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The Design Space of Typeface

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Objective

Font attributes, such as **bold** and *italic*, can be used to encode data in visualization.

Some **visual attributes** have been **researched extensively** but **typography** has not: until now, it has been usually considered a single attribute.

Novel attributes are important because they expand the design space of potential visualizations representations.

"We shape our tools then our tools shape us."
- Marshall McLuhan

Hypotheses

Typography has *variety of different visual attributes* that can be used, separately or together to encode categoric and quantitative data. As a result unique new kinds of visualizations can be created.

Method

1. **Classify**: Many fields use shape and type. What attributes do they use?
2. **Encode**: Can these attributes go beyond differentiating between categories, e.g. encode quantities?
3. **Relate**: What are the similarities between the font attributes and well researched attributes? This provides insight into potential effectiveness of the attribute.
4. **Explore**: How can these attributes be applied? What are some potential novel encodings?

Table of Visual Attributes

		Information Visualization Researchers										Vision Rsch	Cartography	
		Bertin 67	Cleveland 85	MacKinlay 86	Baecker, Marcus 91	Wilkinson 99	Ware 00	Mazza 09	Brath 10,14	Ilinsky 12	Chen, Floridi 13	Munzner 14	Preattentive Perception	MacEachren 95	Tyner 10
Trans-form	Position	X	X	X		I	X	M	N	P	Q	R	V	W			X	X
	Length	X	X			X	X		X	X	X				
	Size (Area)	X	X	X		X			X	X	X	X		X	
	Orientation	X	X			X			X	X	X		X		
	Volume		X	X					X						
Colour	Brightness	X		X		X			X			X	X		
	Hue	X	X	X	X	X	X	X	X			X	X		
	Saturation	X		X		X			X	X	X	X			
Texture	Granularity	X							X					X	X
	Pattern					X	X	X	X						
	Orientation						X	X							
Relation	Connection			X					X						
	Containment			X					X						
Optics	Blur					X			X						
	Transparency					X			X					X	X
	Stereo Depth												X		
	Concavity								X				X		
	Light Direction								X				X		
	Shadow												X		
	Partial occlusion								X				X		
Move-ment	Flicker					X			X				X		
	Speed					X			X				X		
	Direction								X				X		
Shape	Shape	X	X	X		X	X	X	X						
	Angle	X	X												
	Curvature								X						
	Mark								X						
	Line Ending					X	X	X	3				X		
	Closure								X						
	Local Warp								X						
	Edge Type								X		1,2				
	Corner Type								X		3				
	Icon, glyph, etc										4				
Type	Text Labels			X	X		X	X	X	X					
	Punct/Symbol			X					X						
	Pair Delimiters								X						
	Weight			X					X						
	Italic/Oblique			X					X						
	Case/Sm Caps			X					X						
	Underline								X						
	Condensed/Exp			X					X						
	Spacing								X						
	Super/subscript			X					X						
	X-height								?						
	Angle of Stress								?						
Misc	Numerosity								X			X			
	Spatial Grouping						X	?	X					X	X
	Arrangement							?						X	X
	Resolution													X	X
	Artistic Effects												X		

2. Encode

Many font attributes <u>encode</u> *categoric* DATA some attributes support quan*tities*:

Visual Attribute	Samples	Categoric Examples	Quantitative Examples
Text Glyph	A, B, 7	characters, words	- (but alpha-orderable)
Symbols, etc	#,!,#;.	marks	-
Delimiter pair	{} " " **	contained items	-
Font weight	A A A **A**	-	light/book/bold/black/etc
Case	in In IN	lower/upper/ proper/smallcaps	-
Oblique/Italic	A *A*	normal/italic/reverse	-
Underline	A A A	normal/single/wavy/etc	-
Condensed	A A	-	condensed/expanded/etc
Font family	**A** A A	Arial/Times/Courier/...	-
Spacing	AA A A	-	tracking/leading
Super/subscript	A^A	super/sub	-

