

12. Ambient Information Visualization

Peripheral display of information

Vorlesung „Informationsvisualisierung“

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Konzept und Basis für Folien: Thorsten Büring

Outline

- Ambient Information Visualization
- Show cases
- Taxonomy

- Summary and exam hints ;-)

InfoVis vs Ambient InfoVis

- Traditional Information Visualization
 - „The use of computer-supported, interactive visual representations of abstract data to amplify cognition“ (Card et al. 1998)
 - Compress complex high-dimensional data while preserving a maximum of information
 - Scale to large amounts of data
 - Targeting work places of expert users (e.g. business analyst, chemists, ...)
 - Systems require to be in focus of attention
 - Used for longer time periods

InfoVis vs Ambient InfoVis

- Ambient Information Visualization
 - Usually low level of interaction (if any)
 - Abstract summary of (often real-time) non-critical information bits (e.g. current stock price, weather forecast)
 - Embedded into the (physical or virtual) environment
 - Based on peripheral awareness - users can and should focus on their primary tasks
 - Usually non-distracting update of the visualization
 - Pre-attentive processing - users gather the information provided at a glance
 - Often artistic and aesthetic objectives
- Often used as synonyms: calm computing, ambient displays, peripheral displays, notification systems
- Works range from non-interactive physical informative art to interactive screen-based peripheral display of notification data

Informative Art

- Dangling string by artist Natalie Jeremijenko
 - 2.5m long plastic string hanging from the ceiling and providing information about network traffic
 - String is attached to a small electric motor connected to a nearby Ethernet cable
 - A busy network causes a madly whirling string with a characteristic noise
 - A quiet network causes the string to only twitch occasionally
 - <http://sandbox.xerox.com/hypertext/weiser/calmtech/calmtech.htm>
- Smoker's lamp by Galerie Quang
 - Smoke sensors
 - Light turns red by the exhalations of the cigarette smokers nearby



Ambient Orb + Umbrella

- Glass lamp showing stock market trends, weather forecast, local traffic via color encoding
- Umbrella handle showing weather forecast
- <http://www.ambientdevices.com>



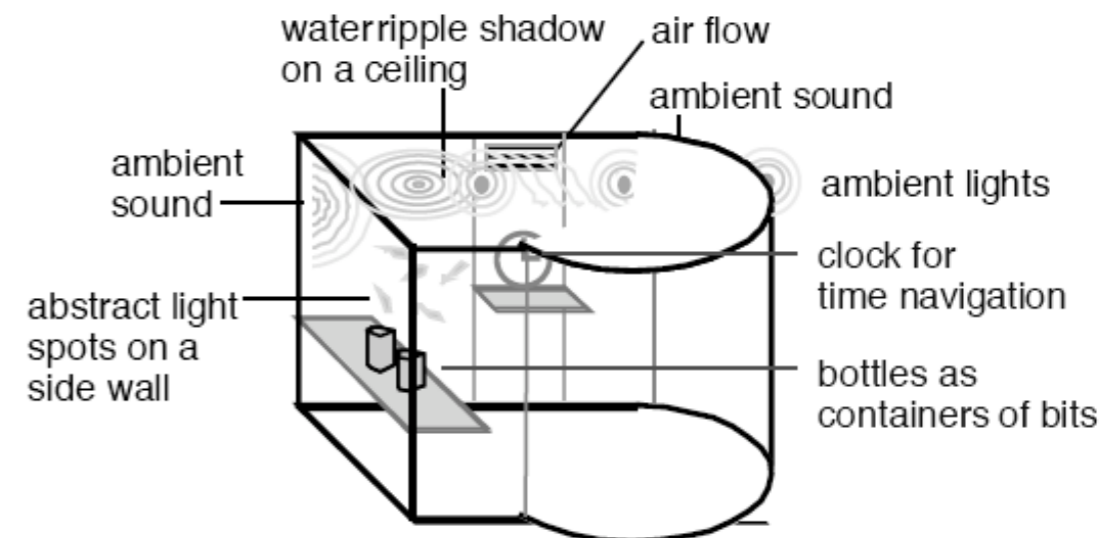
More ambient concepts

- Conceptual ambient displays presented by David Rose in his keynote talk at the Ambient Information Systems Workshop (Pervasive 2007)
- **Source:** http://infosthetics.com/archives/2007/05/ambient_devices_keynote_talk_david_rose.html
- **Google clock**
 - Integrates with Google calendar
 - Shows appointments of the day
 - Background-color changes from blue over yellow to orange to alert people to the beginning & end of events.
- **Wallet**
 - Notifications of special offers
 - State of your credit card accounts (?)
 - Not sure I want that information...



Ambient Room

- Ishii et al. 1998
- Physical architectural space to serve as an interface between humans and digital informations
- Display multiple sources of information in the background of awareness
- Humans can monitor theses sources concurrently
- Example mappings
 - Activity level of distant person / animal shown as water ripples projected to the ceiling (water lamp)
 - Network traffic represented by different levels of vehicle noise - played on demand by uncorking a bottle



Bus Mobile

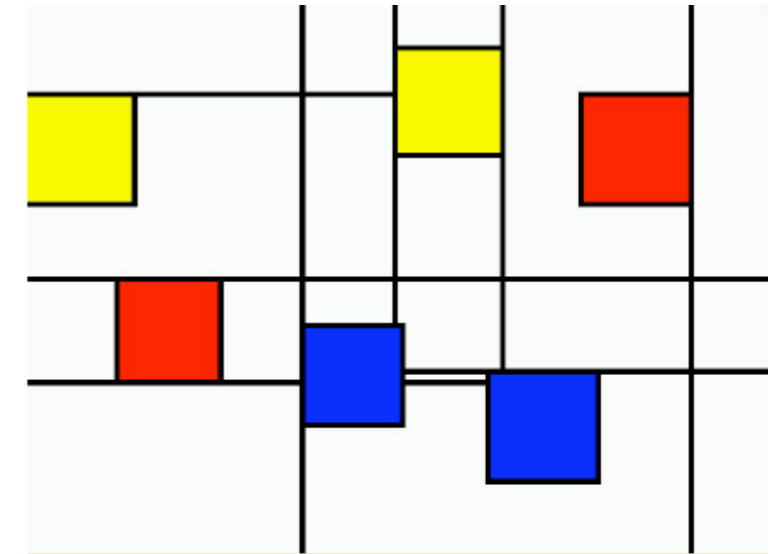
- Mankoff 2003
- Provides information about bus lines approaching a bus stop
- Busses are represented by paper tokens labelled with bus numbers
- Tokens hang from a „white screen“ - a bag
- A bus remains out of sight under the white screen until it is less than 25 minutes away from the bus stop
- Then it moves down to the lowest possible depth in order to start its “approach“



