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

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University of British Columbia

May 16, 2016 @ York University

INTERDISCIPLINARY BACKGROUND

- Electrical Engineering
- Fine Arts Background
- Computer Science

How can we enrich the design of Information systems?

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.

RESEARCH INTERESTS

- Human-Computer Interaction (HCI)
- Collaborative Visual Analytics (CVA)
- Visual Analytics (VA)
- Visualization is an external representation of data which replaces cognition with perception to help people to do tasks more effectively.
- Visualization is complementary to statistical analysis, helps people to explore and communicate insights.

DOMAINS

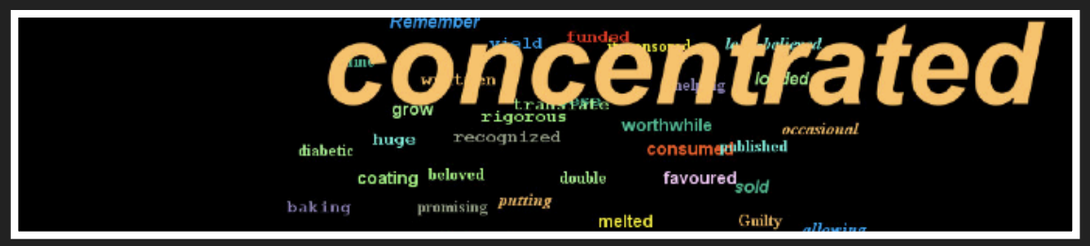
- Business Intelligence
- Intelligence Analysis
- Urban Planning
- Civil Engineering

MY RESEARCH APPROACH & METHODS

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

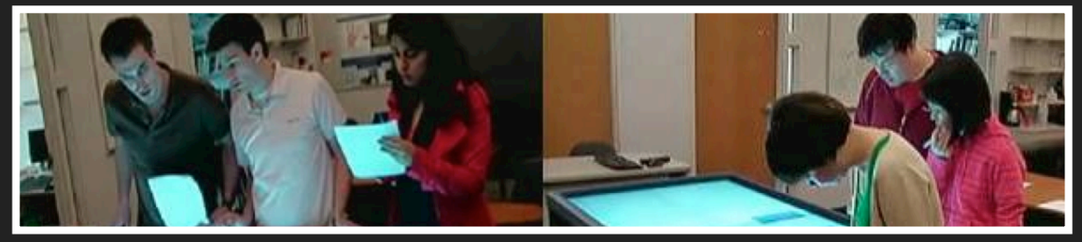
- Ethnography
- Observational User Study
- Case Study
- System Building
- Qualitative & Quantitative Evaluation

MY MAIN RESEARCH CONTRIBUTIONS



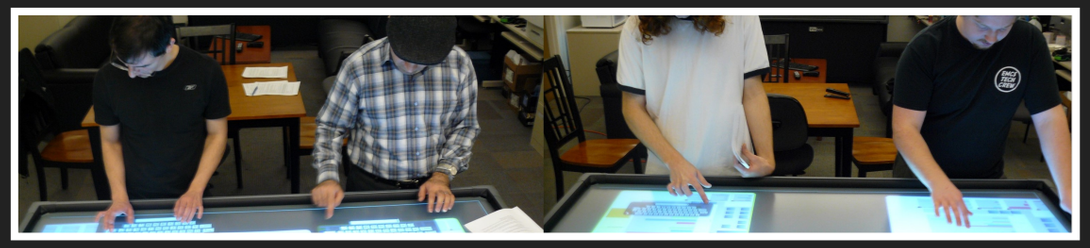
MSc., ICCC 2010

PhD, VAST 2014, Best Paper Award

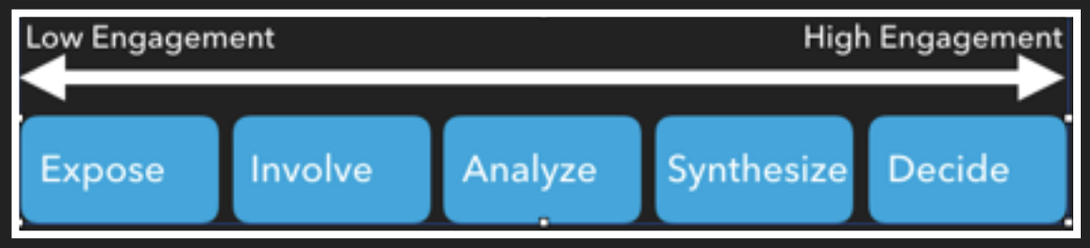


PhD, VAST 2010, InfoVis Journal 2012

Postdoc, CSCW 2015, City Life



PhD, HICS 2013, ITS 2011



Postdoc, IEEE VIS 2015, Personal Vis

OUTLINE OF THE TALK

- Collaborative Visual Analytics
- A selection of my projects:
  - CLIP
  - Participatory Urban Design
- Contributions
- Vision & Future Directions

WHY COLLABORATE VISUAL ANALYTICS?

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

- Visual Analytics:
  - Visual representation & interactive exploration

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


Narges Mahyar Melanie Tory

SUPPORTING COMMUNICATION AND COORDINATION IN COLLABORATIVE SENSEMAKING

Narges Mahyar and Melanie Tory, "Supporting Communication and Coordination in Collaborative Sensemaking", IEEE Transaction on Visualization and Computer Graphics (VAST 14), 2014. **[Best Paper Award]**

Narges Mahyar, and Melanie Tory, "CLIP: A Visual Thinking Space to Support Collaborative Sensemaking and Reasoning", Graphics, Animation and New Media (GRAND) NCE AGM, 4 pages, 2014. **[Best Research Note Honourable Mention]**

CLIP (COLLABORATIVE INTELLIGENT PAD)

