Think New Shapes
Rado (2004)

Four Levels of Visualization

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University of Oxford

OXFORD
e-Research
CENTRE

UNIVERSITY OF
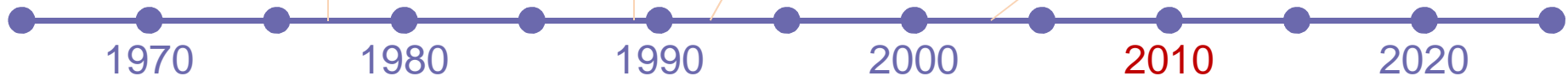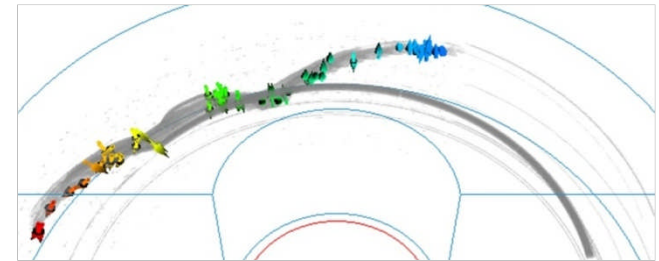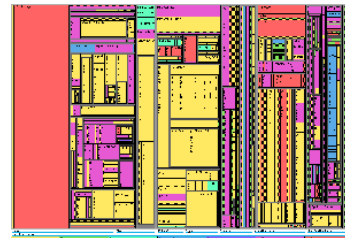**OXFORD**

THINK NEW SHAPES.

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St Anne's College, University of Oxford

23 March 2015

Most Familiar Visual Designs are Very Old
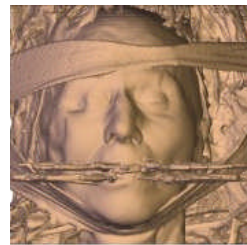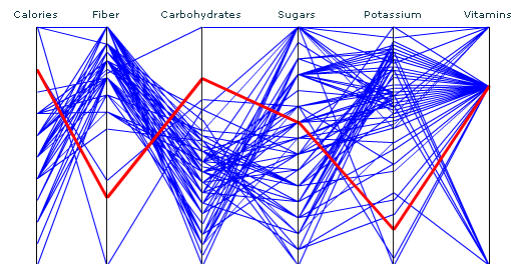
Four Levels of Visualization

1. ## Disseminative Level (This is A!)
   - *A presentational aid for disseminating information or insight to others.*
   - *The creator does not expect to gain much new knowledge.*

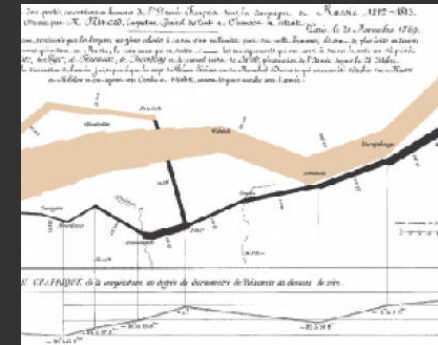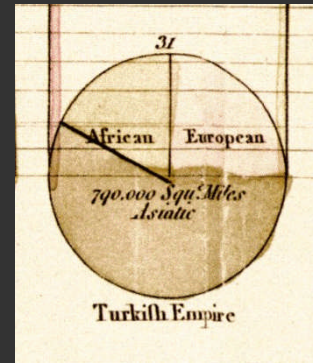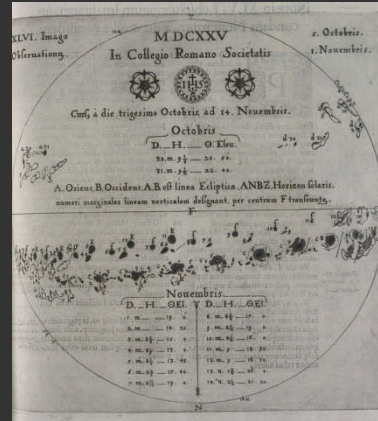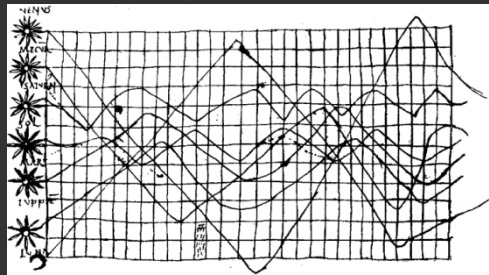2. ## Observational / Operational Level (What, when, where?)
   - *An operational aid that enables intuitive and/or speedily observation of captured data. Often part of routine operations.*
   - *Confirmatory observation, anomaly detection., etc.*

3. ## Analytical Level (Does A relate to B? Why)
   - *An investigative aid for examining and understanding complex relationships (e.g., correlation, causality, contradiction).*
   - *Evaluating hypotheses, models, methods, algorithms and systems.*

4. ## Model-developmental Level (How does A lead to B?)
   - *A developmental aid for improving existing models, methods, algorithms and systems, as well as the creation of new ones.*

Four Levels of Visualization

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2. ## Observational / Operational Level (What?)
   - *An operational aid that enables intuitive and/or speedily observation of captured data. Often part of routine operations.*
   - *Confirmatory observation, anomaly detection., etc.*

3. ## Analytical Level (Why?)
   - *An investigative aid for examining and understanding complex relationships (e.g., correlation, causality, contradiction).*
   - *Evaluating hypotheses, models, methods, algorithms and systems.*