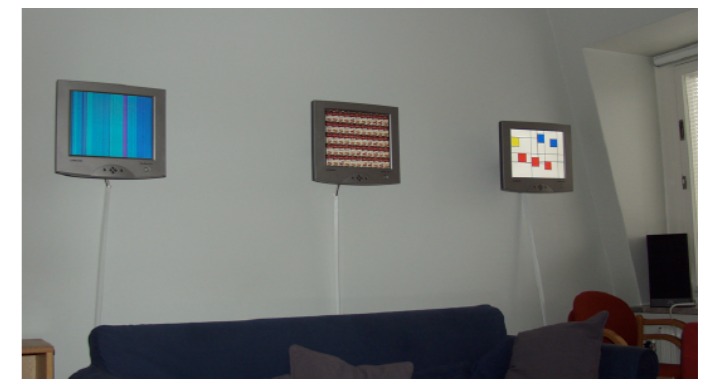
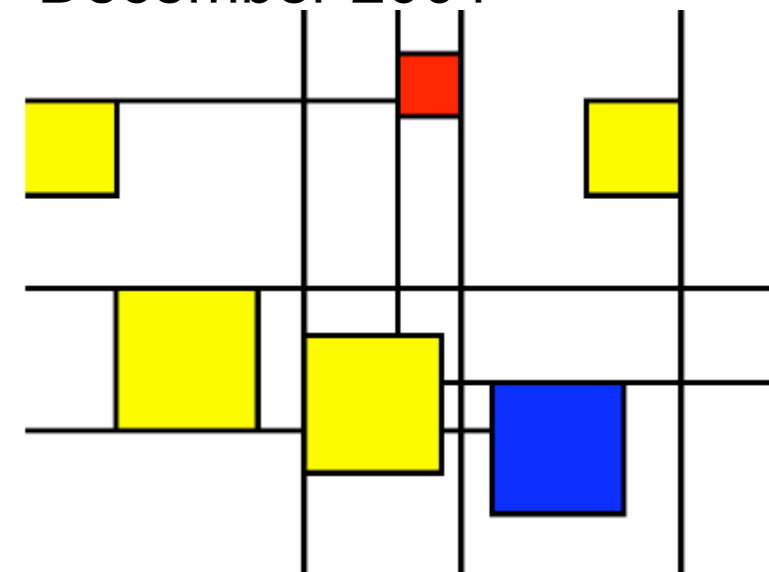
Informative Art

- Holmquist & Skog 2003
- Borrows the styles of modern artists to encode information
- Example 1: weather display inspired by Piet Mondriaan
- Each colored square represents a city
 - Top row, from left to right: Los Angeles, Göteborg, Tokyo
 - Bottom row: Rio de Janeiro, Cape Town, Sydney
- Size of the square: temperature (the bigger the hotter)
- Color of the square: current weather condition, yellow: sunny, red: cloudy, blue: rain

June 2001



December 2001

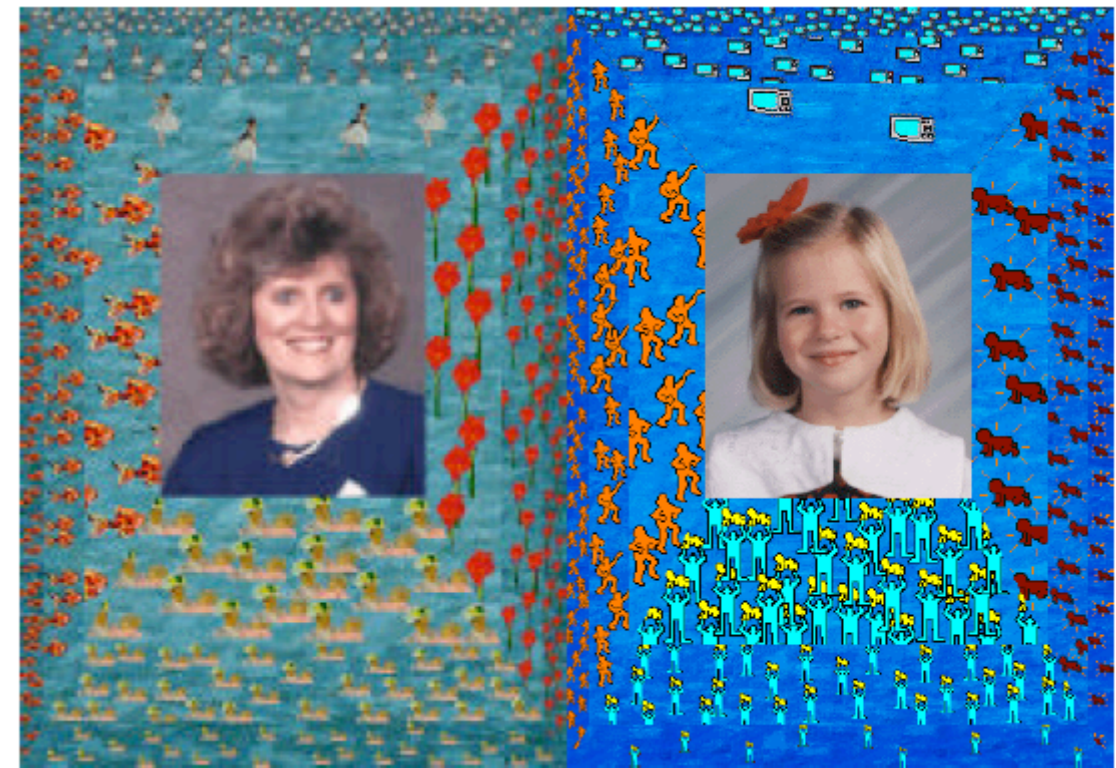


Informative Art

- Example 2: soup clock / egg-timer inspired by Andy Warhol
- Two flavors of Campbell soup can: asparagus soup (yellow) and tomato soup (red)
- When starting the clock, all cans are yellow
- While time passes by the asparagus cans are more and more replaced by red tomato soup cans



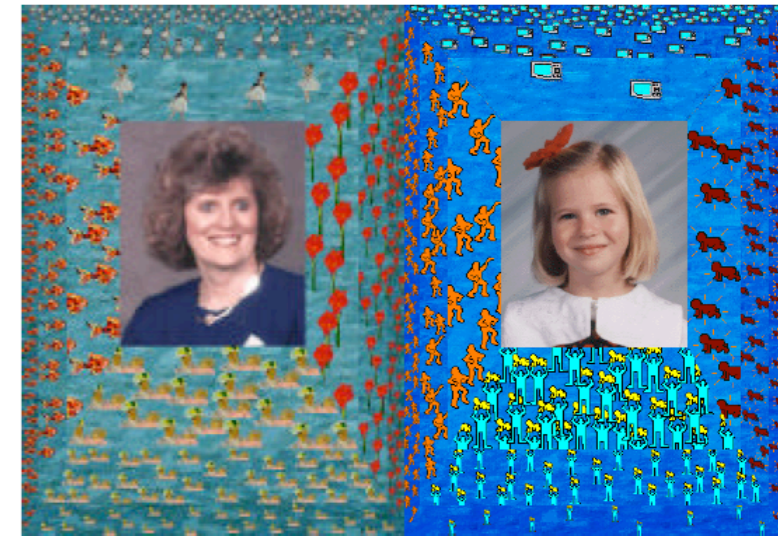
Digital Family Portrait



- Mynatt et al. 2001
- Provides qualitative visualizations of a family member's daily life
- Attempts to capture the observations that would naturally occur to someone living next door or in the same home
- Four sides of the frame map to four variables
 - Events, e.g. planned and unplanned events, special occasions
 - Relationships, e.g. phone calls, letters written etc.
 - Activities: physical movement
 - Health: eat healthy, get exercise etc.

