Vorlesung
Advanced Topics in HCI
(Mensch-Maschine-Interaktion 2)

Ludwig-Maximilians-Universität München

LFE Medieninformatik

Albrecht Schmidt & Andreas Butz

SS2006

http://www.medien.informatik.uni-muenchen.de/

3D-Modellierung manuell und digital

- Blockpraktikum 4SWS in den Ferien
- Gemeinsam mit der Kunstpädagogik (Dr. Guminski)
- Wunsch-Voraussetzungen: 3D-Graphik 1+2 (Hoppe)
- Dauer: 2 Wochen, 18.-22. und 25.-29. September
- 1. Woche: modellieren mit Ton
  - Danach 3D-scan der Ergebnisse
- 2. Woche: animieren mit 3DSmax
  - auf Basis der handmodellierten Objekte
- Nur 7+7 Plätze (6 schon vergeben)
- Bei Interesse email an butz@ifi.lmu.de

Workshop Digitalphotographie

- Kein Schein, freiwilliges Angebot
- Dauer: 1 Woche: 4.-8. September
- Morgens ca.1/2 - 1 Stunde Folien
  - Technische Grundlagen (Optik, Kamera)
  - Bildgestaltung durch
    - Bildaufbau & Perspektive
    - Zeit, Blende
    - Licht

- Tagsüber praktisches Photographieren
  - Vermutlich Architektur + Natur
  - Benötigt: eigene Kamera + Stativ
- Abends Bildbesprechungen am Rechner
- Bei Interesse email an butz@ifi.lmu.de

Chapter 2: Information Visualization

Table of Content

- Motivation & examples
- Information & representation
- What is information visualization
- Perception basics
- Standard techniques
- Principles and Taxonomy
- Options for visualization & more examples

“Graphical excellence is that which gives to the viewer the greatest number of ideas in the shortest time with the least ink in the smallest space.”

-- Edward R. Tufte

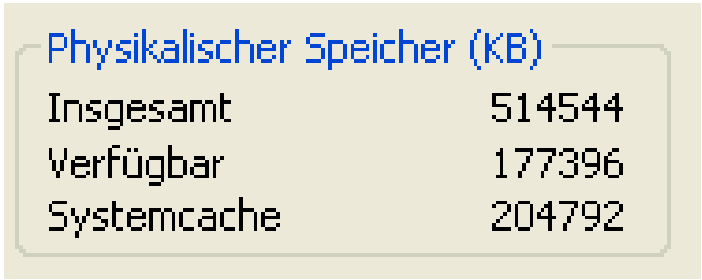
Representation

- What is a good visual Representation?
  - Capture and present the essential
  - Deliberately hide irrelevant parts
  - Appropriate for the recipient and his/her abilities
  - To understand and interpret by the recipient
  - Appropriate for the task

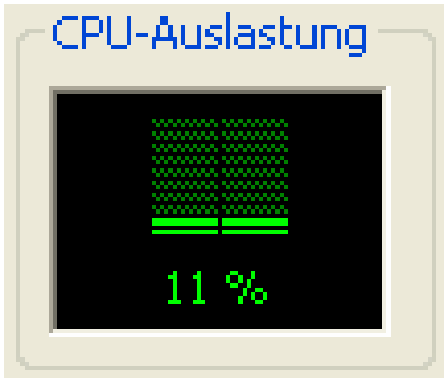
- “Solving a problem simply means representing it so as to make the solution transparent” (Simon, 1981)

- Allow people to look at the presentation and draw the “right” conclusions!

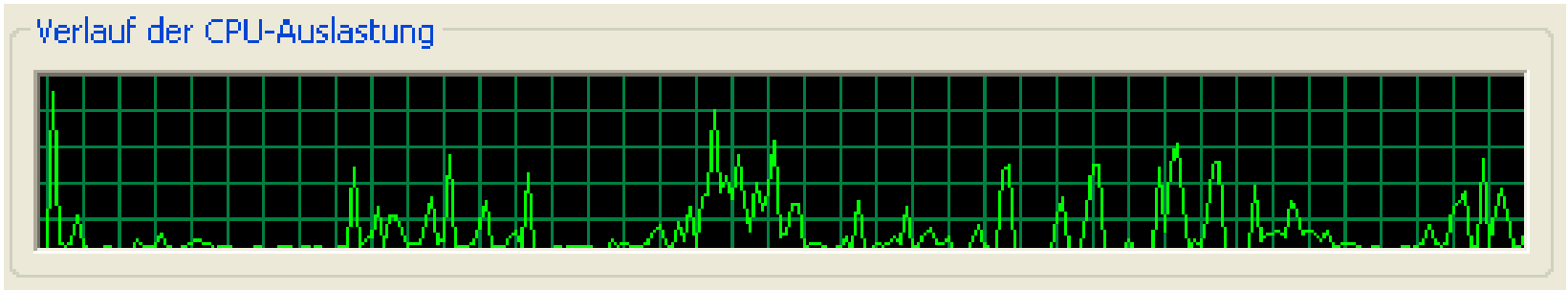
Representations



- Figures / numbers



- Numbers in bar graph



- Plot with history

How to read representations

- Read the plain facts
- Compare representations (visual calculations)
- Identify patterns
- Make interpretations

- Can be enhanced by active diagrams
  - Allow interactive manipulation

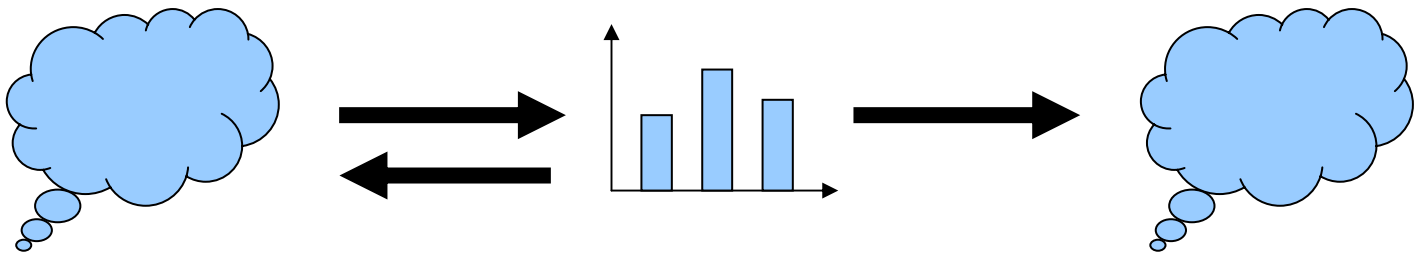
External aids for thinking

The power of the unaided mind is highly overrated. Without external aids, memory, thought, and reasoning are all constrained. But human intelligence is highly flexible and adaptive, superb at inventing procedures and objects that overcome its own limits. The real powers come from devising external aids that enhance cognitive abilities. How have we increased memory, thought, and reasoning? By the inventions of external aids: It is things that make us smart. (Norman, 1993)

- External cognition
  - Internal and external representation and processing weave together in thought
- External cognitive aids can enhance cognition
- An important class of external cognitive aids that make us smart are graphical inventions
  - Charts for navigation
  - Diagrams

Use of visual representations

- Pictures and diagrams are used to communicate existing ideas and thoughts
- Graphical representations can help in developing and formulating ideas and thoughts
- Using visual representations “to think”



Information – to visualize

- What is “Information”?
  - Entities, concepts, things, items that may not have a direct physical correspondence
  - Information is often abstract

- Large sets of data and information
  - Great amount of data
  - Information is generated in many processes

- visualize: to form a mental image or vision of …
- visualize: to imagine or remember as if actually seeing.
  (American Heritage dictionary, Concise Oxford dictionary)

What is Information Visualization

- The use of computer-supported, interactive visual representations of data to amplify cognition. (Card, Mackinlay, Shneiderman ’98)

- ``Transformation of the symbolic into the geometric'' (McCormick et al., 1987)

- ``... augmenting … natural intelligence in the best possible way, ... finding the artificial memory that best supports our natural means of perception.'' (Bertin, 1983)

- “The depiction of information using spatial or graphical representations, to facilitate comparison, pattern recognition, change detection, and other cognitive skills that make use of the visual system.” (Hearst, 2003, CHI-Tutorial)

Information Visualization

- The basic idea
  - Finding for information items an appropriate and meaningful mapping into a 2-D or 3-D physical space.
  - Creating a visual representation that helps to understand data and is useful for analysis and decision-making

- Visual representations are helpful
  - External cognition
  - frame of reference
  - “temp storage” for thinking

- “The purpose of visualization is insight, not pictures”
  - Insight – understanding, discovery, decision making, explanation

Definition by Shneiderman

- Compact graphical presentation and
  - user interface for
  - manipulating large numbers of items (10^2 - 10^6),
  - possibly extracted from far larger datasets.
- Enables users to make
  - discoveries,
  - decisions, or
  - explanations
- about
  - patterns (trend, cluster, gap, outlier...),
  - groups of items, or
  - individual items.

