LARGE INTERACTIVE SURFACES

FOR COLLABORATIVELY EXPLORING & DRIVING MEANING FROM COMPLEX DATA

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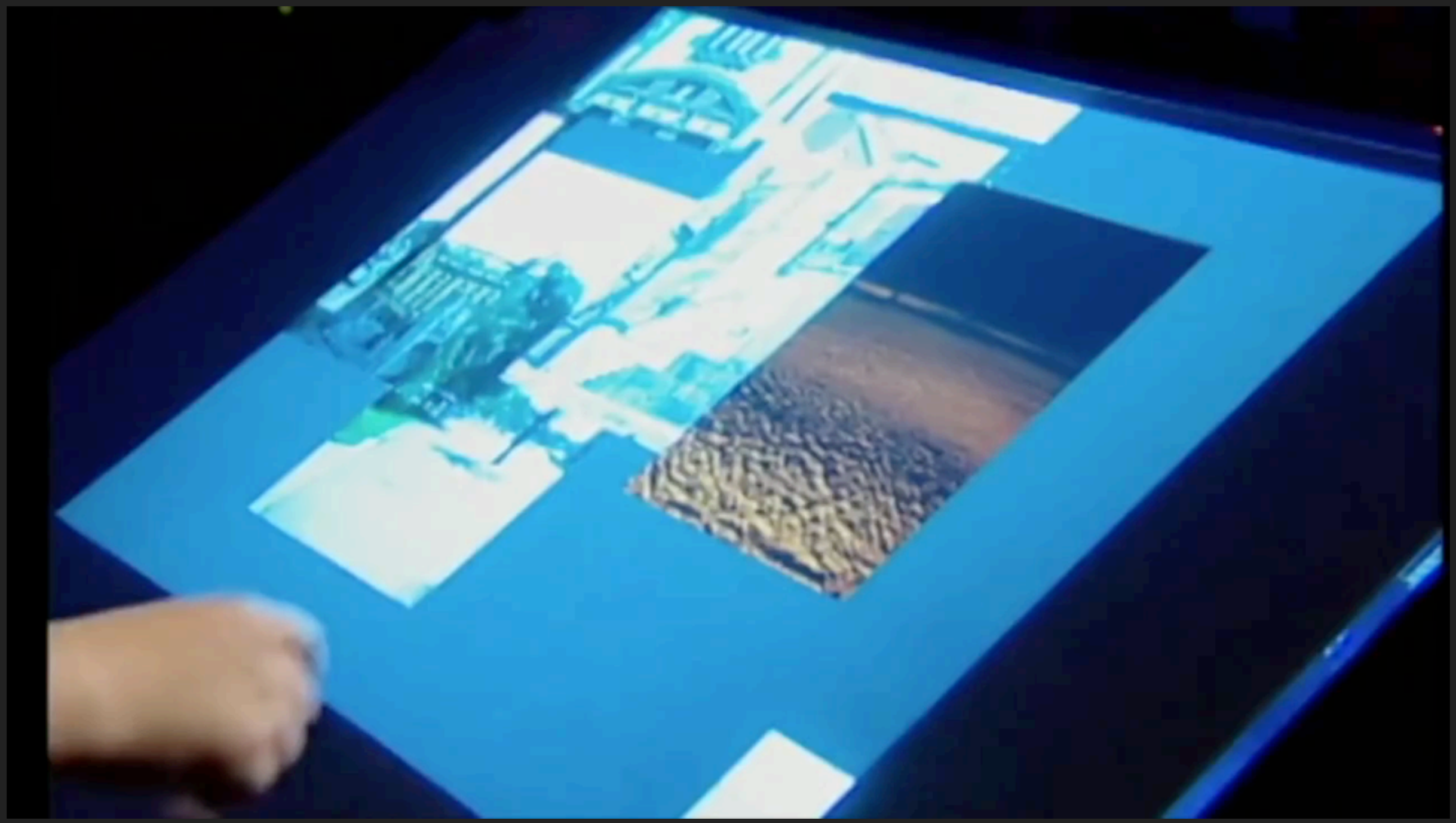
University of British Columbia

March 18, 2016 @ SIAT

THE RADICAL PROMISE OF THE MULTI-TOUCH INTERFACE



Jeff Han, 2006

MULTI-TOUCH SURFACES (WALL DISPLAYS & TABLETOPS)

- Research centres
- Museums
- News
- Classrooms


THE DUOMO

WHO AM I & WHAT AM I DOING

How can we combine fine arts and computer science?

How can art make CS reach beyond CS audiences?

BIO

- I design, develop and evaluate novel visualization & interaction techniques to help people solve complex problems.
- Human-Computer Interaction (HCI)
- Collaborative Visual Analytics (CVA)
- Computer Supported Collaborative Work (CSCW)
- Visual Analytics (VA)

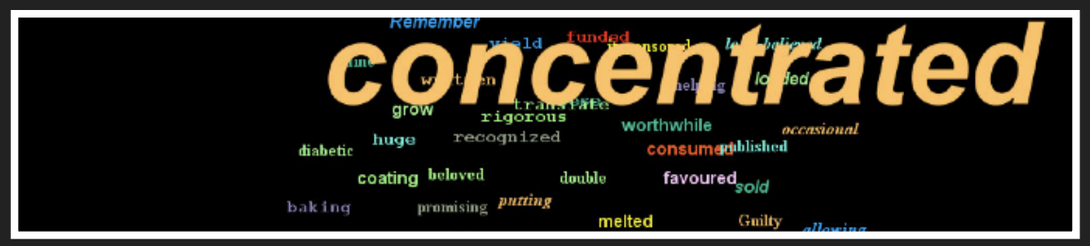
MY RESEARCH APPROACH

- Understanding the domain specific problems
- Designing visualization & interaction technologies
- Evaluating & analyzing the effect

