Understanding Together: Sensemaking in Collaborative Information Seeking

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Outline

1. Problem motivation
2. Research approach
3. Background
4. Study 1
5. Study 2
6. Socio-technical circle
7. Contributions
8. Future work
Problem Motivation

- Collaborative work involves coming together to fulfill shared goals
  - This calls for creating a shared understanding of information

- Group members have different
  - Pieces of information
  - Expertise and skills
  - Roles and responsibilities

- Collaborative sensemaking: How do group members create a shared understanding of information?
Sensemaking in CIS

- Studied sensemaking in the context of CIS activities

- People often collaborate during information seeking activities

- Collaborative information seeking (CIS) is “activities that a group or team of people undertakes to identify and resolve a shared information need” (Poltrock et al., 2003)

- CIS is composed of seeking, sharing, understanding, synthesizing, and using information together.
Outline

1. Problem motivation
2. **Research approach**
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Research gap 1

- Sensemaking considered as *individual* cognitive activity
  - Little understanding of how sensemaking takes place in groups

- Sensemaking has been *implicitly* considered part of information seeking activities
  - Little understanding of how sensemaking takes place during CIS activities
Research gap 2

- Difficult to design interfaces to support sensemaking
  - Particularly hard in the design of collaborative information retrieval (CIR) tools

- Most CIR tools have focused on helping users find and retrieve information
  - Little support for collaborative sensemaking in CIR tools
Research questions

RQ1: Why do people collaborate for sensemaking in CIS activities?

RQ2: What are the characteristics of collaborative sensemaking in CIS activities?

RQ3: How can collaborative sensemaking be supported during CIS activities?
Multi-method research approach

- Two studies conducted to address these gaps
  - Using different methods in different domains
  - Gain holistic understanding of collaborative sensemaking

- Study 1 (RQ1, RQ2)
  - Ethnographic field study of the CIS activities of healthcare providers in a hospital emergency department (ED)

- Study 2 (RQ3)
  - Design, development, and evaluation of a tool CoSense to enhance sensemaking in collaborative Web search.
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What is sensemaking?

Sensemaking is creating an understanding of a situation in order to act effectively.

- Sensemaking is an important aspect of everyday life
  - Look up reviews online before buying a camera

- Part of decision-making (Klein, 2006) and problem-solving (Weick, 1995)

- It is different from interpretation, creativity, and mental-modeling (Klein, 2006)
Sensemaking research

Sensemaking has been studied in:
- Information sciences (Dervin, 2003)
- Organizational sciences (Weick, 1995)
- Human-computer interaction (Russell, 1993)
- Education and learning sciences (Schoenfeld, 1992)

Salient characteristics of sensemaking research:
- Meaning generation and understanding
- Important aspect of individual information seeking tasks
  - Viewed as an individual cognitive activity
  - Missing: role of social interactions during sensemaking
CIS research

- Some CIS studies have focused on the process of CIS
- Others on the characteristics of CIS

<table>
<thead>
<tr>
<th>Aspect of CIS</th>
<th>Studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collaborative formulation of information needs and</td>
<td>(Karamuftuoglu, 1998; Poltrock et al., 2003)</td>
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<tr>
<td>information queries</td>
<td></td>
</tr>
<tr>
<td>Information sharing strategies and patterns</td>
<td>(Prekop, 2002; Talja, 2002)</td>
</tr>
<tr>
<td>Information seeking roles and contexts</td>
<td>(Prekop, 2002; Spence &amp; Reddy, 2007; Reddy &amp; Jansen, 2007)</td>
</tr>
<tr>
<td>Situational awareness</td>
<td>(Sonnenwald &amp; Pierce, 2000)</td>
</tr>
<tr>
<td>Communication</td>
<td>(Poltrock et al., 2003; Twidale et al., 1997)</td>
</tr>
<tr>
<td>Triggers and temporality</td>
<td>(Spence &amp; Reddy, 2005; Reddy &amp; Dourish, 2002)</td>
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</tbody>
</table>
CIS research

- Few have explicitly focused on sensemaking during CIS activities
  - However, studies of CIS have found that sharing the meaning of information is important

- Role of annotations and note-taking (Gorman, 2002)
- Sharing relationships between information objects (Hansen & Jarvelin, 2005)
- Collaborative grounding (Hertzum, 2008)
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Study 1

Ethnographic field study of the CIS activities of healthcare providers in a hospital emergency department (ED)
Why is the ED interesting?