InfoVis is applicable to:

- Text, documents, text archives
- Databases
- Statistics
- Financial data, business data
- Geographic data
- Network information, internet information
- Software
- ...

What tasks are supported by Information Visualization?

- Search
  - Finding a specific information in a data set
- Browse
  - survey, inspect, look for interesting information
- Analysis
  - Comparison-Difference, find outliers and extremes, spot patterns

- Many more…
  - Categorize, Associate
  - Locate, Rank
  - Identify, Reveal
  - Monitor, Maintain awareness

Examples


1997
1998
1999
2000
2001
2002
381,75
53,60
400,00
350,00
300,00
250,00
200,00
150,00
100,00
50,00
VOD.ISE
612 %HIGH-LOW
$ Splits
BPC


10°
10°
15°
15°
20°
20°
25°
25°
30°
30°
H
H
T
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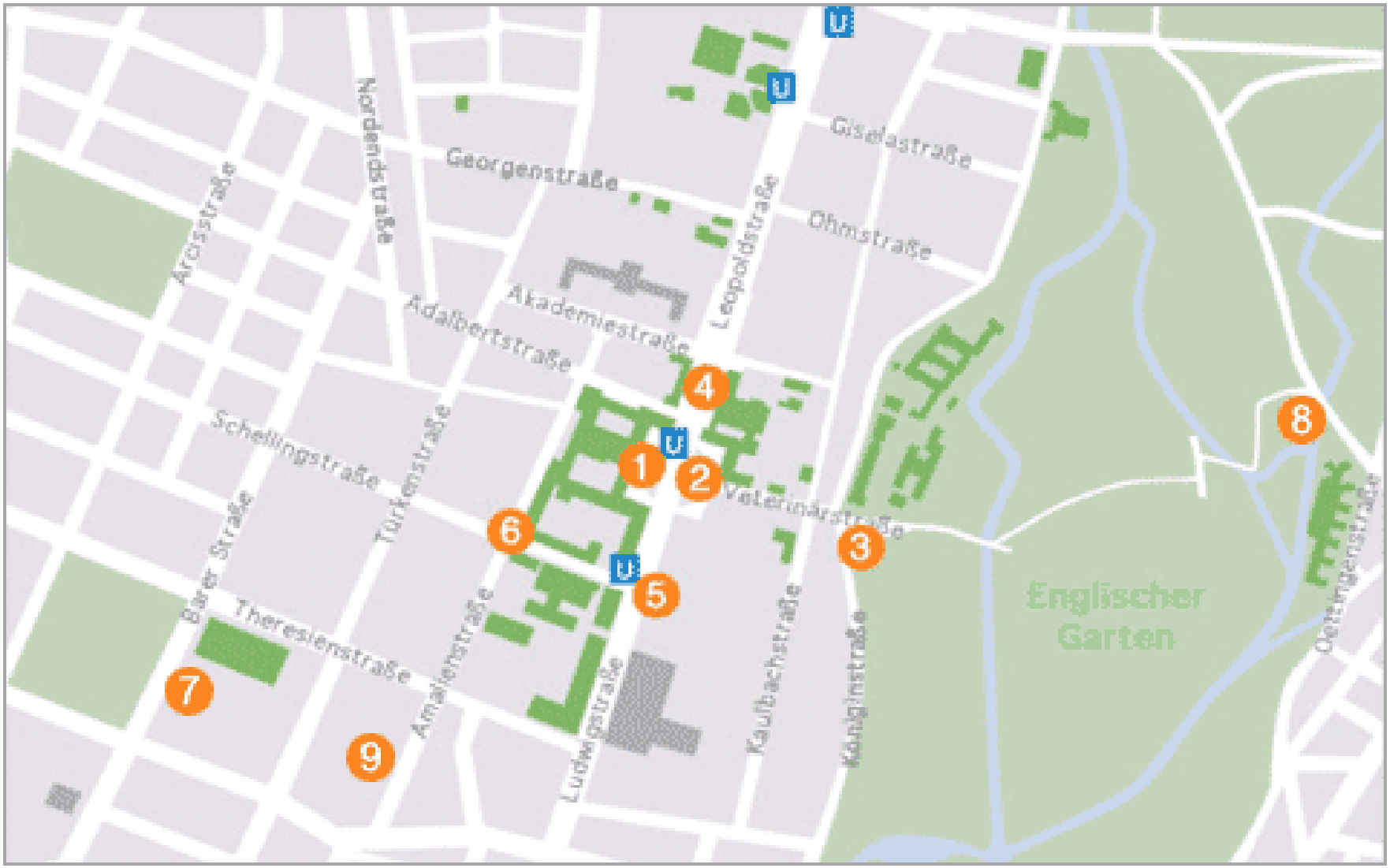
Volumen(rot-grün)
Steigende Kurse
Fallende Kurse
875M
555M
235M
(c) 2002 Innovative Software
Intervall: 1 Tag
24.05.02 14:43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Türkenstraße
Baaderstraße
Theresienstraße
Amalienstraße
Ludwigstraße
Kaulbachstraße
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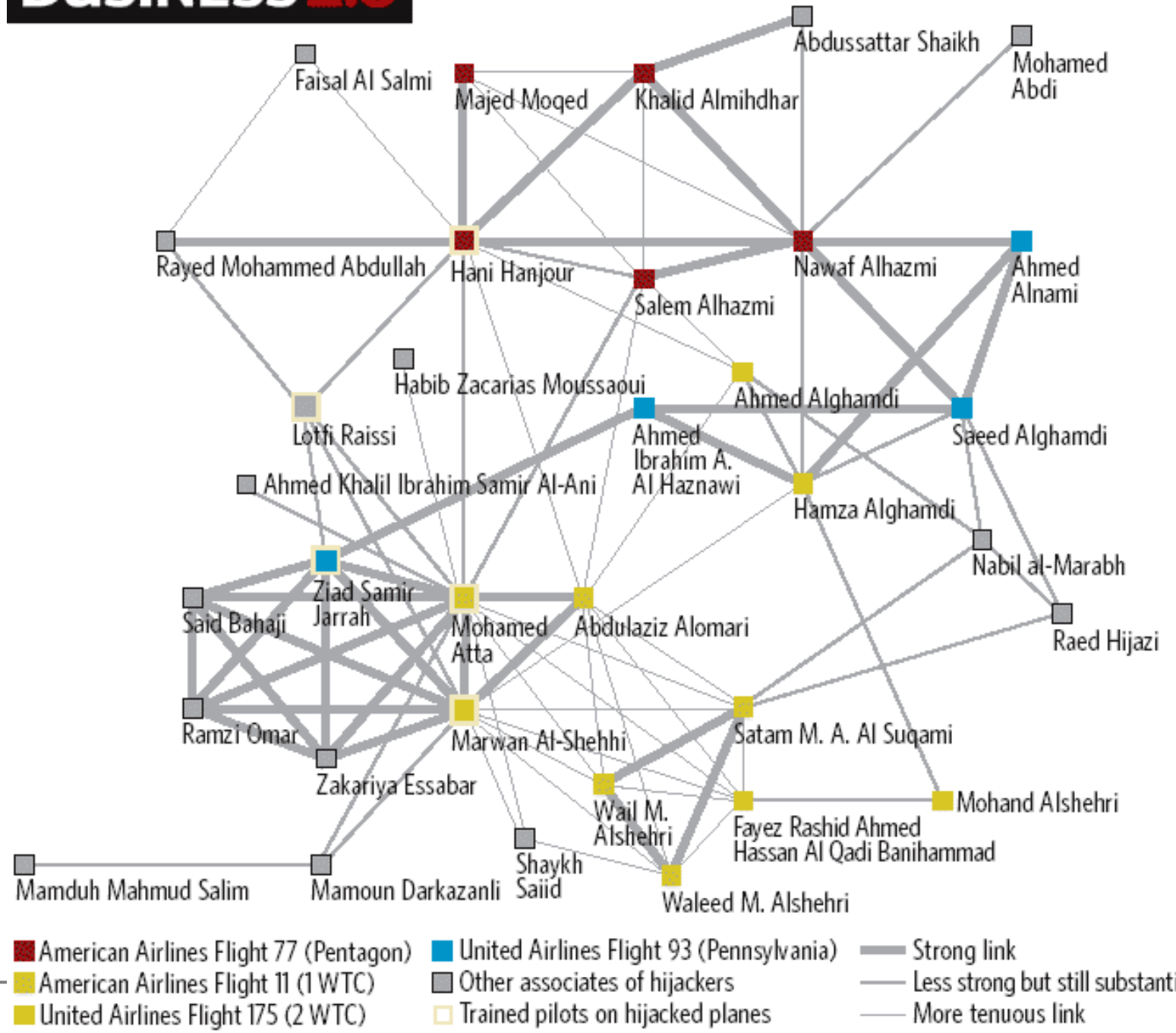
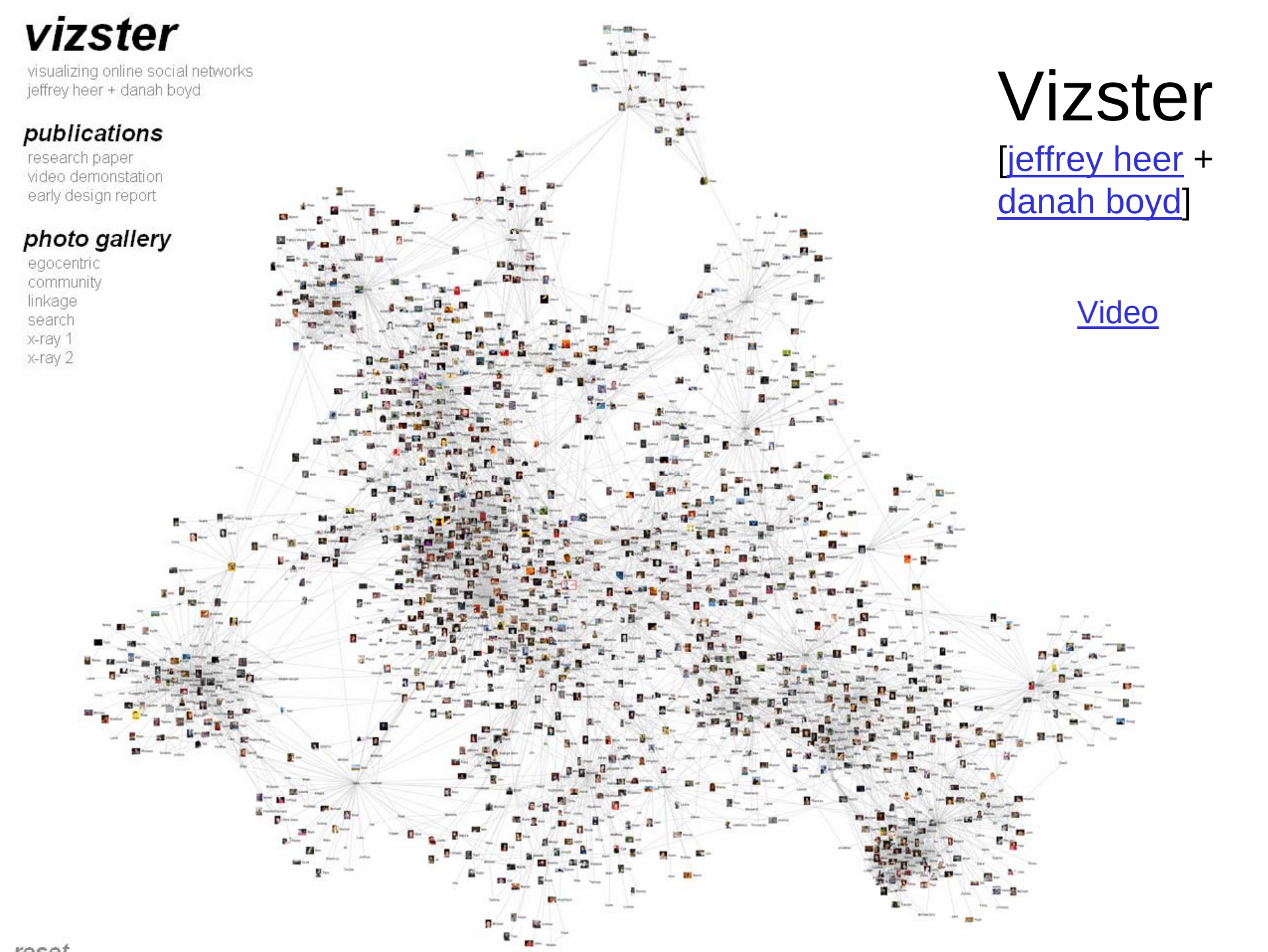
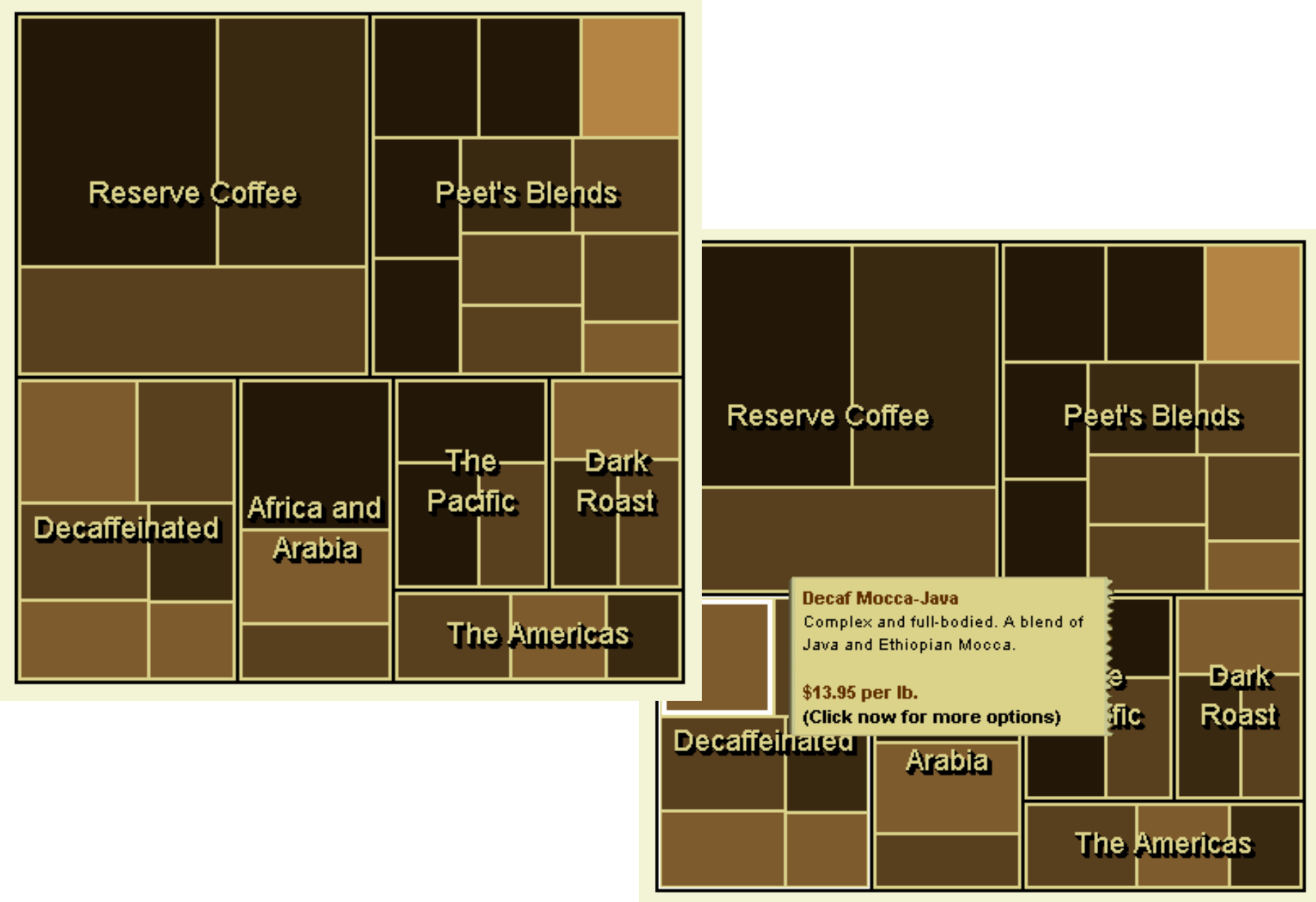