Digital Family Portrait

- Each side has 3 layers of time represented by 3 bands
 - Inner band: the current day
 - Middle band: average of previous three days (before today)
 - Outermost band: average of previous seven days
- Redundant time encodings: size of icons, color shading
- Each variable has 10 levels of measurement
- Represented by density of icons
- Different icon styles matching people's gender and age
- Field trial with web-based portrait and manual measuring
- Result: too complex design, misinterpretation of encoded information, but: users reacted very positive to the idea of a dynamic picture frame
- Redesign reducing the information load



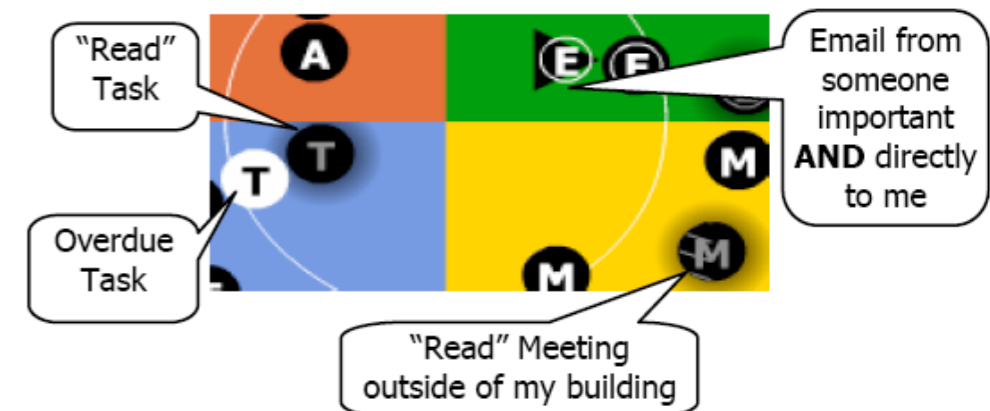
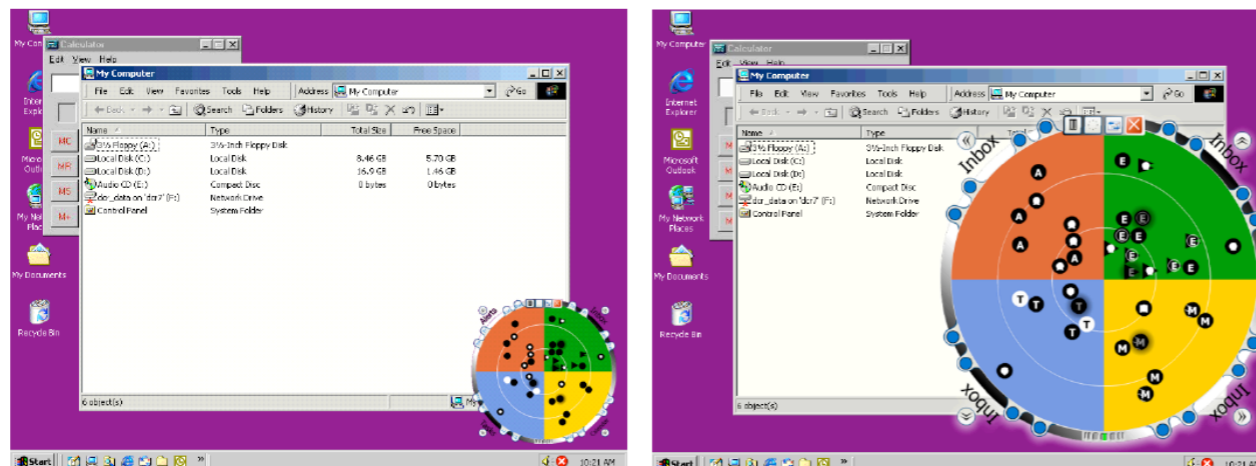
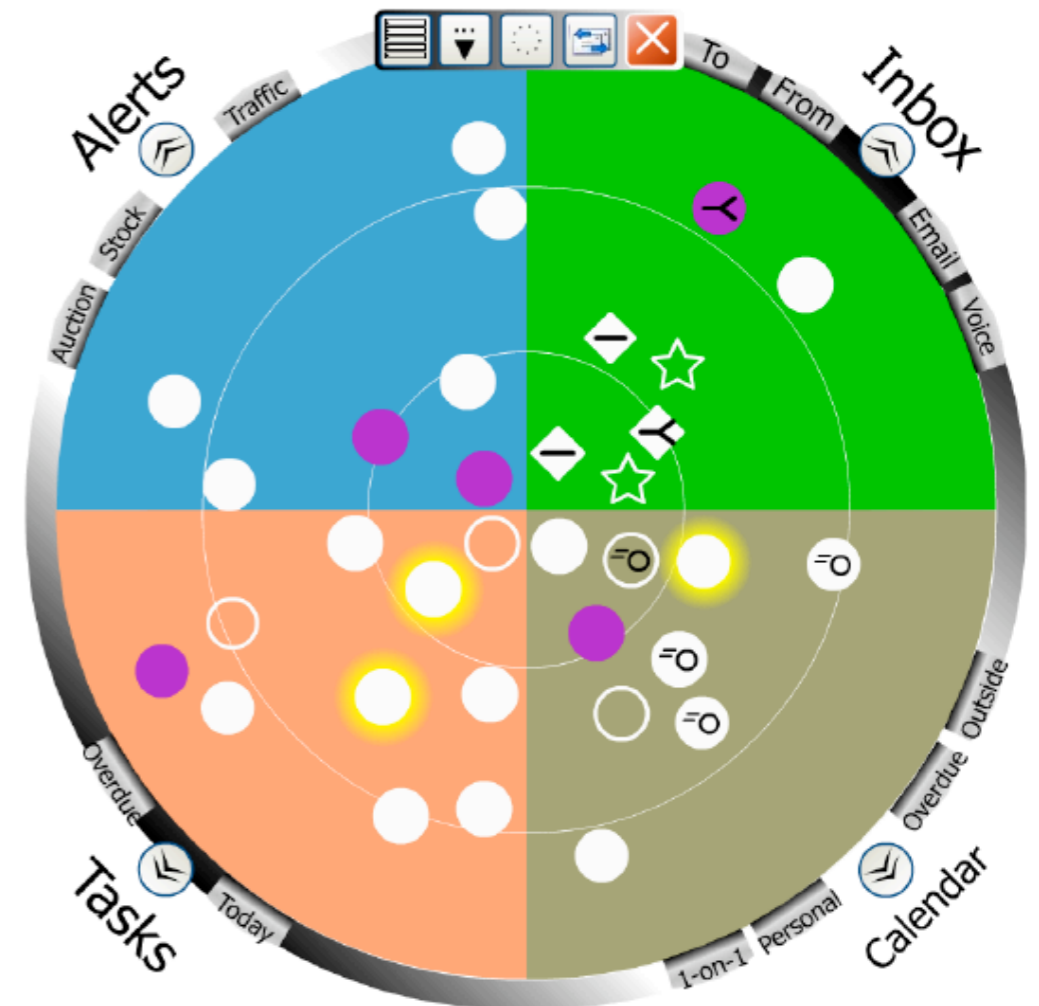
InfoCanvas

- Miller & Stasko 2003
- Abstract pictorial representation of awareness information
- Presented as a painting hung on a wall or a picture frame set on a desk
- Highly customizable display: the user maps each element of a scene to an information source
- Individual mappings also allow for privacy



Scope

- Dantzich et al. 2002, MS Research
- Glanceable notification summarizer
- Shows notifications from e-mail, task manager, information alerts, and appointments
- Circular radar-like screen divided into sectors that group different kinds of notifications
- The more urgent a notification is, the more it moves to the center
- Additional visual attributes of icons are used to encode further notification properties
- Users can magnify areas and drill down on items



Sideshow

- Cadiz et al. 2002, MS Research
- Sidebar on the screen
- Shows weather, traffic, stock market, presence, project status, etc.
- Provides additional alert windows
- Allows for information drill-down