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

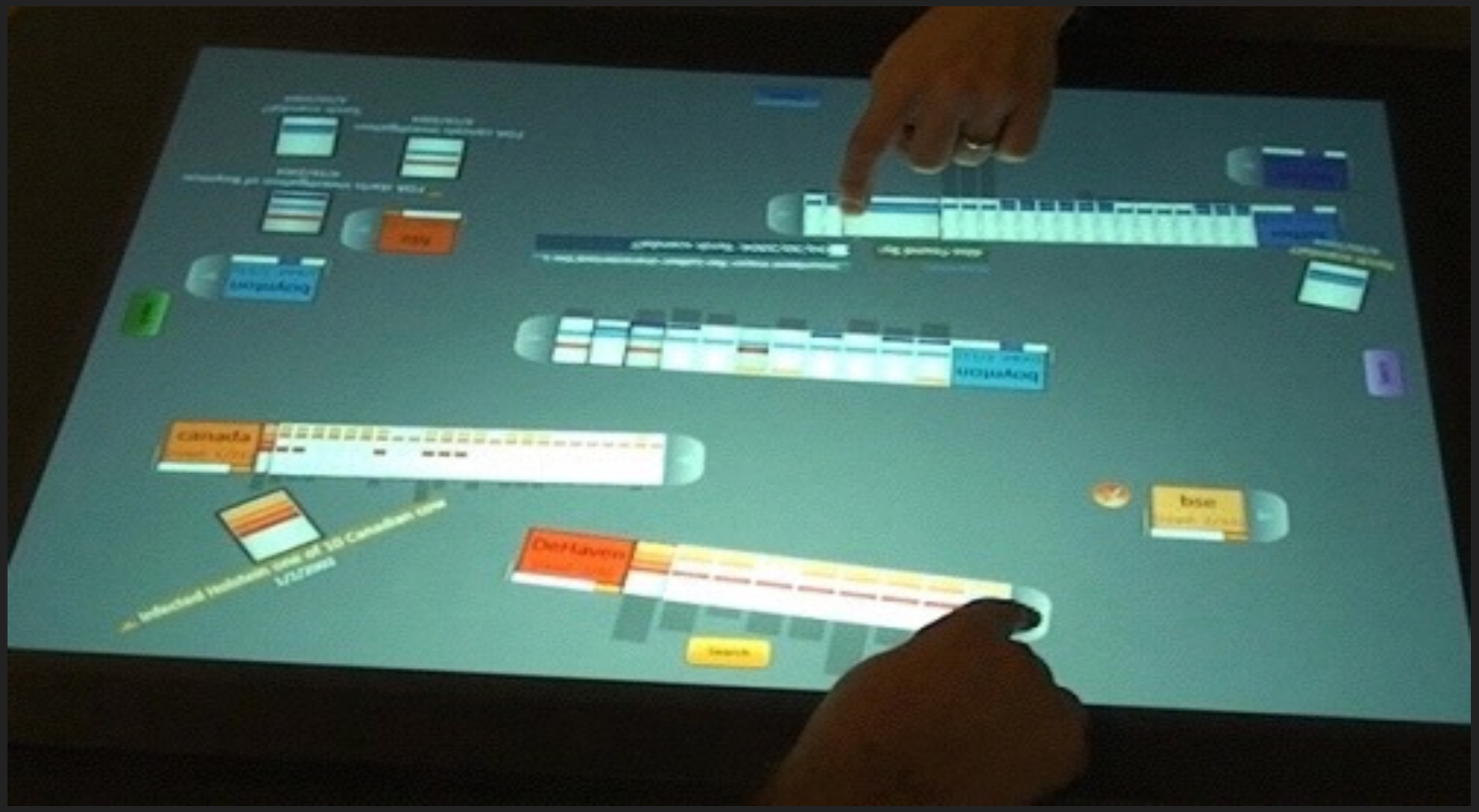
CONTEXT: ANALYSIS OF LARGE SET OF DOCUMENTS

- VAST 2006 challenge dataset
- 240 documents, news articles, maps, images and etc.
- Finding a hidden chemical weapon production.
- Scenario reveals the first clue. Then, analysts were challenged to find the most relevant documents.
- Similar to real life scenarios, there are distractors that could point analysts in the wrong direction.