BUSINESS 2.0
Abdussattar Shaikh
Mohamed Abdi
Faisal Al Salmi
Majed Moqed
Khalid Almihdhar
Rayed Mohammed Abdullah
Hani Hanjour
Nawaf Alhazmi
Ahmed Alnami
Salem Alhazmi
Habib Zacarias Moussaoui
Ahmed Alghamdi
Lotfi Raissi
Ahmed Ibrahim A. Al Haznawi
Saeed Alghamdi
Ahmed Khalil Ibrahim Samir Al-Ani
Hamza Alghamdi
Nabil al-Marabh
Ziad Samir Jarrah
Said Bahaji
Mohamed Atta
Abdulaziz Alomari
Raed Hijazi
Ramzi Omar
Marwan Al-Shehhi
Satam M. A. Al Suqami
Zakariya Essabar
Wail M. Alshehri
Mohand Alshehri
Fayez Rashid Ahmed Hassan Al Qadi Banihammad
Shaykh Saiid
Mamduh Mahmud Salim
Mamoun Darkazanli
Waleed M. Alshehri
American Airlines Flight 77 (Pentagon)
American Airlines Flight 11 (1 WTC)
United Airlines Flight 175 (2 WTC)
United Airlines Flight 93 (Pennsylvania)
Other associates of hijackers
Trained pilots on hijacked planes
Strong link
Less strong but still substantial link
More tenuous link



Vizster

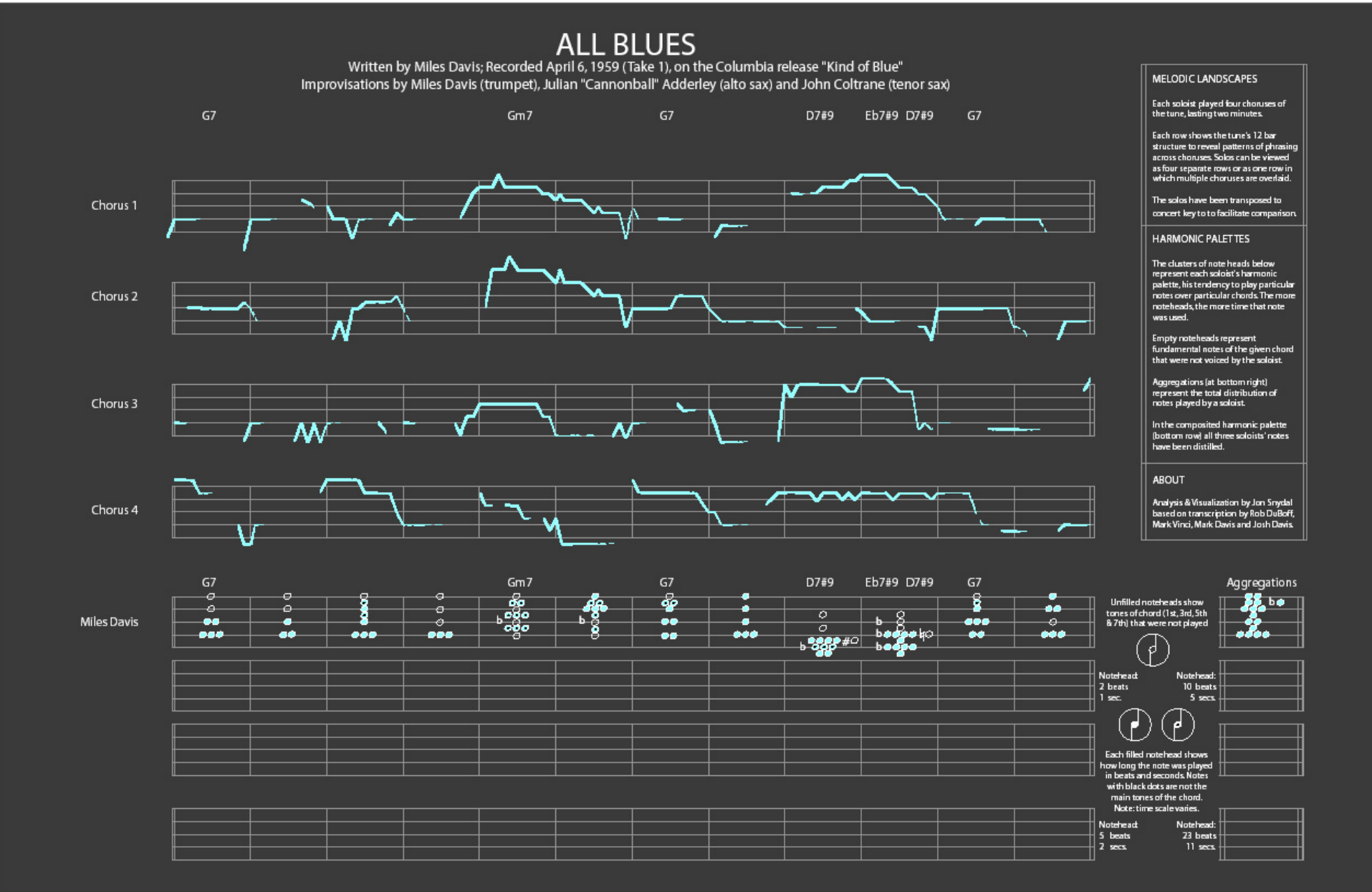
[jeffrey heer + danah boyd]

