From Perception to Abstraction with Interaction and Visualization

Miguel A. Nacenta (nacenta@uvic.ca)
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Collaborators
Brief Personal Introduction
Victoria Interactive eXperiences with Information

Sowmya Somanath
Charles Perin
Miguel Nacenta
Territorial acknowledgements

• I acknowledge with respect the Lekwungen peoples on whose traditional territory the University of Victoria stands, and the Songhees, Esquimalt and W̱SÁNEĆ peoples whose historical relationships with the land continue to this day.

• I feel grateful for working and living in this beautiful place full of history.

• I also acknowledge that the UBC Point Grey campus, from where this virtual seminary is being organized, sits on the traditional, ancestral and unceded territory of the Musqueam people.
Goals

• Show you something that you find useful
• Show you something that you find fun/entertaining
• Preview some of my research interests
  (with an eye on collaboration)
Depth Cues in Images and Displays
Depth Cues in Images and Displays
Stereoscopic ≠ Two eyes (binocular)
Depth Cues in Images and Displays
Depth Cues in Images and Displays
Depth Cues in Images and Displays
Depth Cues in Images and Displays
• Blur for depth perception
• Known to influence perception of size and depth
Simulating the eye’s accommodation
Experiment 1 - Results

- Significant distinction between conditions in non-catch trials (S1-S7)
- No distinction in catch trials (S8-S11)
Experiment 2 - Description
• Gaze-contingent depth of field
  – Contributes to impression of depth and realism
  – Contains some usable information about depth
  – But information is limited and viewer dependant
GaZeR Application

• Open Source, downloadable

• Tobii EyeX

• Lytro Images
Gaze-dependent Gamut Expansion
Can we use gaze-contingent simultaneous contrast?

Can we use this to enhance the ability to discriminate colors?
Experiment 1 - Stimuli
Non-hardware enhancement of perceived Gamut
Can we use gaze-contingent simultaneous contrast?  

✓

Can we use this to enhance the ability to discriminate colors?  

✓

But it is tricky...
FatFonts
### Representation in Visualization

![Image of a map with a color gradient indicating values from a table]

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http://en.wikipedia.org/wiki/File:Same_color_illusion_proof2.png
What are FatFonts?
FatFonts
FatFonts: How They Work

Nesting
FatFonts: How They Work

Nesting

& 3 4 5 6 7 8 9
Scalar Fields
Transmogrifiers
To Transmogrify
To transform in a magical way
Now that the submission and review process is complete, it is interesting to take a look at the numbers. This year, after the review process, we asked the ACs to characterize the papers as either a WiP, LBW, or Other (they could add a comment as to why they deemed it an Other). They could also choose more than one option. In total, 647 submissions. Of the 647 submitted, 281 (43%) were accepted. Table 1 is the breakdown of those submissions by type and Table 2 is the breakdown of type Accept/Reject.

Submissions we received clearly tended to favor in-progress, but we also had a substantial number of breaking work as well. There does seem to be a clear that work-in-progress was more likely being submitted.

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**Submissions and Reviewing?**

![Pie chart showing the breakdown of submissions by type: WiP, LBW, Both, and Other.](chart.png)
Submissions and Reviewing?

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Submissions we received clearly tended to favor WIP-in-progress, but we also had a substantial number of breaking work as well. There does seem to be a clear but in-progress structure. Again, thanks for participating.
Submissions and Reviewing?

We note that the submission and review process is complete, as interesting to take a look at the numbers. This year, or the review process, we asked the ACs to characterize papers as either a WIP, LBW, or Other (they could add a comment as to why they deemed it an Other). They could also choose more than one option. In total, WIP had 647 submissions. Of the 647 submitted, 281 (43%) were accepted. Table 1 is the breakdown of those submissions by type and Table 2 is the breakdown of type Accept/Reject.

Submissions we received clearly tended to favor WIP, but we also had a substantial number of dropping work as well. There does seem to be a clear pattern in these numbers. LBW submissions by AC-described Type.