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

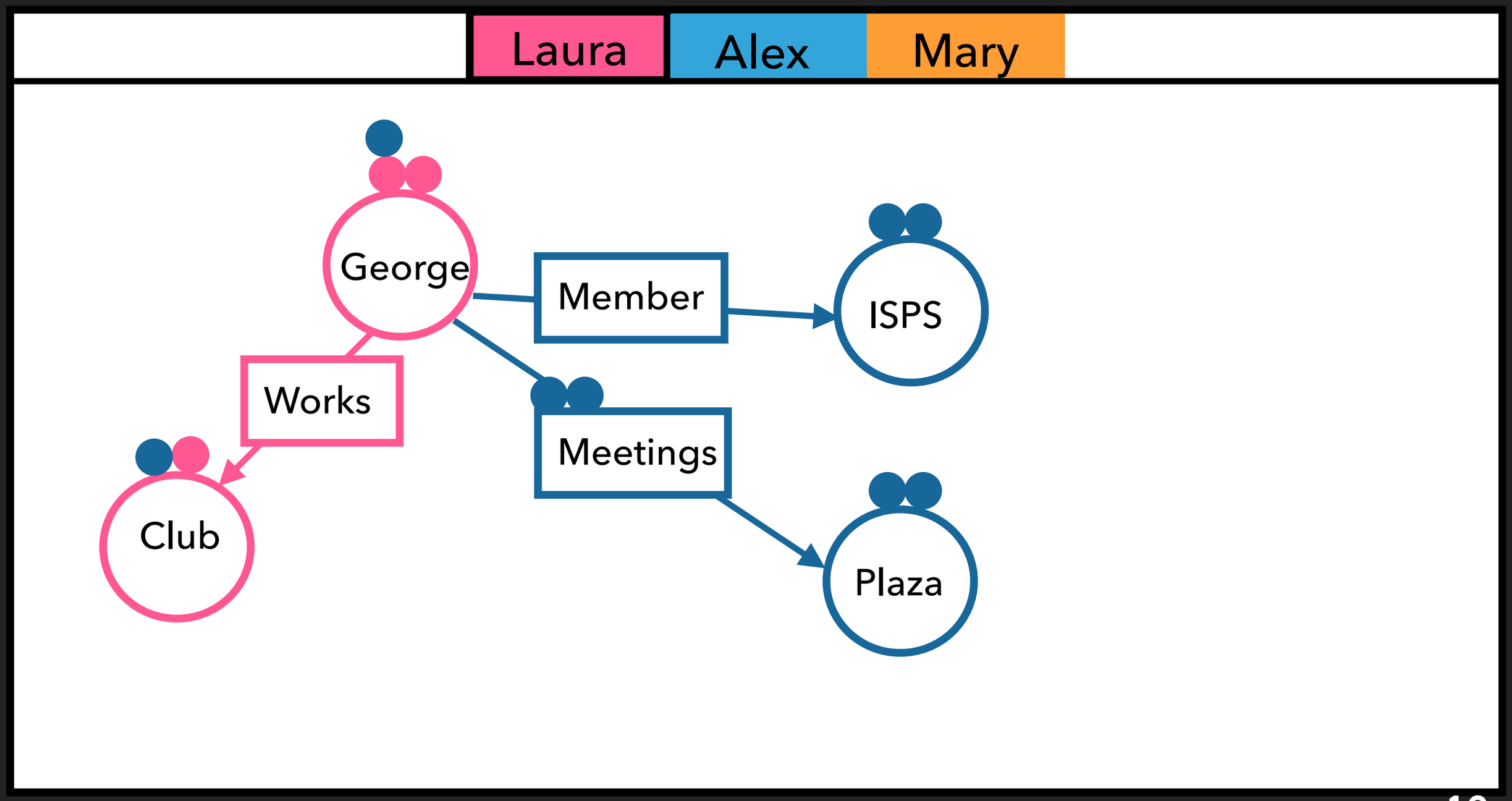


Isenberg & Fisher, 2012

LINKED COMMON WORK (LCW)

- **LCW**: automatically Identifying and visually representing similarities between collaborators' work
  - Partial merging
  - Full merging