METHODS

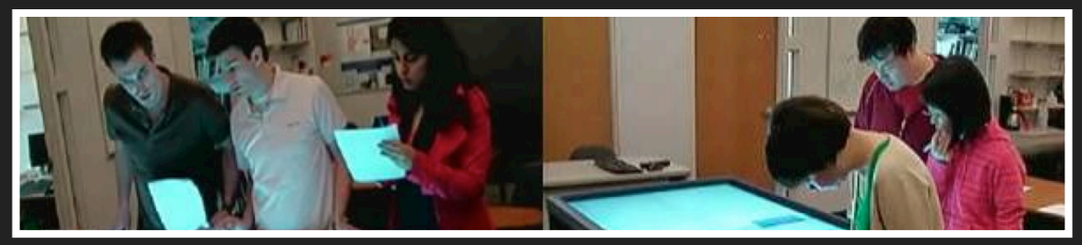
- Ethnography
- Observational User Study
- Case Study
- System Building
- Qualitative & Quantitative Evaluation

MY MAIN RESEARCH PROJECTS



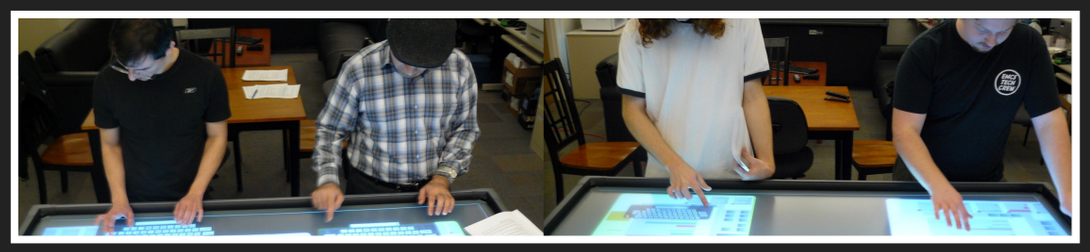
MSc., ICCC 2010

PhD, VAST 2014, Best Paper Award

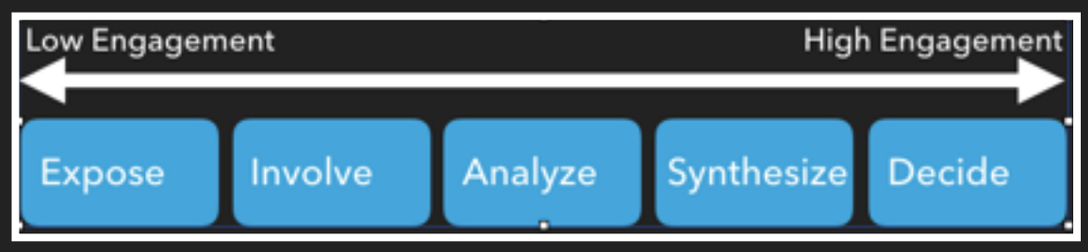


PhD, VAST 2010, InfoVis 2012

Postdoc, CSCW 2015, City Life



PhD, HICS 2013, ITS 2011



Postdoc, IEEE VIS 2015, Personal Vis

WHAT I WANT TO SHARE TODAY

- Overview
  - Design Challenges: Tabletops, CVA
- Projects:
  - Observational User Study
  - CoSpaces
  - Participatory Urban Design
- Contributions & Future Work

OVERVIEW: CVA

WHY COLLABORATE VISUAL ANALYTICS (CVA)?

- Collaboration:
  - Diverse backgrounds
  - Quality of work
  - Individual bias
  - Task Load
- Visual Analytics
  - Visual representation
  - interactive exploration

DESIGNING FOR TABLETOPS: SOME CHALLENGES

- 1. Orientation
- 2. Fluid interactions
- 3. Territoriality: individual vs. group space
- 4. Changes in collaboration styles
- 5. Awareness

COLLABORATIVE VISUAL ANALYTICS: CHALLENGES

Users	Multiple backgrounds
Cognition	Foraging & sensemaking
Analysis results	Consensus, shared insight
Evaluation	Social interaction around data
Visual representations	Multiple displays, novel I/O

Isenberg et al., Infovis, 2012

LET'S TALK ABOUT THE DESIGN PROCESS

1. Understand the problem (real problems!)
2. Design a tool (make lots of mistakes!)
3. Evaluate the tool (this is the hardest step!)
4. Reflect on the design (this is how you advance the field!)


Narges Mahyar


Ali Sarvghad


Melanie Tory

OBSERVATIONAL USER STUDY

Narges Mahyar, Ali Sarvghad, and Melanie Tory, “Note Taking in Co-located Collaborative Visual analytics: Analysis of an Observational Study”, *Information Visualization*, vol. 11, no. 3, pp. 190-204, July 2012.

Narges Mahyar, Ali Sarvghad, and Melanie Tory, “A closer look at note taking in the co-located collaborative visual analytics process,” *IEEE VAST 2010*.

FINDING THE ISSUES: OBSERVATIONAL USER STUDY

USER STUDY

- Task: a business scenario (sales projection decisions)
- Dataset: sales of clothing items in 8 US states for 3 years
- Tool: a current tool from SAP
- Participants: 9 groups of 3
- Process: 90 min
- Observations: videos & interviews, analyzed participants' notes
- Data analysis: qualitative evaluation methods

QUANTITATIVE

- Numeric information
- Objective
- limited

QUALITATIVE

- Non-numeric information
- Highly subjective
- Much harder to deal with, why? why its important?

