Simplification centre

Theory cards

Short explanations of key theories to inform design practice.

Context & conversation

Framing
World knowledge
Co-operative principle

Language and writing

Plain language
Vocabulary
Genre
Basic level objects
Prototypes

Reading and cognition

Schemata
Processing load
Relevance theory
Strategic reading

Visual perception

Affordance
Chunking
Difference threshold
Figure-ground illusion
Gestalt principles
Similarity
Proximity
Closure
Prominence
Sequence

Visual encoding

Types of information
Information transformations
Varying
Arranging
Linking
Semiotics

Acknowledgements: These cards were written, edited and designed by Judy Delin, Yuri Engelhardt, Martin Evans, Clive Richards, Karel van der Waarde, Jenny Waller and Rob Waller.

Framing

The presentation of information in a way that influences the reader's or hearer's response.

Example

The disclaimer that 'investments can go down as well as up' is framed in a way that suggests that they are most likely to go up. The phrase 'tax relief' has been criticised for implying that tax is a burden.

Theoretical background

Framing has been extensively used in discussions of media bias. For example, the Russian rescue of the Beslan hostages was judged differently by headlines that '100 hostages died in the rescue' as against '500 hostages were saved'. It has also been adopted by behavioural economists to explain decision-making behaviour among consumers. Tversky & Kahneman's Prospect Theory demonstrates how people reverse their preferences depending on whether outcomes are described in terms of risks or rewards.

→ *Schemata*

Key references

Goffman, E. (1974). *Frame Analysis*. Cambridge: Harvard University Press.

Tversky, A. and Kahneman, D. (1981). 'The Framing of Decisions and the Psychology of Choice.' *Science* 211

World knowledge

The understanding of the world and the things in it that we expect other people to share with us.

Example

The phrase 'Call us or visit us at www.website.com' invokes our world knowledge that 'calling' means on the telephone, and 'visiting' us means using the internet. We may no longer need to explain these phrases to most people, but we can't rely on world knowledge to understand terms such as 'make a return' or 'become domiciled', sometimes used in government forms.

Theoretical background

This is a similar concept to Schemata but more specifically relates to how we understand language. In order to communicate, we have to rely on some shared understanding with other people. We expect them to know appropriate behaviours (how to fill in a form or make a phone call, for example), what entities are (forms, phones, HMRC, pens), cultural norms (that they have to pay tax), and many other facts, concepts, and relationships. Problems occur when we make incorrect assumptions, and also when we are use a word or idea that appears to belong to world knowledge but which also has a special meaning.

Schemata *Co-operative principle* *Vocabulary*

Key references

Hayes, J R (1996) 'A new framework for understanding cognition and affect in writing';. In: C M Levy and S Ransdell (Eds), *The Science of Writing*. Erlbaum.

Co-operative principle

People co-operate in an effort to understand each other. They make assumptions based on helpful motives, rather than just a literal reading of the content.

Example

Why is it OK for me to respond to the question 'would you like to go for a walk?' by saying 'it is raining' , rather than 'no'. It is because you assume I am co-operating in an effort to communicate, and you therefore make an effort to see the relevance of my response.

The principle

The philosopher HP Grice identified four maxims (rules) that we assume that other people follow in a spirit of co-operation:

Quantity: Give the right amount of information. ⇢ *Schemata*

Quality: Don't say things you know aren't true.

Relation: Be relevant. ⇢ *Relevance theory*

Manner: Be clear and brief. ⇢ *Plain language*

The co-operative principle also explains why communications mislead. So, if a ticket agency offers me concert tickets for £20 but then adds a hidden 'booking fee', it violates the Quantity maxim.

Key references

Grice HP, (1975) 'Logic and Conversation' in Peter Cole and Jerry L Morgan (eds), *Studies in Syntax and Semantics III: Speech Acts*, Academic Press.

Yule, G. (1996). *Pragmatics*. Oxford Introductions to Language Study. Oxford: Oxford University Press.

Plain language

According to the Plain English Campaign, plain English is 'a message, written with the reader in mind and with the right tone of voice, that is clear and concise'.

