



# Data Visualization via Enhanced Maps in a DH Context a Design Perspective

DH Benelux Conference 2024

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## Outline:

- 1 Interpreting through maps
- 2 *Web Mapping*: issues in cartographic design, interaction design & data structure
- 3 Demonstrating a web-based research environment



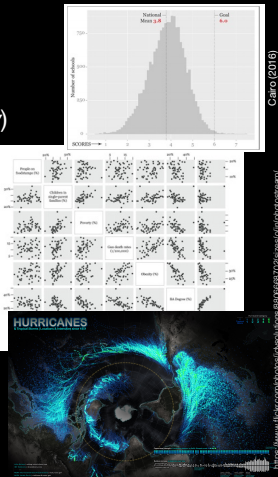
## 1 ~ Interpreting through maps

## Visualization?

- “**Representation & presentation of data** to facilitate **understanding**” [Kirk, 2016]
- **Web mapping**: interactive map visualizations on web [Elliot & Gillies, 2009]
  - Our focus: mapping **data** (thematic maps)
  - ‘**Tools**’ to extract own conclusions [cf. Cairo, 2016]

# When to use?

- Maps can be used in different stages
  - initial **exploration**, get a grasp (*exploratory*)
  - as artefact of **ongoing research** (*discovery & interpretation*)
    - *i.e. "as process"*
  - as **end product** (*communication*)
    - *i.e. "as product / outcome"*

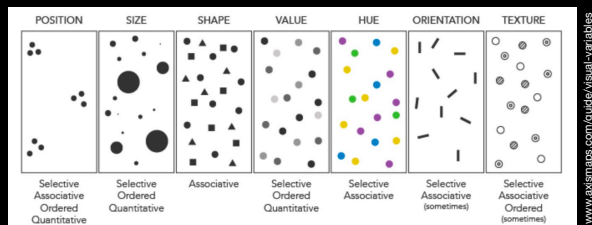


# Maps as abstraction

- “**Not an objective depiction of reality**”
  - the practice of cartography is “as much about removing things as depicting them” [Axis Maps, 2017]
- Map creators **organize & prioritize** [Allen & Queen, 2015]
  - creating “presences and absences” in the resulting maps [Cosgrove, 1999]

# Cartographic design

- “Use of **graphical techniques** to represent geographic information on a map” [ESRI, 2006]
- **Visual variables**: graphical elements representing data, e.g. Bertin’s visual variables [1967]



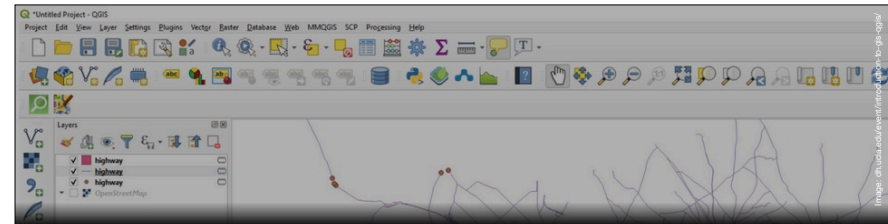
# Cartographic design

- “Use of graphical techniques to represent geographic information on a map” [ESRI, 2006]
- **Visual variables**: graphical elements representing data, e.g. Bertin’s visual variables [1967]
- **Visual hierarchy**: ordering between layers in the foreground and background



# Interaction design

- interaction between the map tool & its user is mediated via the so-called “**user interface**”
  - “in-between device” [Gane & Beer, 2008]
  - **Affordances** [Norman, 2013] — interface *also* a site of power & control [cf. Laurel, 1990]
- Ideally, **tool** in DH context facilitates “acts of interpretation”
  - “..rather than simply returning selected results from a pre-existing data set” [Drucker, 2013]



- “[GIS] Tools for navigation, querying, and feature description convey the **impression** that we are dealing with **static**, descriptive information”
  - but **not** that we are engaging in the “dynamic, often destabilizing” process of **interpretation** (Johnson, 2015)
- Could the affordances of current web-based mapping tools actually support this?