Video

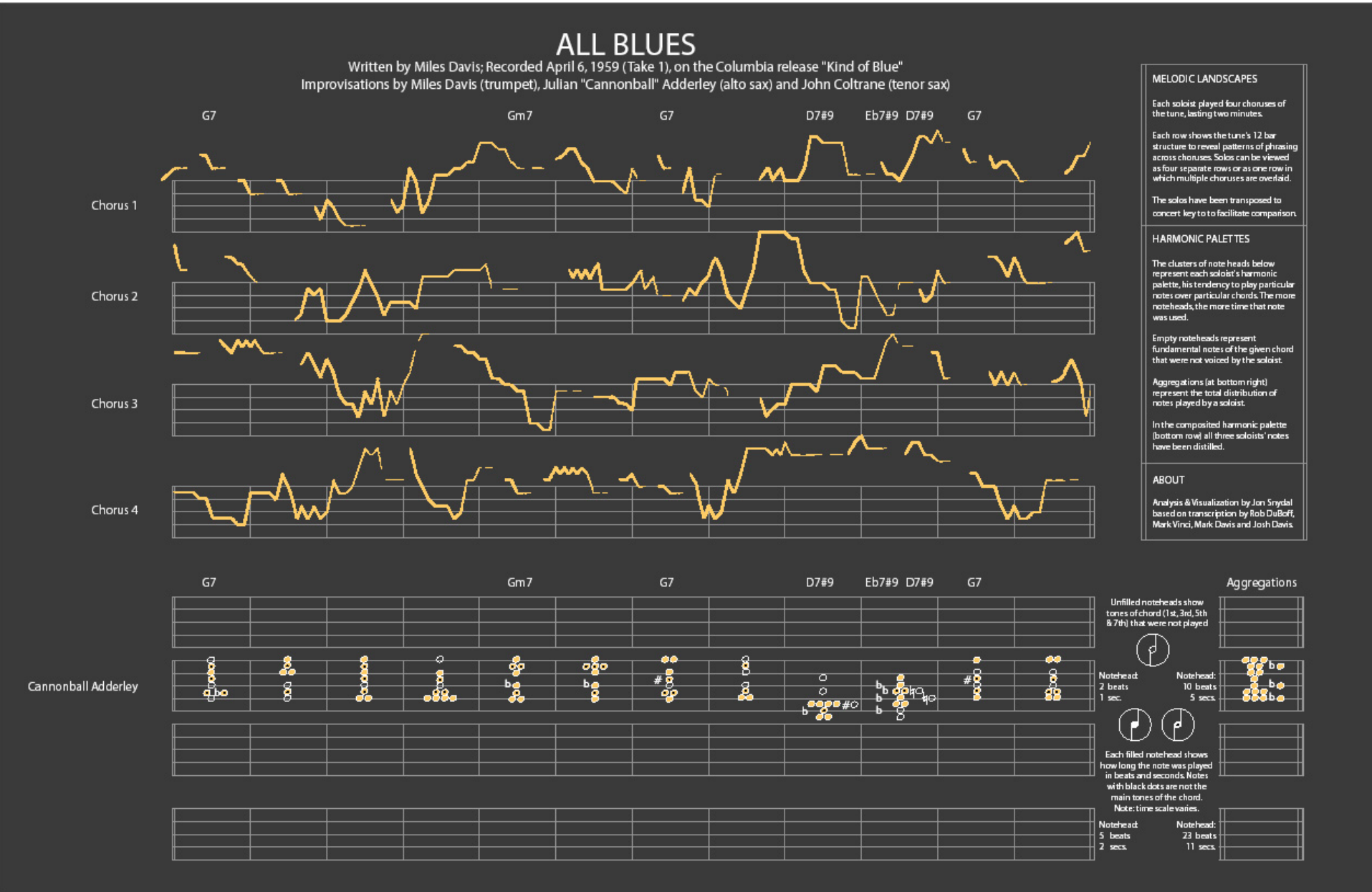


http://www.peets.com/selector_coffee/coffee_selector.asp

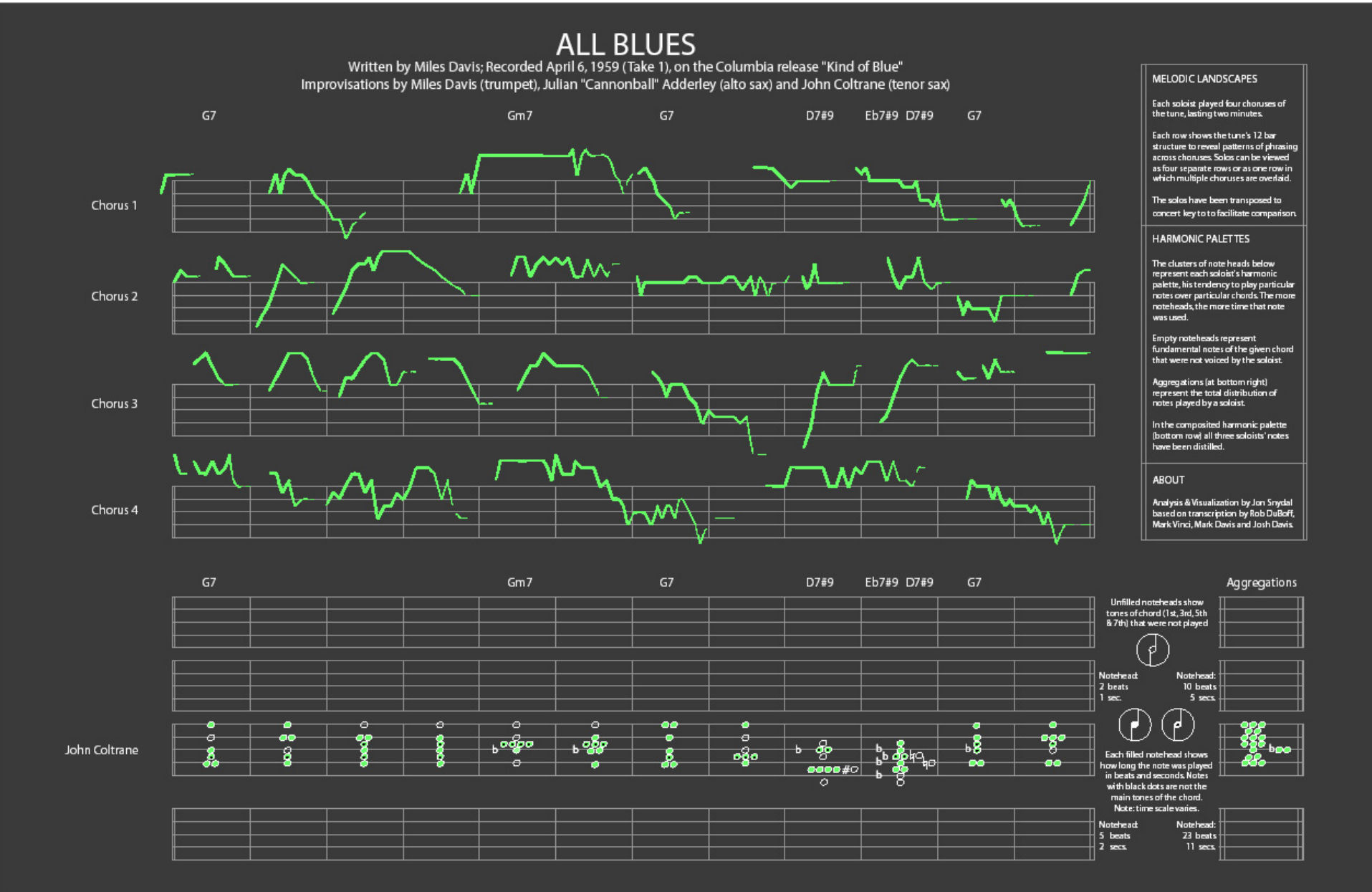
ImproViz [Snydal & Hearst, CHI 2005]



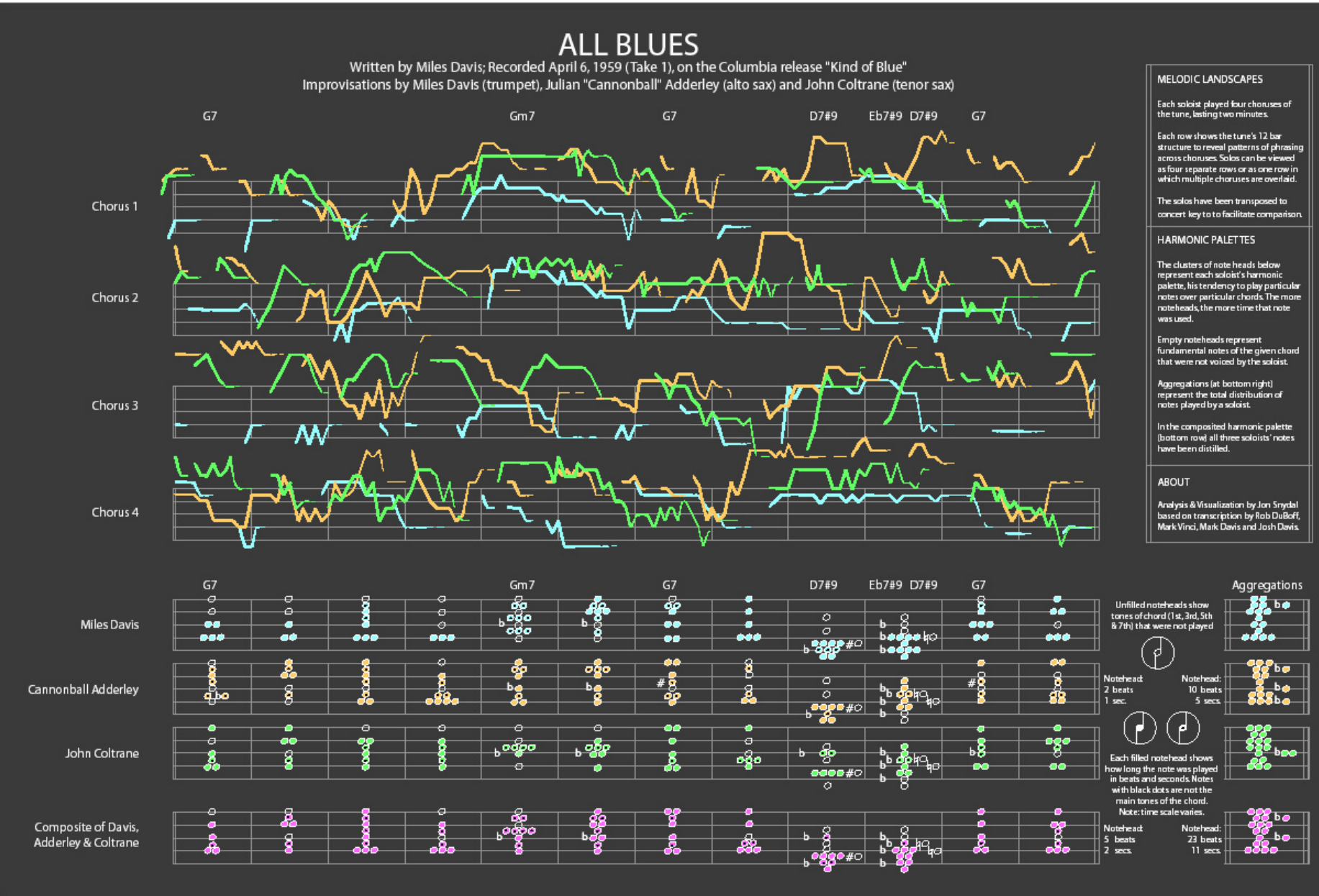
ImproViz [Snydal & Hearst, CHI 2005]