PARTIAL VS. FULL MERGING



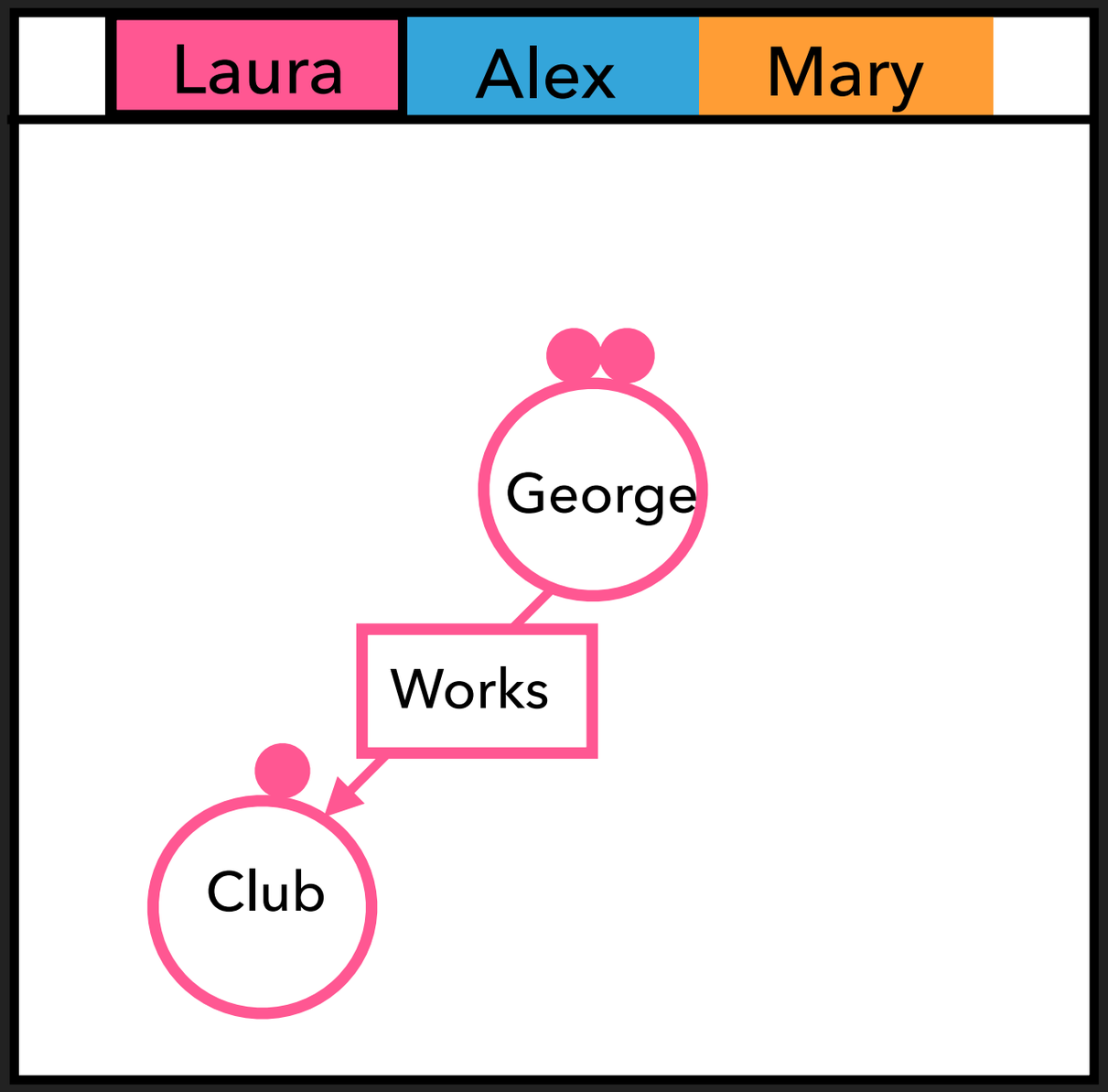
CLIP: VIDEO

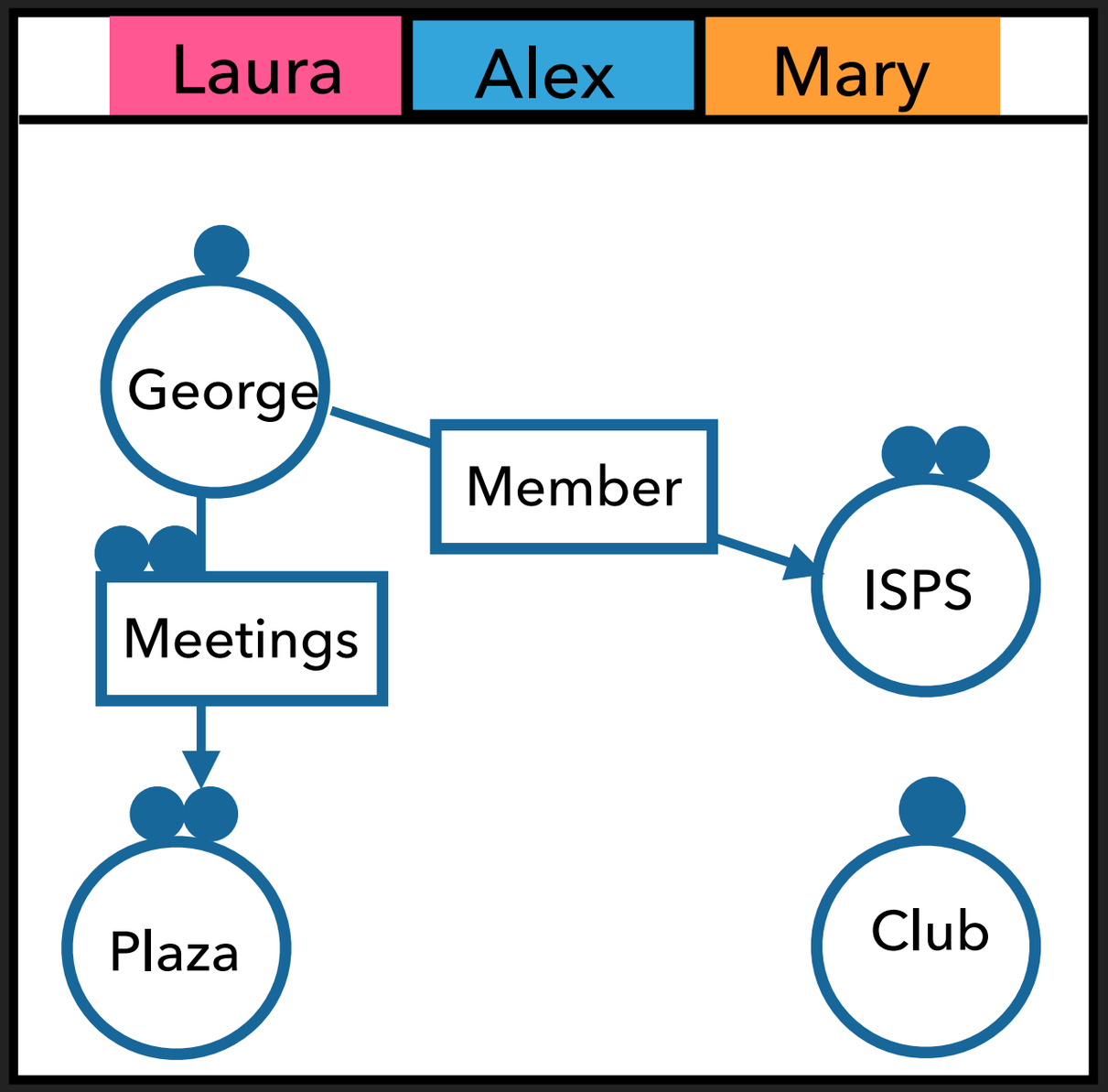

CLIP: A Collaborative Visual Thinking Space to Support
Joint Sensemaking

EVALUATION OF LINKED COMMON WORK (LCW)

- Experimental comparison of CLIP to a baseline tool
- Baseline tool: CLIP without LCW

BASELINE TOOL





USER STUDY & DATA GATHERING

- 48 participants:16 groups of 3, 8 groups in each condition
  - Worked for 90 minutes
  - Used CLIP or Baseline
- Followed by semi-structured interview
- Logged interactions
- Video recorded all the sessions