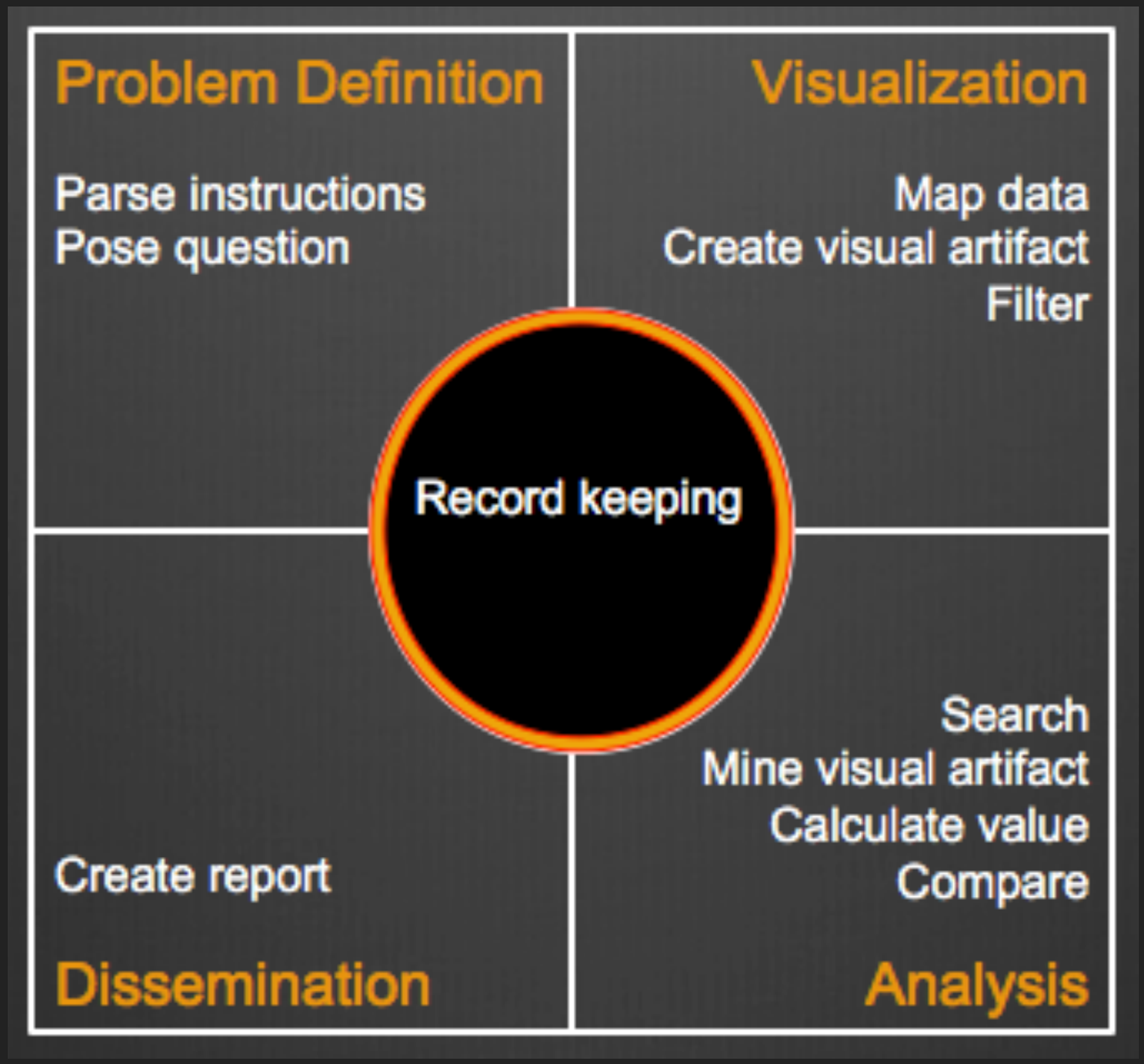
HOW TO DO QUALITATIVE ANALYSIS WELL?

- Limit the bias:
  - More than one coders
  - Independent coding
- Triangulation of mixed-methods

USER STUDY: CHALLENGES

- Task design and choosing the dataset
- Participants (number, real analysts, conditions)
- Motivation (e.g., incentives, prizes, etc.)
- Length of the study (break in the middle)
- Analyzing massive data (We spent nearly 2 months on analyzing gathered information)

COLLABORATIVE VISUAL ANALYTICS FRAMEWORK



AWARENESS PROBLEMS I DISCOVERED IN MY STUDY

- Critical need to support Record Keeping activities
- Notetakers lost track of what others were doing
- Suggests: integrate notes within the application

Q & A


Narges Mahyar


Ali Sarvghad


Melanie Tory


Tyler Weeres

COSPACES (COLLABORATIVE WORKSPACES)

Narges Mahyar, Ali Sarvghad, and Melanie Tory, "Observations of Record-Keeping in Co-located Collaborative Analysis", *HICSS 2013*.

Narges Mahyar, Ali Sarvghad, Melanie Tory and Tyler Weeres "CoSpaces: Workspaces to Support Co-located Collaborative Visual Analytics," *DEXIS 2011*, Nov 2011.