![Diagram](image.png)
Final construction
Two aspects of note

• Capture data from where it is

• Support personal visual representations

Constructive Visualization
(Huron et al., 2014)
Understanding Data Manipulation and Comprehension
Constructive Visualization  
(Huron et al., 2014)

iVoLVER  
(Méndez et al., 2016)

Result of many small-scale decisions and manipulations

Visualization is incrementally generated

Lower level access: data points
Attribute-level operations
Overall mapping between attributes and visuals first
Customization later

Tableau Desktop

Template-based

MS Excel

Tableau's Show me

Bottom-up vs. Top-down: Trade-offs in Efficiency, Understanding, Freedom and Creativity with InfoVis Tools (CHI 2017)

Pilot

- In-classroom study
- 11 students of an introductory InfoVis university course

Main study

- Within subjects design with visualization non-experts
- Controlled environment with interviews
Data and Analysis

Visualization outcomes

415 minutes screen captures

Interviews audio recordings

Qualitative analysis

Thematic analysis
Open coding approach
Tableau

**Benefits**
- More automated
- Rapid exploration

**Limitations**
- Tool-driven design
- Reduced transparency

iVoLVER

**Benefits**
- User-driven
- Transparent

**Limitations**
- Repetitive / Tedious
- Do not scale
Some interesting results

• Depth of understanding
  • Top-down is often “mindless”

• Authorship
  • What people said about their own designs “I did” vs “the system did”

• Variety
  • Bottom-up designs were less constrained and more varied
Important trade-offs

**Bottom-up (constructive)**
- Slow, effortful
- Sense of authorship
- More open
- More transparent

**Top-bottom (currently dominant)**
- Scalable
- Quick and agile
- Sometimes “mindless”
Research Question

How to design bottom-up visualization tools that are also scalable?
(bringing together the best of both approaches)

Considering Agency and Data Granularity in the Design of Visualization Tools (CHI 2018)
How do you get from one to the other?

Visualization by-example

Collective Proxy Objects

Automated Principled Design

Automated Iteration

Abstraction

Automated Choices
Dimensions

1. Agency

2. Granularity
Dimensions

1. Agency

Who carries out the process?

Tool

Designer

2. Granularity

Decisions:

- Selecting the visualization type
- Data transformations
- Visual mappings
What do designers have access to?

Dimensions

Agency

1.

Granularity

2.

Data

- Value
- Subsets
- Attributes
- Tables
- Database

Visual representations

- Mark
- Visualization
- Small multiples
### Design Space

- **Granularity**
  - Fine
  - Coarse

- **Agency**
  - Designer
  - Tool

- **Q1**
  - iVoLVER
  - Mapping Replication

- **Q2**
  - DataMeadow
  - ExPlates

- **Q3**
  - Many Eyes
  - SPSS Chart Builder
  - Tableau Marks Card

- **Q4**
  - LARK
  - Google Spreadsheet Explore Excel Recommended Charts
  - Excel Chart Gallery
  - Tableau Columns and Rows
  - Tableau Show Me Voyager

- **Proxy Objects**
Going more cognitive

• How do people actually get to understanding from visuals?
• Applied to Constraint Programming (has lots of practical applications)
• What do people come up with visually when representing *problems* rather than data or solutions?
Understanding How People Graphically Model (Constraint) Problems

• Study of how people graphically represent problems (as opposed to data)
• Semiotic analysis of graphical elements and problem description constructs
There is an object named K4. It has an attribute WW with the value of 20.
There is a container named nm.
It has an attribute attribute WW.
It has an attribute attribute q3.
There is a container named nm.
It has an attribute attribute WW.
It has an attribute attribute XYZ.
It has an attribute WW where the sum is lessThan 80.
It has an attribute attribute q3 where the sum is lessThanEqual to 50.

Find items that go into KL.
Solution 1.
No objects.
Object K4.
Solution 2.
No objects.
and the hard reality is our economy needs migration from the European Union. I mean, Scotland alone, EU migrants contribute 7 billion pounds every year. They are more likely to be in work. They are less likely to be claiming benefits. They are more likely to be university educated than the population as a whole. One of our biggest challenges in Scotland is growing our working-age population. If we end EU migration, our working population over the next 25 years will fall while our pension at each population [thank you] going up by 50 percent. One last point: [I need to go to] Public services are under pressure. But that's not the fault of migrants. That is the fault of the austerity agenda pursued by the Tories and and banking politicians like that.
Dynamic Network Plaid
References


THANKS

nacentan@uvic.ca