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

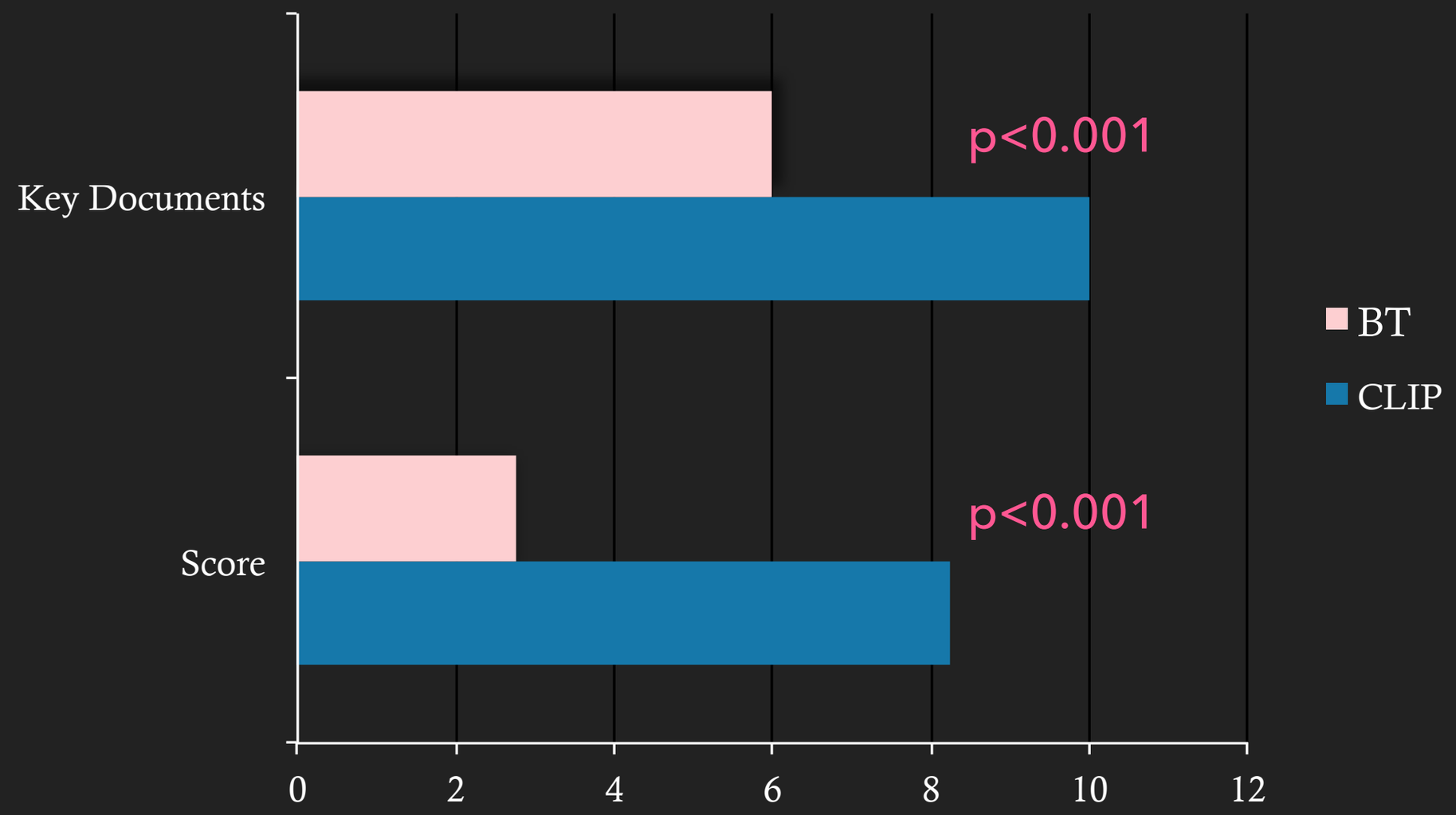
- Conversation analysis
  - Classified and counted statements of 7 different types
  - 2 coders, Krippendorff's alpha = 0.91
- Spent around **520 hours** on data analysis

METRICS SCHEME

DH	Discussion / generating Hypotheses
RV	Referring to Visualization
CO	Coordination
SA	Seeking Awareness
VF	Verbalizing Findings
QF	Question about Findings
RU	Related but uncategorized