Example

'Send us your form by 1 September' is plain language; 'Submission of the application is required no later than 1 September' is not.

Theoretical background

Plain language is backed by research evidence that calls for:

- words that are both common and short. ⇢ *vocabulary, basic level*
- personal pronouns ('we' and 'you').
- short sentences. ⇢ *processing load*
- active constructions ('I kicked the ball' is active, whereas 'the ball was kicked' is passive).
- clear and legible design, which is increasingly included in plain language guidelines.

These particular guidelines relate to English, and guidance about other languages will differ. Plain language is the best known simplification approach, but critics have pointed to limitations. It should not replace user-testing, and it should not replace a more radical transformation of content.

Key references

Cutts M (2013) *Oxford Guide to Plain English*. 3rd ed. Oxford, UK

Waller R (2011) *What makes a good document? The criteria we use*. Technical paper 2. Simplification Centre.

Vocabulary

English has words derived from Old Norse, French, Italian, Latin, Greek, Dutch, German, Arabic, and many other languages. This gives us a lot of choice when trying to find the right words.

Example

House: home, property, residence, dwelling, domicile, address.
Money: cash, payment, amount, emolument, premium, salary, wage, instalment, deposit, rebate, bonus, lump sum, accrual.

Theoretical background

Plain language principles call for common words. In English, these tend to be of Germanic origin, while technical words often come from French or Latin, the languages of the church and the ruling classes several centuries ago.

But how do we know which words are most common? Large-scale studies of language databases (corpora) can tell us the relative frequency of words, and show them in context so that we can see how they're used. Nowadays, dictionaries are built using corpora to provide evidence of the current meaning of words.

Key reference

Most English language corpora can be accessed via www.english-corpora.org, and other languages have equivalent corpora. Be aware that each corpus will be biased by the kinds of texts that were collected in the first place. For example, some are historic, or regional (for example, US English, British English).

Collins COBUILD Advanced Learner's Dictionary: The Source of Authentic English, Ninth edition 2018

Tiersma, P. (1999) *Legal Language*, University of Chicago Press

Genre

A well known document type that triggers expectations among users about its content and organising principles.

Example

I open my post in the morning and find two communications from the same company. I read one carefully because it is a bank statement, and throw one out because it is junk mail. Before even opening the statement, I know how it is likely to be organised, and what to do with it, because I know it will follow well-known conventions – genre rules.

Theoretical background

Genre theory comes from the world of literary criticism (and originates with Aristotle). Linguists have used it to account for differences in different kinds of documents, and it has also been applied to typographic layout to explain how designers apply consistent structures that readers understand, even though these are rarely written down. Genre conventions often originate with production technology, but persist even after the original reason has gone (the narrow columns in newspapers are an example). Departing from genre conventions is sometimes necessary, but carries risks that users will not know how to treat the resulting innovative format.

Key references

Bhatia, V. (2004) *Worlds of Written Discourse: A Genre-Based View*, Continuum International Publishing Group Ltd

Waller, R. '(1990) 'Typography and discourse', in R Barr et al (eds), *Handbook of Reading Research*, vol II, NY: Longman, 341-380.

Basic level objects

To simplify information is to achieve 'cognitive economy'. Language organises things in hierarchies, from the general to the specific. In cognitive terms, the middle (basic) level is the easiest to understand.

Example

Eleanor Rosch's Principles of Categorisation include three levels:

Superordinate:	mammal
Basic:	dog
Subordinate:	wire-haired terrier

Theoretical background

We know that children learn basic level language first, and experiments have shown that we organise most of our knowledge around basic level concepts. In perception tests, people recognise basic level terms more quickly and accurately. One reason might be the link between basic level language and visualisation: we can all have a single mental image of a dog, but we can only visualise a wire-haired terrier if we know what it is. We cannot have a visual image of a 'mammal'.

