Bridging From Goals to Tasks with Design Study Analysis Reports

Heidi Lam*, Melanie Tory*, and Tamara Munzner+
October 4, 2017

* Tableau Software
+ University of British Columbia
So I want to design a visualization, and my user says:

“As a flight reservation coordinator, I want to understand why there are so many failed purchase requests today.” *

How do I design a visualization for analysis questions like this?

To design a visualization from domain questions...

So I want to design a visualization, and my user says:

“As a flight reservation coordinator, I want to understand why there are so many failed purchase requests today.”

How do I translate domain language analysis questions to abstract tasks?

Problem: Hard to get from domain questions to tasks

Domain Question

“Why are there so many failed requests today?”

not a lot of guidance here

Task Classifications

Abstract Tasks → Encoding & Interaction

Identify extremes
[Munzner, 2014; Brehmer & Munzner 2013]

Analyze outliers
[Schutz et al. 2013]

Find extremum
[Amar et al. 2005]
Our Contribution

Bridges between domain questions and task classifications

Domain Question

“Why are there so many failed requests today?”

Task Classifications

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Identify extremes
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→ Encoding & Interaction
Our Contribution

Bridges between domain questions and task classifications

Analysis Goals Framework

Domain Question

"Why are there so many failed requests today?"

Analysis Goal

Abstracted question

Analysis Steps

Typical steps to achieve goal

Task Classifications

Abstract Tasks

Identify extremes
Paper Selection

287 InfoVis papers
filtered to
20 design-study papers with analysis reports
segmented to
32 analysis reports

Open Coding

tagged with 12 goals

segmented to many analysis steps

Affinity Diagramming

discussed to define / refine.. split / merge
~12 goals

a framework of 9 analysis goals arranged across 2 axes
Pros & Cons of open-coding design-study papers

Design-study papers are digested analysis reports, not raw behaviour logs

**Pros:** Capitalize on previous thinking about abstractions from multiple authors across multiple domains

**Cons:** Steps extracted are not actual analysis sequences
- Only proof of existence
- Incomplete (e.g., floundering typically not reported)
- Ordering in analysis reports not not reliable

Coded InfoVis design-study papers from 2009-2015
Pre-2009 InfoVis papers did not contain analysis reports we need; InfoVis has the most design-study papers

Proposed framework is *a thinking tool*, not a model of visual analysis
## An analysis goals framework: 9 goals + 2 axes

<table>
<thead>
<tr>
<th>Specificity</th>
<th>Explore</th>
<th>Describe</th>
<th>Explain</th>
<th>Confirm</th>
</tr>
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<tbody>
<tr>
<td># Populations</td>
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Increasing specificity of the analysis outcome
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**Explore** the data to identify interesting trends, patterns, or anomalies

“Lots of failed requests today…”
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<tr>
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<td>&quot;Many are Class Z and R with error code 78...&quot;</td>
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**Explore** the data to identify interesting trends, patterns, or anomalies

**Describe** the population with a set of attributes
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**Explore** the data to identify interesting trends, patterns, or anomalies

“Lots of failed requests today…”

**Describe** the population with a set of attributes

“Many are Class Z and R with error code 78…”

**Explain** an observation by finding the main contributor

“Agent DYS handled a lot of these requests…”
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**Explore** the data to identify interesting trends, patterns, or anomalies

**Describe** the population with a set of attributes

**Explain** an observation by finding the main contributor

**Confirm** beliefs about a population

“Lots of failed requests today…”

“Many are Class Z and R with error code 78…”

“Agent DYS handled a lot of these requests…”

“Wonder if Agent DYS was responsible for the spike…”
## An analysis goals framework

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Single population analyses start with an observation and end with a definition for a subpopulation with that observation.

Multiple population analyses start with population definitions and end with similarities and/or differences between populations.

“Lots of failed requests today…”

“Failed requests with Airline A80 and flight number 4360 are all of Class Z and R, with error code 78…”

“Failed requests and successful requests…”

“Both types involved Agent DYS…”

“Agent Z7F handled more failed requests…”
An analysis goals framework

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How to use the framework?

Domain Question

“How are there so many failed requests today?”

Analysis Goal

Identify Main Cause

Task Classifications

Abstract Tasks

Identify extremes
An analysis goals framework

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How to use the framework?

Analysis Goals Framework

Domain Question

“Why are there so many failed requests today?”