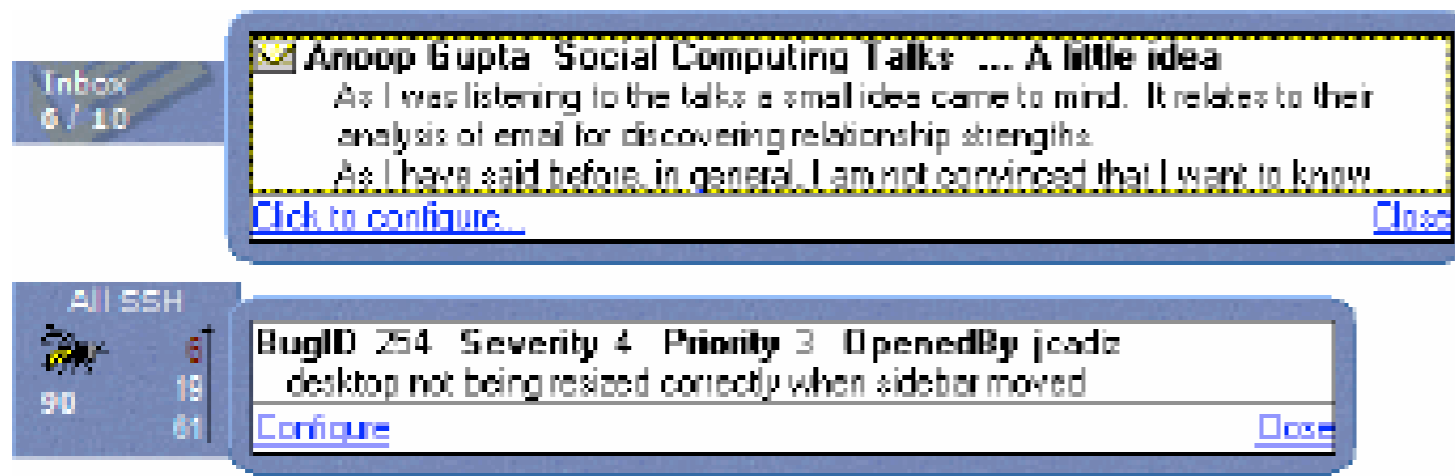


Figure 3: Two types of alert windows provided by Sideshow. When new mail arrives or when a bug of interest changes, a window fades in with a summary of the information. Users can click on the alert window to get more information.

I have a meeting in 23 minutes
There are 6 unread and 10 total messages in my inbox.

2 of my buddies are online, 4 are online but unavailable, and 19 are offline.

Anoop is online (indicated by the icon and the picture of Anoop looking at me).

Gavin is online but unavailable (indicated by the icon and the picture of Gavin looking away from me).

Current information on how the stock market is doing.

There are 90 bugs in my bug database. 6 are high priority, 19 are medium priority, and 61 are low priority.

Current 5-day forecast for my region.

Snapshot of the traffic on the bridge I have to use to get home.

Map of the status of all the traffic in my region.

I can click the new button to add tickets to my sidebar.



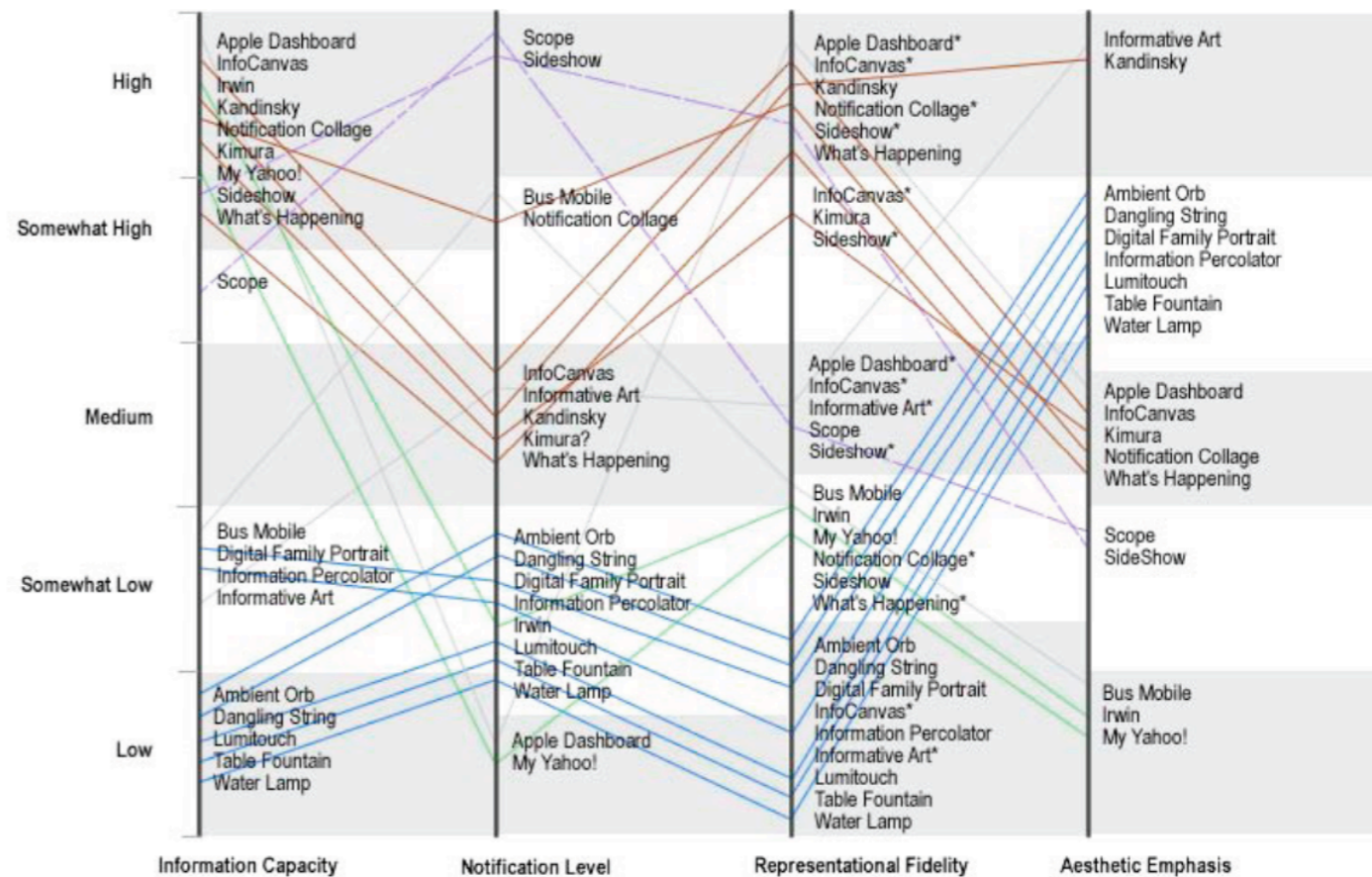
Widget and Feed Collections

- Provides awareness of information
- Is this still ambient information visualization?