So there is an implication here for icon design. Plain language writing should make as much use of basic language as possible – this means being wary both of abstract language at the superordinate level, and of jargon at the subordinate level. ⇢ *Prototypes*

Key references

Rosch, E. , Mervis, C., Gray, W., Johnson, D., & Boyes-Braem, P. (1975) Basic Objects in Natural Categories. *Cognitive Psychology* 8: 382-439.

Lakoff, G. (1987) *Women, fire and dangerous things.* University of Chicago Press.

Prototypes

All members of a category are not equal - some are more prototypical than others.

Example

If asked to name a bird, most people will name something like a robin or a blackbird – rather than a penguin or an ostrich. These are birds, but are less 'birdy' than the prototype.

Theoretical background

In classical theories of categorisation, objects are placed in categories because they share certain features. But the philosopher Ludwig Wittgenstein noticed that some categories (his example was games) include objects with little in common with one another. He used the term 'family resemblance' to explain why they are in the same category. Eleanor Rosch talks about 'natural categories', in which objects are defined by their distance from the prototype for that category. So furniture is a table but more distantly a lamp. A bird is a robin but also an ostrich. Prototype theory points both to opportunities and pitfalls for information designers. Using prototypical examples helps achieve cognitive economy (people recognise them faster), but in social categories they can perpetuate stereotypes (for example, that a truck driver is protypically male, or a nurse protypically female). ⇢ *Basic level objects*

Key references

Rosch, Eleanor (1973). 'Natural categories'. *Cognitive Psychology*. 4 (3): 328–350

Rosch, Eleanor (1988), 'Principles of Categorization', *Readings in Cognitive Science*, Elsevier, pp. 312–322.

Schemata (or 'Schemas')

Mental structures that organise our knowledge. Related terms are stereotypes, scripts and mental models.

Example

When supermarkets were introduced in the 1950s, customers were given instructions about how to use them (pick up a basket, help yourself, pay at the checkout when you have finished). This is because their existing shopping schema was completely different. Many people have poorly developed schemata about topics such as pensions, tax, health, technology and the law.

Theoretical background

Schema theory ('schemata' is the plural of the Greek word 'schema') is associated with the psychologist Frederic Bartlett, and it is also central to the work of the child psychologist Jean Piaget, who saw schemata as the basic building blocks of thinking. We see every object as part of a set of similar objects, with similar purposes and characteristics.

→ *World knowledge*

Key reference

Bartlett, F.C. (1932), *Remembering: An Experimental and Social Study.* Cambridge: Cambridge University Press

Anderson, R. C. & Pearson, P. D. (1984). A schema-theoretic view of basic processes in reading. In P. D. Pearson (Ed.), *Handbook of Reading Research* (pp. 255-291). New York, NY: Longman.

Processing load

The amount of work we can do in working memory – the part of our brain that processes immediate information.

Example

Some mental tasks require you to compare a lot of information – for example, choosing a mortgage involves comparing interest rates (now and later), entry and exit charges, time periods, flexibility and other factors. 'Processing load' describes the limit to what you can manage. When driving in a complex city centre, many drivers switch their radio off – this reduces processing load and frees up cognitive capacity for the main task of driving.

Theoretical background

Theories of memory and cognition usually propose a distinction between long-term, short-term and working memory (although the last two are not separate in all theories). Working memory has limited capacity, and this may explain why plain language is often easier to understand – with short sentences, less has to be retained in memory before the whole can be processed, and familiar words need less effort to process.

Plain language

Key reference

Baddeley, A.D., Hitch, G.J.L (1974). Working Memory, in G.A. Bower (Ed.), *The psychology of learning and motivation: advances in research and theory* (Vol. 8, pp. 47-89), NY: Academic Press.

Relevance theory

To minimise processing effort, we look for relevance in every communication.

Example

We receive a complicated form from a government agency. We assume they wouldn't send it if it isn't relevant to us. We have to make inferences about its relevance to us, and as a result we risk forming the wrong view of its content.

Theoretical background

Relevance theory is a cognitive theory developed from Grice's Co-operative Principle. It proposes that human evolution has resulted in cognitive systems which minimise processing effort by actively seeking out relevance in communication. In the words of Deidre Wilson, 'Relevance is defined in terms of cognitive (or contextual) effects and processing effort: other things being equal, the greater the cognitive effects and the smaller the processing effort, the greater the relevance'.

