Increasing the Utility of Quantitative Empirical Studies for Meta-analysis

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Four Recommendations to Increase the Utility of Quantitative Empirical Studies

- Quantitative empirical studies are valuable tools in visualization evaluation, but may not be usable in meta-analyses
  - Meta-analyses may focus on different aspects of individual studies and have very different goals
  - Comparison between studies require common ground

- Derived **4 recommendations** based on our experience in a previous systematic review to make empirical studies more amenable to meta-analyses:
  1. Use comparable interfaces
  2. Capture usage patterns
  3. Isolate interface factors
  4. Report study details

Recommendation 1:
Use Comparable Interfaces

- Identify and match key components in the interface to enable comparison between interface **factors** for single-factor studies

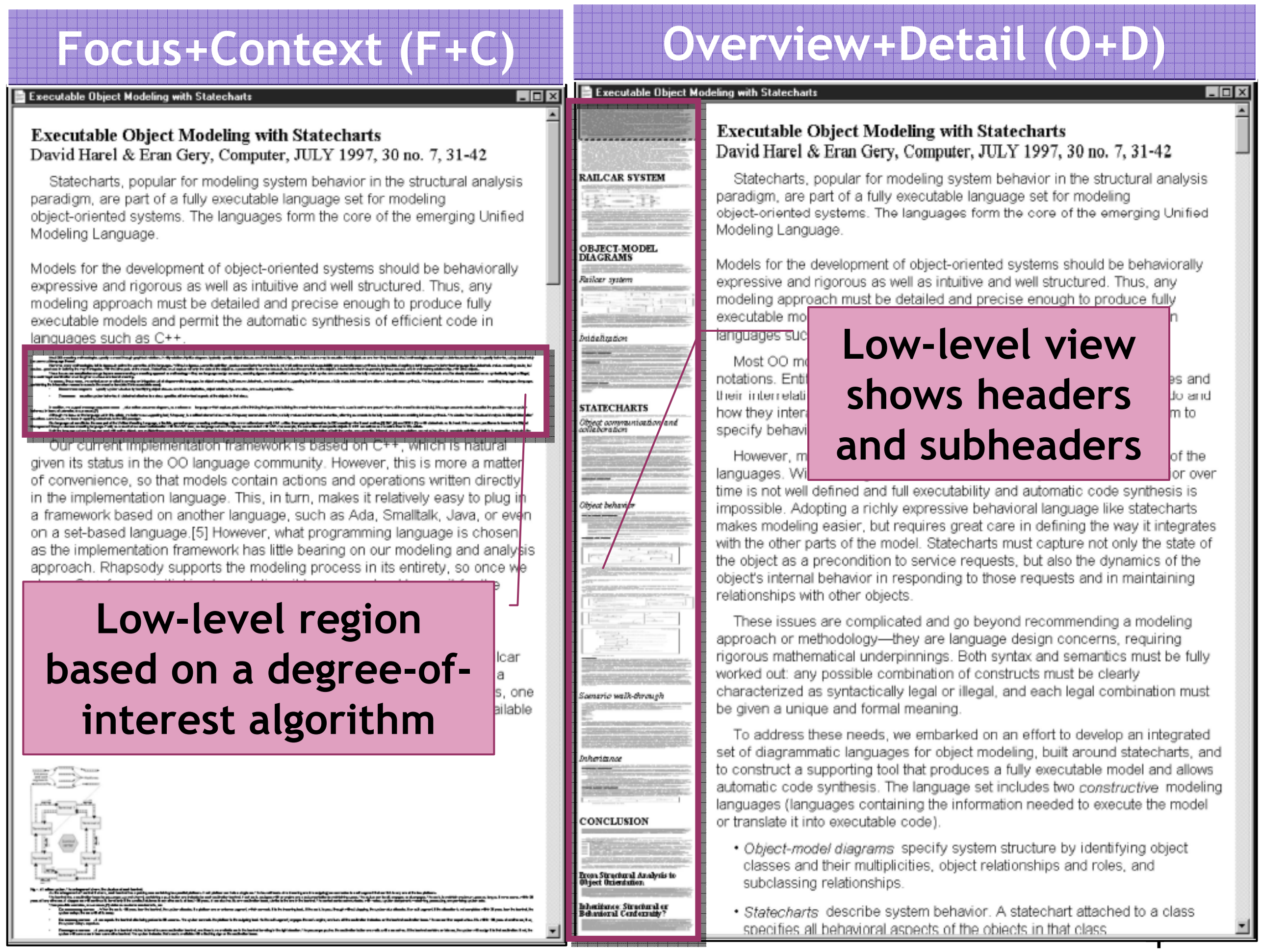
- Paper proposed five key components, focus on one in this talk:

  1. Basic Visual Element
  2. **Information content**
  3. Levels of display
  4. Levels in data
  5. Interaction complexity

