**1. Electronic Visualization Laboratory (evl)** University of Illinois at Chicago www.evl.uic.edu

> 2. Natural Language Processing Laboratory (nlp) University of Illinois at Chicago www.nlp.cs.uic.edu

3. Laboratory for Advanced Visualization and Applications (lava) University of Hawaii at Manoa lava.manoa.hawaii.edu

\*jauris2@uic.edu

## "Show me data."

## **Observational study of a**

# conversational interface in visual data exploration

Jillian Aurisanoev \* Abhinav Kumarnip Alberto Gonzaleziava Khairi Redalava Jason Leighiava Barbara DiEugenionip Andrew Johnsonev

Visualization construction

## Thought to interactions: lost in

**Initial coding** 



InfoVis novices' struggle with visualization construction. Even with the aid of visualization software, such users may face challenges when translating their questions into appropriate visual encodings, or interactively refining the representation to achieve a desired result.

#### translation



In addition, there is a gap between the rich semantics of questions, hypotheses, findings and insights, and the poor semantics of visualization interactions. Information is likely lost in translation.

## Visual data exploration through a conversational interface

A natural language interface to visual data exploration would allow a user to directly specify questions through speech, allowing the user to focus on higher-order tasks, such as hypothesis generation and question formulation.

However, visual data exploration involves repeated cycles of visualization construction and interaction, as well as reasoning across many visualizations generated over the course of an exploratory session. A *'conversational interface'*, which maintains a dialog with the user through natural language and gestures, could support these complex tasks.

Initial coding has yielded a set of broad categories to group related conversational elements in the dialog between subject and data analysis expert.







In this study, subjects were able to ask any question without needing to specify a particular desired visualization response. In many cases, the context of the question in the analysis was essential to interpretation and effective visualization generation.

We noted that there were often mismatches between the explicit request to the data analysis expert and the implicit visualization task, evident from context. In essence, the subject sometimes did not ask for the visualizations they needed, even when given the freedom to ask for anything directly.

Developing approaches to use context in providing effective visualizations, should be a major system priority in conversational interfaces



#### **Observational, exploratory study**



We conducted an observational, exploratory study to observe the interaction between a subject and a remote data analysis expert (DAE) who assists the subject in an exploratory data analysis task.



#### Details before zoom and filter? Zoom and filter before overview?



Most visualization systems are designed to support 'Overview first; zoom and filter; details on demand', because it enables users to put information into context and explore from more generality to specificity based on observed patterns in the data. This approach is also compatible with many input modalities (mouse, touch, etc).

But, we noticed that with natural language users can skip the overview step to get right to zoomed/filtered views, or details of interest. But, they then lack the context needed to understands this information. This must be taken into account when designing responses to conversational inputs.

## Imprecision and complexity: a challenge and an opportunity



2) No graphical interface

3) No restrictions with regard to communication; encouraged to think-aloud.

4) Visualizations presented on a tiled-display wall, allowing analysis across many visualizations at once.

feed; mirrored display.

2) Tableau to generate; Sage2 (display wall middleware) to present visualizations

3) Chat box for textual communication

4) Virtual pointer for window manipulation.

#### Data analysis scenario



Exploratory data analysis task: analyze city of Chicago crime data from 2010-2014 to provide suggestions as to how to deploy police in 4 Chicago neighborhoods.

#### **details** 15 subjects: 7 male and 8 female Length: 45 min- 1.5 hours

Study

Number of visualizations: 18-48 (avg: 33) Number of visualization questions: 11 to 32 (avg: 18) Most interaction modalities to visualization systems, such as clicking a check box or dragging a slider, produces one predictable response from the system. In contrast, conversational inputs can be complex, vague and imprecise. Users may use this imprecision in several ways.

1. Users can under-specify the visualization they wish to see, when uncertain. A conversational interface presents an opportunity to provide responses that help users find direction. Also, imprecise visualization commands may allow users to avoid visualization construction errors.

2. Users can specify many interaction tasks in a single command (eg. "Zoom, pan and filter for thefts."). These shortcuts may yield different patterns of interaction than in conventional interfaces, and warrant further study.

#### **Future work**

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Ongoing analysis on 1. How do people interact with a conversational interface? 2. What is similar and different in conversational inputs vs other inputs? 3. What can we learn about requirements in conversational interface design?