The content of any communication is understood in the context of (a) what you know about the intentions of the sender, and (b) what you think they assume about you. Information designers can help make intentions clear, and they can help people pick out relevant information with less effort, to maximise their understanding.

Co-operative principle

Key references

Sperber, Dan; Wilson, Deirdre (1995). *Relevance: Communication and Cognition*. Wiley-Blackwell.

Strategic reading

The process of reading actively, with a reading order and pace that suits the reader's purpose.

Example

Most people read a story or novel from beginning to end in a straight line, but almost no one reads a dictionary in that way. Most reading for problem-solving requires us to be selective and strategic rather passively follow a linear path.

Theoretical background

It has been shown that active readers (who vary their pace, and reading order in response to an awareness of their purpose) are more effective than passive readers who fail to monitor their understanding. Information documents are usually structured to enable strategic reading, with access structures designed for easy navigation, and graphic formats that show the relationship between different parts of the text.

Key references

Britton. B.K., Glynn, S. (eds.) (1987) *Executive Control Processes in Reading*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Wright P, (1988) 'Functional Literacy: Reading and Writing at Work', *Ergonomics* 31:265.

Wright P, (1988b) 'The Need for the Theories of NOT Reading: Some Psychological Aspects of the Human-Computer Interface' in Ben AG Elsendoorn and Herman Bouma (eds), Working Models of Human Perception, Academic Press.

Affordance

The quality of an object that allows or encourages a user to perform an action.

Example

On a door, the shape of the handle, or push-plate, tells you how to open it – whether to pull or push; whether to turn a handle. In a document, a single large heading tells you where to start reading. In a form, the size and shape of an answer space tells you whether to tick, sign or write a sentence.

Theoretical background

The term 'affordance' is most closely associated with the psychologist and usability expert Don Norman, whose 'Psychology of Everyday Things' became a best seller. The term was originally introduced by the psychologist James J Gibson whose theories suggest that people actively seek meaning in their environment, and look for 'action possibilities'.

→ *Gestalt principles*

Key references

Gibson, James J. (1979), *The Ecological Approach to Visual Perception*, ISBN 0-89859-959-8

Norman, Donald (1988) *The Design of Everyday Things*, ISBN 0-465-06710-7

Chunking

Presenting information in short chunks to make it easier to process.

Example

The account number on a credit card has sixteen digits, but they are grouped into four groups of four. This allows people to read the number in easily grasped chunks, when transcribing it onto a form or web page.

1234 5678 9012 3456

Theoretical background

The psychologist George Miller showed that people could recall up to five words or seven digits immediately after hearing them. His paper entitled 'The Magical Number Seven' is much cited, although this should not be seen as a precise guide.

Chunked information is easier to use for several reasons:

- it allows for the limitations of working memory, which struggles to cope with long strings of information. ⇢ *Processing load*
- its graphic appearance makes information easier to skim read. ⇢ *Strategic reading*
- the graphic arrangement of chunks on a page can communicate their relationship. ⇢ *Gestalt principles*

Key reference

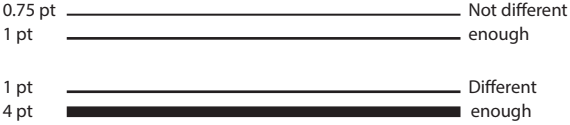
Miller, G. (1956). 'The magical number seven, plus or minus two: Some limits on our capacity for processing information'. *Psychological Review*, 63, 81-97.

Difference threshold

In perception, this is the smallest difference that a person can detect. In information design, it is the minimum graphic difference that is significant and memorable.

Example

The difference between a 1 pt rule (line) and a 4 pt rule is easily seen. However, the difference between a 0.75 pt and a 1pt rule may be just about detectable, but it is not significant enough to be used in an information hierarchy. The principle applies to colour, typefaces and other design features used to encode information.