2 ~ *Web Mapping*: issues in cartographic design, interaction design & data structure

# Current web mapping tools

- Standard tools (e.g. Google Maps, Kepler.gl):
  - Relatively **straightforward** importing & visualization of data with precise geolocations
  - Issues in:
    - handling uncertainty (1), interaction design (2) & data structure (3)



# Issue 1: **Uncertainty**

- Often, **uncertainty** (for geodata) is divided into
  - **where** (positional uncertainty)
    - e.g. where was this painter working exactly?
  - **when** (temporal uncertainty)
    - e.g. when was this painter active?
  - **what** (attribute/thematic uncertainty)
    - e.g. are we sure these archive documents talk about the same painter?
  - see also: [MacEachren et al. 2005; [e-education.psu.edu/geog486/node/693](http://e-education.psu.edu/geog486/node/693)]
- **Few established ways** to deal with uncertainty in web mapping tools
  - Import data w/**uncertain** or **unknown** geo-coordinates often **impossible**

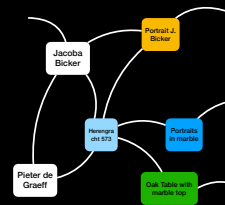
# Issue 2: **Interaction design**

- Limited exploration & analysis possibilities map tools:
  - Search & filtering functionality generally **focused on singular data points**
    - Aggregated searches & using underlying metadata often impossible
  - No searching for map points **without assigned location**



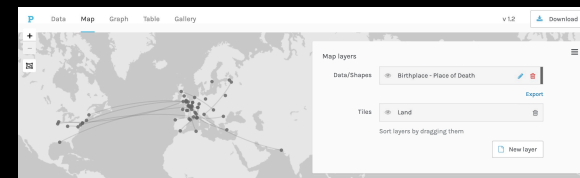
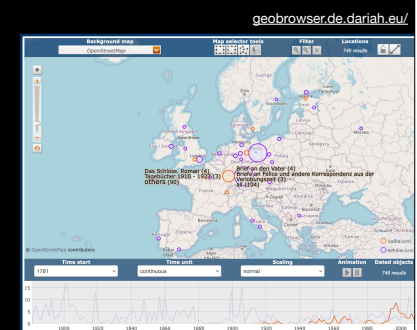
# Issue 3: **Data structure**

- Frequently common identifiers to distinguish data properties are missing (e.g. Linked Data URIs)
  - → Impossible to dive deeper into underlying metadata of map points & to explore *beyond* these points



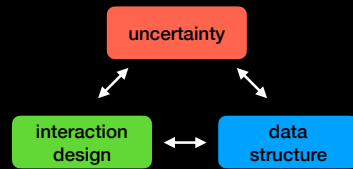
# Solutions?

- Some DH tools have emerged with specific foci\*
  - e.g. DARIAH-DE Geobrowser (→ temporal comparisons)
  - Palladio (→ networks)



[hdlab.stanford.edu/palladio/](http://hdlab.stanford.edu/palladio/)

# Few explicit combinations

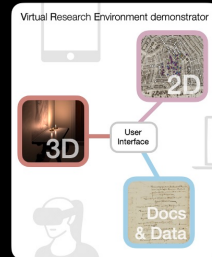


3 ~ Demonstrator web-based research environment

- Abraham Bol (Kunstschilder)
- Adriaen van Cneckebeeck (Kunstschilder)
- Aert Pietersz (Kunstschilder)
- Aert Pietersz (Kunstschilder)
- Antoon Goeteris (Kunstschilder)
- Claes Corneliszoon Moeyaert (Kunstschilder)
- Francoys van Cneckebeeck (Kunstschilder)
- Francoys van Cneckebeeck (Kunstschilder)
- Frans Boels (Kunstschilder)
- Frans Boels (Kunstschilder)
- Frans Gijssers (Maybe artistic painter)
- Gerbrand Brederode (Kunstschilder)
- Gowert Janszn, alias Mijpheer (Kunstschilder)
- Guillaume van der Put (Maybe artistic painter)
- Isaak Bol (Kunstschilder)
- Jacob Bol I (Kunstschilder)
- Jacob Bol II (Kunstschilder)
- Jacob Lenarts, (Kunstschilder)
- Jan Harmensz. Muller (Kunstschilder/dealer)
- Valerius van der Hoeven (Kunstschilder/dealer)
- Willem van Nieulandt II (Kunstschilder)

