History

Heidnisch Self evident Memory enhancement illiterate
Bilderstreit Antiker
Moderne mehr Bilder in Science

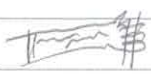
Papyrus Text + Image Pictures
Manuscript Text + Image
Book Text Image
Electronic Text + Image + Picture + Video

Central Perspective
- before function clear no occlusion  water wheel
- ~~after~~ viewers don't move Artistic skill
- after Duchamp Stairs

Scientific Illustration

Observation Thistle of Dioscorides 

Induction Why / How Descartes Rainbow 

Methodology How does it work Bloodstream Harvey 

Self Illustration phenomena illustrate themselfes PET Scan 

Classification Order Evolution 

Begriffsbildung Reflect on Observations Electromagnetic Fields 

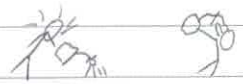
Difference Verbal and Pictorial

Language	Picture / Pictogram
The coffe is in the cup	
Discrete Letters/Sounds	one continuous
Explicit, symbols express relationships	Implicit, integrated
Grammatical Rules	No clear Rules
Asstract	Concrete
sequential	simultaneous

Visual and Verbal Representation

Images based on conventions — Constructivist / Learned

Images understood spontaneously — Direct Perception Gibson / Realistic

Cultural Dependency - Image of sweating Kid 

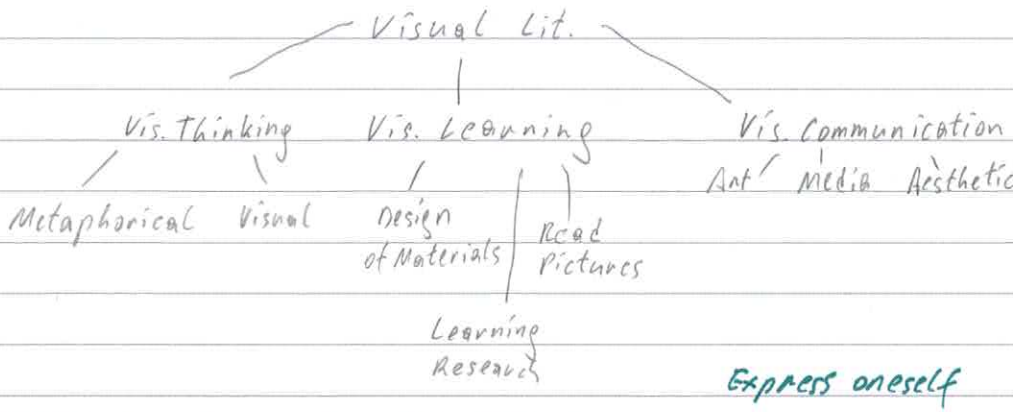
Analogous pictures — Drawing Photograph

Logical pictures — Graph, Chart

Visual Literacy

Narrow - Wide

read/write understand



Express oneself

Thinking depends on Perception

Thinking in Pictures

Learn through images

Also Didactics of Vis. Learning

Visual Communication

Aborigeneers distant point of view / oblique

Uncle Sam frontal / direct

Lise Meitner / Otto Hahn not the assistant

Direct Perception

Innate / Culture Invariant

Without Learning Color + Shape

Cannot be unlearned Illusions still perceived

Immediacy quick / hardwired Ls and Ts

Study through neuroscience

Conventional Representation

reading / writing / math symbols

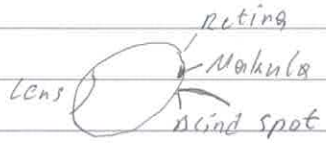
hard to learn, rapid change

embedded in cultural context

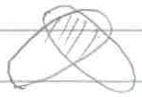
Powerful representation

Study through psychology, HCI

Human Eye



Rods B/W 100 million
Cones Color 6 million

Depth perception Field of Vision 

Lateral Inhibition Contours / change

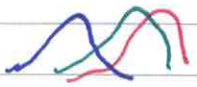
Color perception

shade Wavelength
saturation # different wavelength
brightness Light intensity

color blind can't pick berries

Trichromatic Color Theory in Cones

Hues mixed additive

3 different pigments Rot / Grün / Blau 

Can not explain afterimages / color blindness R/G

Color opponent theory in Retina and corpus geniculatum / Zwischenhirn

3 pairs: Red-Green, Blue-yellow, Black-White