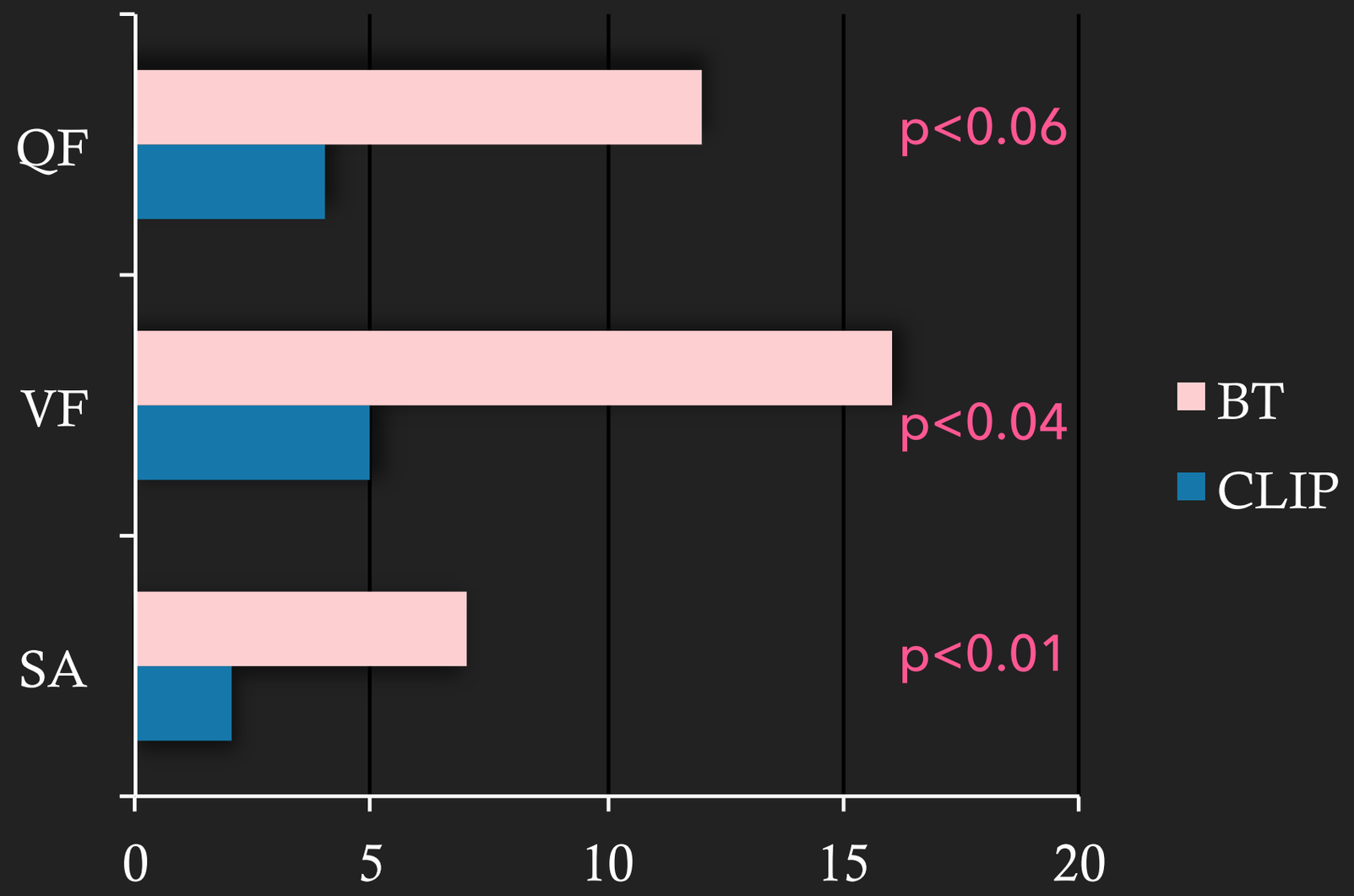
HYPOTHESES

H1: Better performance



HYPOTHESES

H4: Less reliance on verbal communications for awareness



FUTURE APPLICATIONS OF THIS PROJECT

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

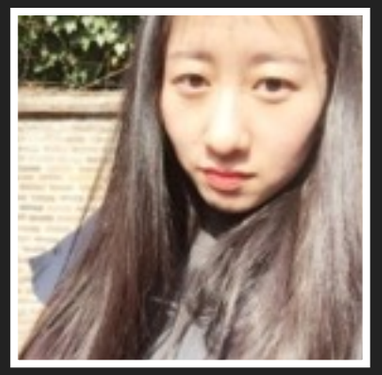

Narges Mahyar


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.

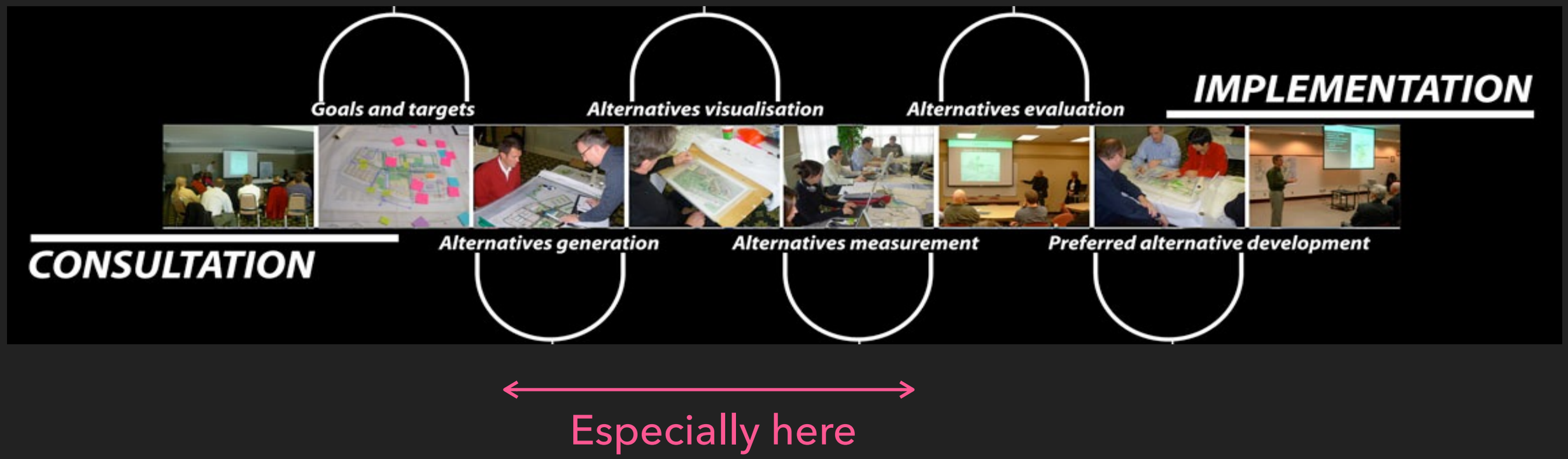
Narges Mahyar, Siyi Meng, Jialiang Xiang, Kellogg S. Booth, Cynthia Girling, and Ronald Kellett, "A Multi-Display Environment for Community Planning", Graphics Interface, 2016, in press.

PARTICIPATORY URBAN DESIGN

CONTEXT

- Break-out group work session at a public workshop or design charrette.
- E.g. “designing” a neighbourhood centre for a suburban neighbourhood with intent of increasing the neighbourhood walkability.
- Indicators: increased population, population density, housing mix, amount of commercial floor area, new jobs.

GAPS IN CURRENT SUPPORTING TOOLS



- Early in the process where influential (and difficult to reverse) directions are considered with relatively little information

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: METHODS

- Observed the system in action
- Interviewed and closely worked with experts
- Led the design and mentored 2 students to develop new features
- Evaluation: heuristic evaluation, internal test, pilot, user study

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?

