DESIGNING COLLABORATIVE VISUAL ANALYTICS TOOLS: FROM SUPPORTING EXPERTS TO ENGAGING THE PUBLIC

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INTERDISCIPLINARY BACKGROUND

- Electrical Engineering
- Fine Arts Background
- Computer Science
How can we combine fine arts and computer science?

How can art make CS reach beyond CS audiences?
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)
WHO AM I & WHAT AM I DOING

DOMAINS

- Business Intelligence
- Intelligence Analysis
- Urban Planning
- Civil Engineering
WHO AM I & WHAT AM I DOING

MY RESEARCH APPROACH & METHODS

- Understanding the domain specific problems
- Designing visualization & interaction technologies
- Evaluating & analyzing the effect
- Ethnography
- Observational User Study
- Case Study
- System Building
- Qualitative & Quantitative Evaluation
WHO AM I & WHAT AM I DOING

MY MAIN RESEARCH CONTRIBUTIONS

MSc., ICCC 2010

PhD, VAST 2010, InfoVis 2012

PhD, HICS 2013, ITS 2011

PhD, VAST 2014, Best Paper Award

Postdoc, CSCW 2015, City Life

Postdoc, IEEE VIS 2015, Personal Vis
OUTLINE OF THE TALK

- Collaborative Visual Analytics (CVA)
- A selection of my projects:
  - CLIP
  - Participatory Urban Design
- Contributions
- Vision & Future Directions
WHY COLLABORATE VISUAL ANALYTICS (CVA)?

- **Collaboration:**
  - Diverse backgrounds/expertise
  - Quality of work
  - Individual bias
  - Task Load

- **Visual Analytics:**
  - Visual representation & interactive exploration
### Collaborative Visual Analytics: Challenges

<table>
<thead>
<tr>
<th>Users</th>
<th>Multiple backgrounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognition</td>
<td>Foraging &amp; sensemaking</td>
</tr>
<tr>
<td>Analysis results</td>
<td>Consensus, shared insight</td>
</tr>
<tr>
<td>Evaluation</td>
<td>Social interaction around data</td>
</tr>
<tr>
<td>Visual representations</td>
<td>Multiple displays, novel I/O</td>
</tr>
</tbody>
</table>

Isenberg et al., Infovis, 2012
CLIP (COLLABORATIVE INTELLIGENT PAD)

CLIP is a collaborative thinking space that helps people to record, organize, and share their externalizations.

RESEARCH PROBLEMS

▸ How to support collaborative sensemaking?

▸ How to support externalizations?
  ▸ organize, record, and share findings, hypotheses, and evidence.

▸ Evaluate the effect on awareness, communication & coordination?
CAMBIERA: FOR COLLOCATED VISUAL ANALYTICS OF DOCUMENT COLLECTIONS

Isenberg & Fisher, 2012
## CONTEXT

- **Task:** VAST 2006 challenge, a mystery task
- **Dataset:** 240 documents
- **Setting:** Collocated collaborative analysis
LINKED COMMON WORK (LCW)

- **LCW**: automatically identifying and visually representing similarities between collaborators’ work
  - Partial merging
  - Full merging
PARTIAL VS. FULL MERGING

Laura | Alex | Mary

George

Works

Member

Meetings

ISPS

Plaza

Club
CLIP: A Collaborative Visual Thinking Space to Support Joint Sensemaking
EVALUATION OF LINKED COMMON WORK (LCW)

- Experimental comparison of CLIP to a baseline tool
- Baseline tool: CLIP without LCW
BASELINE TOOL
USER STUDY & DATA GATHERING

- 16 groups of 3, 8 groups in each condition
- Worked for 90 minutes
- Used CLIP or Baseline
- Followed by semi-structured interview
HYPOTHESES

Linked Common Work will improve:

- H1: Performance
- H2: Communication
- H3: Coordination
- H4: Awareness
METRICS AND ANALYSIS

- Performance
  - Scoring scheme (from Isenberg et al., 2012):
    - Positive points for finding and connecting relevant facts
    - Negative points for incorrect hypotheses
    - Number of key documents found (out of 10)
METRICS AND ANALYSIS: DEVELOPING NEW METRICS

- Conversation analysis
  - Classified and counted statements of 7 different types
  - 2 coders, Krippendorff’s alpha = 0.91
- Spent around 520 hours on data analysis
## METRICS SCHEME

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DH</td>
<td>Discussion / generating Hypotheses</td>
</tr>
<tr>
<td>RV</td>
<td>Referring to Visualization</td>
</tr>
<tr>
<td>CO</td>
<td>Coordination</td>
</tr>
<tr>
<td>SA</td>
<td>Seeking Awareness</td>
</tr>
<tr>
<td>VF</td>
<td>Verbalizing Findings</td>
</tr>
<tr>
<td>QF</td>
<td>Question about Findings</td>
</tr>
<tr>
<td>RU</td>
<td>Related but uncategorized</td>
</tr>
</tbody>
</table>
Hypotheses

H1: Better performance

- Key Documents
- Score

p<0.001

Key Documents
Score

BT
CLIP
H4: Less reliance on verbal communications for awareness

QF
VF
SA

p<0.06
p<0.04
p<0.01

BT
CLIP
FUTURE APPLICATIONS OF THIS PROJECT

- LCW for different domains, e.g. co-authoring documents
- LCW for different collaborative settings, e.g. distributed software development
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
MY MAIN RESEARCH CONTRIBUTIONS

- Proposing a framework for CVA + role of note taking
- The effects of integrating record keeping into a CVA tool
- Introducing LCW method, new metrics for CVA
- Metrics for engagement
- 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
SHORT-TERM RESEARCH GOALS

- Collaborative note taking in different settings and domains

- LCW for different domains, e.g. co-authoring documents

- Use of multi-display eco-system for public engagement
SHORT-TERM RESEARCH GOALS

- Visualization design for public engagement

- Infographics & donut charts based on domain experts’ suggestions
SHORT-TERM RESEARCH GOALS

- Understanding user engagement

**Low engagement**
- Expose
- Involve
- Analyze

**High engagement**
- Synthesize
- Decide

LONG-TERM RESEARCH GOALS

- Multimodal interaction for collaboration
- Evaluation methods for InfoVis & CSCW
- Visual storytelling
- Visualization for personal discovery, e.g. health data
- Bridging between computational/analytics & design/fine arts
INFOVIS & CSCW RESEARCH AT MSR

Society of Appliances
SketchStory
Self-tracking

SandDance
Designers’ Designs
Bio Crystal
THANKS TO MANY
THANK YOU!

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CVA | PROJECTS | CLIP, URBAN DESIGN | CONTRIBUTIONS | VISION & FUTURE DIRECTIONS

COSPACES (COLLABORATIVE WORKSPACES)