Text labels also support other encodings:
- *Literal encoding*: i.e. the literal text
- *Ordered encoding*: i.e. alphabetic order
- *Proportional encoding*: i.e. modify elements of the character sequence to encode data [Bra14].
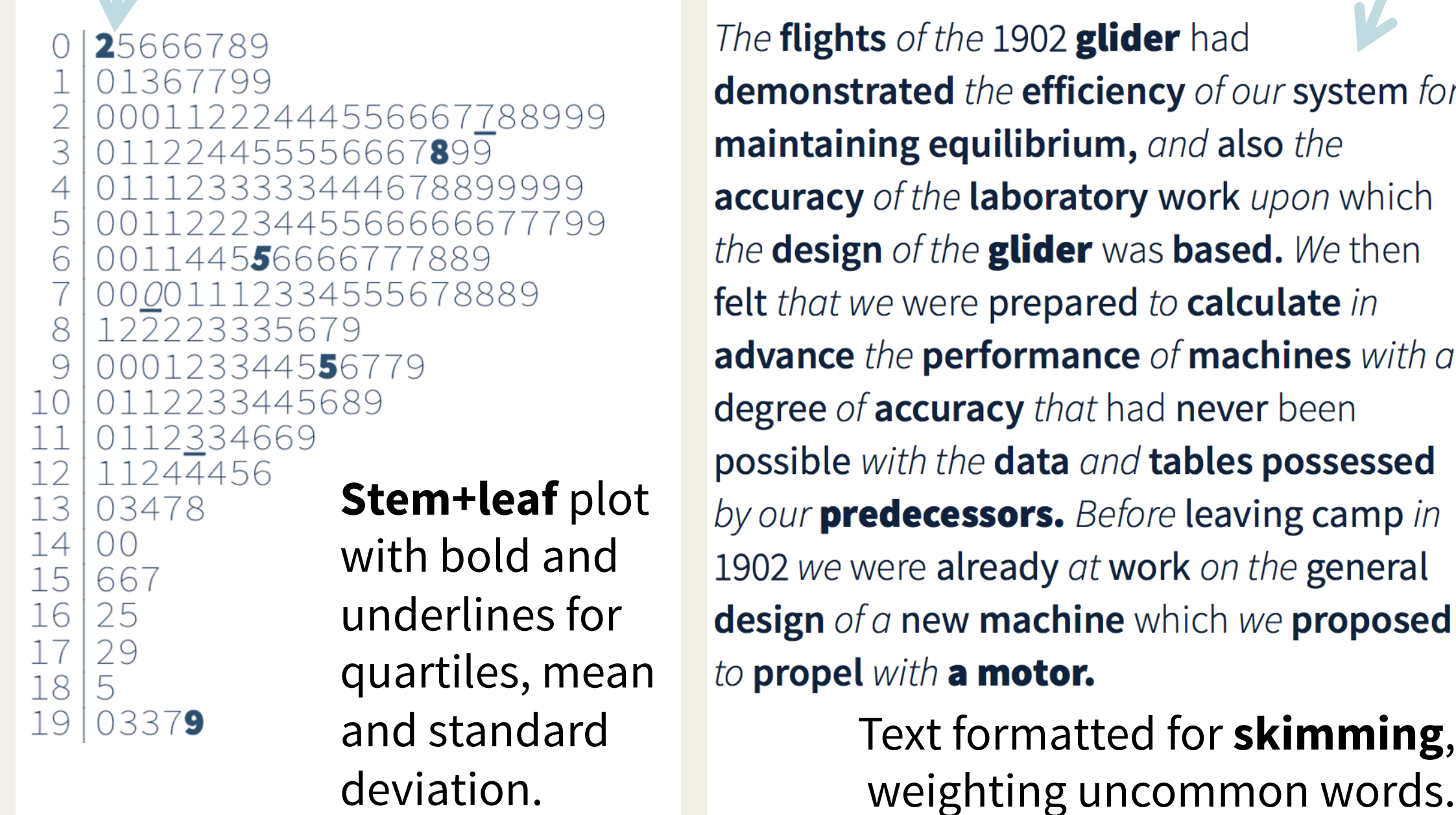
3. Relation to Visual Channels

Type attributes can be **mapped to well known visual channels**, e.g. bold increases the overall intensity across the text area and at a micro-level the width of a glyph's stroke.