DESIGN OBJECTIVES

- Orientation
- Fluid interactions
- Territoriality: individual vs. group space
- Changes in collaboration styles
- Awareness
- Visual Record Keeping (VRK)

VISUAL RECORD KEEPING (VRK)

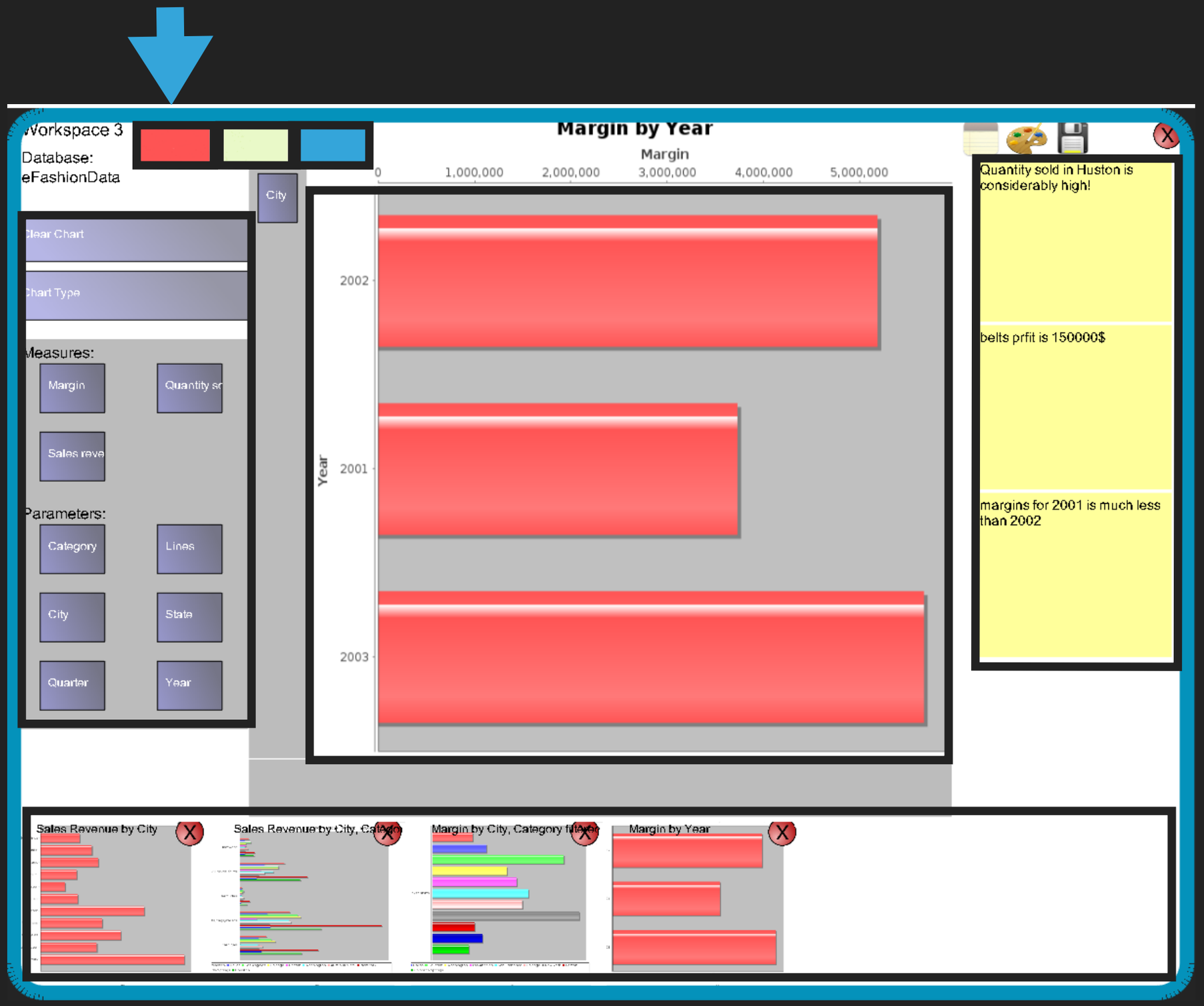
- VRK in VA context:
  - Capturing analysis history & visually represent it
- Many researchers have mentioned the advantages of record-keeping/history in visualization.
- Speculations:
  - More important in collaborative task.
  - Improving communication & dissemination.