DESIGN OBJECTIVES: INTEGRATING INDIVIDUAL DISPLAYS

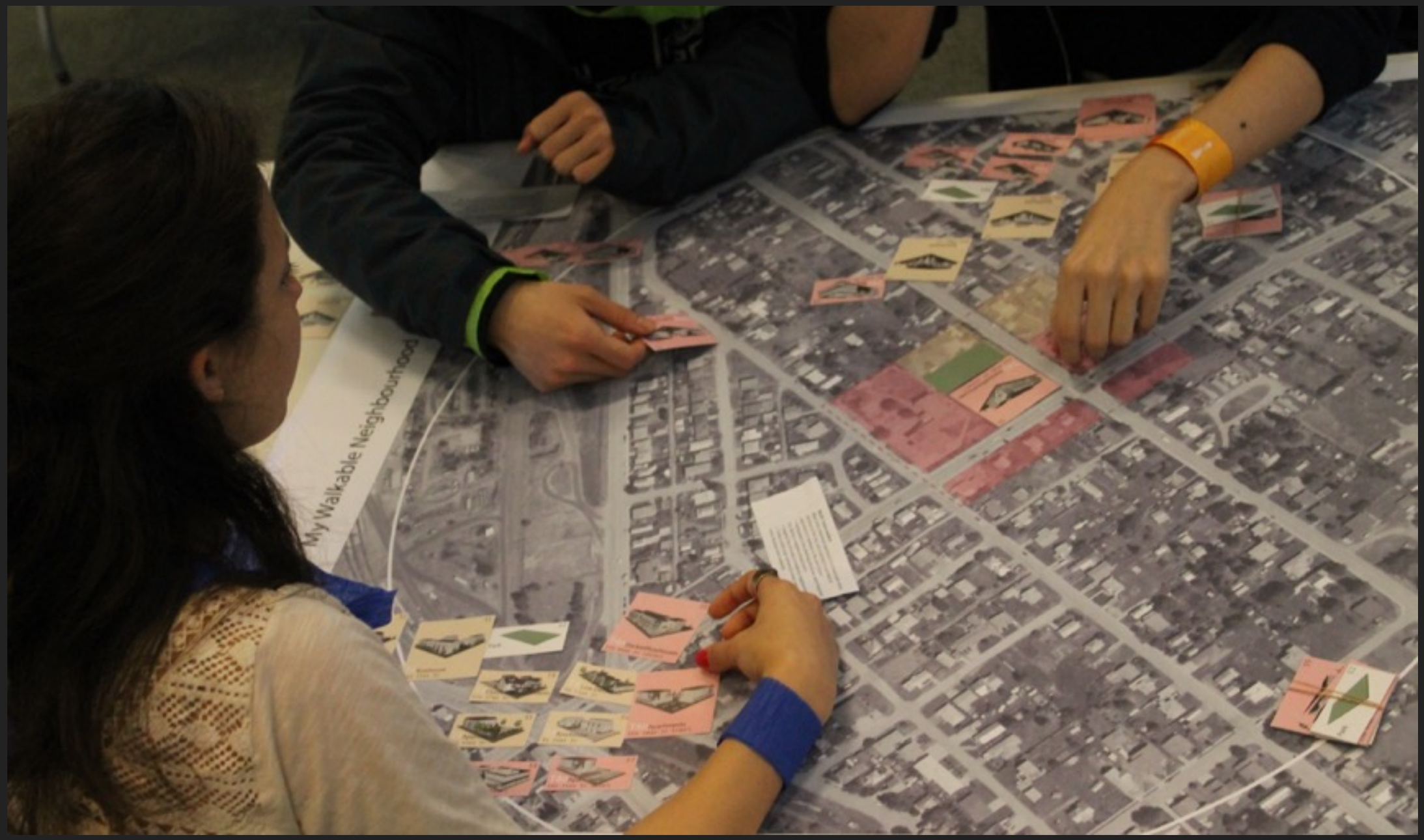
- iPad 3D viewer app
  - Improve interactions with the 3D wall display
- iPad indicator app
  - Improve interactions with metrics

PERSONAL DISPLAY

USER STUDY

- 40 participants: 8 groups of 5
- 2 conditions: paper vs. multidisplay tabletop
- Data gathering:
  - videos
  - pre and post session surveys
  - focus group
  - two independent observers' notes

PAPER-BASED



TABLETOP DISPLAY

WALL DISPLAY

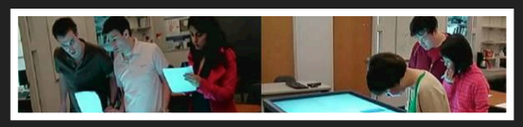
COLLABORATIVE CONTRIBUTIONS AND CO-CREATION OF DESIGN

ROLE OF 3D IN UNDERSTANDING THE DESIGN

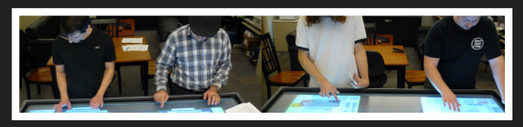
ANALYSIS IN PROGRESS

- Study a multi-display interactive tabletop system in action
- 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

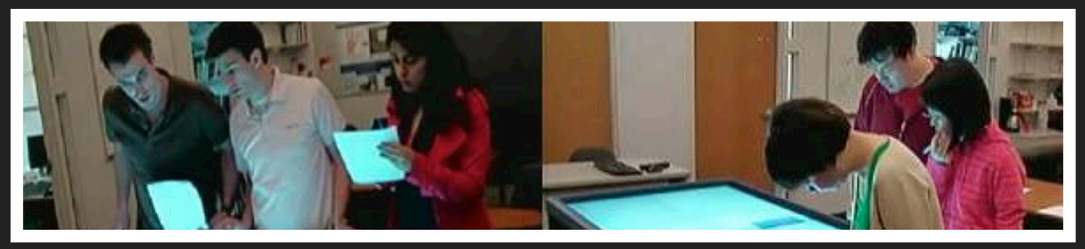
- Investigating a multi-display CVA tool for engagement