Not different enough

Different enough

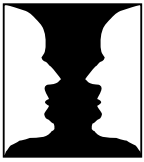
Theoretical background

The minimal difference that can be detected by the human eye is sometimes known as the Just Noticeable Difference, or JND. Its theoretical origins can be traced to an 18th century psychologist, Ernst Heinrich Weber. In practical graphic design, the JND is rarely enough to create a sufficiently differentiated set of graphic signals.

Figure-ground illusion

When we look at any visual object, we need to distinguish between the thing we should be looking at (the figure), and the background. Sometimes the background can itself form a figure, but it is impossible to see both figures at once.

Example



The face-vase illusion is a classic example.

At first I saw this icon in a train as a black moon.

It is hard to check the relative position of these football teams because we can't read the white type and the black type at the same time

Theoretical background

The Gestalt psychologists were interested in how we distinguish shapes and edges from among visual phenomena. Detecting objects is basic to human perception, and is early to develop in infants. In seeking to make sense of the world, we make probabilistic guesses about what we are looking at, which we check against the rest of the image, and our own experience of visual objects.

⇢ *Gestalt principles*

Gestalt principles

The Gestalt principles describe the way we impose organisational principles on our visual perception.

Example

If I want to draw a square I don't have to draw four complete sides. I can draw just three of them, and using the Closure principle, our perceptual system will see it as a square. Just drawing four dots will do the same thing.

Theoretical background

Gestalt psychology, developed in Germany in the 1920s, was interested in the way people seek organisation in visual forms (the word Gestalt means 'shape' or 'form'). Psychological theory has moved on from the Gestalt movement, but the laws of visual organisation they described are still influential among designers, and are key to the understanding of how graphic design can contribute to meaning in information displays. The Gestalt principles of Similarity, Proximity, and Closure are described in separate cards.

Similarity, Proximity, Closure

Key references

Wertheimer, M. (1923). Laws of organisation in perceptual forms. Available in translation at https://psychclassics.yorku.ca/Wertheimer/Forms/forms.htm

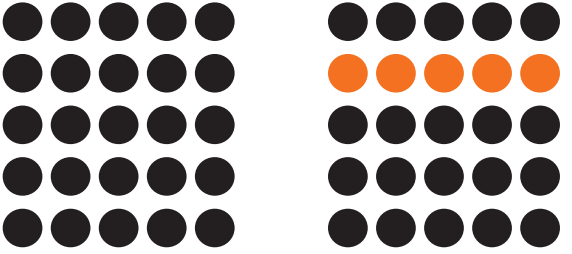
Pettersson, Rune (2017). Gestalt principles: Opportunities for designers. Chapter 27, page 425 - 434 in: Alison Black, Paul Luna, Ole Lund, and Sue Walker *Information Design: research and practice*. London: Routledge.

Similarity

A Gestalt principle: we see things as a group or a category if they are similar in shape or colour.

Example

Colour coding systems and icon systems use the Similarity principle. We see the 25 dots on the left as a single group. But on the right the same 25 dots can be seen as three groups (two black ones and a red one).



Theoretical background

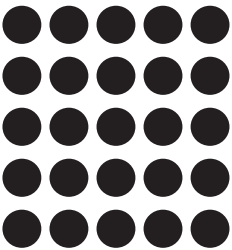
⇢ Gestalt principles

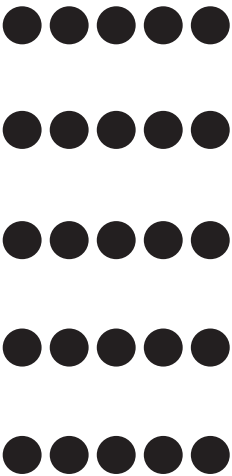
Proximity

A Gestalt principle: we see things as a group or a category if they are close to one another.

Example

Graphic designers use the Proximity principle when they group related items together. We see the 25 dots on the left as a single group. But on the right the same 25 dots can be seen as five rows.