TASK & DATASET

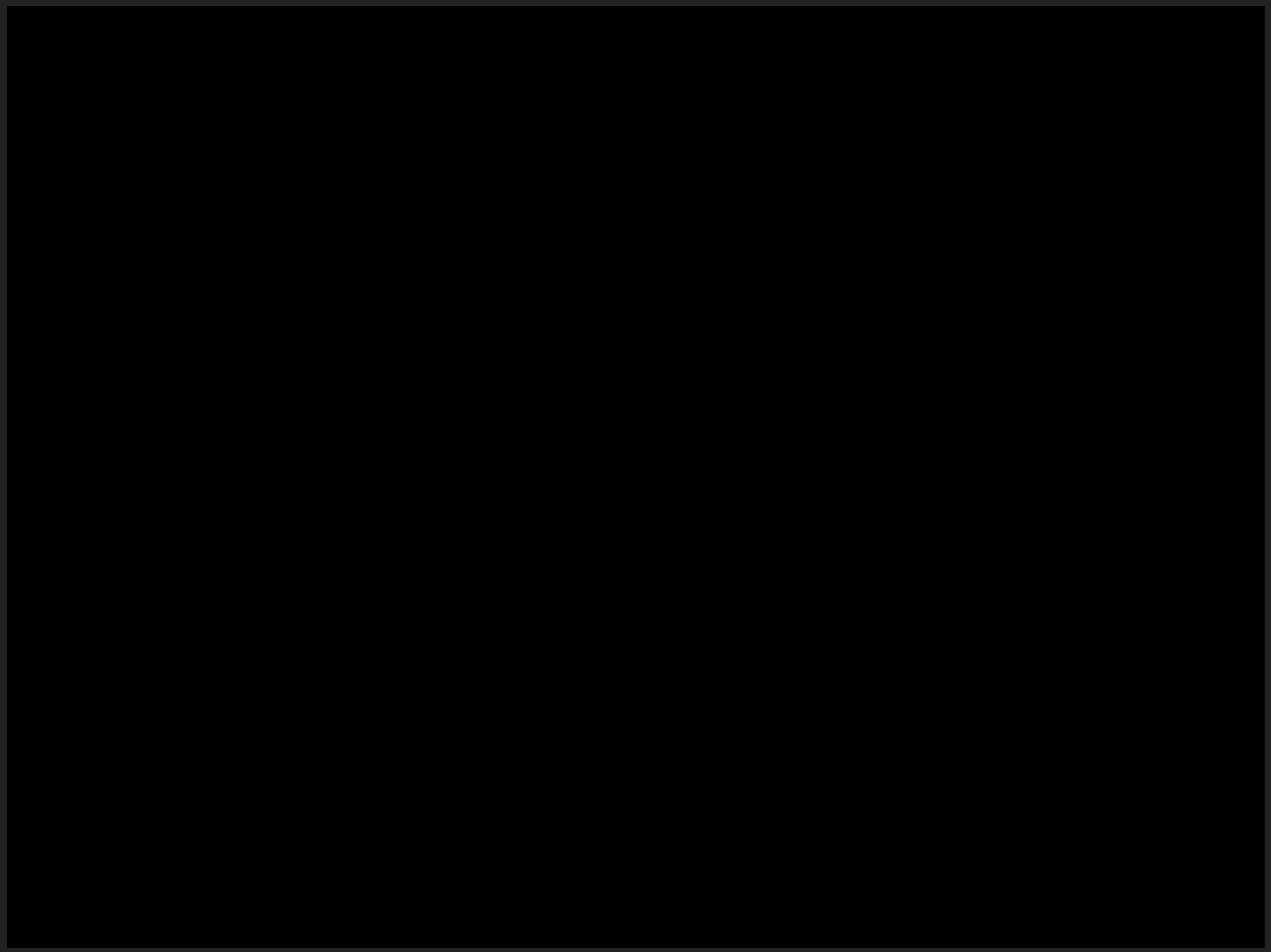
- A business scenario:
  - Find trends in the sales of most popular product lines
  - Analyze the sales data and at the end prepare a report for your CEO
  - Explains possible reasons for the sales anomalies
- Dataset:
  - sale data, 8 US states, 3 years, 9 columns, 3273 rows

Sales Revenue by City
Workspace 2
Measures:
Parameters:
SHIFT

COSPACES


Workspace 3
Database:
eFashionData
City
Clear Chart
Chart Type
Measures:
Margin
Quantity sc
Sales reve
Parameters:
Category
Lines
City
State
Quarter
Year
Margin by Year
Margin
0
1,000,000
2,000,000
3,000,000
4,000,000
5,000,000
Year
2002
2001
2003
Quantity sold in Huston is considerably high!
belts prfit is 150000$
margins for 2001 is much less than 2002
Sales Revenue by City
Sales Revenue by City, Categor
Margin by City, Category filtered
Margin by Year

COSPACES: VIDEO



USER STUDY

- 10 groups of 2
- Two tasks: 20 and 40 minute sessions
- Follow up interview and questionnaire
- Captured video
- Logged history
- Two independent observers

1. SUPPORT FOR INDIVIDUAL VS. GROUP SPACE (TERRITORIALITY)

- Worksheet: work territory, either personal or shared
- Flexibility of use: panning, re-sizing, rotating

2. SUPPORT FOR CHANGES IN COLLABORATION STYLES

- All users performed part of the task individually and discussed their results at the end
- Worksheet flexibility facilitated changes in collaboration styles

3. SUPPORT FOR AWARENESS

- While pairs maintained awareness of each other work, Tabs were not used as much as we expected
- 17/20 assessed Tabs as useful in their evaluation. (average:4.95 out of 6.0, STDEV of 1.07)
- "...real time update of [the] other's view was interesting, because [I] could keep [myself] updated all the time...".
- "...being able to see others' workspaces, [and] keep track of them in own workspace" was one of the most useful features of the system.

4. SUPPORT FOR VISUAL RECORD KEEPING

- Actions on History
  - Actions and Collaboration Styles
  - Actions and Analysis Phases
- Record-Keeping Behaviours

