Data Driven Guides: Supporting expressive design for Information graphics

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Analysts & Researchers

Source: Google Search Trends
Artists, Journalists, Bloggers, Designers

Source: Google Search Trends
## Visualization Design Tools

<table>
<thead>
<tr>
<th>Less expressive (Automatic)</th>
<th>More expressive (Manual)</th>
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Less expressive (Automatic)
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Visualization Design Tools

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Less expressive (Automatic)
Visualization Design Tools


Less expressive (Automatic) vs More expressive (Manual).
Interviews with infographic designers.
Interviews with infographic designers.

Participants

- 2 professional designers
- 3 master student designers
- 1 visualization researcher.
Interviews with infographic designers.

*Participants*

- 2 professional designers
- 3 master student designers
- 1 visualization researcher.

- 2 ~ 10 years of experience in graphic & infographic design.
Interviews with infographic designers.

**Participants**
- 2 professional designers
  - 3 master student designers
  - 1 visualization researcher.
- 2 ~ 10 years of experience in graphic & infographic design.
- Mostly use vector editing tools such as Adobe Illustrator.
Interviews with infographic designers.

Participants
• 2 professional designers
• 3 master student designers
• 1 visualization researcher.
• 2 ~ 10 years of experience in graphic & infographic design.
• Mostly use vector editing tools such as Adobe Illustrator.

Questions
• What difficulties they face in creating infographics?
Interviews with infographic designers.

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**Questions**
- What difficulties they face in creating infographics?
- Overall design practice.
Interviews with infographic designers.

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Questions
• What difficulties they face in creating infographics?
• Overall design practice.
• How they manually encode data into graphics.
Interviews with infographic designers.

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**Questions**
- What difficulties they face in creating infographics?
- Overall design practice.
- How they manually encode data into graphics.

**Related work**
1. Lack of flexible design in visualization construction tools

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ManyEyes
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More expressive (Manual)

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iVisDesigner
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Improvise

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1. Lack of flexible design in visualization construction tools

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Difficult to add annotations & embellishments.
1. Lack of flexible design in visualization construction tools

Less expressive (Automatic)

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**Difficult to add annotations & embellishments.**

**Difficult to design new visual marks & layouts.**
2. Tedious manual encoding required in graphic design tools

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Less expressive (Automatic)

More expressive (Manual)
2. Tedious manual encoding required in graphic design tools.
3. Absence of data binding for custom/imported charts in graphic design tools

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Less expressive (Automatic)

More expressive (Manual)
3. Absence of data binding for custom/imported charts in graphic design tools

To customize this chart, ungrouping is required resulting in loss of data binding.
Design Goals
Design Goals

1. Maintain **flexibility** in the design process.
   
e.g., not enforcing a predefined outcome or specific order of operations.
Design Goals

1. Maintain **flexibility** in the design process.

2. Provide methods for accurate **data-driven drawing**.
Design Goals

1. Maintain **flexibility** in the design process.

2. Provide methods for accurate **data-driven drawing**.

3. Support persistent **data binding** for freeform graphics.
Data Driven Guides:
Supporting expressive design for Information graphics

Length guide

Area guide

\[ d = \text{length} \]

\[ d = \text{area} \]
Data Table

Graph
<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
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Data Table

Data-Driven Guides
Flexible direct manipulation
To manipulate to create a custom layout
Maintain proportional lengths
To preserve data integrity
Snap to a guide
To support accurate data-driven drawing
Data-binding using guides as the backbone of associated shapes. (2D deformation for vector graphic)
Logo Design

User Interface Design

Architectural Design

Drawing

Designer’s Friends: Rulers, Grids, Guides
Length and area guides can also be used as a **Position guide**.

Length guide

\[ d = \text{length} \]

Area guide

\[ d = \text{area} \]

Default guide color: **Cyan**
Visual variables
Fundamental channels for encoding information.

J. Bertin, 1983.

Rankings of visual variables by J. Mackinlay, 1986.
Visual variables

Fundamental channels for encoding information.

- Position
- Length
- Angle
- Slope
- Area
- Volume
- Color Saturation
- Color Hue
- Density
- Texture
- Connection
- Containment
- Shape

Frequently used in infographics, although often misused.

J. Bertin, 1983.

Rankings of visual variables by J. Mackinlay, 1986.
Use Cases
Use cases

1. **Drawing** data-driven graphics
OECD Better Life Index by GDP of G7 Countries.

Source: OECD better life index and World Bank Open Data (2016).
OECD Better Life Index by GDP of G7 Countries.

Source: OECD better life index and World Bank Open Data (2016).
Create & manipulate
Radial layout & link inspection
Composite structure & copy and paste
Deforms
Linear blend skinning

Related Work
Linear blend skinning

Rest pose

Old point in a shape.