# Demo from Virtual Interiors project

- Research on cultural production & consumption of creative industries, context of 17th Century Amsterdam (2018-22)
  - Demonstrators 2D & 3D research environments [e.g. Huurdeman & Piccoli, 2021]
- Focus here: demo 2D maps environment
  - Visualizes part of dissertation research by Li [2023]
    - Li, W. (2023). *Painters' playbooks: Deep mapping socio-spatial strategies in the art market of seventeenth-century Amsterdam* [PhD Thesis, University of Amsterdam]
  - Physical locations as "anchor for the alignment of historical maps, archival materials, and modern databases" (e.g. ECARTICO)



Deep mapping of artists' locations [Li, 2023; 2024]

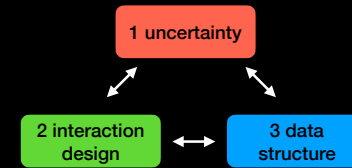
Slide: Weixuan Li

# Co-design method [e.g. Zamenopoulos & Alexiou, 2018]

- Close & frequent interdisciplinary collaboration between
  - involved art historian (W. Li)
  - HCI researcher
  - expert digital editions (E. Posthumus)
- Demonstrator created in iterative steps
- Literature cartographic, UI design [e.g. MacEachren, 2015; Ahlberg & Shneiderman, 1994; White & Roth, 2009]



# Demonstrator implementation



**1.1 Positional uncertainty**

Map markers: basic display of artists' locations

Polygon shapes: whole area that artist may have worked in (upon click)

**1.1 Positional uncertainty**

Map markers: basic display of artists' locations

Polygon shapes: whole area that artist may have worked in (upon click)

**1.2 Temporal uncertainty**  
Data visualized via adjustable time range filters (1, 10 or 20-year ranges)

**1.3 Attribute uncertainty**  
Inspected via item details & included references

**2. Interaction design**  
Dynamic searching & filtering via side-panels  
Seamlessly linked spatial & list-based views

**2. Interaction design**  
"Multi-Queries" (view comparative distributions)

Filtered: "pieter pieters ..." 6

Item list

Text Images

pieter pietersz. lastman,rembrandt,govort flinck

Data: data/csv/dataset.csv  
6 results (1625-1645)

Results with assigned location 6

- Govert Flinck  
Kunstschilder, Foreign immigrant, 1615
- Pieter Pietersz. Lastman  
Kunstschilder, Indigenous Amsterdamer, 1583
- Pieter Pietersz. Lastman  
Kunstschilder, Indigenous Amsterdamer, 1583
- Rembrandt Harmensz. van Rijn  
Kunstschilder, Domestic immigrant, 1606
- Rembrandt Harmensz. van Rijn  
Kunstschilder, Domestic immigrant, 1606
- Rembrandt Harmensz. van Rijn  
Kunstschilder, Domestic immigrant, 1606

About

Item list

**2. Interaction design**  
"Multi-Queries" (see comparative distributions)

Streetplans Data 1625-1645 Filtered: "pieter pieters ..." 6

Item list

Text Images

- Pieter Pietersz. Lastman
- Govert Flinck 1639
- Rembrandt Harmensz. van Rijn

**2. Interaction design**  
"Multi-Queries" (see comparative distributions over time)

Active selection: 180

Item list

Text Images

Data: data/csv/dataset.csv  
180 results (1585-1700)