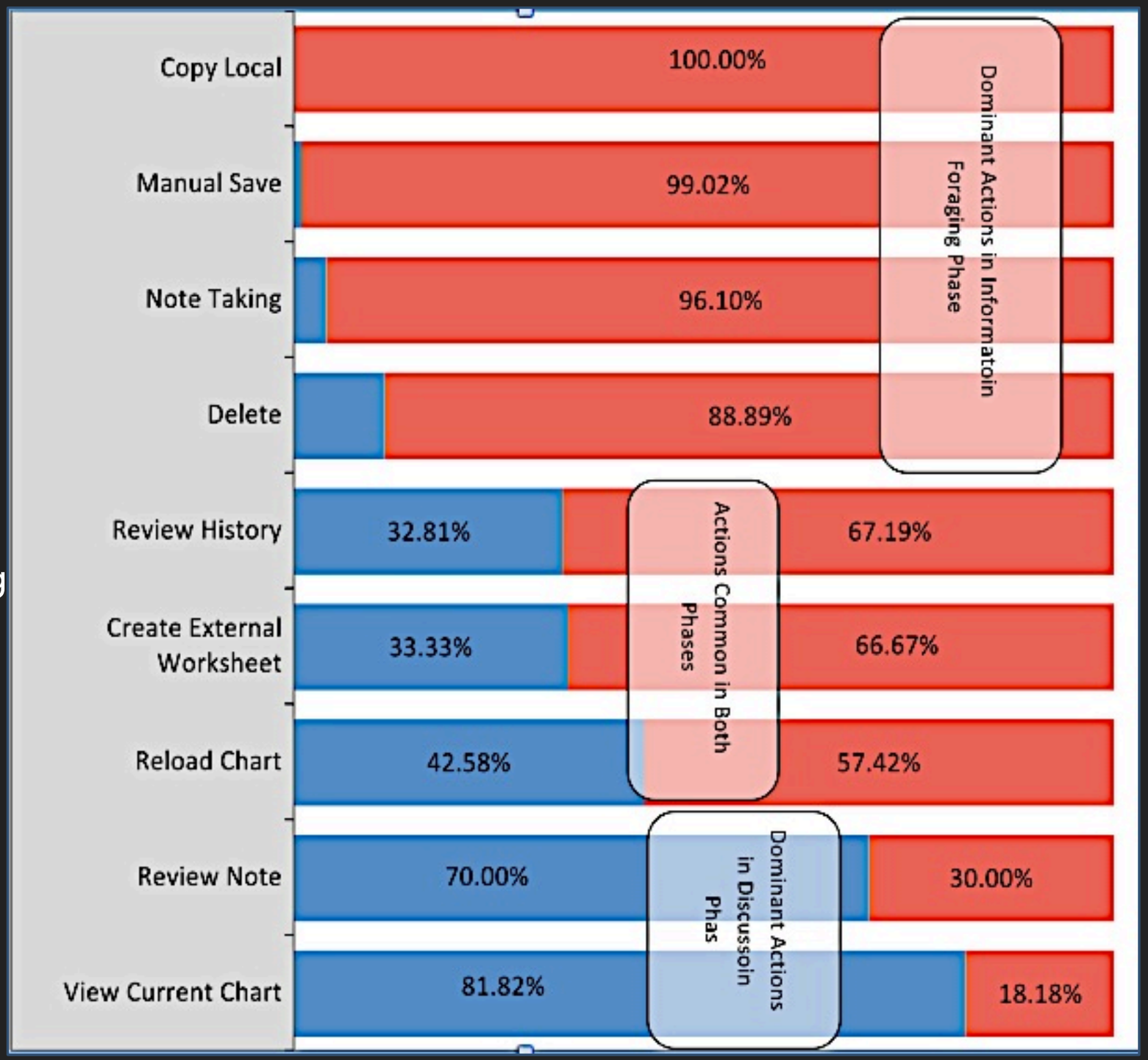
ACTIONS ON HISTORY

Actions	Frequency
1. Reload a chart	155
2. Review history	128
3. Manual save	102
4. Delete	99
5. Note taking	77
6. Review notes	30
7. Use tabs	11
8. Copy local	4
9. Create external worksheet	3

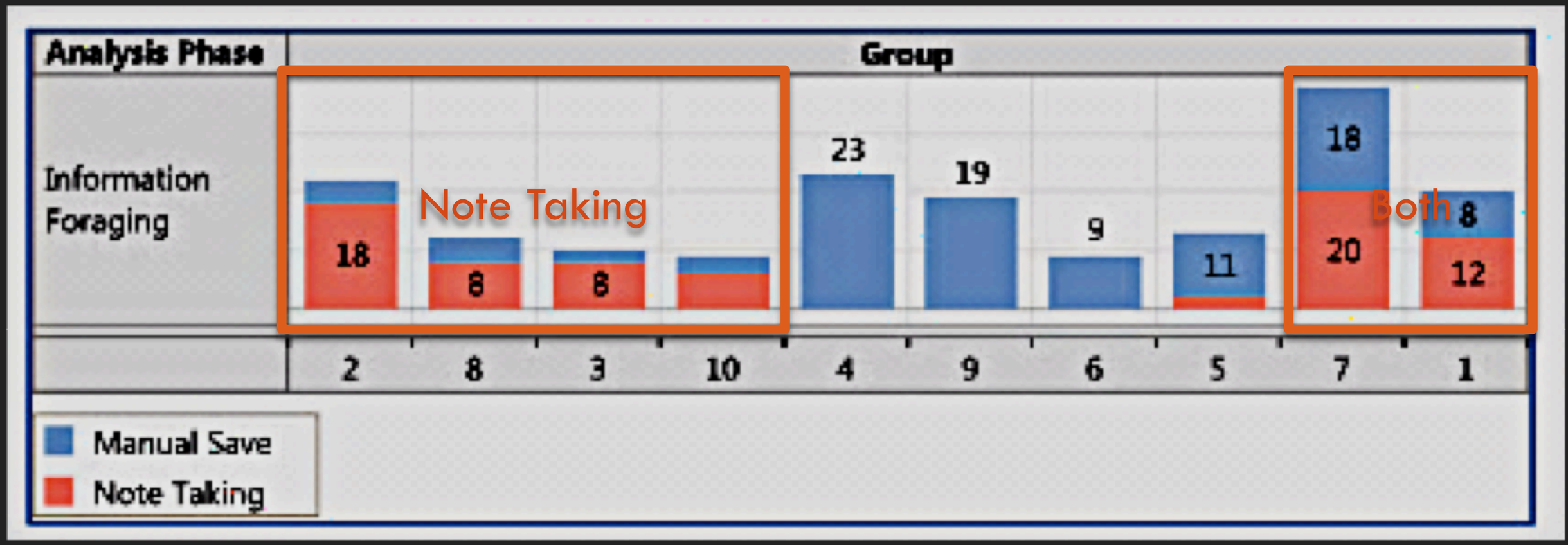
ANALYSIS PHASES & INTENTIONS: RELOADING CHARTS