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

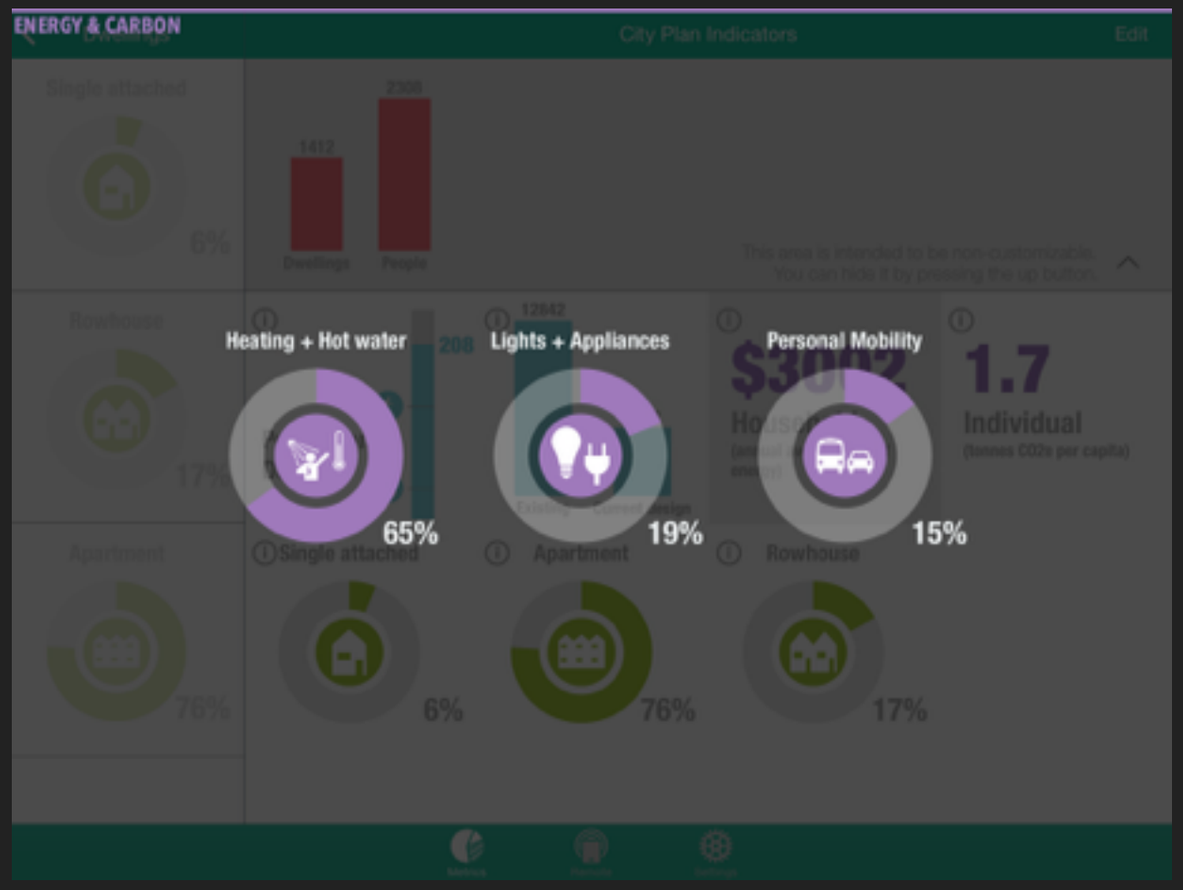


- LCW for different domains, e.g. co-authoring documents

- Use of multi-display eco-system for public engagement

SHORT-TERM RESEARCH GOALS

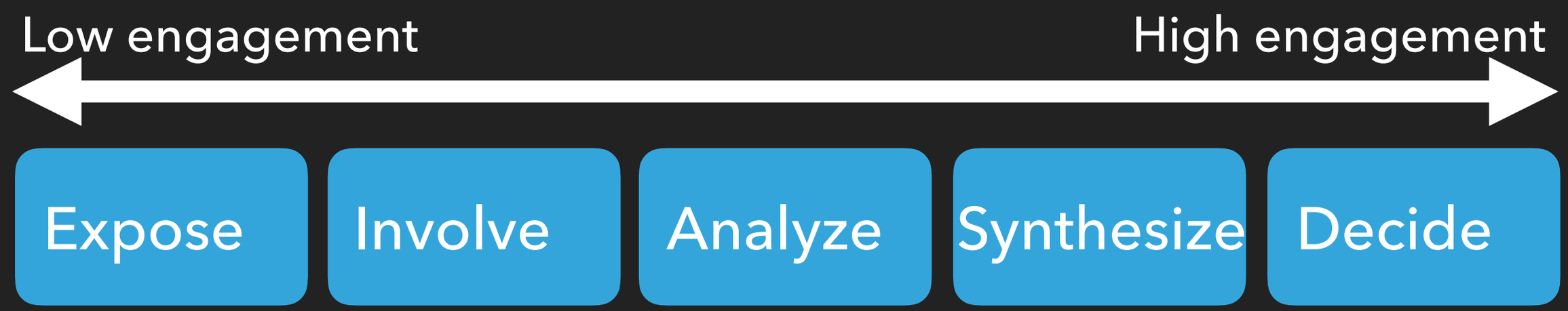
- Visualization design for public engagement



- Infographics & donut charts based on domain experts' suggestions

SHORT-TERM RESEARCH GOALS

- Understanding user engagement



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.

LONG-TERM RESEARCH GOALS

- Multimodal interaction for collaboration
- Novel displays to engage novice users
- Visual storytelling
- Visualization for personal discovery, e.g. health data
- Evaluation methods for InfoVis & CSCW
- Bridging between computational/analytics & design

THANKS TO MANY

THANK YOU!

NARGES MAHYAR

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SLIDES, PAPERS, AND MORE:
WWW.CS.UBC.CA/~NMAHYAR