Results with assigned location 180

- Abraham Barents  
(Maybe artistic) painter, Indigenous Amsterdamer, 1654
- Abraham Lamberts van den Tempel  
Kunstschilder/shopkeeper, Domestic immigrant, 1622
- Abraham Nicolaesz van der Cappen  
Kunstschilder, Indigenous Amsterdamer, 1616
- Abraham de Ryp  
Kunstschilder, Indigenous Amsterdamer, 1644
- Adam Pietersz. de Craemer  
(Maybe artistic) painter, Domestic immigrant, 1638
- Adriaan van Tooren  
(Maybe artistic) painter, Domestic immigrant, 1646
- Adriaan Imbrechts  
Kunstschilder, Southern immigrant, 1593
- Adriaan Imbrechts  
Kunstschilder, Southern immigrant, 1593
- Adriaen Willemsz Vermeulen  
(Maybe artistic) painter, Domestic immigrant, 1655
- Adriaen van Nieulandt I  
Kunstschilder/dealer, Southern immigrant, 1587
- Aernout Smit  
Kunstschilder, Domestic immigrant, 1641
- Albert Jansz. Klomp  
Kunstschilder, Indigenous Amsterdamer, 1625
- Albert Storms  
(Maybe artistic) painter, Foreign immigrant, 1626

About

Item list

**2. Interaction design**  
Spatial multi-selections

Rembrandt Harmensz. van Rijn

Data source: https://ecartico.org

Birth date: 1669-07-15  
Death date: 1669-10-04

Category: Kunstschilder (filter)

Immigrant: Domestic immigrant (filter)

Birth Year: 1606 (filter)

Ecartico ID: 6292  
Address: jodenbreestraat 4  
Active at this address: 1639-1658

● Highlight all locations of this item

**3.1 Data structure**  
Linked Data to display data & connect to other sources (identifiers ECARTICO)  
Biographical information (ECARTICO), artworks (Wikidata), etc.



Rembrandt Harmensz. van Rijn

Details | Linked Data | Annotations

Depictions of this artist:

Works by this artist:

External vocabularies:

- data.bibliotheken.nl
- viaf.org
- www.biografischportaal.nl
- nl.nl
- www.wikidata.org
- id.rijksmuseum.nl
- data.bibliotheken.nl
- nl.handle.net
- www.biografischportaal.nl

3.2 Data structure

ECARTICO as "lynchpin" to connect to other linked data, e.g. Wikidata [Hurdeman, Piccoli & Van Wissen, 2021]

Picture

Artwork by: Jan Abrahamsz. (van) Beerstraten I & II

Year: 1650

Description: SA-2999-De Dam met het oude stadhuis-Gezicht op de Dam met het oude stadhuis bij winter

Source: <http://www.wikidata.org/entity/Q17883196>

3.2 Data structure

ECARTICO as "lynchpin" to connect to other linked data, e.g. Wikidata [Hurdeman, Piccoli & Van Wissen, 2021]

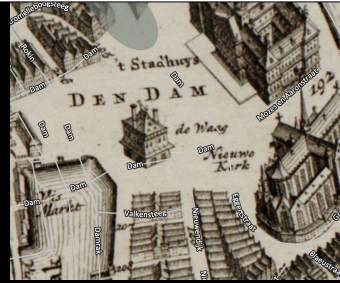
# Evaluation

- A prototype of the maps interface evaluated
  - User study (2021) focused on usability (Jacko, 2012)
    - Highlighted tool's usefulness & potential for deep exploration
    - Also: potential improvement points cartographic design & usability (partially addressed)
- Study further underlined that map visualizations, as abstractions of reality, need to carefully balance visual variables, visual hierarchy & interaction design

# Conclusion

# Conclusion

- Discussed conceptual framework
  - Complexities & opportunities in web mapping
  - Through lens of cartographic design, interaction design & data structure
- Challenges geographical maps (abstract representations of reality)
  - When visualizing multifaceted historical datasets fraught with uncertainties
- 2D maps research environment (open source) exemplifies ways to address these challenges
  - By visualizing positional and temporal uncertainty, by using dynamic searching and filtering, and via interconnected Linked Data



# Acknowledgements

- Many thanks to all Virtual Interiors team members
- In particular Weixuan Li and Etienne Posthumus, involved in the co-design (2019-21) of the initial version of the 2D maps demonstrator

# Data sources in demo

- Data on artist and art dealer locations (research Weixuan Li)
- Biographical information and links (ECARTICO)
- Paintings and related metadata (Wikidata)
- Background maps (hosted by Amsterdam Time Machine (historical maps) & ArcGIS (contemporary map))
- Streetplan layers (Adamlink)



[www.virtualinteriorsproject.nl](http://www.virtualinteriorsproject.nl)