- Information Foraging:
  - Review exciting chart (50)
  - Reuse existing chart (39)
- Discussion:
  - Review exciting chart (62)
  - Reuse existing chart (4)

ACTIONS & ANALYSIS PHASES



VISUAL RECORD KEEPING BEHAVIOUR



DISCUSSION

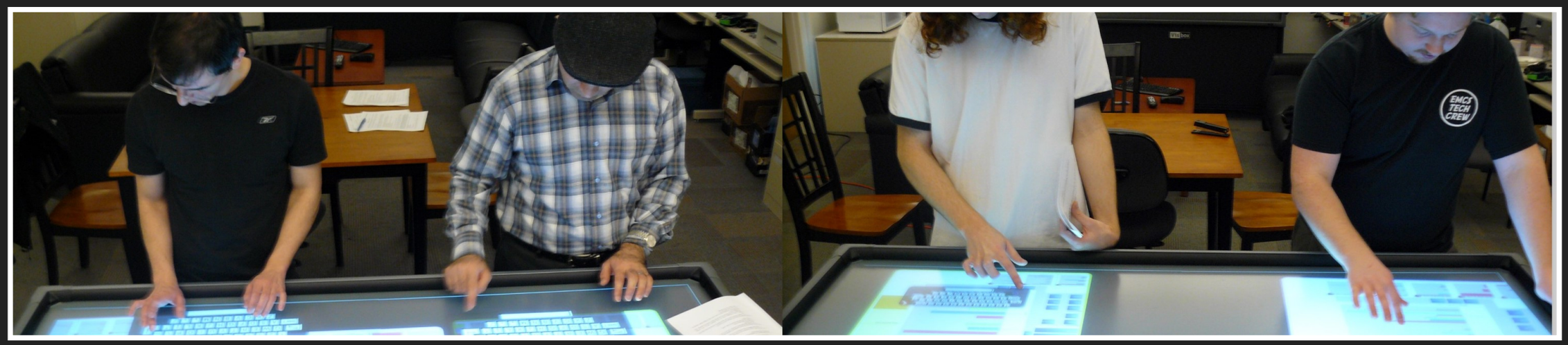
- Importance of Visual Record Keeping in CVA:
  - Gain awareness
  - Share work
    - Starting point for discussion
- VRK played an important role in all phases of analysis
- 2 different strategies for capturing findings:
  - chart-saving focused vs. note-focused

CONCLUSION

- 1. Support for individual vs. group space (territoriality)
- 2. Support for changes in collaboration styles
- 3. Support for awareness during loosely coupled work
- 4. Support for tracking history:
  - Inferred intention/s related to them
  - Relations to analysis phases & collaboration styles

DESIGN IMPLICATIONS

- Supporting multiple history views:
  - detailed, bookmarked, filtered, customized
- Support for sharing:
  - Direct & indirect (unobtrusive and non-icteruptive)
  - Support for history management
- Support for note taking and reuse:
  - 2 of the prevalent record-epping actions



Q & A

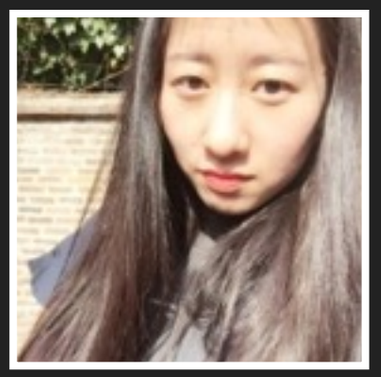

Narges Mahyar


Kellogg Booth


Ronald Kellett


Cynthia Girling


Jialiang Xiang


Siyi Meng

PARTICIPATORY URBAN DESIGN

Ronald Kellett, Kellogg Booth, **Narges Mahyar**, “Collaborative Technology for Stakeholders Engagement in Urban Design”, Information Technology and City Life Workshop, CSCW 2015, March 2015.

PARTICIPATORY URBAN DESIGN

BEFORE I ARRIVED AT UBC: RESEARCH PROBLEM

- How to use visualization and collaboration technologies to increase public engagement?

DEPLOYED VERSION

- Multi-touch tabletop

- Large-screen wall displays
- Visualization for sustainability metrics

MY ROLE IN THIS PROJECT: NEW RESEARCH PROBLEMS

- What are the limitations of a single shared interactive display in supporting collaborative analysis scenario?
- What are the ways which we can design multi-display eco-system to better support multi-users' interactions?