- **Nature of ED work**
  - Diverse case-mix
  - Mix of co-located and distributed collaboration
  - Time-criticality
  - Unavailability of information
  - Need for seamless collaboration between providers with different skills, backgrounds, expertise.
Research site

Penn State Hershey Medical Center

- 500-bed teaching hospital
- ~50,000 ED visits a year.
- 27 rooms and hallway beds

Pre-hospital services

- LifeLion (911 calls)
- UEMS (Inter-facility transport)
Study participants

- Physicians
  - Attending physicians (3)
  - Residents (6-7)
  - Physician’s assistants (1)

- Nurses
  - Staff nurses (13)
  - Triage nurses (1-2)
  - Charge nurse (1)

- Registration associates
  - Secretary (1)
  - Mini-registration associates (2)

- Various support staff
  - ED technicians (3-4)
  - Support assistants (1)

- EMS staff
Information and Communication Tools

- Whiteboard
- Computerized provider order entry system (FirstNet)
- Paper forms
Why qualitative methods?

- Collaborative sensemaking is **interactive** and **enactive**
  - Interested in capturing details of people’s interactions and actions
  - People usually find it hard to articulate what they do in their routine work

- No a-priori hypothesis or pre-conceived ideas about variables that might affect collaborative sensemaking

- Ethnographic study
Data collection and analysis phases

- Data was collected in two phases
  - Phase 1: Using a grounded theory approach (Glasser and Strauss, 1967)
  - Phase 2: Focused more by using a working definition of collaborative sensemaking:

Collaborative sensemaking occurs when two or more people create a shared understanding of information by
1) Interacting with others to share individual understandings of information
2) Interpreting others’ interactions with information
Data collection

- Fieldwork using ethnographic techniques
  - from Jan ‘07 – Dec ‘08
  - Phase 1 (Jan ‘07 to July ‘07), Phase 2 (Sep ‘07 – Dec ‘08)

<table>
<thead>
<tr>
<th>Data collection techniques</th>
<th>Quantity (# of hours/units)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observations</td>
<td>170 hours</td>
</tr>
<tr>
<td>Artifacts collection</td>
<td>12 artifacts</td>
</tr>
<tr>
<td>Shadowing</td>
<td>15 shadowing sessions</td>
</tr>
<tr>
<td>Critical incidents collection</td>
<td>17 critical incidents</td>
</tr>
<tr>
<td>Informal interviews</td>
<td>17 interviews (20-30 minutes each)</td>
</tr>
<tr>
<td>Formal semi-structured interviews</td>
<td>14 interviews (30-45 minutes each)</td>
</tr>
</tbody>
</table>
Data analysis

- Grounded theory: systematic generation of theory from empirical data (Glasser & Strauss, 1967)
  - Unit of data analysis is the incident
    - Instances of collaborative sensemaking
  - Coding
    - Open coding -> selective coding -> theoretical coding
Validity, reliability and generalizability

- **Triangulation**
  - Using a variety of data sources and data collection techniques

- **Member checking**
  - Verifying data with participants

- **Generalizability**
  - Ethnographies are usually single-site studies
  - Goal is to find the general in the particular
Findings

1. Occasions for collaborative sensemaking
   1. Ambiguity of information found during CIS activities
   2. Role-based distribution of information
   3. Lack of expertise

2. Characteristics of collaborative sensemaking
   1. Prioritizing relevant information
   2. Sensemaking trajectories
   3. Activity awareness

4. Study 1
Occasions: Role-based information distribution

- Information is not distributed equally among group members
  - Different group members have access to different pieces of information due to their roles
  - These information pieces need to be synthesized

- Roles can be
  - Organizational
  - Search/domain expert or novice
Example: Role-based information distribution

House manager asks CN why the patient has had an atypical trajectory (IMC -> ICU -> IMC -> floor bed)

CN reads patient’s record and tells house manager that patient was transferred from Florida IMC where he had surgery

CN asks RN for the patient’s detailed medical history. RN looks through her nursing notes and tells CN why patient was moved so many times. CN in turn tells the house manager.
Characteristics: Sensemaking trajectories

- Collaborative sensemaking has a strong temporal aspect
  - Products of sensemaking passed on across group members with time
  - Individual sensemaking of group members affected each other

- Sensemaking trajectory is the steps in the sensemaking process and the ‘sense’ made at each step
Example: Sensemaking trajectories

CN1 tells CN2 that a patient is 8-weeks pregnant, when the patient is that the patient is 8-months pregnant.