4. ## Inventive Level (How?)
   - *A developmental aid for improving existing models, methods, algorithms and systems, as well as the creation of new ones.*

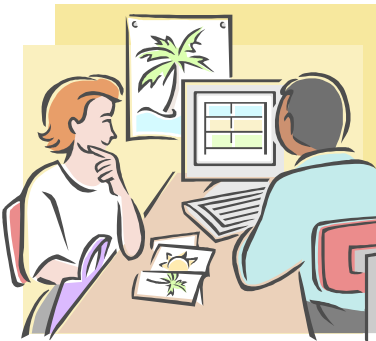# Some Common Modes of Visualization

analysts

presenter

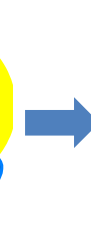viewers

(a) an analyst

(c) an analyst & a viewer

(d) a presenter & an audience

(b) a team of analysts

(e) an analyst, a presenter & an audience

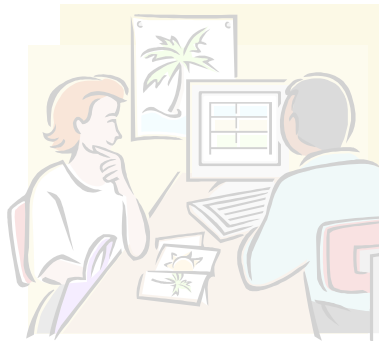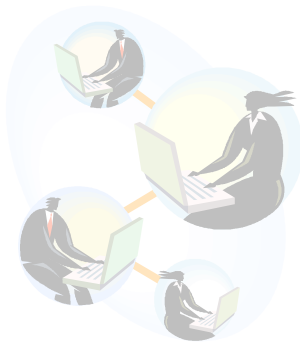# Some Common Modes of Visualization

| analysts | presenter | viewers |

(a) an analyst

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Visual Embellishment
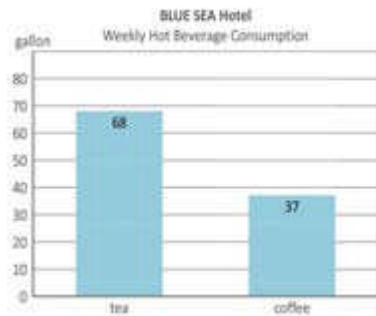
- Positive impact on memory
- Negative impact on visual search
- Likely positive impact on concept grasping

Borgo *et al.,* TVCG, 2012

Some Common Modes of Visualization

analysts

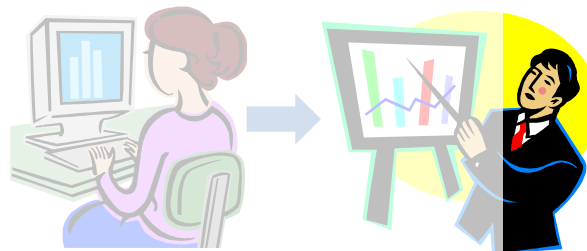presenter

viewers

(a) an analyst

(b) a team of analysts
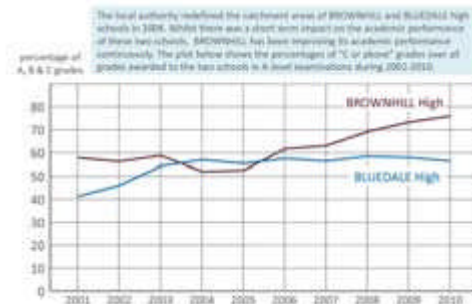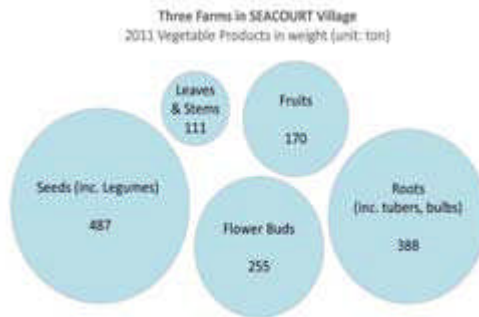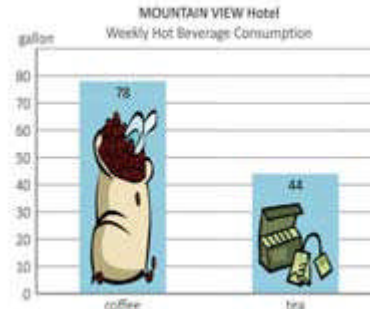
(c) an analyst & a viewer

(d) a presenter & an audience
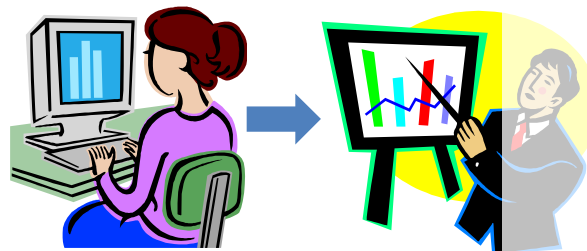
(e) an analyst, a presenter & an audience

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Poetry Visualization (with Utah)

- Initial experiments
- Multivariate visualization
- Support close reading

Abdul-Rahman, et al., CGF, 2013

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Poetry Visualization (with Utah)