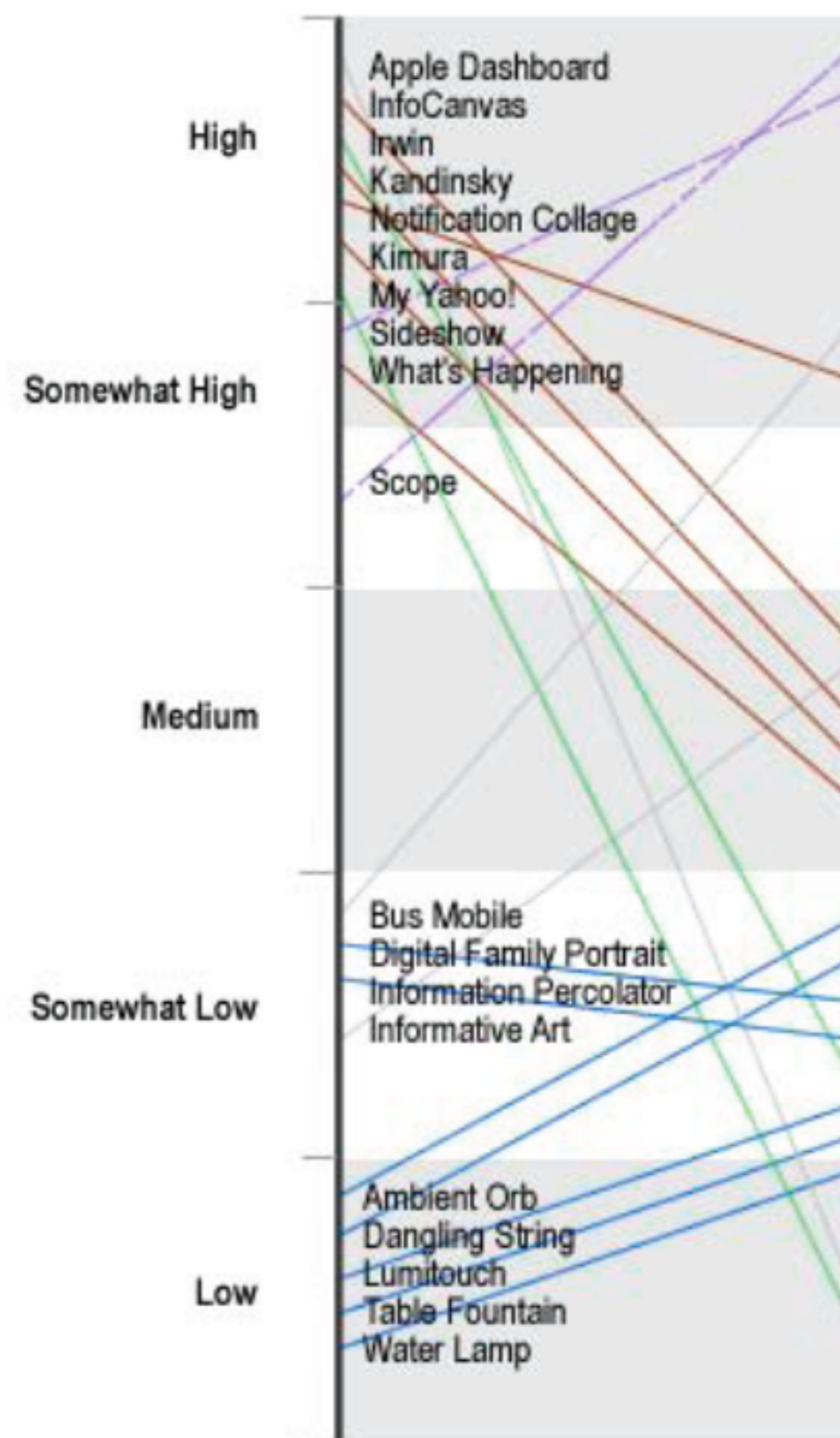
Taxonomy of Ambient InfoVis

- Pousman & Stasko 2006
- Based on 19 systems
- Design Dimensions
 - Information capacity
 - Notification level
 - Representational fidelity
 - Aesthetic emphasis
- Design Patterns
 - Symbolic sculptural displays
 - Multiple information consolidator archetype
 - Information monitor display archetype
 - High-throughput textual display archetype



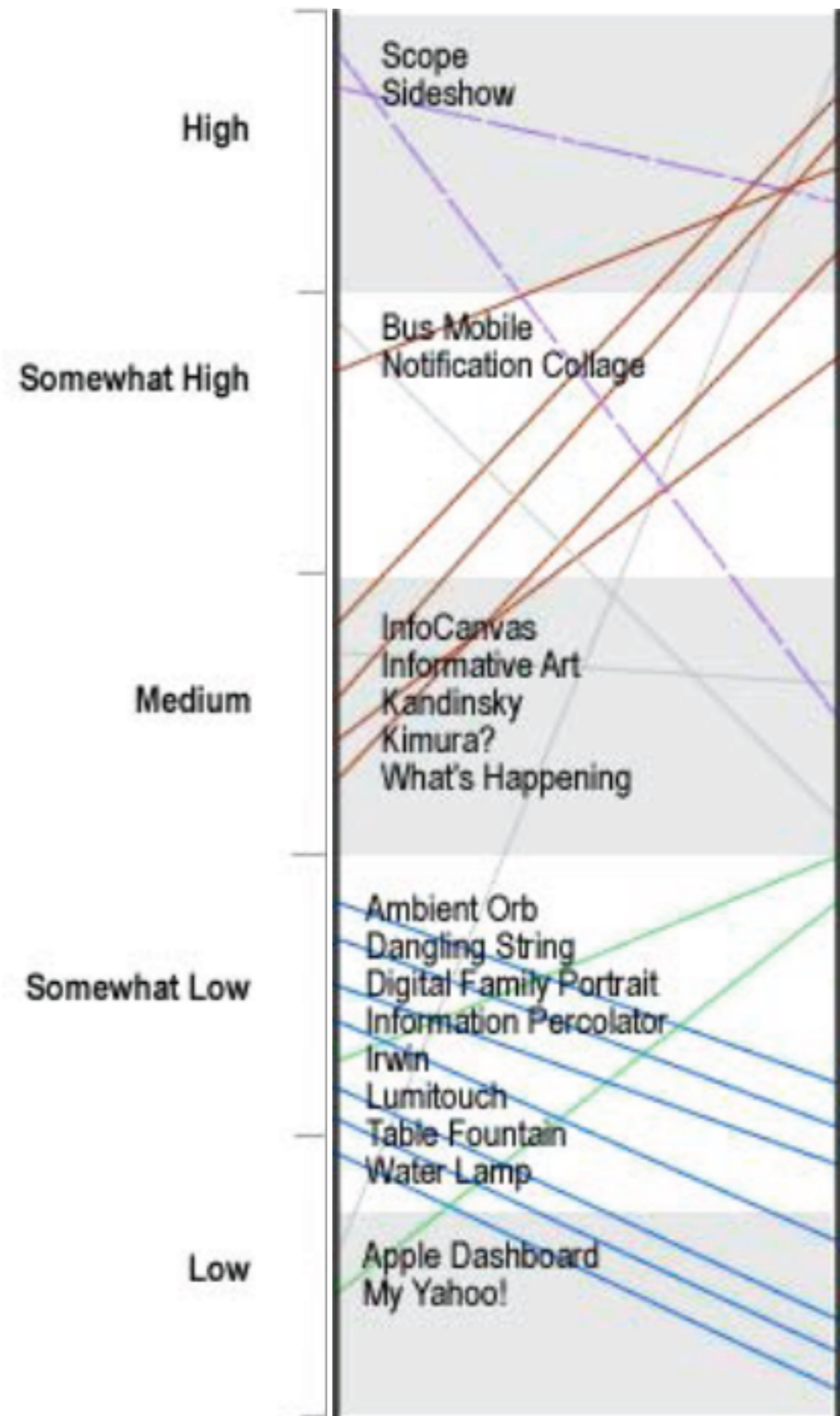
Information Capacity

- Number of information elements that are displayed
- Information capacity can be increased by devoting more space for visualizing information and / or by transitioning through a set of views over time (e.g. automatic slide show, scrolling)
- Problem: too many information sources decrease the „view at a glance“ objective
- Observation
 - Systems with low information capacity are typically physical displays
 - Systems with high information capacity are typically screen-based