Theoretical background

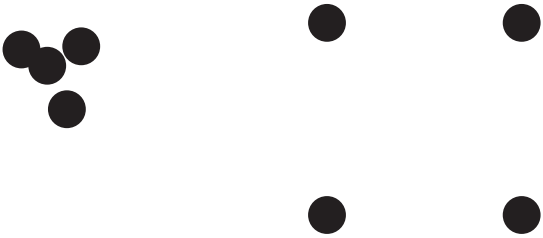
⇢ Gestalt principles

Closure

A Gestalt principle: we see alignments of visual objects as significant, and actively look for shapes and structures.

Example

We see the 4 dots on the left as a random group. But on the right the same 4 dots can be seen as a square. The grid systems used by graphic designers use the Closure principle – readers see the resulting visual order as organising the content into significant sequences or groups.



Theoretical background

⇢ Gestalt principles

Prominence

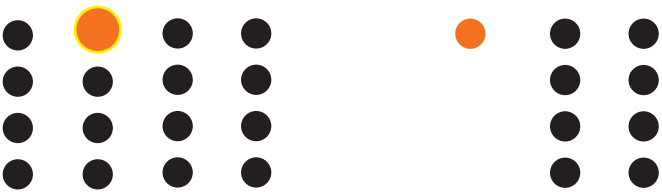
We focus on the most prominent feature.

Example

A newspaper headline on the front page.

Graphic designers use various techniques to focus the attention of the reader onto the most important information, including

- size and colour
- position (for example, at the top of the page
- isolation in space.



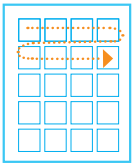
Theoretical background

⇢ Gestalt principles

Sequence

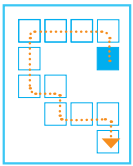
We look for sequences among elements, using Gestalt principles and other cues.

Top left to bottom right: Unless there is another cue, we tend to follow the normal reading order (in English, from top left).



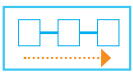
The most prominent feature: alternatively the starting point may be shown by a prominent heading or graphic feature.

Using the proximity principle, the next move is to the nearest element.



Numbered steps

Connecting lines



Narrative cues: the content may suggest the reading order. Comic books often use pictorial content to link to the next frame.

Proximity

Affordance

Types of information

Types of information that can be visually encoded are set out here.

Information type	Question	Encodings ⇢ *related theory cards*
Configuration and visual appearance	What does it look like?	Picturing ⇢ *arranging*
Spatial location	Where?	Mapping ⇢ *arranging*
Point in time	When?	Positioning along an axis ⇢ *arranging*
Quantity	How much or how many?	Positioning along an axis ⇢ *arranging* Sizing, repeating ⇢ *varying*
Proportion	What proportion?	Proportional partitioning ⇢ *arranging*
Order	Which order or ranking?	Ordering by position ⇢ *arranging* Sizing, repeating, gradient coding ⇢ *varying*
Category	Which group or category?	Grouping by position ⇢ *arranging* Colour coding, shape coding ⇢ *varying* Grouping by boundary ⇢ *linking*
Relationships between entities – being present or not	Does a given relationship hold (between 2 entities)?	Coupling by adjacency, nesting ⇢ *arranging* Grouping by boundary, connecting ⇢ *linking*

Information transformations

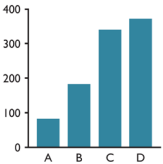
For opening up visual encoding options, ***information*** *of one type may be* ***transformed*** *into another type* ⇢ *Types of information*

Question	Can be transformed into	Examples
Where? *spatial location*	How much or how many? Which order or ranking? Which group or category?	distances nearest, furthest location names
When? *point in time*	How much or how many? Which order or ranking? Which group or category?	durations chronological order daytime, nighttime
How much or how many? *quantity*	Which order or ranking? Which group or category? What proportion?	low, medium, high normal, exceptional percentages
What proportion? *proportion*	How much or how many?	absolute numbers
Which order or ranking? *order*	Which group or category? Does a given relationship hold (between 2 entities)?	group A, group B same rank?
Which group or category? *category*	What does it look like? Does a given relationship hold (between 2 entities?	 same category?
Does a given relationship hold? (between two entities) *relationships between entities – being present or not*	Which order or ranking?	degrees of separation