Excite Inhibit → more precise

Color Constancy chromatic adaption

High Level Vision

/ Body Perception, Heartbeat, Peripheral Vision

Conscious - unconscious

Active Saccades, Fokus

Orientation Head/Eye Movement

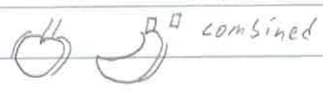
+ Change
  Movement
  Patterns

- Radio Waves
  Magnetic Field
  Ultraviolet Light

Object Perception > Pattern / Color
  shape, color, texture, location - Previous Knowledge / Expectations
  dominant

Feature Integration Theory Object perception

basic properties → combined
curvature, line, orientation of line



Recognition by Component

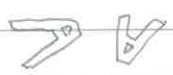
Primitives - Geons - view invariant, Discriminable, Noise resistant
cylinder, sphere

how distinguish similar objects?

Alignment Method

Viewed object → transform → Stored object
size, position, orientation

Example: Character Recognition



more complex than size, position, orientation?

Gestalt Psychology — Object perception

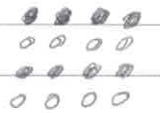
Whole thing - not parts — Mind adds structure, whole is more

Figure - Ground
first → meaning

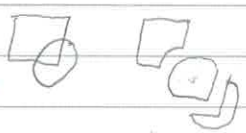
Good Continuation

Law of proximity
belong together

Law of similarity
organized together



Gute Gestalt
simple Structures



Example: GUI interface buttons belong together, Window has gute Gestalt

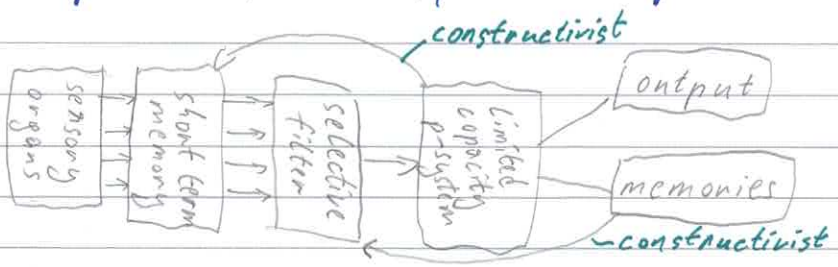
Information Processing Approach — Object Perception — constructivist

Computer Analogy — Data driven ⇔ Gestalt Conceptually driven

sensory organs → short term memory → long term memory

too simplistic - experience, culture, feedback loops

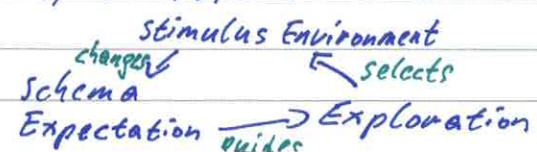
Broadbent



Selfridge — parallel pattern matching + transformation — see Alignment Method
Neural Net feature detection

Pandemonium — Wortlexikon, Gedächtnis, Kontext, Grammatik

Perceptual Cycle



integrates data driven - conceptual

Ecological Approach to Object Perception — Gibson — direct perception

Vision connected to Eyes in Head and Body on ground — evolutionary
no immobile observer — no limited stimulus - different angle

Perception immediate from optical arrangement — opposed to inform. processing + constr

around observer, structured environment
Ambient Array — changing viewpoint + occlusion

Texture — equal amount → equal area

Affordance — function derived from shape

— no long term memory

Invariance — under light, size, movement, transformation — not memory immediate perce
reflection

Constructed

Information processing
Neisser, Brunner

Perception active + constructive
not directly by stimuli
stimuli ↔ expectations, knowledge
hypotheses flawed?
explains illusions

Why perception usually correct?

