, "Ethnographic Methods for Experimental Design: Case Studies in Visual Search. Human Computer Interaction International," Los Angeles, CA, August 2015.
2. McNamara, Laura A; Cole, K.S.; Stevens-Adams, Susan. Where Do I Start? Practical Methods for Design Studies in Information Visualization and Visual Analytics. Tutorial Presented at IEEE VisWeek/VAST, Paris, France, November 2014.

3. Stevens-Adams, S.M.; Cole, K.S.; McNamara, Laura A. 2014. "Theory, Framework and Method for Software Design Studies in Security and Intelligence Analysis Work Environments." IEEE Joint Intelligence and Security Informatics Conference The Hague, Netherlands, September 2014.
4. Carroll, M; Burris, E.; Chow, JG; McNamara, L.A.; West, R.D. 2014. "Expert Knowledge Evaluation of Coherent Change Detection (CCD) Imagery: Developing a CCD Interpretability Metric." SENSAC Tri-Services Radar Conference, Washington, DC, July 2014
5. Cole, K.S.; Stevens-Adams, S.M.; Ganter, J.H.; McNamara, Laura A. 2014 "Applying Cognitive Work Analysis to a Synthetic Aperture Radar System." Human Computer Interaction International, Crete, Greece, June 2014.
6. Cole, K.S.; Stevens-Adams, S.M.; McNamara, Laura A. 2014. "Hierarchical Task Analysis of a Synthetic Aperture Radar Analysis Process." Human Computer Interaction International Crete, Greece, June 2014.

**Jean Scholtz** ([jean.scholtz@pnnl.gov](mailto:jean.scholtz@pnnl.gov)) is Chief Scientist at Pacific Northwest National Laboratory. Jean has worked in user evaluation area for over 30 years. In her work at NIST she was responsible for developing the CIF, the Common Industry Format, for reporting usability evaluations. This is now an ISO standard that many companies use in their Request for Proposals. At PNNL, she was on the original committee who started the VAST Challenge. She has used information gleaned from the VAST Challenge to assess guidelines for visual analytics environments that are not covered in the HCI literature. Recent publications include:

1. Scholtz, J., Love, O., Whiting, M., Hodges, D., Emanuel, L., Stanton-Frazer, D. (2014) "User-Centered Evaluation: Evaluating underlying models." Proceedings of BELIV'14, Paris, France.
2. Tarrell, A., Fruhling, A., Borgo, R., Forsell, C., Georges G. Grinstein, G., and Scholtz, J. (2014) "Toward visualization specific heuristic evaluation." Proceedings of BELIV'14, Paris, France.
3. Scholtz, J., Whiting, M. Plaisant, C., Grinstein, G. (2013) "Evaluation of Visual Analytics environments: The road to the visual analytics science and technology challenge evaluation methodology." *Information Visualization*. 2013.
4. Chinchor, N., Cook, K., and Scholtz, J. (2012) "Building Adoption of Visual Analytics Software." *Expanding the Frontiers of Visual Analytics and Visualization*. London: Springer, pp 509-530.
5. Scholtz, J. (2011) Developing Guidelines for Assessing Visual Analytic Environments. *Information Visualization* 10(3): 212-231
6. Isenberg, P., Elmqvist, E. and Scholtz, J. 2011. Collaborative Visualization: Definition, Challenges, and Research Agenda. *Information Visualization* 10(4): 310-326 (2011).

#### ADDITIONAL REFERENCES

We may be able to discuss these references during the session but in addition, these along with other references will be included as handouts.

- [1] Amar, R., & Stasko, J. (2004). A knowledge task-based framework for design and evaluation of information

visualizations. In Information Visualization, 2004. INFOVIS 2004. IEEE Symposium on (S. 143–150). IEEE.

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- [4] Freitas, C. M., Luzzardi, P. R., Cava, R. A., Winckler, M., Pimenta, M. S., & Nedel, L. P. (2002). On evaluating information visualization techniques. In Proceedings of the working conference on Advanced Visual Interfaces (S. 373–374). ACM.
- [5] Scapin, D. L., & Bastien, J. C. (1997). Ergonomic criteria for evaluating the ergonomic quality of interactive systems. *Behaviour & information technology*, 16(4-5), 220–231.
- [6] Shneiderman, B. (1996). The eyes have it: A task by data type taxonomy for information visualizations. In *Visual Languages, 1996. Proceedings., IEEE Symposium on* (S. 336–343). IEEE.
- [7] Zuk, T., & Carpendale, S. (2006). Theoretical analysis of uncertainty visualizations. In *Electronic Imaging 2006* (S. 606007–606007). International Society for Optics and Photonics. Abgerufen von <http://proceedings.spiedigitallibrary.org/proceeding.aspx?articleid=728263>