ImproViz [Snydal & Hearst, CHI 2005]



ImproViz [Snydal & Hearst, CHI 2005]



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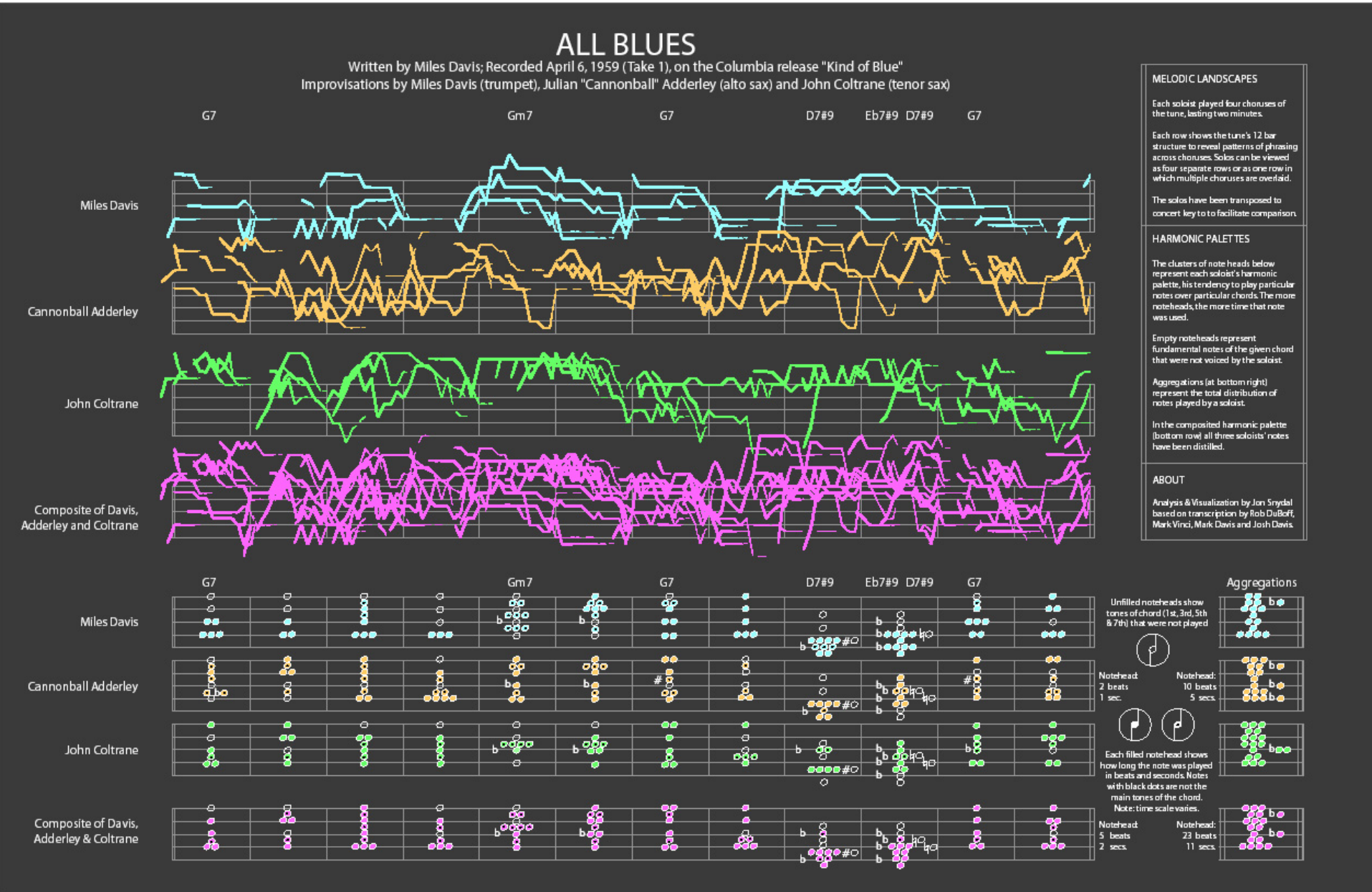


Goal of Information Visualization

- Use human perceptual capabilities to gain insights into large data sets that are difficult to extract using standard query languages
- Exploratory Visualization, look for
  - Structure
  - Patterns
  - Trends
  - Anomalies
  - relationships

- Provide a qualitative overview of large, complex data sets
- Help to find regions of interest and appropriate parameters for more focused quantitative analysis

Knowledge crystallization

(Storey, 2004)

- Knowledge crystallization involves getting insight about data relative to some task

- Steps required in a Knowledge Crystallization task:
  - Information foraging/browsing (from repositories, people…)
  - Search for/build a schema (representation) –need to know what to include/omit
  - Instantiate schema with data
  - Problem solve to trade-off features
  - May have to search for a new schema..
  - Package the patterns found in some output product (i.e. a concise briefing of results)

- A visualization tool has to support or automate some of these steps, it is a cognitive aid during our process of schematization
- So we need data, a task and a schema

Knowledge crystallization (2)