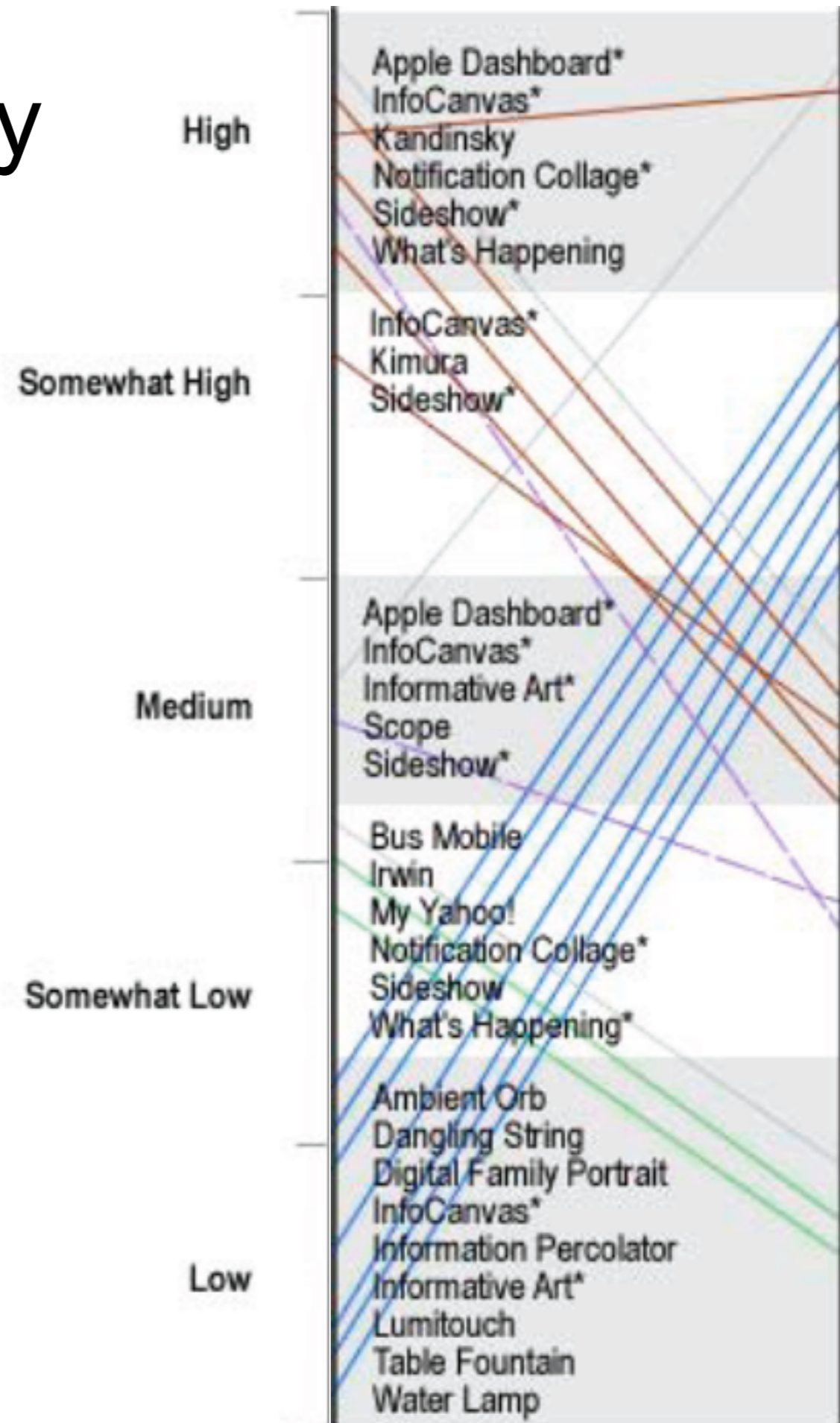
Notification Level

- Degree to which system alerts are meant to interrupt a user
 - Demand attention (e.g. system dialog window)
 - Interrupt (e.g. alarm)
 - Make aware (e.g. flashing)
 - Change blind (see lecture on perception)
 - User poll (user receives information on-demand, e.g. Apple Dashboard, My Yahoo)
- In adherence to the objective of peripheral awareness most systems fall into the „Change blind“ and „Make aware categories“



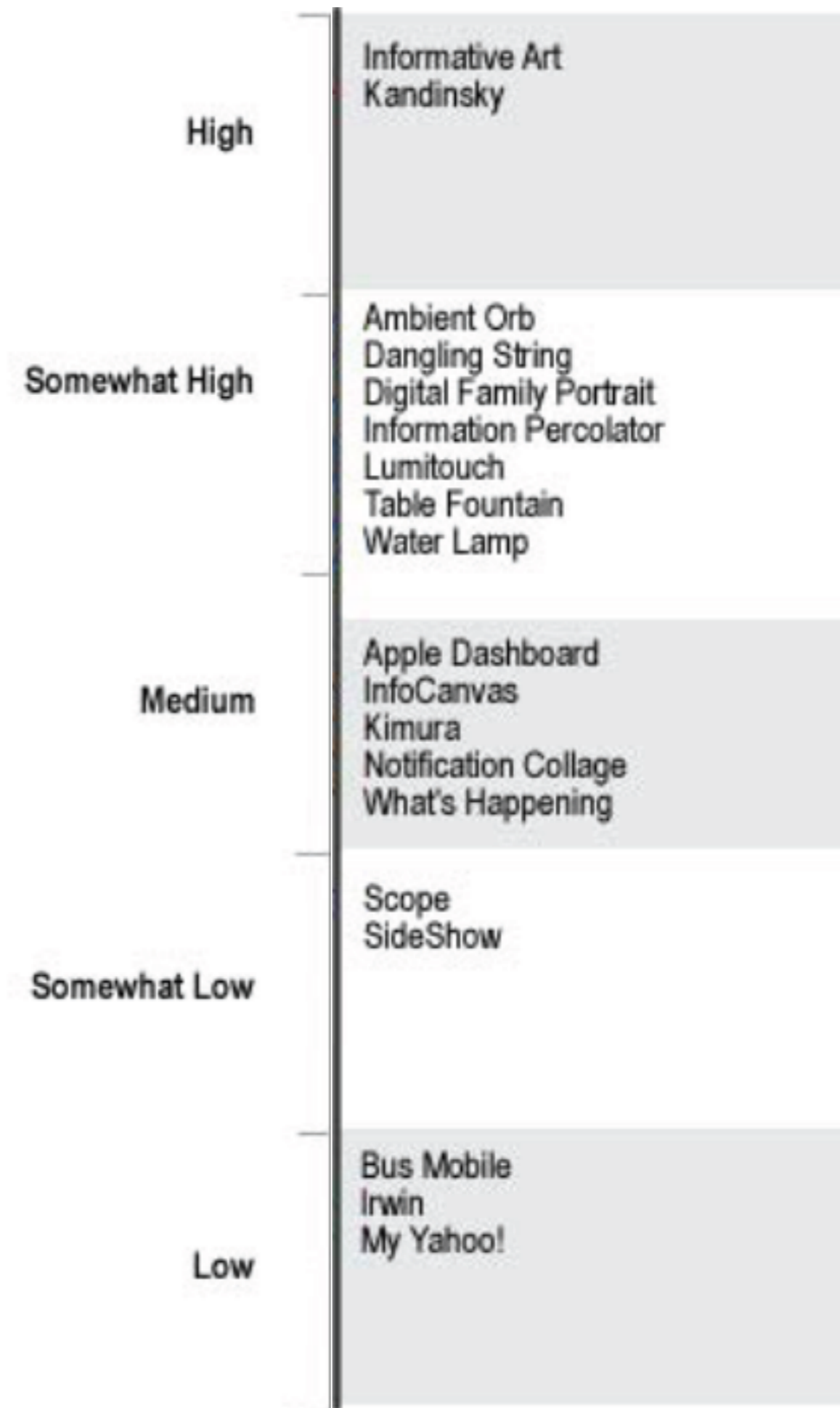
Representational Fidelity

- Degree of concreteness / abstractness of information display
 - Indexical (concrete): photographs, measuring instruments, maps, descriptive text segments
 - Iconic: drawings, doodles, caricatures
 - Iconic: metaphors
 - Symbolic: language symbols (letters and numbers)
 - Symbolic: abstract symbols
- Systems marked with an * are present in more than one category
- Systems featuring physical displays usually focus on abstract symbols