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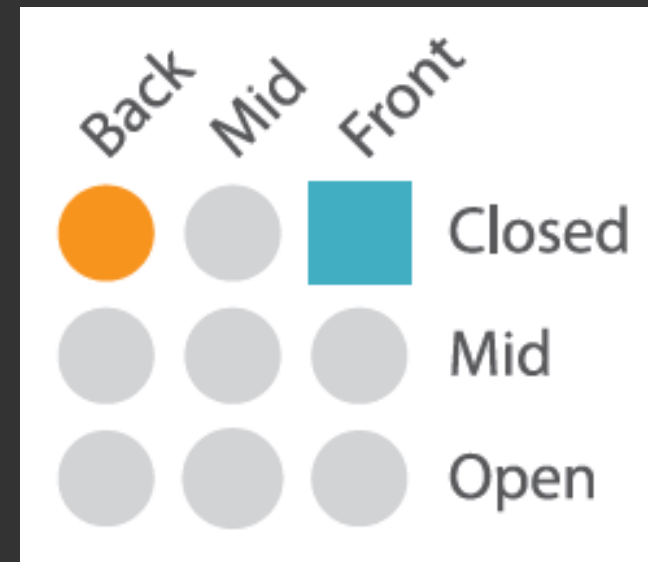
Poetry Visualization (with Utah)