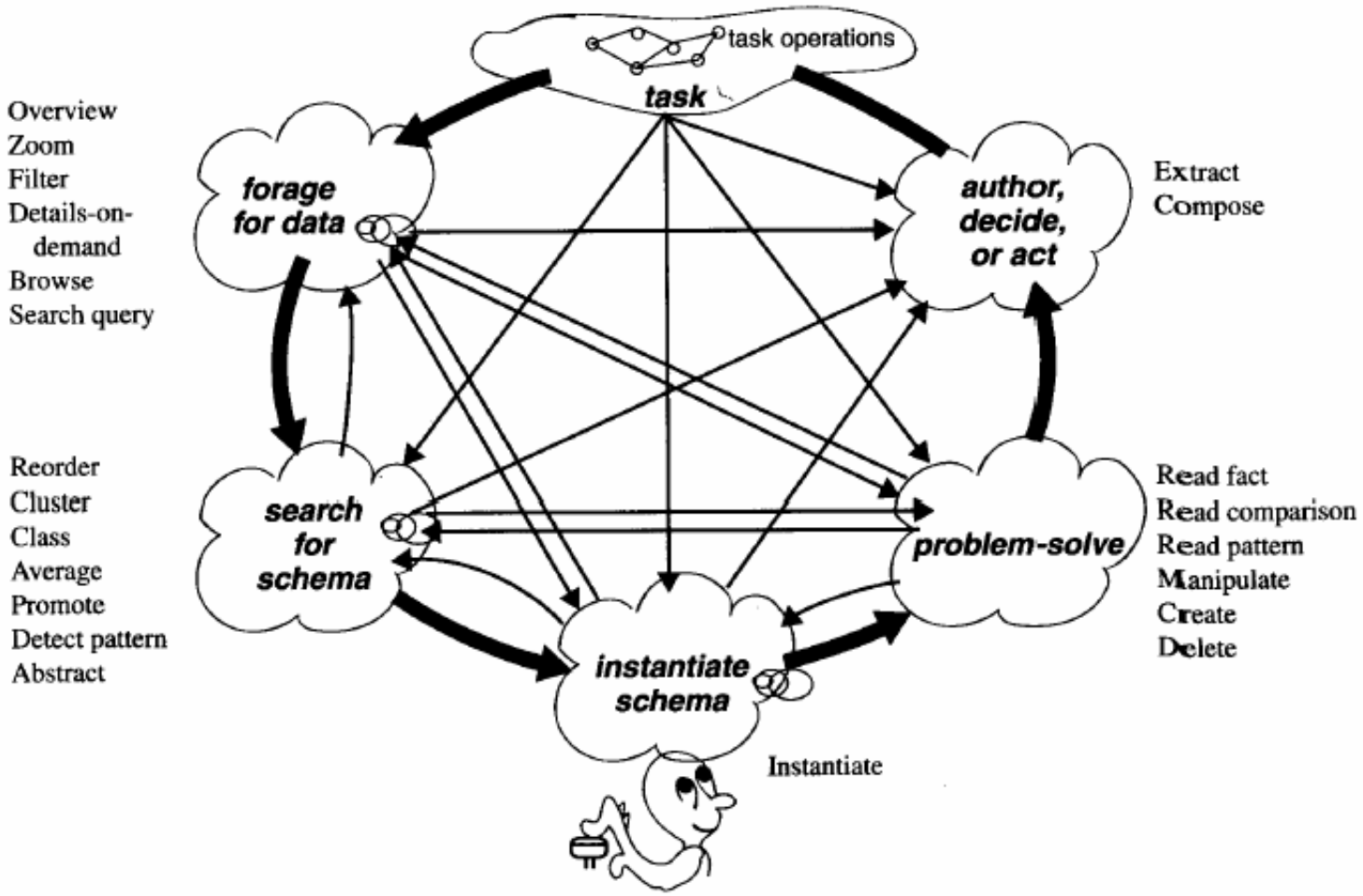


FIGURE **1.15**

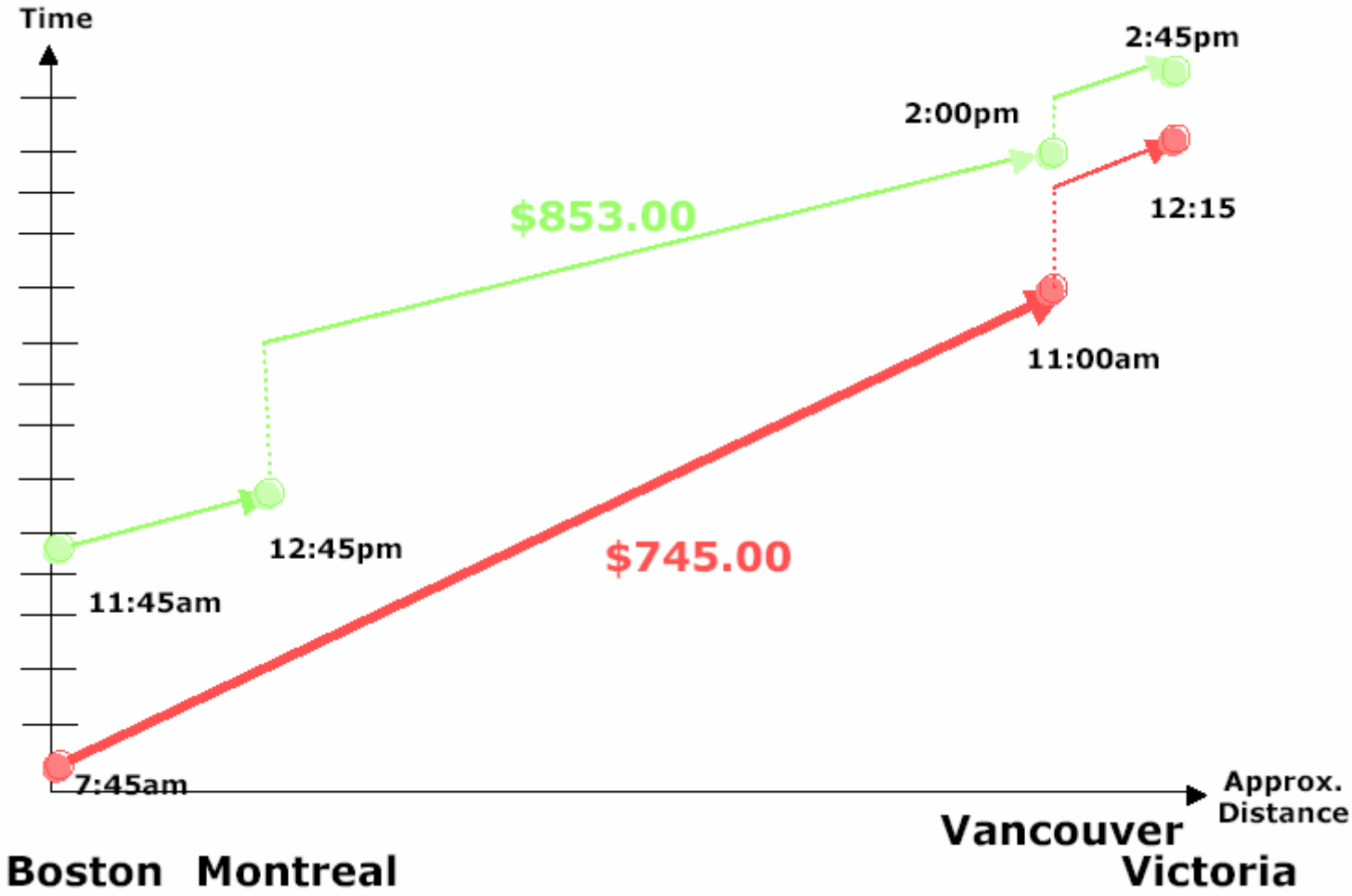
Knowledge crystallization.

(Storey, 2004)

Example – Air fare (1)

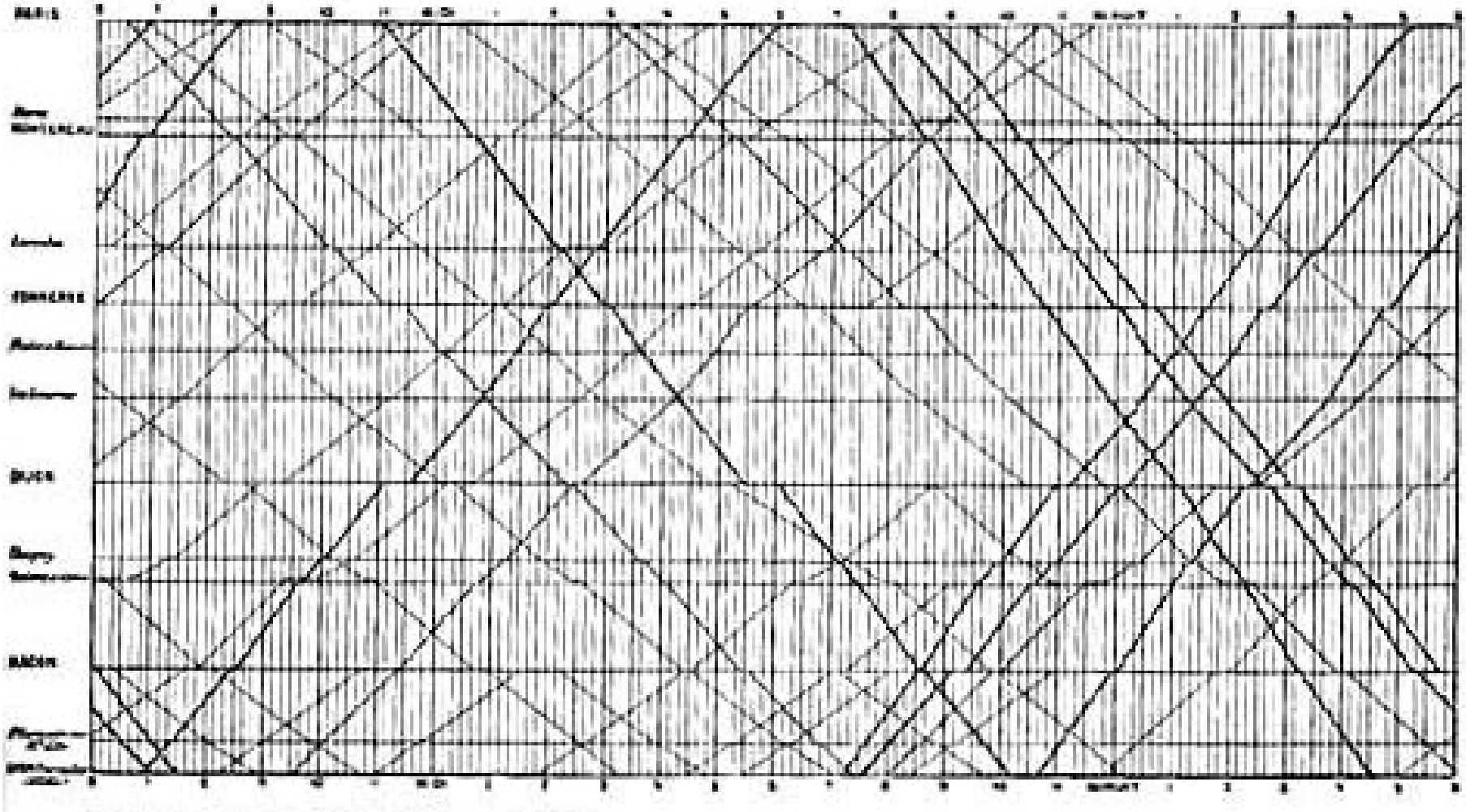
(Storey, 2004)

Example – Air fare (2)



(Storey, 2004)

1885 French train schedule by E.J. Marey



Mapping Problem

- A lot of information does not imply any obvious spatial mapping!