Deformed

Related Work
Rest pose

Spatial Transformations (changes in guides)

Deformed

Linear blend skinning

Related Work
Linear blend skinning

Related Work

Skinning weight (Transformation amount)

\[ p_i' = \sum_{j=1}^{m} w_{ij} T_j p_i, \]
Related Work
Deforms
Used as a Position Guide
American’s Uninsured Rate Dips Below 10%

% of uninsured rate in the U.S.

2010: 16.0%
2011: 15.1%
2012: 14.7%
2013: 14.4%
2014: 11.5%
2015: 9.2%

Crowdfunded Projects on Kickstarter in 2012

Source: Company Reports, Economist.

Money pledged, $m (Total: 319.8)
Games: 83.1
Film and video: 58
Design: 50.1
Music: 35
Technology: 29
Publishing: 15.3

Success rate, %
Music: 56.8
Film and video: 40.5
Design: 40.3
Technology: 37.5
Games: 32.6
Publishing: 29.6

**Cyan: Data-Driven Guides**

Used as flexible rulers.
Four area guides are used to encode a single shape.
Use cases

1. **Drawing** data-driven graphics

2. **Retargeting** existing artworks
MONSTROUS COSTS
Total House and Senate
campaign expenditures,
in millions

1972 74 76 78 80 82 est.

$300
$250
$200
$150
$100
$ 50

Source: Center for Responsive Politics

Original
By Nigel Holmes
Use cases

1. **Drawing** data-driven graphics

2. **Retargeting** existing artworks

3. **Proofreading** existing infographics
Proofreading existing infographics

By Nigel Holmes.

By Tiffany Farrant-Gonzalez.
The length of marks do not match the length of guides (curved).
Proofreading existing infographics

Length guide (Radius)

Area guide

$49,633,063

$24,201,440

$25,560,000

By Tiffany Farrant-Gonzalez.
Informal usability evaluation with designers.

Participants

• 13 master student designers
  (architecture, urban planning, and infographic design etc)
Informal usability evaluation with designers.

**Participants**

- 13 master student designers (architecture, urban planning, and infographic design etc)
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Informal usability evaluation with designers.

Participants

• 13 master student designers
  (architecture, urban planning, and infographic design etc)

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• Frequently used tools include vector & image editors
  (programming: only 2 people).
Informal usability evaluation with designers.

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- 13 master student designers (architecture, urban planning, and infographic design etc)
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**Procedure**
- A 60 min session with a 15 min tutorial
Informal usability evaluation with designers.

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- Pre-task and post-task surveys
Informal usability evaluation with designers.

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**Procedure**
- A 60 min session with a 15 min tutorial
- Pre-task and post-task surveys
- 2 replication tasks
- 1 creative task

* We did not measure time
Results

Creative Tasks

- Two selected infographics created by participants.

Data: GDP of G5 Countries.
Results

Creative Tasks

- Two selected infographics created by participants.

Post-task surveys (5-point Likert scale)

1. Interactions with DDG were intuitive. ($\mu = 4.0, \sigma = 0.71$)

Data: GDP of G5 Countries.
Creative Tasks

Post-task surveys (5-point Likert scale)

1. Interactions with DDG were intuitive. ($\mu=4.0$, $\sigma=0.71$)

2. DDG is useful for positioning and measuring custom shapes based on data compared to rulers or grids. ($\mu=4.7$, $\sigma=0.63$)
Results

Creative Tasks
• Two selected infographics created by participants.

Post-task surveys (5-point Likert scale)
1. Interactions with DDG were intuitive. ($\mu=4.0$, $\sigma=0.71$)

2. DDG is useful for positioning and measuring custom shapes based on data compared to rulers or grids. ($\mu=4.7$, $\sigma=0.63$)

3. DDG is useful for designing creative and expressive infographics ($\mu=4.9$, $\sigma=0.38$)

Data: GDP of G5 Countries.
Results: qualitative feedback

“Currently, I need a calculator to make data graphic, which is pretty arduous. This tool makes it much easier to try things out and experiment with the graphics.” - P10.
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“I think that this would be a wonderful aid in creating graphics for architectural representations.” - P3.
Results: qualitative feedback

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“I think that this would be a wonderful aid in creating graphics for architectural representations.” - P3.

“I usually do very analytical infographics, using traditional forms like bars or circles. Because of that, I’m not quite sure if data guides might be very useful” - P5.
Limitations

1. *Data-driven guides currently works with a tabular dataset.*

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2. Difficult to generate guide elements such as axes and legends.

3. Other visual variables have to be manually encoded such color or angle.
Future work

1. *Reusable* creative infographic *templates*.
Future work

1. Reusable creative infographic templates.

2. Data-driven guides for other visual variables.
Future work

1. *Reusable creative infographic templates.*

2. *Data-driven guides for other visual variables.*
   - Color, angle, shape, slope etc.

3. *Intelligent systems for automatically providing design feedback.*
Data Driven Guides: Supporting expressive design for Information graphics

www.namwkim.org/ddg