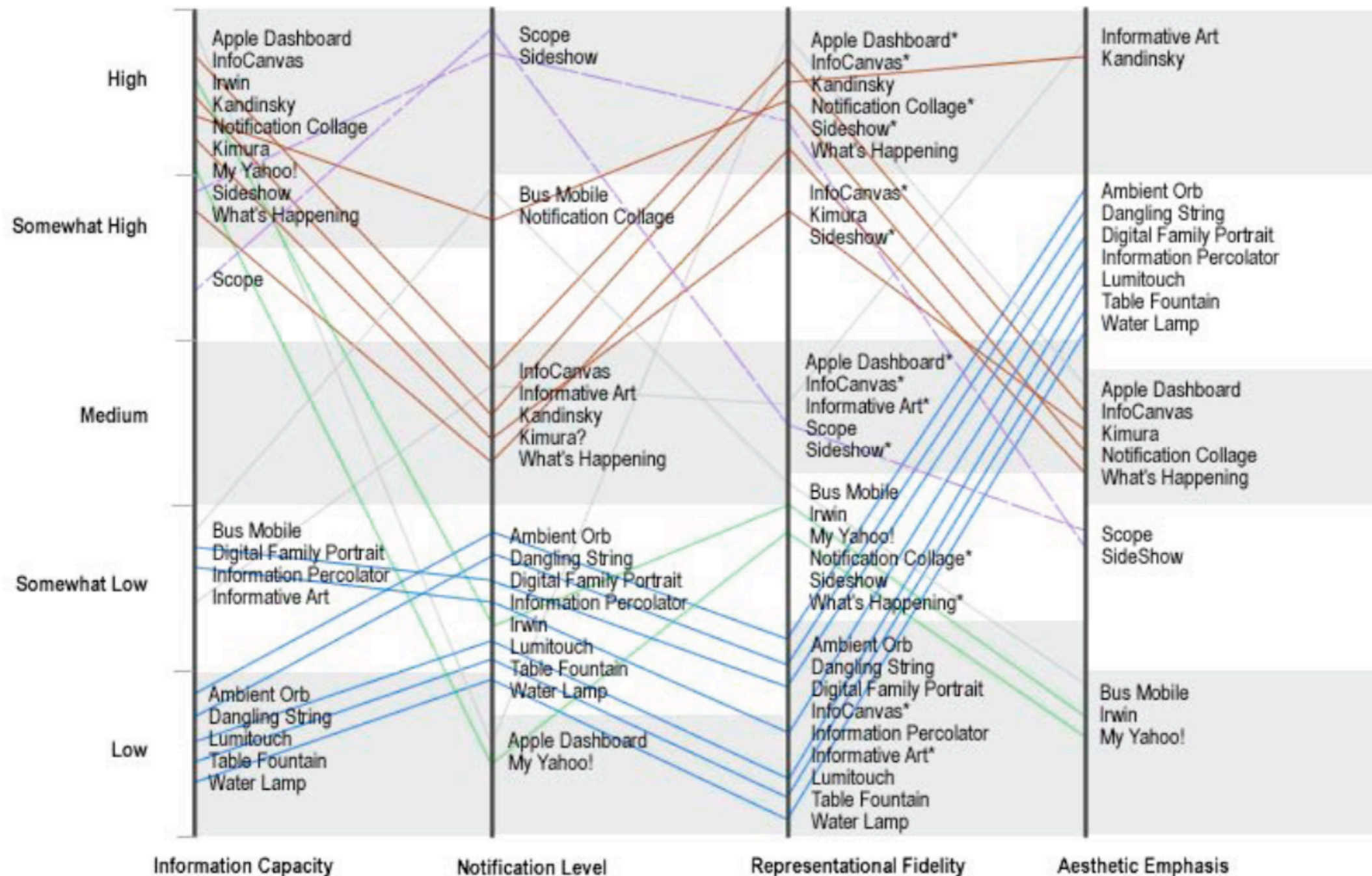
Aesthetic Emphasis

- Degree to which the system designers focussed on aesthetic considerations (very subjective)
- Does not / cannot measure how successful the designers were at doing so
- Most systems have medium to high degrees of aesthetic emphasis



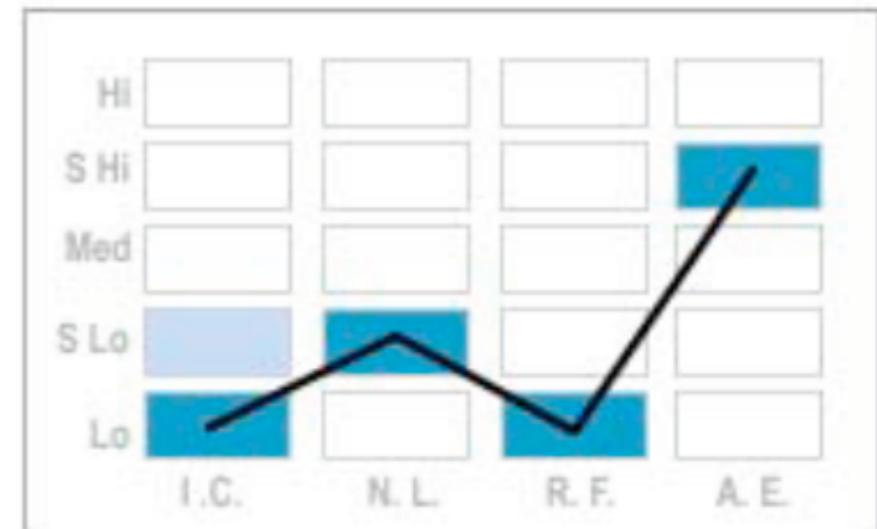
Design Patterns

- Clustering in PCP (emphasized by color) remain four main archetypes of ambient InfoVis systems