- Basic Question:
  How to map non-spatial abstractions into effective visual representation?

- Approach:
  Use interactive techniques and visual representations to augment or amplify the user's cognition

How Information Visualization can Amplify Cognition

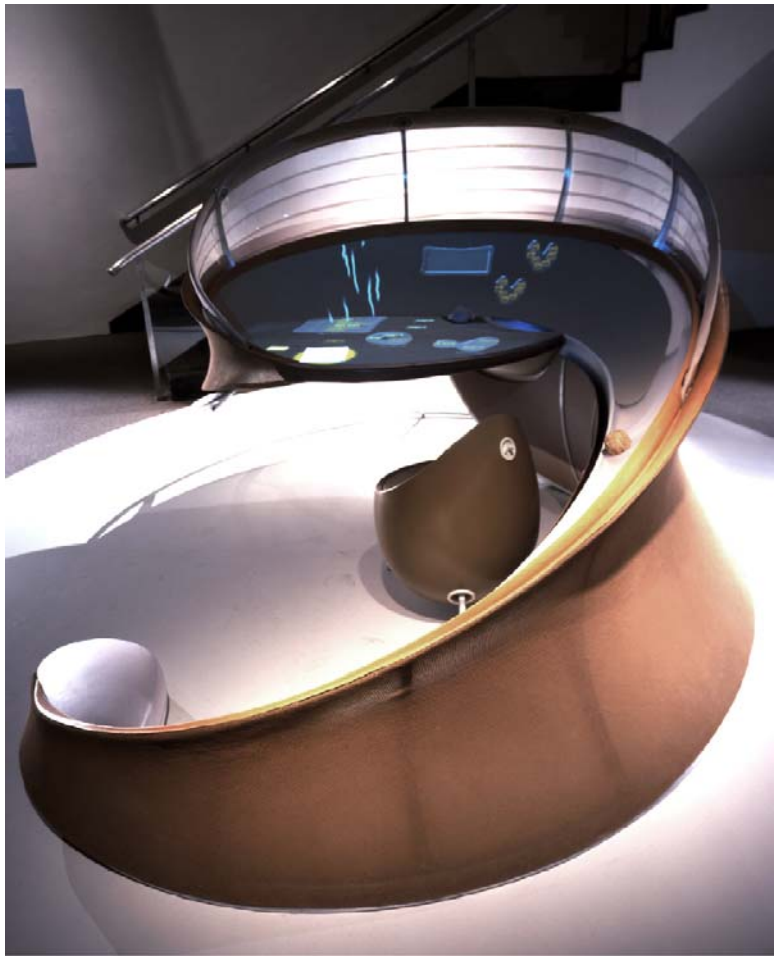
Different ways in which visualizations *could* help amplify cognition:

1. By increasing memory and processing resources available
   - Parallel perceptual processing
   - Offload work from cognitive to perceptual system
2. By reducing the amount of time to search
   - High data density
   - Greater access speed
3. Enhancing the detections of patterns and enabling perceptual inference operations
   - Abstraction and Aggregation
4. Aid perceptual monitoring
   - Color or motion coding to create pop out effect
5. By encoding information in an Interactive Medium

Information Visualization
Basic Key Principles

- Abstraction
- Overview ➔ Zoom+Filter ➔ Details-on-demand
- Direct Manipulation
- Dynamic Queries
- Immediate Feedback
- Linked Displays
- Linking + Brushing
- Provide Focus + Context
- Animate Transitions and Change of Focus
- Output is Input
- Increase Information Density

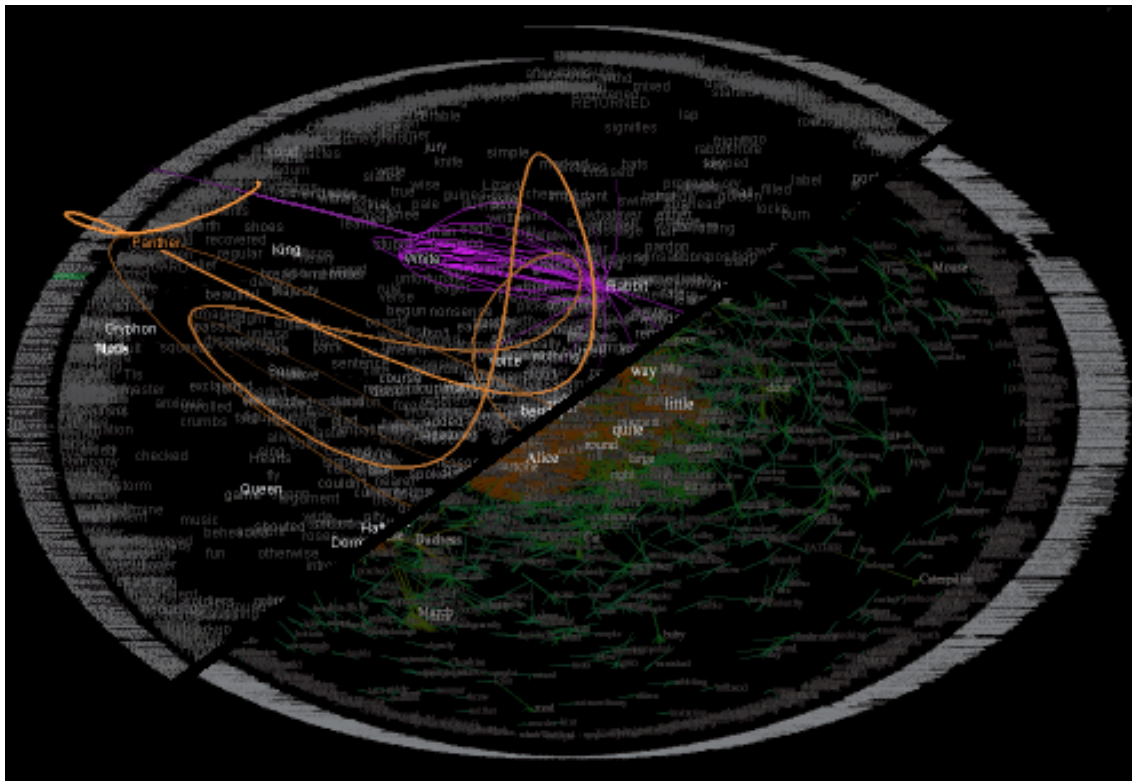
MindSpace (Brad Paley, http://www.didi.com/brad/)



- Interaktive Visualisierung einer Hierarchie
- Verschiedene synchonisierte Darstellungen
- Gruppenbildung durch aneinanderrücken von Objekten
- Spielerisches Ordnen und Klassifizieren

Live demo

TextArc (Brad Paley, http://www.textarc.org/)



Live demo

- Interaktive Textvisualisierung
- Wörter eines Textes werden in einer Ellipse geschrieben
- Verbindungslinien zwischen allen Vorkommen eines Wortes halten das Wort wie Gummifäden
- Spielerische Analyse der Textstruktur

References

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  - http://bailando.sims.berkeley.edu/infovis.html
  - http://bailando.sims.berkeley.edu/talks/chi03-tutorial.ppt
- Margret-Anne Storey
  - http://www.csr.uvic.ca/~mstorey/
  - http://www.cs.uvic.ca/~mstorey/teaching/infovis/course_notes/introduction.pdf
- Ben Shneiderman
  - http://www.cs.ubc.ca/~tmm/courses/cpsc533c-03-spr/readings/shneiderman96eyes.pdf