2D map demonstrator link: <https://2d-demo.virtualinteriorsproject.nl/>

3D demonstrator: Huurdeman & Piccoli (2021), 3D Reconstructions as Research Hubs, Open Archeology journal

## References

- ESRI (2016). A to Z GIS: An illustrated dictionary of geographic information systems. Redlands, Calif. : ESRI Press : Independent Publishers Group [distributor]. <http://archive.org/details/tozgisillustrate0000unse>
- Ahlberg, C., & Shneiderman, B. (1994). Visual information seeking using the FilmFinder. Conference Companion on Human Factors in Computing Systems - CHI '94, 433-434. <https://doi.org/10.1145/259963.260431>
- Allen, T., & Queen, S. (2015). Beyond the Map: Unpacking Critical Cartography in the Digital Humanities. Visible Language, 49(3), Article 3. <https://journals.uc.edu/index.php/vl/article/view/5907>
- Axis Maps. (z.d.). What is a map? Geraadpleegd 6 februari 2024, van <http://web.archive.org/web/20180207064633/http://www.axismaps.com/guide/general/what-is-a-map/>
- Bertin, J. (1967). Sémiologie graphique. Moulon et Gauthier-Villars.
- Cairo, A. (2016). The Truthful Art: Data, Charts, and Maps for Communication (1st dr.). New Riders Publishing.
- Cosgrove, D. (1999). Mappings. Reaktion Books.
- Drucker, J. (2013). Performative Materiality and Theoretical Approaches to Interface. Digital Humanities Quarterly, 007(1).
- Earley-Spadoni, T. (2017). Spatial History, deep mapping and digital storytelling: Archaeology's future imagined through an engagement with the Digital Humanities. Journal of Archaeological Science, 84, 95-102. <https://doi.org/10.1016/j.jas.2017.05.003>
- Elliott, T., & Gillies, S. (2009). Digital Geography and Classics. Digital Humanities Quarterly, 003(1).
- Fry, B. (2016). Visualizing data. O'Reilly.
- Gane, N., & Beer, D. (2008). New Media: The Key Concepts. Berg Publishers.
- Huurdeman, H. C. (2021). Virtual Interiors 2D Research Environment demonstrator (v1.0.2) [Software]. Zenodo. <https://doi.org/10.5281/zenodo.5172687>
- Huurdeman, H. C. (2017). Dynamic Compositions: Recombining Search User Interface Features for Supporting Complex Work Tasks. Proceedings of the Second Workshop on Supporting Complex Search Tasks co-located with the ACM SIGIR Conference on Human Information Interaction & Retrieval (CHIIR 2017), 1798, 21-24. <http://ceur-ws.org/Vol-1798/paper5.pdf>
- Huurdeman, H. C. (2024, februari 5). Virtual Interiors 2D Research Environment. GitLab. <https://gitlab.com/uvacreate/virtual-interiors/virtual-interiors-2d-research-envi>
- Huurdeman, H. C., & Piccoli, C. (2021). 3D Reconstructions as Research Hubs: Geospatial Interfaces for Real-Time Data Exploration of Seventeenth-Century Amsterdam Domestic Interiors. Open Archaeology, 7(1), 314-336. <https://doi.org/10.1515/opa-2020-0142>
- Huurdeman, H. C., Piccoli, C., & van Wissen, L. (2021, juni 1). Linked Data in a 3D Context: Experiential Interfaces for Exploring the Interconnections of 17th-Century