This mapping allow visual channel heuristics to be applied to type attributes, such as ranking alternative attributes, or assessing potential separable/ integral combinations of multiple attributes.

	Position	Length/Size	Orientation	Intensity	Shape	Containment
Text Glyph					◆	
Symbols					◆	
Delimiter pair					◆	◆
Font weight				◆	◆	
Case				◆	◆	
Oblique/Italic			◆			
Underline	◆	◆				
Condensed		◆		◆		
Font Family					◆	
Spacing		◆		◆		
Super/subscript	◆	◆				

1. Classify

There are many fields and examples to draw on. From these **define a list of potential attributes.**


```
37.06
37.05  defg
37.04  XYcdefg
37.03  WXYcdfg<
37.02  MNRVWc
37.01  JMNPQRVW
37.00  IJMNPQRVW
36.99  GIJMPQV
36.98  GIJQ
36.97  CFGHI
36.96  BCFGH
36.95  BCFH
36.94  BC
36.93>AB
36.92  A
       Jan 15
```

```
static bool
getpn(str)
    char    *str;
    int     i = 0;

while (*str != '\0')
    if (i >= PNMAX)
        return FALSE;

Set pn to the digits ignoring spaces and dashes

    if (*str != ' ' && *str != '-')
        if ('0' <= *str && *str <= '9')
            pn[i++] = *str - '0';
```

4. Explore Applications

```
0  2 5 6 6 6 7 8 9
1  0 1 3 6 7 7 9 9
2  0 0 0 1 1 2 2 2 4 4 4 5 5 6 6 6 7 7 8 8 9 9 9
3  0 1 1 2 2 4 4 5 5 5 5 6 6 6 7 8 9 9
4  0 1 1 1 2 3 3 3 3 4 4 4 6 5 6 6 8 9 9 9 9 9
5  0 0 1 1 2 2 2 3 4 4 5 5 6 6 6 6 6 6 7 7 9 9
6  0 0 1 1 4 4 5 6 6 6 7 7 7 8 8 9
7  0 0 0 0 1 1 1 2 3 3 4 5 5 5 6 7 8 8 8 9
8  1 2 2 2 2 3 3 5 6 7 9
9  0 0 0 1 2 3 3 4 4 5 5 6 7 7 9
10 0 1 1 2 2 3 3 4 4 5 6 8 9
11 0 1 1 2 3 3 4 6 6 9
12 1 1 2 4 4 4 5 6
13 0 3 4 7 8
14 0 0
15 6 6 7
16 2 5
17 2 9
18 0
19 0 3 3 7 9
```

Stem+leaf plot with bold and underlines for quartiles, mean and standard deviation.

The flights of the 1902 **glider** had **demonstrated** the **efficiency** of our system for maintaining equilibrium, and also the accuracy of the **laboratory** work upon which the design of the **glider** was based. We then felt that we were prepared to calculate in advance the performance of machines with a degree of accuracy that had never been possible with the data and tables possessed by our **predecessors**. Before leaving camp in 1902 we were already at work on the general design of a new machine which we proposed to propel with a **motor**.

Text formatted for **skimming**, weighting uncommon words.

Discussion

There are at least **ten font-specific attributes to be exploited** by information visualization.

A. *Novel Applications*: Many possibilities to consider, such as search facets, proportional encoding of quantities along strings, knowledge maps, enhanced labeling such as cartograms.

B. *Evaluation*: While visual channel mappings may help short term, more evaluation is required, such as user testing or novel metrics.

C. *Background*: There is 500+ years of typographic history to explore.

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