- Supporting close reading

Abdul-Rahman, et al., CGF, 2013
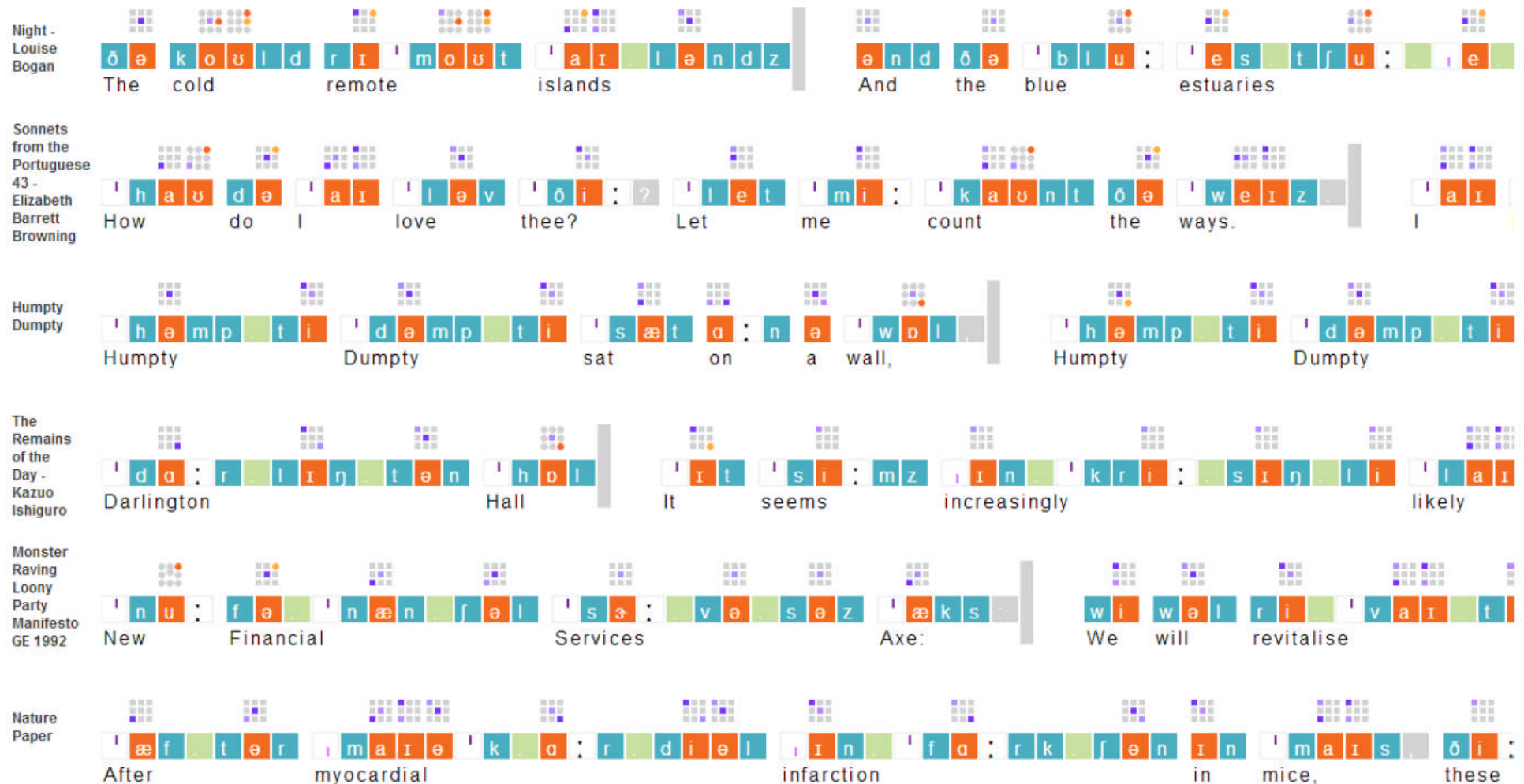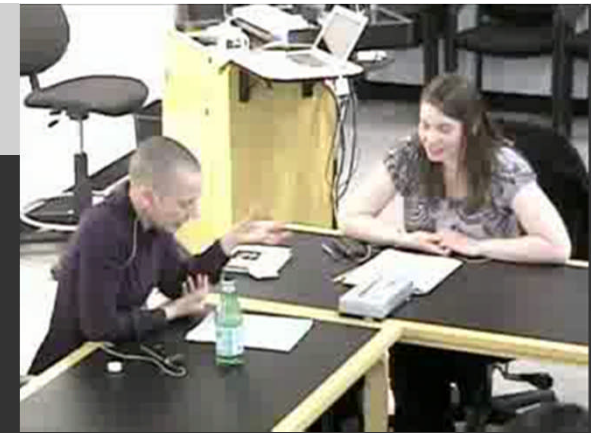
Visualizing Glacier Movement
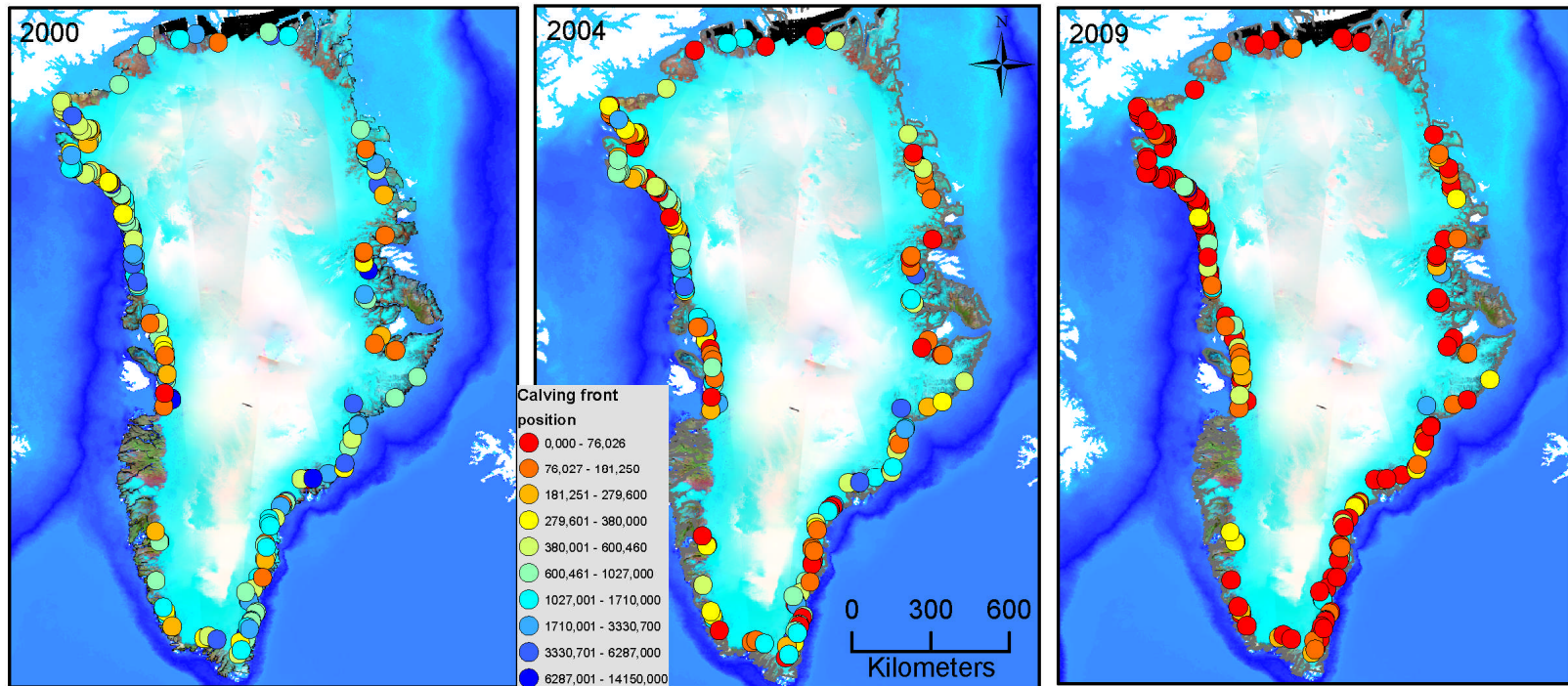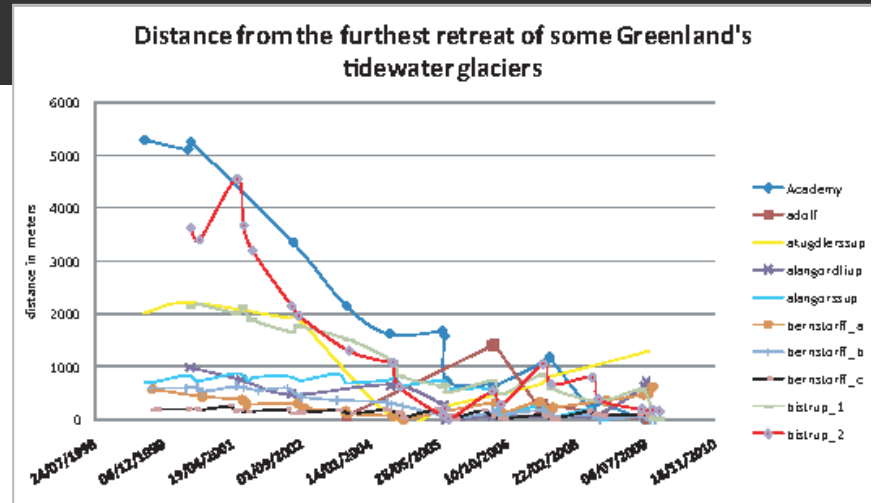
10 years
200+ glaciers

Y. Drocourt, R. Borgo, K. Scharrer, T. Murray, S. I. Bevan and M. Chen, "Temporal visualization of boundary-based geo-information using radial projection," *Computer Graphics Forum*, 2011