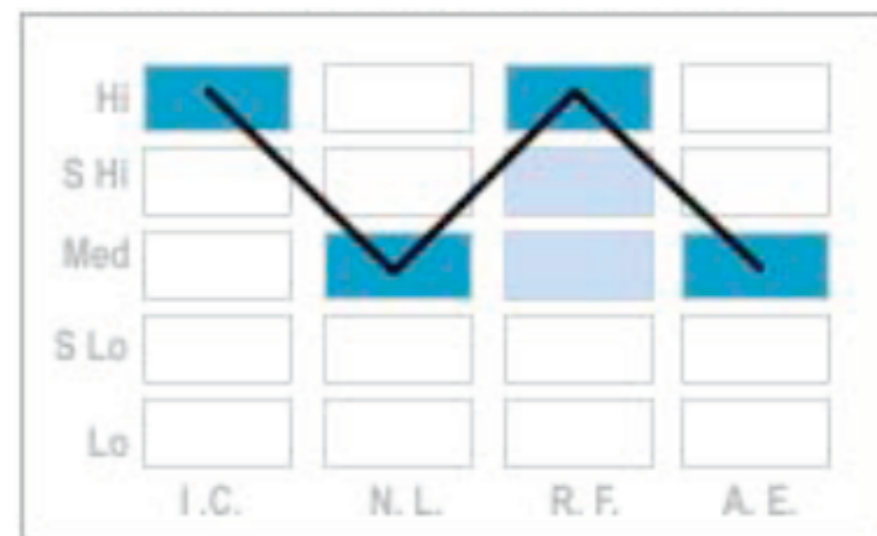


Design Patterns

- Symbolic sculptural displays
 - Display few information elements - often a single element
 - Abstract information representation, often sculptural
 - Intended to be decorative objects - highly aesthetic
 - Examples: Family Portrait, ambient orb, dangling string
- Multiple information consolidator archetype
 - Display many individual information elements in a consolidated manner
 - Typically screen-based
 - Make users aware of changes, often through blinking of elements
 - Reasonably decorative for the benefit of customization and information capacity
 - Examples: InfoCanvas



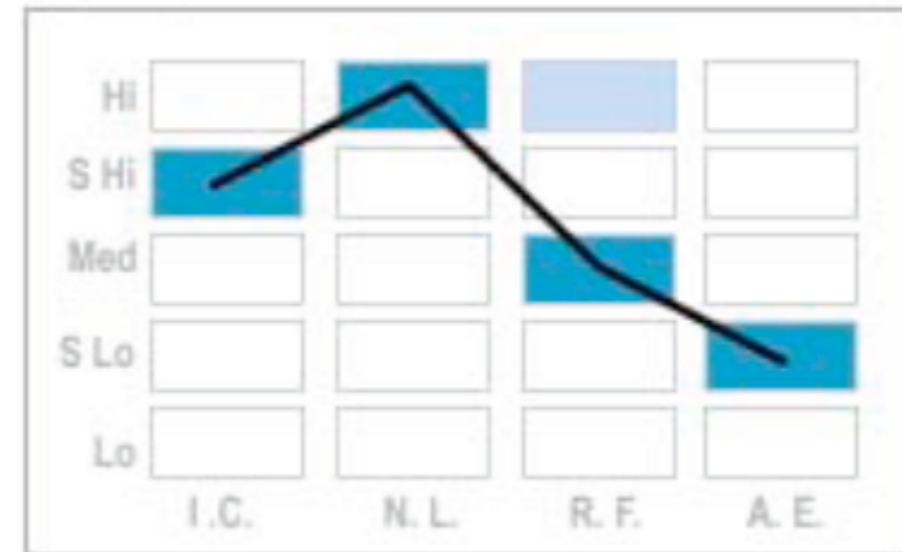
a) Symbolic Sculptural Display Archetype



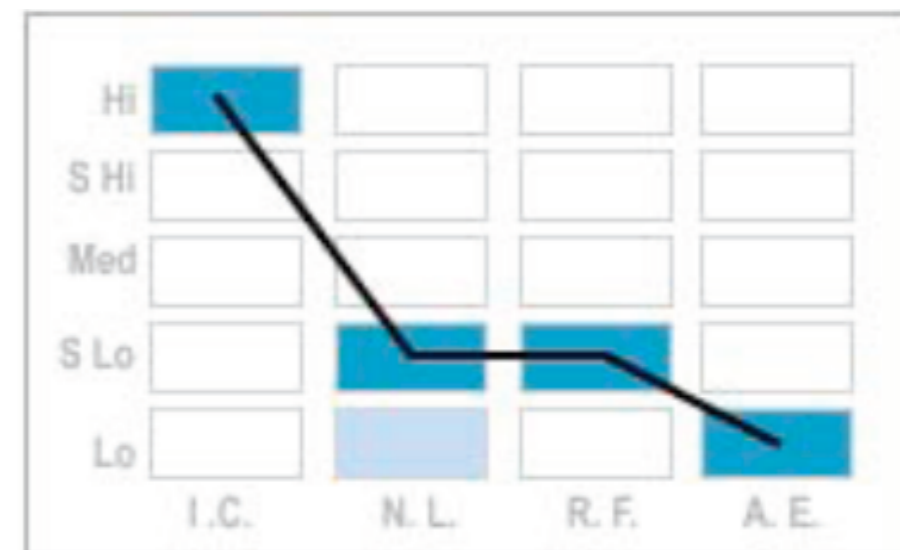
b) Multiple Information Consolidator Archetype

Design Patterns

- Information monitor display archetype
 - Peripheral part of a user's computer desktop
 - Visualize multiple sources of information, often via visual metaphors
 - Offer multiple notification mechanisms of different strengths
 - Achieve aesthetics but it is not their main focus
 - Example: Sideshow
- High-throughput textual display archetype
 - Represent voluminous information by using text and icons
 - No interruption-level notification
 - Focus on information conveyance
 - Example: My Yahoo!



c) Information Monitor Display Archetype



d) High-Throughput Textual Display Archetype

Lecture overview, hints for oral exams

- Perception
 - Preattentive processing
 - Gestalt Laws
 - Change Blindness
 - Data encoding – glyphs
 - Data encoding – color
 - Characteristics of Visual Properties
- Multidimensional IV
 - Reference model and data terminology
 - Visualizing data with < 4 variables
 - Visualizing multivariable data
 - Geometric transformation, Glyphs
 - Pixel-based, Dimensional Stacking
 - Downscaling of dimensions
 - Case studies: support for exploring multidimensional data
 - Rank-by-feature, Dust & magnet
 - Clutter reduction techniques

Lecture overview, hints for oral exams

- InfoVis & Interaction

- Direct Manipulation (DM)
- Common Interaction Techniques
 - Brushing, Zooming & Panning, Dynamic Queries
- Attribute Explorer
- Brushing Histograms vs. DQ
- Dynamic Queries and Movable Filters

- Graphs

- Networks and trees
- Data structures
- Graph drawing, graph layouts
- Graph visualization examples
- Comparing node-link and matrix representations
- Interaction and animation

Lecture overview, hints for oral exams

- Hierarchical data and tree representations
 - 2D Node-link diagrams
 - various types...
 - Enclosure
 - Treemaps of sorts...
 - Circular visualizations
- Time-based visualization
 - Historic time-based graphics
 - Timeline representations
 - Use case: time-based computer desktops
 - Searching time-based data

Lecture overview, hints for oral exams

- Text visualization
 - Characteristics of text data
 - Detecting patterns
 - SeeSoft, Arc diagrams, Visualizing Plagiarism
 - Keyword search
 - TextArc, Enhanced scrollbar, TileBars
 - Cluster Maps
 - Visualization for the document space
 - WEBSOM, ThemeScapes
 - Cluster map vs keyword search
 - Presentation
 - Zoomable user interfaces (ZUIs)
 - Space-scale diagrams
 - 2.5D, Advanced ZUI designs
 - Orientation in ZUIs
- Overview+detail interfaces
 - Abstract overviews
 - View coordination + Layout
 - Zoom factors
 - focus&context
 - Generalized fisheye view
 - Graphical fisheye
 - Graph fisheye
 - Speed-Coupled Flattening
 - Symbolic Representation of Context
 - Ambient Information Visualization
 - Show cases
 - Taxonomy