CN2 remembers a patient who was 7 months pregnant and brought to the ED where the baby died.

CN2 tells attending physician about the case, stressing on the advanced stage of pregnancy

Not only is information shared but the meaning of the information.
Study 1 Discussion

- Strauss’ notion of trajectories (Strauss et al., 1985)
- Temporal trajectories (Reddy, 2002)

- Sensemaking trajectories: temporal connections between the sensemaking of individual group members
  - Sense evolves along the trajectory

- Practical implications: In CIR tools
  - persistence of products of sensemaking
  - representing information and sense made chronologically using timelines
Design implications for CIR tools

- Design ideas for supporting sensemaking
  - Visualization of sensemaking trajectories which show chronologically information found and sense made
  - Activity timeline of the different actions performed by group members with respect to an activity over time.
  - Support the roles and expertise of group members
    - Shared representation should enable role-specific information encoding
    - Enable experts to comment on and annotate information
Study 1 summary

- Conceptual contributions
  - Occasions for collaborative sensemaking
  - Characteristics of collaborative sensemaking
  - Collaborative sensemaking framework

- Technical contributions
  - Design implications for supporting collaborative sensemaking in CIS tools
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Study 2

Tool-based study of sensemaking during collaborative Web search tasks
Background: Collaborative Web search

- People collaborate during Web search (Morris, 2008)

- Tools have been developed to support collaborative Web search (Morris, 2007; Pickens et al., 2008)

- Lack of understanding of users’ behavior during collaborative Web search, specifically sensemaking behavior
Study Design

- **Formative study**
  - Identified **sensemaking challenges** in using a collaborative Web search tool, *SearchTogether*

- **Design**
  - **new tool** *CoSense* to help users overcome sensemaking challenges

- **Evaluation of CoSense**
  - **how sensemaking takes place** during collaborative Web search
  - **how tools can be designed** to support sensemaking
SearchTogether (UIST, 2007)

- Search session
- Query history
- Add comments and ratings to Web pages
- Chat with collaborators

5. Study 2
Formative study: Design

- **Goal:** Understand how SearchTogether supports sensemaking

<table>
<thead>
<tr>
<th>Task</th>
<th>Vacation planning 2-phase design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participants</td>
<td>6 groups (3 in each group)</td>
</tr>
<tr>
<td>Tools used</td>
<td>SearchTogether</td>
</tr>
<tr>
<td>Data collection</td>
<td></td>
</tr>
</tbody>
</table>
  - Interviews
  - Observations
  - Audio and video recording |

5. Study 2
Formative study: Findings

- Sensemaking challenges
  - Awareness
    - Context and action awareness
  - Sensemaking trajectories
    - Steps in the sensemaking process
  - Sensemaking handoffs
    - Understanding information found asynchronously

5. Study 2
CoSense

- Integrated with SearchTogether

- Four views of information
  - Search strategies view
  - Timeline view
  - Workspace view
  - Chat-centric view

SearchTogether

Database

CoSense

5. Study 2
CoSense: Search strategies view

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5. Study 2
CoSense: Timeline view
CoSense: Workspace view
CoSense: Chat-centric view
Evaluation of CoSense

- Goal: Examine if CoSense improved sensemaking challenges faced in formative study

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<tr>
<th>Task</th>
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<tbody>
<tr>
<td>Participants</td>
<td>18 participants (4 in each group)</td>
</tr>
<tr>
<td>Tools used</td>
<td>SearchTogether and CoSense</td>
</tr>
</tbody>
</table>
| Data collection  | - Interviews  
|                  | - Observations  
|                  | - Log data  
|                  | - Online questionnaire          |
Evaluation of CoSense: Findings