Varying

Visual components within a visualization can be visually varied to represent quantity, order, or category membership. ⇢*Types of information*

Encoding	Type of information shown & how	Examples
Sizing	shows quantities or order by varying the surface area of visual components.	bar chart, word cloud, size-ranked symbols on a map
Repeating	shows quantities or order by the use of multiples of visual components.	Isotype chart, dot plot, dot matrix chart
Gradient coding	shows order by the use of gradated differences in brightness or saturation, transparency, fuzziness, etc.	heatmap table, brightness, gradient on a map
Colour coding	shows category membership by the use of colour.	coloured lines on a subway map
Shape coding	shows category membership by the use of shape.	the outline shapes of signs in a traffic sign system



Key reference

www.VisDNA.com

Arranging

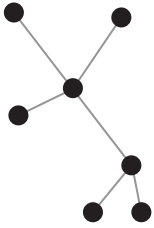
Visual components can be spatially arranged to represent all types of information shown on the card 'Types of information'.

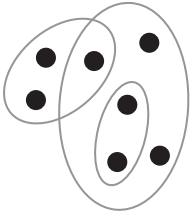
Encoding	Type of information shown & how	Examples
Picturing	shows configuration and visual appearance of entities or scenes in the physical world (existing or imagined), using methods such as perspective projection.	pictorial/technical illustration
Mapping	shows the two-dimensional layout (typically horizontal) of physical configurations (existing or imagined), using methods such as cartographic projection.	world map, street map, floor plan
Positioning along an axis	shows quantities or points in time by arrangement along an axis with a measurement scale.	scatter plot, timeline, clock face
Proportional partitioning	shows percentages of a total by dividing a given surface area into proportionally sized partitions.	pie chart, stacked bar, treemap
Ordering	shows order by arrangement into a sequential spatial order, or into spatially ordered levels of indenting.	comic strip, bump chart, ordered list, indented hierarchy
Grouping by position	shows category membership by spatial proximity or alignment.	rows and columns in a table
Coupling by adjacency	shows the presence of a given relationship between two entities by placing one visual component next to another visual component of the same kind.	icicle diagram, sunburst diagram
Nesting	shows the presence of a given relationship by placing one visual component inside another visual component of the same kind.	circle packing

Linking

Visual components within a visualization can be linked by configurator components to represent relationships between entities or category membership. ⇢*Types of information*

Encoding	Type of information shown & how	Examples
Connecting	shows the presence of a given relationship between two entities by linking two visual components of the same kind with a 'configurator component', e.g. a line or arrow.	flow chart family tree network graph
Grouping by boundary	shows category membership, or the presence of a given relationship between two entitities, by corraling visual components with a 'configurator component' such as a demarcating line, enclosure or shared background.	Venn diagram





Relationships may be symmetrical (e.g. is a friend of) or asymmetrical (e.g. is a child of). The latter case requires some form of directional indication (e.g. arrows, spatial ordering).

Key reference

www.VisDNA.com

Semiotics

In semiotic theory a pictorial illustration is thought of as a kind of 'sign' that can be analyzed at three levels. To fully understand a sign a 'reader' must be able to interpret it at all three levels.

Syntactic level

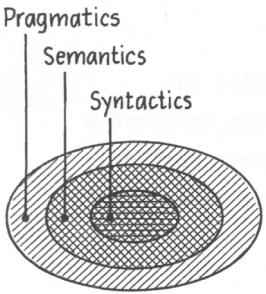
At the syntactic level the visual qualities of and spatial relationships amongst the various components depicted in an illustration must be understood.

Semantic level

The semantic level links the various components within an image to what they represent – their meaning.

Pragmatic level

Interpreting a pictorial illustration at the pragmatic level requires some comprehension of its cultural and usage context.



Key reference

Goldsmith, E. (1980). 'Comprehensibility of illustration – an analytical model' *Information Design Journal* 1(3), 204-213