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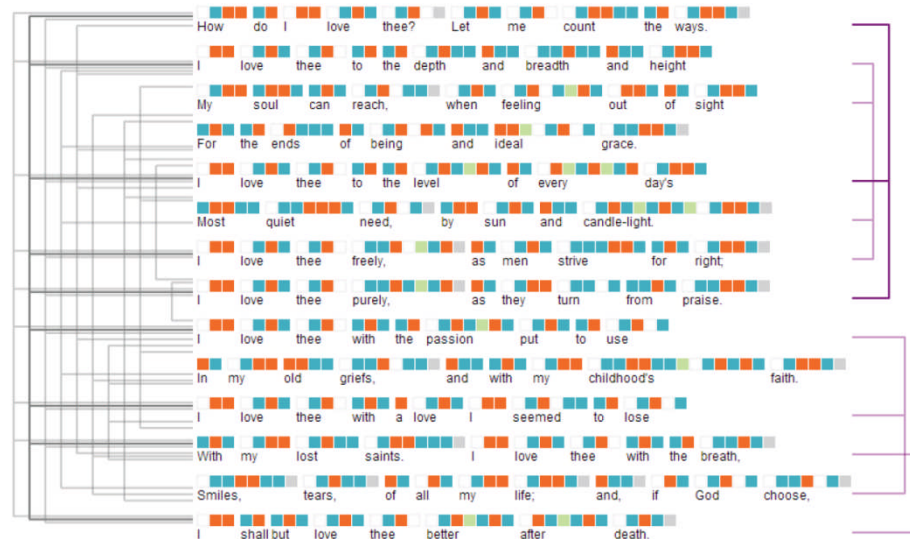
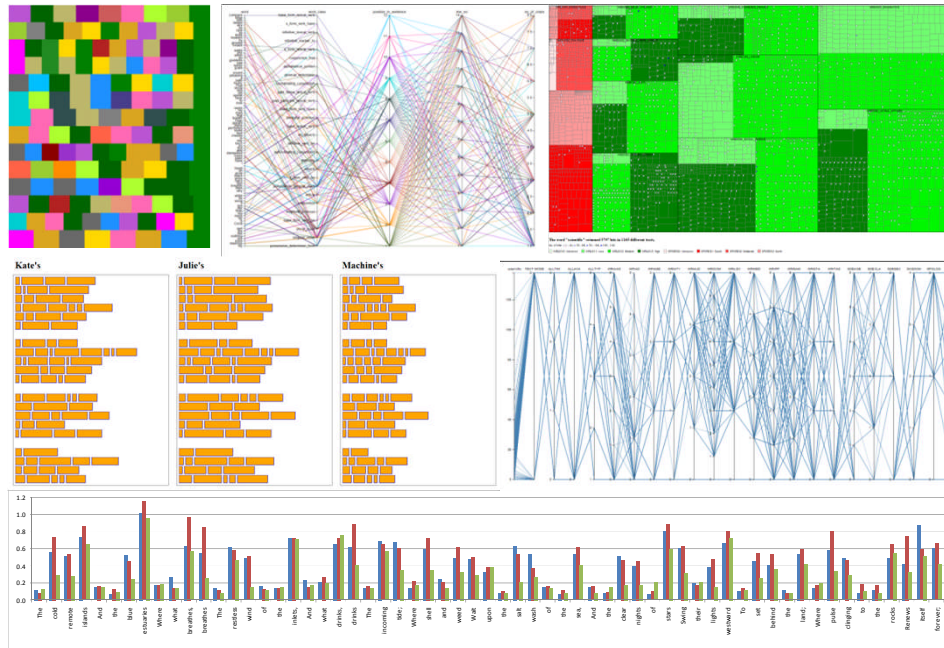2. ## Observational / Operational Level (What?)
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Document Readability Analysis

- Transform textual units to multivariate records
- Some computational analysis

Oelke, D., Spretke, D., Stoffel, A., Keim, D., Visual readability analysis: How to make your writings easier to read, IEEE VAST, 2010

colormap of overall readability score

(a)

(b)