- CoSense views supported sensemaking during
  - Synchronous and asynchronous search
  - Initial vs. handoff stages of search

- Also supported different styles of sensemaking
CoSense feature usage: During task

- During synchronous search
  - Most used views: search strategies and chat-centric
  - Example:
    - bainbridgevineyards.com
    - coffee.net
    - crystalseas.com
    - enjoyseattle.com
    - guidetosanjuans.com
    - italianrestaurantsseattletimes.com
    - maps.google.com
    - pageworx.google.com
    - parksof.gov
    - sanjuansafaris.com

- During asynchronous search
  - Most used views: timeline and workspace
  - Example:
    - "there's a tour of the arctic circle..."
    - "Helsinki Central railway station - Wikipedia, the free encyclopedia"
    - "I'd be interested in seeing this train station for the..."
    - "Image: Finlandia Hall - Wikipedia, the free encyclopedia"
    - "Finlandia Hall - Wikipedia, the free encyclopedia"
    - "Chat"
CoSense feature usage: During questionnaire

**Search strategies view**
- **Skills and strategies** of group members

**Timeline view**
- **Connections** between different content

**Workspace view**
- Group members’ **contributions and roles**

**Chat-centric view**
- Group members’ **contributions and decisions reached**

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Sensemaking strategies for handoff

- Search-lead strategy

Proportion of search and sensemaking activities for two participants

- Sensemaking-lead strategy
Study 2 Discussion

- Characteristics of collaborative sensemaking
  - Sensemaking trajectories
  - Prioritizing information
  - Managing group representations

- Differences in sensemaking strategies
  - Search-lead and sensemaking-lead strategists had different view preferences
  - No difference in strategies for success in sensemaking
Design challenges

- Important design issues
  - How much information to represent in trajectories?
  - What should be the granularity for information prioritization?
  - How should group representations be structured?
  - How should the products of sensemaking be stored?
Study 2 summary

- Technical contributions
  - Design features that can support collaborative sensemaking during a CIS task
  - Design challenges to support collaborative sensemaking in CIR tools

- Conceptual contributions
  - Strategies for search and sensemaking
  - Success in collaborative sensemaking
  - Taxonomy of collaborative sensemaking in CIS tasks
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6. **Socio-technical circle**
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Adapted from (McDonald, 2000)

Socio-technical circle

Study 1: Field study in the emergency department
- Occasions for collaborative sensemaking
- Characteristics of collaborative sensemaking

Study 1
- Framework for collaborative sensemaking in CIS tasks
- Design implications for collaborative information retrieval tools

Study 2: Collaborative sensemaking during Web search
- Formative study
- Sensemaking challenges during collaborative Web search tasks

Study 2
- Design and development of CoSense
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Contributions

RQ1: Why do people collaborate for sensemaking in CIS activities?
- Ambiguity of information
- Role-based distribution of information
- Lack of expertise

RQ2: What are the characteristics of collaborative sensemaking in CIS activities?
- Sensemaking trajectories
- Activity awareness
- Prioritizing relevant information
Contributions

RQ3: How can sensemaking be supported during CIS activities?

- Design implications from the ethnographic study
- Different features of CoSense are useful in different ways during synchronous, asynchronous, and handoff conditions
- Design challenges of supporting sensemaking in CIS tools
Contributions to academic communities

- To CSCW
  - How and why groups come together to understand information and design recommendations for CIR tools to support this.

- To HCI
  - How information can be better represented and visualized for collaborative sensemaking.

- To information sciences
  - Explicates how sensemaking takes place in CIS activities
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8. **Future work**
Future work

- Extending thesis ideas further
  - Conceptual development of sensemaking trajectories and exploring the role of activity awareness further

- Exploring collaborative information behavior (CIB)
  - Role of social interactions during Web search
  - Large-scale studies of search and sensemaking patterns to build models of CIB
  - Build CIR tools that enhance sensemaking
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- Friends and colleagues
References


References


References


References


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- User sketches inspired by [www.xkcd.com](http://www.xkcd.com)
Questions?