MY ROLE IN THIS PROJECT: METHODS

- Observed the system in action
- Interviewed and closely worked with experts
- Led the design and mentored 2 students to develop new features
- Leading the evaluation: an observational study

DESIGN OBJECTIVES

- Personal displays
  - Individual space to explore and customize data
- Visual history
  - Record and review session history
  - Tracking the session, understanding decision making

INTEGRATING INDIVIDUAL DISPLAYS

- iPad 3D viewer app
  - Improve interactions with the 3D wall display
- iPad indicator app
  - Improve interactions with metrics
- iPad history app
  - Record and visually represent the interaction history

SUPPORTING GROUP DYNAMICS

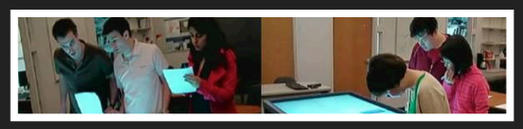
INDIVIDUAL & GROUP DISCOVERY

FUTURE APPLICATIONS OF THIS PROJECT

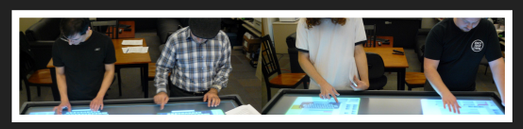
- Use of multi-display eco-system for public engagement
- Evaluate the effects on:
  - learning
  - engagement
  - collaboration dynamics

Q & A

RESEARCH CONTRIBUTIONS



- Proposing a framework for CVA + role of note taking



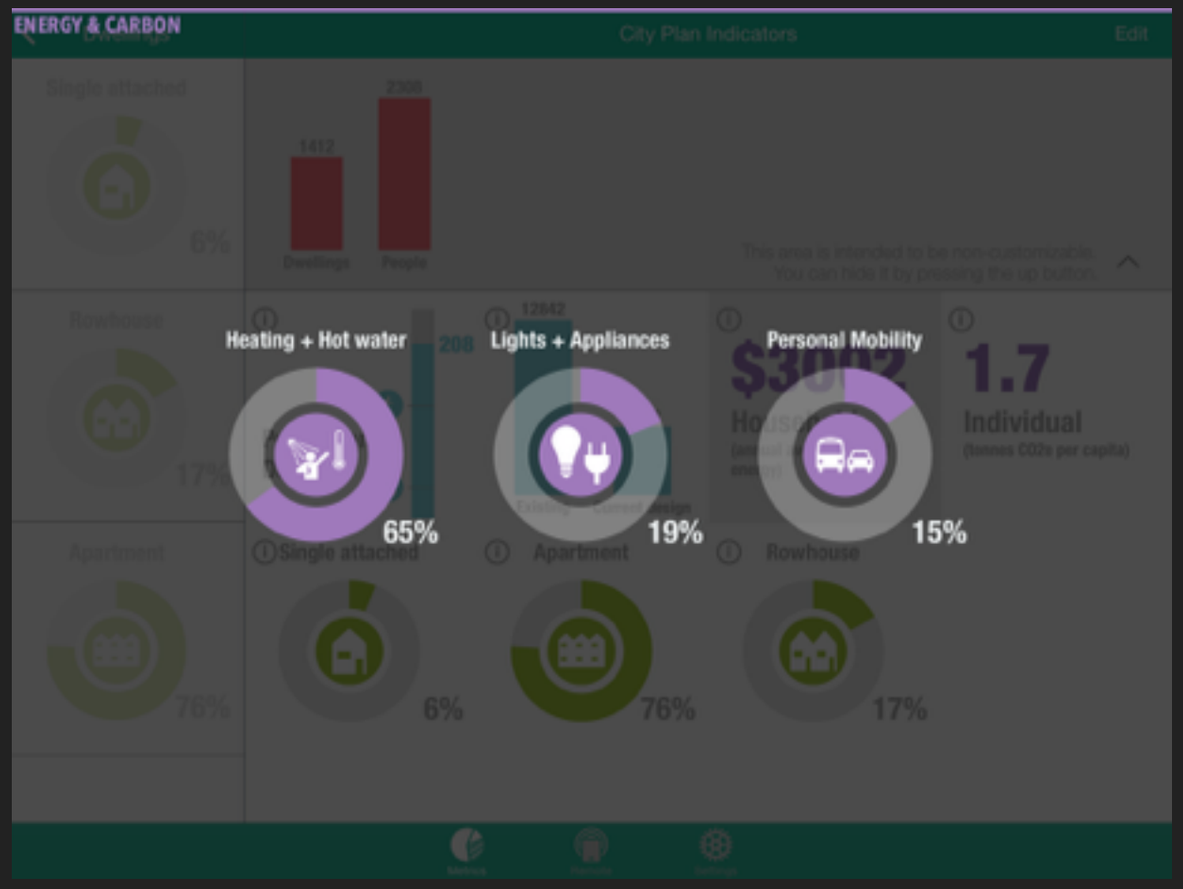
- The effects of integrating record keeping into a CVA tool

- Investigating a multi-display CVA tool for engagement

VISION: TOWARDS MORE ENGAGING DESIGNS

- Develop effective & engaging visualization techniques & collaboration technologies
- Develop theories about engagement
- Bring more design elements to CS
- Explore potentials of multi-touch surfaces for engaging novice users
- Revisit principles and guidelines for CSCW

VISUALIZATION DESIGN FOR PUBLIC COMMUNITY PLANNING



- Infographics & donut charts based on domain experts' suggestions

ENGAGEMENT IN INFOVIS

- Understanding user engagement

Expose | Involve | Analyze | Synthesize | Decide

Narges Mahyar, Sung-Hee Kim, and Bum Chul Kwon, "Towards a Taxonomy for Evaluating User Engagement in Information Visualization", *Workshop on Personal Visualization: Exploring Everyday Life*, IEEE VIS 2015, 4 pages, 2015.

THANK YOU!

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