(c)
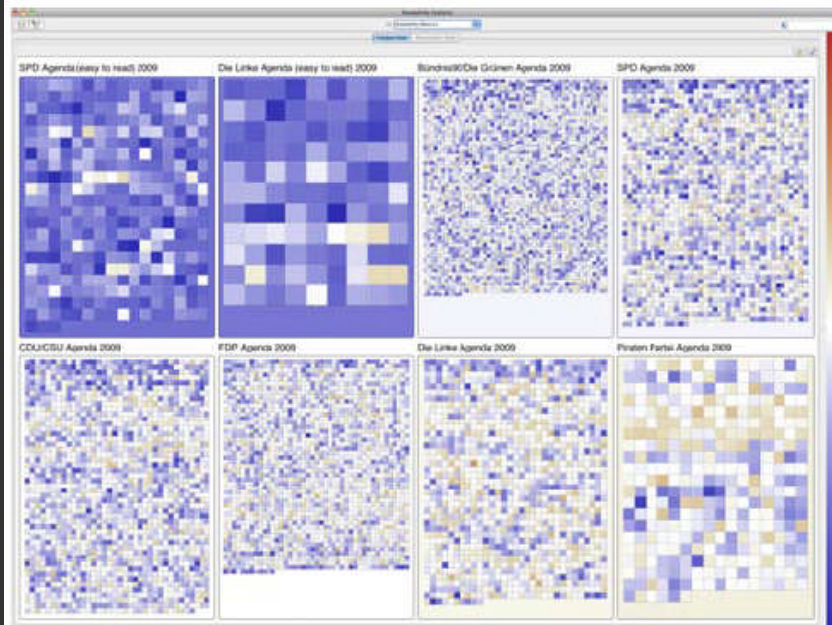
(a) Average Readability Score
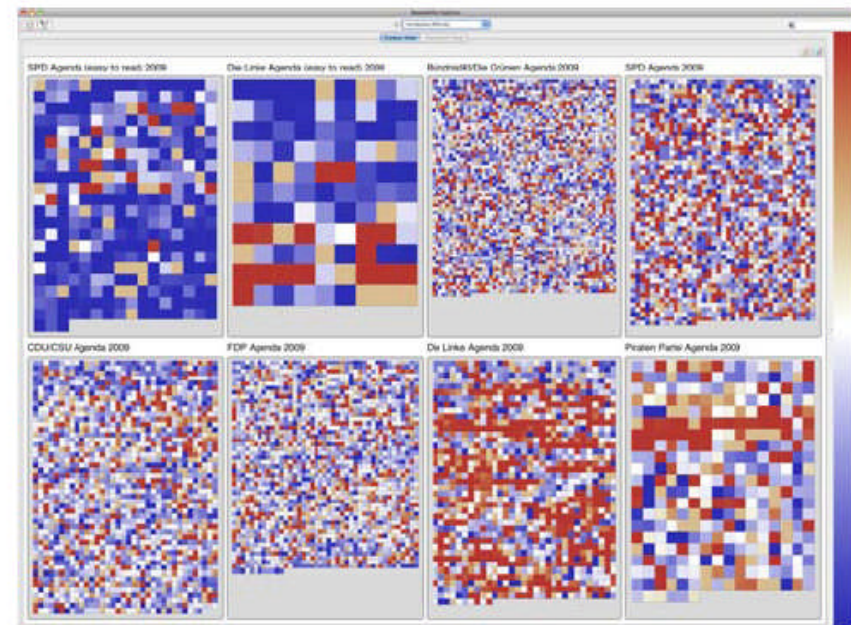
(b) Feature: Vocabulary Difficulty
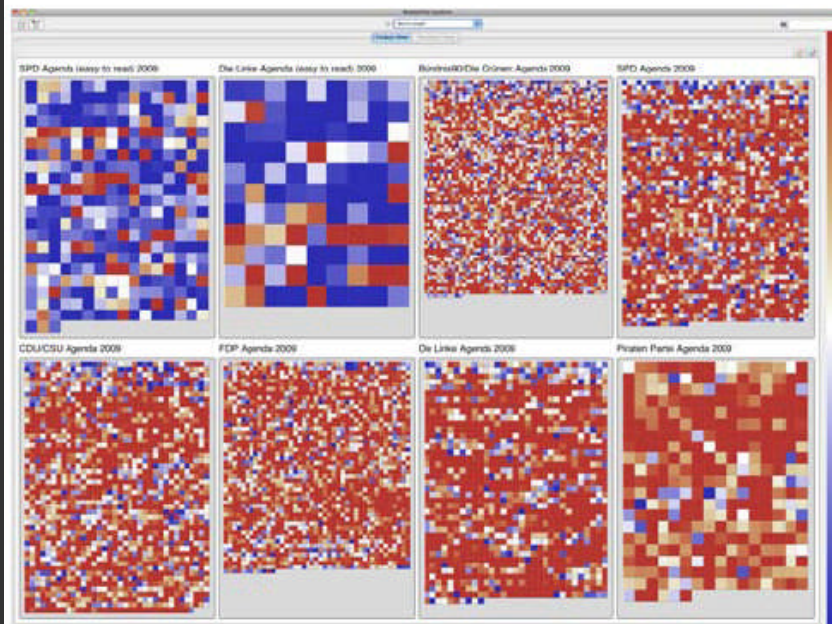
(c) Feature: Word Length
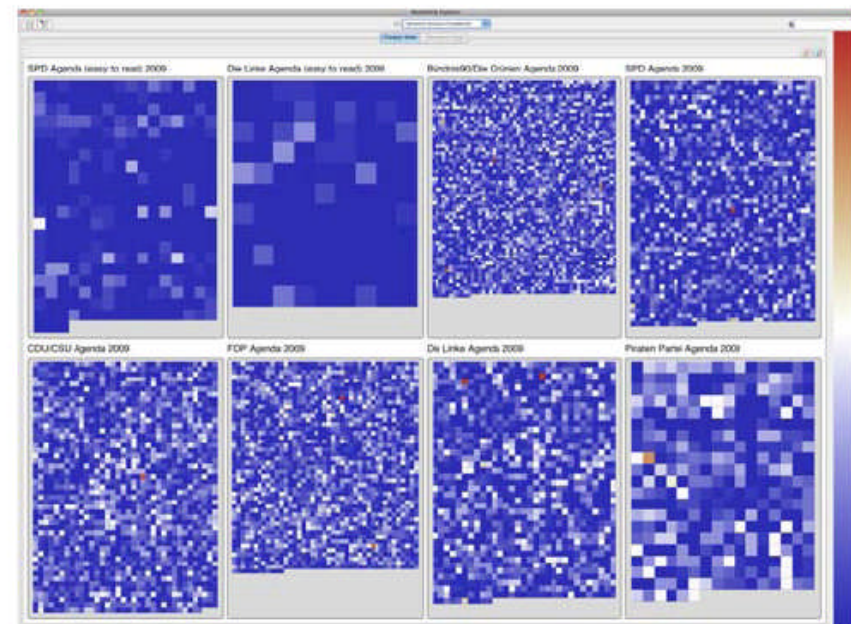
(d) Feature: Sentence Structure Complexity

Figure 8: Visual Analysis of 8 election agendas from the elections of the German parliament in 2009.