Recommendation 1:
Use Comparable Interfaces

Information content: what is displayed on the interface

- In our review, we wanted to know how different **spatial data-level arrangements** affect interface use:
  - F+C (embedded)
  - O+D (separate)
- The two interfaces also differed in content:
  - F+C uses a **dynamic** algorithm to determine content readability
  - O+D has **static** headers/subheaders
- Unable to tease out effects of data-level arrangements in time & accuracy results

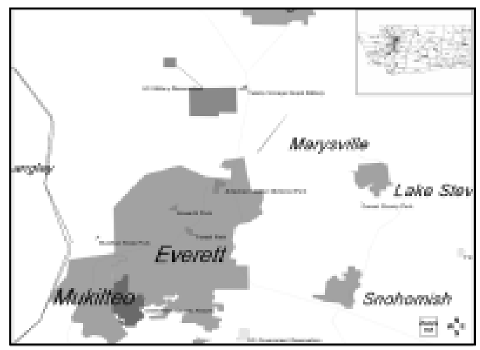


Hornbæk & Frøkjær's 2001/3 document-reading study

Proposed Approach to Recommendation 1:
Follow-up Studies

- It may be difficult to study the entire system **and** follow our recommendation to ensure comparable interfaces
  - E.g., The degree-of-interest algorithm in Hornbæk & Frøkjær's 2001/3 document-reading study is part of the F+C interface

- It is also difficult to tease out factors in advance
  - E.g., Differing levels of data between the Montana and Washington maps in Hornbæk et al.'s 2002 Map-navigation study



Washington map

Montana map

➢ Do follow-up studies to investigate identified factors

Recommendation 2:
Capture Usage Patterns

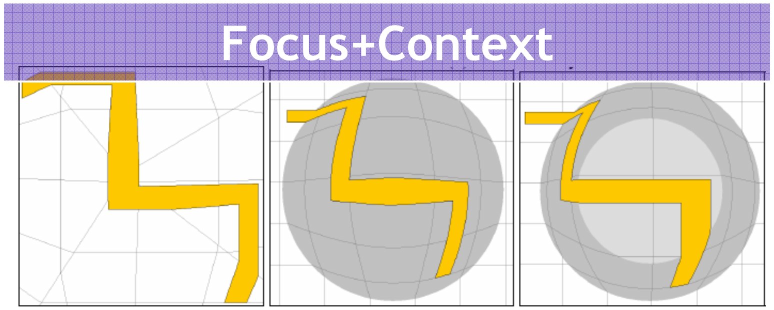
- Provide usage patterns as insight into **how** an interface is used
  - separate from statistical results

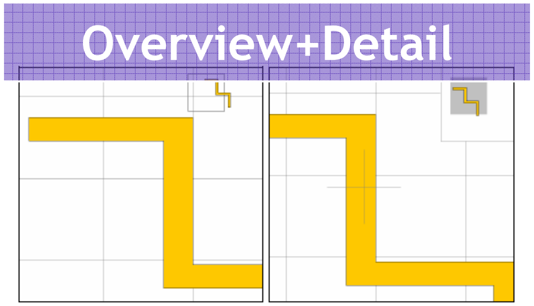
- Despite being unable to use the time & accuracy results to tease out effects of data-level arrangement in Hornbæk and Frøkjær document-reading study, we **could** infer reading patterns from study paper
  - O+D better supports exploration since the overview offers navigation possibilities in a stable layout
  - F+C layout changes with user clicks
  - Insight into how spatial data-level arrangement affect use!

- Provide **observations** of interface use:
  - Participant strategies
  - Interface choice
  - Interactivity (e.g., with eye-gaze recordings, usability logs)

Recommendation 3:
Isolate Interface Factors

- Completely cross all factors to allow isolating effects of a single factor in a multi-factor study





- Gutwin & Skopik's 2003 2D-steering study has at least 3 factors
- We were only interested in the effects of spatial data-level arrangement, but not the other two (effective steering path, interaction complexity)
- We were unable to isolate the effect of spatial data-level arrangement for our purpose of review, as the factors were not fully-crossed

➢ Do **follow-up studies** to look at a subset of the factors to limit the number of conditions

Recommendation 4:
Report Study Details

- Chen and Yu (2000) recommended standardizations in reporting
  - Testing information
  - Statistical results
  - Descriptions of visual-spatial properties of information visualization systems

- We added a few based on our systematic review
  - Task instructions: to ascertain levels of clues provided
  - Interaction video/demo: to understand interaction complexity

- Use **online materials** as workaround for publication page limits
  - Online supplementary materials
  - Online project websites

Possible Outcomes:
Standardize Studies at a Re-usable level

- We proposed 4 recommendations to better empirical studies:
  1. Use comparable interfaces → Do follow-up studies
  2. Capture usage patterns → Provide observations
  3. Isolate interface factors → Do follow-up studies
  4. Report study details → Post online materials

- Doing so will hopefully:
  - Enable and encourage reviews and meta-anayses to capture existing knowledge
  - Enable building of interface-factor repositories at a re-usable level