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<th>Input</th>
<th>Single population with the observation</th>
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</table>

| Analysis Goal | Identify Main Cause |

| Output | Main data slice of the input (sub)population |

Task Classifications

“Failed request records”

“Class Z and R together, and error code 78 correspond to 100% of failed transactions associated with A80 and Flight Number 4360 ... travel agent Z7F might be the right stakeholder to contact for resolution.”
How to use the framework?

Analysis Goals Framework

Domain Question

“How are there so many failed requests today?”

Analysis Goal

Identify Main Cause

Analysis Steps

Typical to achieve goal

Task Classifications

Abstract Tasks

Identify extremes
Goal breaks down to Steps

<table>
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<th>Analysis Report</th>
<th>Our Framework</th>
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<tr>
<td><strong>Input</strong></td>
<td></td>
</tr>
<tr>
<td>A spike in the time trend of daily failed airline transactions</td>
<td>A population with an observation found at the aggregate population level</td>
</tr>
<tr>
<td><strong>Steps</strong></td>
<td>(iteratively)</td>
</tr>
<tr>
<td>(one example loop)</td>
<td></td>
</tr>
<tr>
<td>Identified that Airline A80 had contributed the most failed transactions</td>
<td>Identify the likely dominant attribute that causes the observation</td>
</tr>
<tr>
<td>Confirmed that the airline’s contribution is worse than historical average</td>
<td>Confirm the identified attribute</td>
</tr>
<tr>
<td>Filtered to focus on airline A80’s failed transactions</td>
<td>Refine the analysis population by applying the identified dominant attribute</td>
</tr>
<tr>
<td><strong>Output</strong></td>
<td></td>
</tr>
<tr>
<td>Travel agent Z7F contributed to most of airline A80’s failed transactions</td>
<td>The dominant attribute that explains the observation</td>
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Easy to map Steps to Tasks

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<th>Munzner Actions &amp; Targets*</th>
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<td>Analyze&gt;Consume&gt;Discover Search&gt;Locate Query&gt;Identify</td>
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...and many more...

Bridging From Goals to Tasks...

Domain Question

“Why are there so many failed requests today?”

Analysis Goals Framework

Input

Single population with the observation

Analysis Goal

Identify Main Cause

Output

Main data slice of the input (sub)population

Analysis Step 0

Identify the likely dominant attribute that caused the observation

Analysis Step 1

Analysis Step 2

Abstract Tasks

Task Classifications

Task 0

Identify Extremes

Task 1

Task 2
Summary: An analysis goals framework

A thinking tool to help designers map domain analysis questions, to abstract goals and steps, that can easily translate into existing tasks classifications.

Analysis goals are characterised by:
- Axes of specificity (Explore, Describe, Explain, Confirm) and the number of populations (Single, Multiple)
- Analysis inputs and outputs
- Typical analysis steps

Framework derived empirically from open coding design-study papers
- Grounded in reports of real analyses from a (relatively) diverse set of domains
- **Call for action**: Help us improve this framework by collecting more goals from other sources!!
Bridging From Goals to Tasks with Design Study Analysis Reports

Heidi Lam, Melanie Tory and Tamara Munzner, Member, IEEE

Abstract—Visualization researchers and practitioners engaged in generating or evaluating designs are faced with the difficult problem of transforming the questions asked and actions taken by target users from domain-specific language and context into more abstract forms. Existing abstract task classifications aim to provide support for this endeavour by providing a carefully delineated suite of actions. Our experience is that this bottom-up approach is part of the challenge: low-level actions are difficult to interpret without a higher-level context of multiple goals and the analysis process. To bridge this gap, we propose a framework based on abstract reports derived from analysis.

Supplementary Materials of “Bridging from Goals to Tasks with Design Study Analysis Reports”, InfoVis 2017

Heidi Lam, Melanie Tory, and Tamara Munzner

1 Design study papers considered
2 Summary of analysis and assignments

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An analysis goals framework

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http://www.cs.ubc.ca/labs/imager/tr/2017/GoalsToTasks
### Specificity

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**Describe** two or more populations by comparing one to another

“Wonder how the failed requests compared to the successful ones?”

**Explain** the reason behind differences

“Failed requests are more from Agent Z7F…”

**Confirm** suspected similarities or differences between populations

“Wonder if requests handled by Agent Z7F are more likely to fail?”