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Research Problem: Commonplaces in the 18th-century Literature

- **Similarity measures, and text alignment**
  - *Chicago: ARTEL/PAIR and Ency./PAIR projects since 2009*
  - *PhiloLogic, PhiloLine: English, French, Greek, Latin.*

Les chinois rapportent qu'il disoit souvent: *c'est dans l'occident que se trouve le veritable saint*. Et cette sentence estoit tellement gravée dans l'esprit des sçavans, que soixante-cinq ans aprés la naissance de nostre seigneur, l'empereur Mimti touché de ces paroles, et déterminé par l'image d'un homme qui se presenta à luy durant le sommeil venant de l'occident, envoya de ce costé-là des ambassadeurs, avec ordre de continuer leur voyage jusqu'à ce qu'ils eussent rencontré le saint que le ciel luy avoit fait connoistre. C'estoit à peu prés le temps auquel Saint Thomas preschoit dans les Indes la loy chrétienne; et si ces mandarins eussent suivi leurs ordres, peut-estre que la Chine auroit profité de la prédication de cet apostre. Mais les dangers de la mer, qu'ils craignirent, les obligea de s'arrester à la premiere isle, où ils trouverent l'idole Fo ou Foe, qui avoit déja corrompu les Indes plusieurs siecles auparavant, de son execrable doctrine. (LeComte [1696])

Né 478 ans avant le Christ, il disait souvent, tel un prophète : Dans l'Occident se trouve le véritable saint. Soixante-cinq ans après la naissance du Christ, l'Empereur Mimti, interprétant cette parole du Maître, et sollicité par un songe, envoya vers l'Occident des ambassadeurs, avec ordre de continuer leur voyage jusqu'à ce qu'ils eussent rencontré le saint. En ce temps-là, saint Thomas prêchait dans les Indes la foi chrétienne ; et si ces mandarins s'étaient acquittés de leur mission, au lieu de s'arrêter dans la première île à cause du danger de la mer, peut-être la Chine aurait-elle fait partie de l'Église romaine... (Hazard [1935])

R. Horton, M. Olsen, G. Roe, "Something borrowed: sequence alignment and the identification of similar passages in large text collections," *Digital Studies / Le champ numérique*, Vol 2, No 1, 2010,
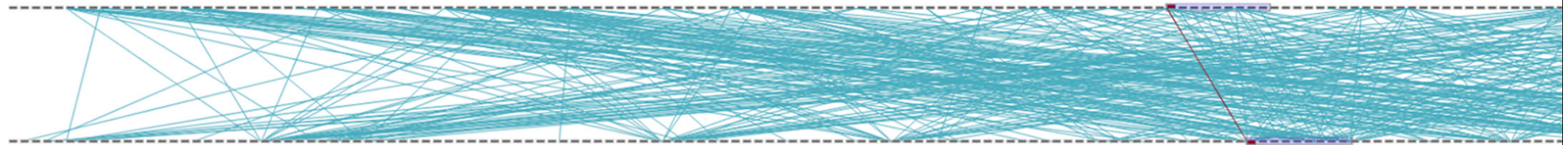
Methods

- A method consists of a set of tools
  - *Word matching*
  - *Language Processing*
  - *Visual Processing*
  - *Operators*
- A simple flow chart

Examples of Alignments

The quick brown fox jumps over the lazy dog.

The quick brown fox jumps over the lazy dog.

M Any Word

Save Time

Telephone

- In the 1870s, Bell travelled around to give demos 'in concert halls, where full orchestras and choruses played "America" and "Auld Lnag Syne into his gadgetry.'

- Around 1880, Queen Victoria installed a pair of telephones at Winsor and Buckingham Palace

