A Knowledge Task-Based Framework for Design and Evaluation of Information Visualizations

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On the whole, InfoVis has been concerned more with faithfully representing data than with facilitating analytic processes.
SeeIT (Visible Decisions)
Grocery Store Spending Survey Visualization
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Spotfire Pro 4.0
1987 Baseball Data Visualization
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“[Managers] think they understand the relationships between cause and effect in their organizations. But in fact, the links between actions and results are infinitely more complicated than most managers suspect…”

David Freedman
Harvard Business Review

Can we help?
User Analytic Goals

- Complex decision-making
- Learning a domain
- Identifying the nature of trends
- Predicting the future
The Analytic Gaps

- **Rationale Gap**
  - Analyst Perceptual Processes
    - Perceiving Useful Relationships
      - **Worldview Gap**
    - Explaining Relationships

- **Representation of Data**
  - Higher-Level Analytic Activity
Bridging the Gaps

- Six **knowledge tasks** for designers for bridging analytic gaps
  - Grouped according to which gap they fill
  (worldview, rationale)
Knowledge Task Summary

- **Worldview Tasks**
  “Do we show the right things to the user?”
  1. Domain parameters
  2. Multivariate explanation
  3. Hypothesis confirmation

- **Rationale Tasks**
  “Will the user believe what they see?”
  1. Expose uncertainty
  2. Concretize outcomes
  3. Formulate cause/effect
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Worldview Task 1: Determine Domain Parameters

Facilitate acquisition and transfer of knowledge and/or metadata about domain parameters
Worldview Task 1: Determine Domain Parameters

Grokker 2 (Groxis)
WWW Map for “Exotic Vacations”
Worldview Task 2: Multivariate Explanation

Support the discovery of useful correlative models – especially those involving many variables
Worldview Task 2: Multivariate Explanation

IN-SPIRE (PNNL)
Dynamically Adjustable Categorization
Worldview Task 3: Confirm Hypotheses

Provide facilities for users to formulate and confirm hypotheses about the data set.
Worldview Task 3: Confirm Hypotheses

InfoZoom 3.71 (HumanIT)
Retail Data Visualization
Worldview Task 3: Confirm Hypotheses

IN-SPIRE (PNNL)
Hypothesis Verification
Knowledge Task Summary

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Rationale Task 1: Expose Uncertainty

Expose the sources and effects of uncertainty in data measures and aggregations
Rationale Task 1: Expose Uncertainty

SeeIT (Visible Decisions)
Grocery Store Spending Survey Visualization, Augmented
Rationale Task 1: Expose Uncertainty

ThemeExplorer (Diakapoulos et al., InfoVis ‘04)
Explicitly Representing Uncertainty in a Themescape
Rationale Task 2: Concretize Relationships

Show the elements comprising relationships and translate into real-world outcomes
Rationale Task 2: Concretize Relationships

Attribute Explorer (Tweedie et al., CHI ‘94)
House Searching
Rationale Task 2: Concretize Relationships

FundExplorer (Csallner et al., InfoVis ’03)  
Mutual Fund Diversification Tool
Rationale Task 3: Formulate Cause and Effect

Clarify the source and nature of possible causations
Rationale Task 3: Formulate Cause and Effect

Tarantula (Eagan et al., InfoVis ‘01)
Software Fault Visualization
Rationale Task 3: Formulate Cause and Effect

IN-SPIRE (PNNL)
Time Evolution of Document Themes
## Knowledge Task Summary

### Worldview Tasks
“Do we show the right things to the user?”

1. Domain parameters
2. Multivariate explanation
3. Hypothesis confirmation

### Rationale Tasks
“Will the user believe what they see?”

1. Expose uncertainty
2. Concretize outcomes
3. Formulate cause/effect
Using the Tasks

- Generate novel user and system subtasks
- Identify shortcomings in data
- Discover useful representations
- Heuristic evaluation of analytic capability
Future Directions

- Conduct case studies of design and evaluation
- Rethink lower-level tasks and task taxonomies in an analytic light
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