Good for brief ambiguous stimuli

Direct

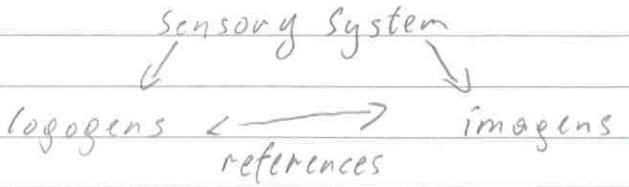
Gibson

Bottom up
unambiguous invariant optical flow fi

Meaning direct not through memory
can't explain illusions
can't explain meaning

Good for long intensive looking

Dual coding Theory — Memory for Images / Memory for Verbal



Phylyshyn

no images
transformed to linguistic

don't forget pixels of image
→ image stored as proposition

Kosslyn

mental images in brain

not pixel image → transfoumed
neuroscience shows difference images/words

Pre Attentive

automatically
not conscious
short term
immediate

parallel pattern recognition

color, orientation, size, curve, blinking

Attentive Processes

controlled search
explicit processing
mental effort

intentional, task oriented
selective analyzation + interpretation

Sense Combination

Fire seen, smelled, heard, felt — not comparable

Equivalent Information — same thing different information

Analogous Qualities — intensity common, duration common

Corresponding Psychophysical Properties — intensity increases logorithmically

Corresponding Information — parallel, different channels, analogous

Mutual Influence — competing focus

Primacy of Visual Perception - no
spatial, object oriented

Audio
sequential, planar
guides visual attention

Integration of Text and Image

Redundancy — Text and Image the same

Complementary — neither fully self explanatory

Supplementary — One is supporting

Juxtaposition — image-text contradictory

Stage Setting — attune people to context

Benefits of Visualisation

Larger Cognitive Resources
better short term memory, Large amounts of data, parallel text serial

Faster Search
grouping of information, high density

Pattern Recognition
Recognition not memory, ASstraction + Aggregation, Organization e.g. Timelin

Perceptual Inference
simutaneous comparison starplot

Perceptual Monitoring
Dashboard

Interactivity
Thinking with artifacts filter, choose representation, zoom detail

Evaluation GUI, SW design Time, Problem solved

Independent → Dependent variable

Quantitative
Experiment Las Test

Questionaire Exact Definition, Define Target Group, Short, Large Samples, Overw
Too personal / uncomfortable, Misunderstandings - one way communication
Logfile Analysis Instrument SW No extremes ticked
unobstrusive, accurate interpretation difficult
Eye Tracking
which Elements attract vision Interpretation, short time, unnatural

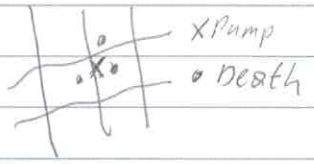
Qualitative
Interviews structured, semi structured, open
detailed, two way clarifications subjective, Lot of data, not comparable
Focus Groups about 7 people
contradictory opinions, detailed data, participation, domination
Observation Anthropology / Field Study
hard, don't see everything, behaviour change video
Thinking out Loud
detailed reasons intrusive, unnatural

abstract / Anorexic, Financial Data flow of water, physical, spatial

Information Visualization not Scientific Viz

no obvious analogy in real world cholera outbreak

amplify cognition with viz external cognition



gain insights, not numbers

~~kr~~ new knowledge, decision making

Visual Analytics

interpretation of Data

Analytical Reasoning by interactive visual interfaces

Analytical Component - ML, Regression

exploratory, open solution space, generation of insight

Interactivity

age, gender hyperbolic Tree

Grouping of Elements Scrolling, filtering, Zoom, Focus, Dynamic

Multiple Views, Overview-Detail, Queries

Rearranging data Windows Explorer, Drill down search criteria dynamic change

Mapping aggregate, transform visual mappings views axes

natural sequence

Data Types

Nominal
Ordinal
Quantitative

Information Visualization

Geometric Techniques — high dimensional, occlusion — Scatterplots, Parallel Coordinates

Icon Techniques — good form, compact, clarity, good for human perception — Starglyph, Chernoff Faces — limited axes, overlap

Pixel Oriented — Heatmap

Network / Graphs — big, confusing — Matrix Representation — unintuitive, no occlusion
temporal evolution — intuitive, neighbours
different colored lines

Hierarchical Structures — Treemap

Dynamic Representation — time data — confusing - make interactive slider

3D Representations — occlusion, confusing — transparent objects

Incomplete Data — interpolate / drop — faulty sensor, message date formats