Design spaces: Continuing theme

- impose systematic structure on set of possibilities for specific problem
  - to capture the key variables at play
  - to support reasoning about design choices

- delineate
  - cross-cutting / independent / orthogonal

- axes / dimensions / categories

- many names
  - design spaces, taxonomies, typologies, classifications, frameworks, models, ...

- space within which to express design patterns [Javed/Elmqvist]

Design spaces: What are they?

- Criteria
  - purposeful
  - interpretable
  - generalizable

Design spaces: What are they for?

- describe and analyze portions of design space to understand differences among designs & suggest new possibilities [Card & Mackay 1997]

- design spaces provide an actionable structure for systematically reasoning about solutions [Egan et al 2020]


Design spaces: How to create?

- open coding source material
  - grounded theory / thematic analysis / qualitative analysis
  - literature review
  - synthesize across existing theories, compare & contextualize

- personal reflection
  - reflective synthesis

- complex combinations...

Design spaces: Multiple examples

- datatset: temporal, timeline visual encoding
  - domain: genomic epidemiology, paper figure visual encoding
  - domain: journalism, data wrangling activities
  - domainagnostic: abstract tasks

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Propose typology creation method: mixed qual and quant

Use method to develop typology in specific domain

Domain prevalence design space

By the numbers

Design space axis: Chart types used in genEpi

Design space axis: Chart combinations of heterogeneous data

Design space axis: Enhancement choices, atop base chart types

GEViT example

Assessment

• descriptive power
  – provided common language for describing data visualization in genEpi
  – established gap: unmet tooling needs
  – validated in followup GEViTRec work

• generative power
  – built automatic recommender system using domain prevalence design space

Journalists are data wranglers...

Data Wrangling

An Actionable Framework for Multi-Table Data Wrangling

From an Artifact Study of Computational Journalism
Key finding: journalists use many, many tables

- workflow complexity varies greatly
- current interactive wrangling applications do not scale well
- re-characterize wrangling design space to match these observed practices
A Multi-Level Typology of Abstract Visualization Tasks

**Assessment & adoption**
- **descriptive power**
  - analyze & compare task sequences, clarify means and ends
- **generative power**
  - early stages of problem-driven work: abstracting & requirements gathering
- **evaluative power**
  - context for field studies, task set for lab studies
- **adoption**
  - hundreds of papers

**Final design space: three axes**
- why, what, how

**Mapping terms**
- **Table 1**: Look-up table of
  - upper components, middle components, lower components, middle components, lower components, lower components

**Mapping our Vocabulary to Previous Work**

**Process**
- **Directionality**
  - Bottom-Up
  - Top-Down

**Constructing a Typology**

**Summary: Multiple design spaces**
- **Design space**
  - analysis goals: resource material
  - analysis reports: extracted from design study papers

**VAD Book: Visualization Analysis and Design**

**VAD Book**
- **Map**
  - 36 terms

**Bridging From Goals to Tasks with Design Study Analysis Reports**
- **http://www.cs.ubc.ca/labs/imager/tr/2017/GoalsToTasks/**

**Tasks, Goals, to Previous Work**
- **Assessment: Cross-check**
  - **cross-check coverage of multi-table framework vs actions taxonomy**
  - **verify descriptive power**

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**Multi-table data wrangling design space**

- **Object type**
  - Row, Column

- **Table**
  - Create
  - Navigate
  - Transform
  - Combine

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**A mid-level gap?**

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**Task abstraction: Gap**

- **High level of abstraction**
  - e.g. “report data”

- **Low level of abstraction**
  - e.g. “interacting”

---

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### Design spaces: How to assess? Larger context: theory types

- Ben Shneiderman, Designing the User Interface: descriptive, explanatory, prescriptive, predictive
- Paul Ralph, Toward Methodological Guidelines for Process Theories & Taxonomies in Software Engineering, IEEE TSE 2020

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**More information**
- [this talk](http://www.cs.ubc.ca/~tmm/talks.html#stanf22)
- [book](http://www.cs.ubc.ca/~tmm/vadbook)
- [full courses, papers, videos, software, talks](http://www.cs.ubc.ca/group/infovis)