Primary source: J. Gleick, book, 2012
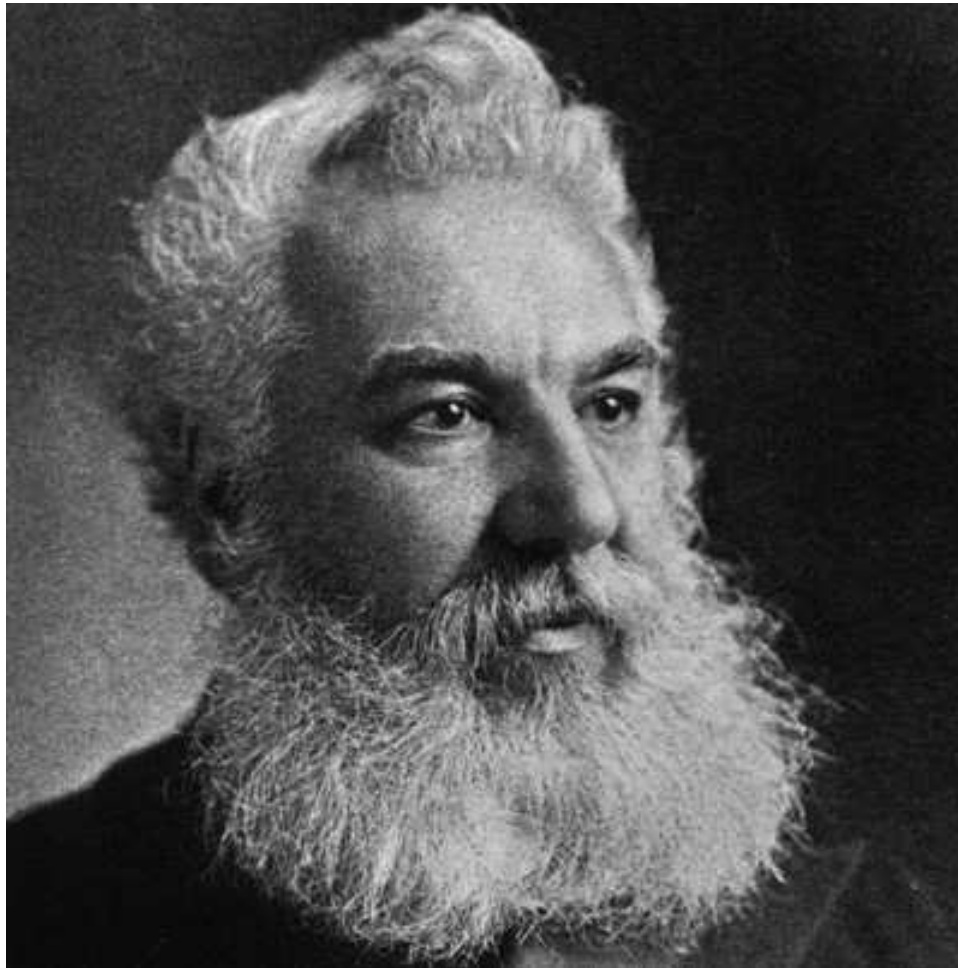
Alexander Graham Bell (1847-1922)

■ Had Alexander Bell invented visualization, he would probably have said:

"Mr. Information, come here. I want to see you."

Acknowledgement

University of Oxford
- Alfie Abdul-Rahman
- Saiful Khan
- Eamonn Maguire
- Simon Walton
- Hui Fang

- *Colleagues in OeRC, OCCAM, ...*

Swansea
- Rita Borgo
- Phil W. Grant
- Iwan Griffiths
- Mark W. Jones
- Bob Laramee
- Adrian Morris
- Tavi Murray
- Irene Reppa
- Kilian Scharrer
- Ian Thornton

- *ROs and PhDs (below)*

Stuttgart
- Tom Ertl
- Daniel Weiskopf
- Ralf Botchen ...

Rutgers
- Deborah Silver
- Carlos Correa

Purdue (VACCINE)
- David Ebert

Heidelberger
- Heike Jänicke

Utah
- Chris Johnson, Kate Coles, Julie Lein, Miriah Meyer
- Chuck Hansen

Cardiff
- Andrew Aubrey
- Dave Marshall
- Paul Rosin
- Gary Tam

RIVIC
- Nigel John
- Ralph Martin
- Reyer Zwiggelaar

Past PhDs and ROs:

- C.-Y. Wang (PhD, 1989-1992)
- Mark W. Jones (PhD, 1991-1994)
- Abdula Haji Tablib (PhD, 1990-1994)
- Mike Bews (PhD, 1992-1996)
- Malcolm Price (MPhil, 1997-1998)
- Adrain Leu (PhD, 1996-1999)
- Simon Michael (PhD, 1996-1999)
- Steve Treavett (PhD, 1997-2000)
- Mark Kiddell (RA, 1999-2001)
- Ben Smith (TCA, 1999-2001)
- S.-S. Hong (PhD, 1998-2002)
- Abdul Haji-Ismail (PhD, 1998-2002)
- H.-L. Zhou (MPhil, 2000-2002)
- Andrew S. Winter (PhD, 1999-2002)
- David Rogeman (PhD, 1999-2003)
- Paul Adams (TCA, 2002-2004)

- Tim Lewis (RA, 2004-2005)
- Gareth Daniel (PhD, 2001-2004)
- David P. Clark (PhD, 2001-2005)
- Dave Bown (RA, 2005)
- Ann Smith (PhD, RA, 2001-2006)
- Siti Z. Zainal Abdin (PhD, 2003-2007)
- Alfie Abdul Rahman (PhD, RA, 2004-7)
- Joanna Gooch (PhD, 2004-2007)
- Shoukat Islam (PhD, RA, 2004-2009)
- David Chisnall (PhD, RA, 2005-2008)
- Phil Roberts (RA, 2005-2008)
- Rudy R. Hashim (PhD, 2005-2008)
- Dan Hubball (MPhil, 2007-2008)
- Owen Gilson (PhD, 2006-2009)
- Lindsey Clarke (PhD, 2007-2010)
- Heike Jänicke (RO, 2009-2010)
- Farhan Mohamed (PhD, 2008-)
- Ed Grundy (PhD, 2009-)

- Rita Borgo (2009-2011)
- Hui Fang (2009-2011)
- Yoann Drocourt (PhD, 2010-2011)
- Karl Proctor (PhD, 2009-2011)
- Andrew Ryan (PhD, 2010-2011)
- Phil Legg (RO, 2010-2011)
- David Chung (PhD, RA, 2010-2011)
- Matthew Parry (MPhil, RA, 2010-2011)
- Richard M. Jiang (RO, 2010-2011)
- Brian Buffy (RO, 2011, 2013)
- Kai Berger (RO, 2012-2013)
- Karl Proctor (RO, 2012-2013)
- Jeyan Thiyagalingam (RO, 2013)