Predicting Insight-Directed Behavior in a Brain Imaging Analysis Task

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ABSTRACT

The analysis of brain imaging data is key to many vital research areas in neuroscience and cognition. However, as in many applications in scientific visualization, analyzing these data is both difficult and slow-paced. Improvements to the speed and accuracy of the analysis process could have a significant impact on the ability of these researchers to perform more and better experiments. In this work, we present a pilot study demonstrating a novel approach to identifying the patterns that lead to wasted time in the analysis process, as well as the patterns that are most productive. Our approach combines observation-driven task analysis with insight evaluation and measures of cognitive load to isolate common interaction patterns that either precede or lead away from useful discoveries. Our preliminary results show a predictable set of patterns that could be automatically identified as part of evaluation or adaptive analysis software.

Index Terms: H.5.m [Information Interfaces and Presentation (HCI)]: Miscellaneous

1 INTRODUCTION

- Motivation: brain imaging analysis. Critical area. Lots of different types of data, mishmash of analysis software. Bottleneck in research.
- What's needed is a better understanding of the analysis process; how it works, what makes it not work.
- Our approach: task analysis + insight and cognitive load. Task analysis with more data about what's going on in the black box.

2 RELATED WORK

[goal is to build on existing task analysis work by combining with evaluation methods that tell us more about critical points in the user's process.]

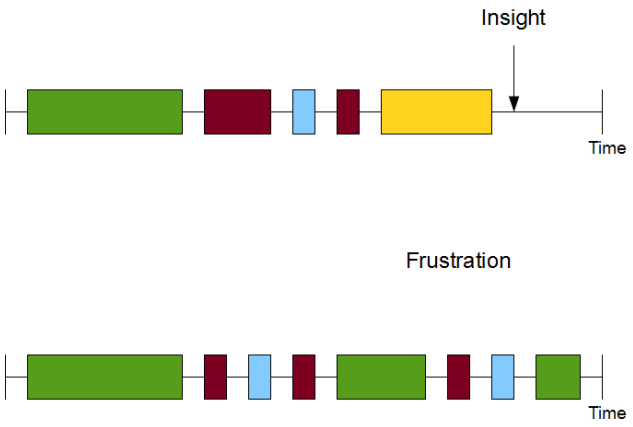
2.1 Task Analysis in Scientific Visualization

This work adds to a body of knowledge established by previous task analysis work in the visualization domain. [springmeyer [10]. pirolli and card [8]. useful findings, show where vis fits in the overall analysis process.]

[amar and stasko [1]. influential coding scheme, borrowed for our analysis. gotz and zhou [2] isenberg et al. [4]. direct inspirations for our observation design. but we add on to these methods using insight and cognitive load evaluation.]

2.2 Insight Evaluation

[growing evaluation method that focuses on insight as goal of analysis. may provide a guide to productive user behavior. introduced by saraiya et al. [9] and expanded upon in North [5]. summarize basic idea, methodology. yi et al. [11] contribute a taxonomy of processes that lead to insight. these are used in our analysis coding scheme.]



2.3 Cognitive Load and Visualization

[in addition to identifying the areas of productive behavior, we also want to identify frustrating and unproductive interaction patterns. cognitive load analysis can assist in this. introduced in paas and van merrienboer [7]. can be measured in a variety of ways, as discussed in paas [6]. in our work, we choose method x because y.]

[huang et al. [3] have previously applied cognitive load to evaluation visualization. we expand on this by integrating it with insight evaluation and task analysis. our ultimate goal is to make the task analysis more directly applicable to models by using both insight and cognitive load as measures of what and how the user is thinking, in addition to measuring how the user interacts. in the following section we describe our observation methods.]

3 METHODS

- Participants: EEG scientists around Brown/Tufts area. Working on different problems, some similar data and issues.
- Task: something specific and limited. What works across participants? Can we design something with a clear answer or answers? One interface or set of interfaces?
- Procedure: how to measure cognitive load? (GSR?) Standard insight evaluation and coding. Video and interaction capturing.

4 RESULTS

- Common patterns in general. Are there individual differences? Can they be grouped?
- Patterns correlated with insights and cognitive load. What patterns precede frustration points? What patterns precede an insight? What about different qualities of insight?
- More detail about patterns: is there a point where a good pattern turns into a bad pattern?

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5 Discussion

- Are the patterns predictable? Do they associate with heuristics about good analysis, interface design?
- More about individual differences if there are any.
- Modeling for evaluation. Would a model be part of this paper or a followup?
- What other situations might this be generalized to?

6 Conclusion

- Limitations, future work. Model? Generalizing?
- Restate introduction, etc.

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