Microsoft Research
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Collaborative Visualization, Tabletop Touch

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Collaborative Text Analysis
The Cambiera Project

Design Data and Tasks

- 310 newspaper articles
- Find relevant articles
- Form hypotheses, connections
Follow separate hypotheses  (correct or incorrect)
Capitalize on the group effort
Follow separate hypotheses (correct or incorrect)

Capitalize on the group effort

“It’s confusing when everybody has a pointer.”
### Collaborative Information Analysis Processes

<table>
<thead>
<tr>
<th>Process</th>
<th>Description</th>
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<tbody>
<tr>
<td>Clarify</td>
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<tr>
<td>Strategize</td>
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<tr>
<td>Discuss Collaboration Style</td>
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<td>Validate</td>
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<tr>
<td>Select</td>
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<tr>
<td>Operate</td>
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<tr>
<td>Parse</td>
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<tr>
<td>Browse</td>
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</tbody>
</table>

Loosely Coupled Work  ↔  Closely Coupled Work

Isenberg et al., CHI 2008
Support individual & group

• Surface application with parallel input
• Provide peripheral awareness information of others’ work
## Awareness Overview

<table>
<thead>
<tr>
<th>Related searches</th>
<th>Search order</th>
<th>Who read</th>
<th>Read Frequency</th>
</tr>
</thead>
</table>

**Who searched**

- mad cow
  - (read: 2/39)

**Collaborative Brushing and Linking – the other view:**

- bse
- boynton
  - Also Found By

- 02/02/2002: Luthor Announces Biotech Lab to Locate I
Collaborative Brushing and Linking

**Awareness information**

- Did another search also find my document?
- Has someone else issued my search?
- Has someone extracted the same document?
- Has someone read the same document?
Handling Many Objects
How to design multi-object operations?
How to design multi-object operations?
How to design multi-object operations?
Research Questions

• How do virtual and physical techniques carry over?
• How will people use hands and fingers?
• How dextrous will they be?
• Will they focus on single objects or groups?
Related Work

Pile-N-Browse

From (Wu et al., 2006)
Studying gestures

Select Group 1: hold and tap

From (Wobbrock et al., 2009)
Goals

• Study tasks with manipulation of large number of small objects
• Compare gestures from physical/mouse to surface
• Derive gesture vocabulary
Conditions

**Mouse (M)**
- 24” Desktop Screen
- Single click, marquee selection, ctrl+shift click
- Rendered circles

**Surface (S)**
- 24”x18” MS Surface Screen
- Single finger touch, convex hull
- Rendered circles

**Physical (P)**
- 24”x18” MS Surface Screen
- Any physical interaction
- Game chips

**All**
- Physical circle sizes matched
- 200 circles total, 4 colors (50 circles per color)
Participants

- 32 (25 male, 7 female)
- All users do the Surface, and *either* mouse or physical

- Mouse + Surface (MS)
- Surface + Mouse (SM)
- Physical + Surface (PS)
- Surface + Physical (SP)

Data for 32 Surface, 16 Mouse, 16 Physical
1. Separate blue and white chips into clusters
2. Spread blue cluster so no 2 circles overlap
3. Timed clustering
1. Gesture sets from Task 1 & 2
   • From video analysis in physical & surface condition
   • Both successful & unsuccessful gestures
2. Timing results from Task 3
   • Analyzed with a 2x2 mixed Anova
3. Participant comments
1. **One handed – applied to a group**
   - Splayed hand pushes pieces
   - One hand shove
   - Pinch
   - Hand and palm
2. One handed – applied to single item
   - Drag single item
   - Select single items with multiple fingers
   - Toss single object
3. Two handed – applied to single group
   • Both hands coalesce large group to small
   • Two-hand transport
   • Add/remove from selection
4. Two handed – applied to > 1 group

- Drag two objects with pointer fingers
- Two hands grab points in sync
- Rhythmic use of both hands
- Two hands grab groups
5. **Surface Only**

- One hand hull manipulation
- Two-hand hull manipulation
- Treat finger like a mouse
- Push hard to multi-select
6. Physical Only

• Lift up
• Go outside the lines
• Slide around objects
• Texture-based
• Toss chips between hands
• Drag and drop some chips on the way
Fingertip-based most popular
Difference based on starting condition
  • Starting in physical: 88%
  • Starting in mouse/surface: 56%/50%
70% used multiple hands for >1 group
On Surface many used fingers as a mouse
  • Starting in mouse: 50%
  • Starting in physical: 25%
Timing Results

**Surface is sign. faster than Mouse**
- Surface: 116s, Mouse 134s, \((F_{1,14}=6.10, p=.027)\)
- No effect of cond. order \((F_{1,14}=9.28, p=.352)\)

**Physical is sign. faster than Surface**
- Physical: 89s, Surface: 120s \((F_{1,14}=11.96, p=.004)\)
- Sign. effect for cond. order (PS < SP) \((F_{1,14}=11.482, p<.001)\)

**Impact of first condition**
- Participants starting in Physical sign. faster on Surface (PS < MS) \((t_{1,2}=2.38, p<.035)\)
Surface perceived as sign easier than Mouse

- No effect between Physical/Surface

88% preferred clustering task on Surface compared to Mouse

- 44% preferred Surface to Physical

Perceived advantages

- Physical: tactile feedback
- Surface: drag over circles, two handed interaction
- Mouse: select dispersed circles
Discussion

- Participants showed influence of previous condition
  - Gestures sets and work speed influenced
- Multi-touch grouping was common
- Two-handed interaction common
  - Wide variety of coordinations (in sync, in parallel, ...)

Discussion