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

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University of British Columbia
February 2016 @ UWB
WHO AM I & WHAT AM I DOING

INTERDISCIPLINARY BACKGROUND

- Electrical Engineering
- Fine Arts Background
- Information Technology
- 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
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, VAST 2014, Best Paper Award

PhD, HICS 2013, ITS 2011

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

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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
CLIP: VIDEO

CLIP: A Collaborative Visual Thinking Space to Support Joint Sensemaking
EVALUATION OF 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>
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<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>
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HYPOTHESES

H1: Better performance

Key Documents
- BT
- CLIP

Score
- BT
- CLIP

p<0.001
HYPOTHESES

H4: Less reliance on verbal communications for awareness

![Bar chart showing comparison between BT and 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

- Critical 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
SHORT-TERM RESEARCH GOALS

- Visualization design for public engagement
SHORT-TERM RESEARCH GOALS

- Understanding user engagement

Low engagement

Expose
Involve
Analyze
Synthesize
Decide

High engagement

SHORT-TERM RESEARCH GOALS

- LCW for different domains, e.g. co-authoring documents
- Use of multi-display eco system for public engagement
LONG-TERM RESEARCH GOALS

- Multimodal interaction for collaboration
- Note taking in different settings and domains
- Evaluation methods for InfoVis & CSCW
LONG-TERM RESEARCH GOALS

- Visual storytelling
- Visualization for personal discovery, e.g. health data
- Art and Media, e.g. interactive visual installation for personal & group discovery
VISION: MORE INTERDISCIPLINARY DESIGN FOR ENGAGEMENT

- Develop effective & engaging visualization techniques & collaboration technologies
- Develop theories about engagement
- Bring more design elements to CS
- Multi-touch surfaces potential
- Revisit principles and guidelines for CSCW
HOW I CAN CONTRIBUTE TO THE DEPARTMENT

- Interdisciplinary background in complementary areas: CSCW, VA
- Fine arts background: further contributions in HCI
- Strong history in interdisciplinary research: industry & academia
THANKS TO MANY
THANK YOU!

NARGES MAHYAR

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OBSERVATIONAL STUDY


This is the way we should be interacting with machines from now on!

Jeff Han, 2006
## CLIP: RESEARCH PROBLEMS

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TEACHING PHILOSOPHY

› Engaging and motivating students
› Integrating research and teaching
› Providing a collaborative environment
› Being available and accessible
› Fostering creativity & respecting individual differences
› Developing critical thinking & reasoning
TEACHING EXPERIENCES

› TA : CS courses: instructor, marker, admin

› Guest lecturer: several HCl courses

› Fine art instructor

› Co-founder of Creative Children Institute
ACM ISS (INTERACTIVE SURFACES & SPACES), 2016