## References

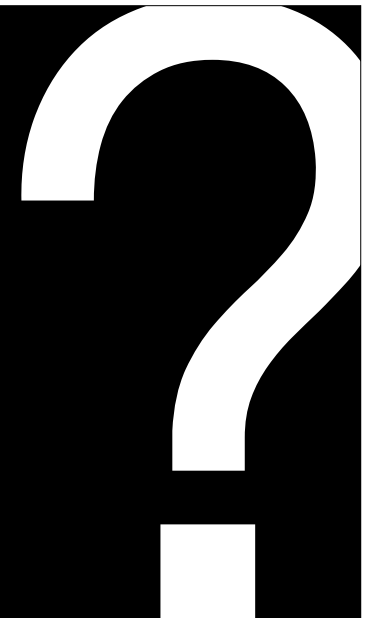
- Jacko, J. A. (Red.). (2012). Human Computer Interaction Handbook: Fundamentals,
- Evolving Technologies, and Emerging Applications, Third Edition (3rd edition). CRC Press.
- Johnson, Tyler Duane. (2015). Interpretation at the Controllers Edge—The Role of Graphical
- User Interfaces in Virtual Archeology [MSc thesis]. University of Arkansas, Fayetteville.
- Kirk, A. (2019). Data Visualisation: A Handbook for Data Driven Design (2nd edition). SAGE Publications Ltd.
- Koller, D., Frischer, B., & Humphreys, G. (2009). Research challenges for digital archives of 3D cultural heritage models. Journal on Computing and Cultural Heritage, 2(3), 1-17. <https://doi.org/10.1145/1658346.1658347>
- Li, W. (2023). Painters' playbooks: Deep mapping socio-spatial strategies in the art market of seventeenth-century Amsterdam [PhD Thesis, University of Amsterdam]. <https://hdl.handle.net/11245.1/bdaca776-71c2-4ff2-b5fa-12fbabe1a5b>
- Li, W. (2024). Deep Mapping Uncertain Historical Sources: Visualizing Business Knowledge of Painters in Seventeenth-Century Amsterdam. Journal of Knowledge.
- Li, W., Piccoli, C., & van den Heuvel, C. M. J. M. (2019, juli 19). Embracing Complex Interfaces: Linking Deep Maps and Virtual Interiors to Big Data of the Dutch Golden Age. DH Conference Complexities 2019: Short Paper.
- MacEachren, A. M., Robinson, A., Hopper, S., Gardner, S., Murray, R., Gahegan, M., & Hertzler, E. (2005). Visualizing geospatial information uncertainty: What we know and what we need to know. Cartography and Geographic Information Science, 32(3), 139-. Gale Academic OneFile.
- Norman, D. (2013). The Design Of Everyday Things (Revised edition). Basic Books.
- Pavlovskaya, M. (2016). Digital Place-Making: Insights from Critical Cartography and GIS. In C. Travis & A. Von Lünen (Red.), The Digital Arts and Humanities (pp. 153-167). Springer International Publishing. [https://doi.org/10.1007/978-3-319-40953-5\\_9](https://doi.org/10.1007/978-3-319-40953-5_9)
- White, R. W., & Roth, R. A. (2009). Exploratory Search: Beyond the Query-Response Paradigm. Morgan & Claypool Publishers.
- Zamenopoulos, T., & Alexiou, K. (2018). Co-design As Collaborative Research. Bristol University/AHRC Connected Communities Programme. [https://connected-communities.org/wp-content/uploads/2018/07/Co-Design\\_SP.pdf](https://connected-communities.org/wp-content/uploads/2018/07/Co-Design_SP.pdf)

## Misc links

- Brief cartography guide
  - <https://www.axismaps.com/guide>
- Cartography and Visualization course
  - <https://www.e-education.psu.edu/geog486>
- Visualization lecture Hugo (2018)
  - <https://www.slideshare.net/TimelessFuture/visualization-lecture-clariah-summer-school-2018>
- Some mapping advice
  - <https://www.tableau.com/about/blog/2017/8/10-ways-add-value-your-dashboards-maps-75709>
  - UX Patterns maps: <https://twitter.com/smashingmag/status/1247068814589792256>
- Chart usage guidelines:
  - [eazybi.com/blog/data-visualization-and-chart-types](https://eazybi.com/blog/data-visualization-and-chart-types)
- Improving the 'data-ink ratio':
  - [darkhorseanalytics.com/blog/data-looks-better-naked](https://darkhorseanalytics.com/blog/data-looks-better-naked)
- Geocoding in QGIS
  - <https://guides.library.ucsc.edu/DS/Resources/QGIS>
- Webmapping via QGIS
  - [https://www.qgistutorials.com/en/docs/web\\_mapping\\_with\\_qgis2web.html](https://www.qgistutorials.com/en/docs/web_mapping_with_qgis2web.html)

## Discussion

- Questions, ideas, suggestions?





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