Human Communication 1 Lecture 26

Graphical Communication

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based on the slides by **Alex Lascarides, Jon Oberlander**
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Communication is not just language

There is much non-linguistic information available when people speak:

- facial expression
- ‘body language’
- non-linguistic cues about the participants—dress etc.
- the immediate environment as referent—what we can see that our communication partners can see

But if language generally is accompanied by non-linguistic information, it is also true that graphics rarely appear alone.

Systems of Graphical Communication

We will focus on graphical representations used in the communication of content, and we will be most interested in similarities and differences between them and sentential languages.

- graphics are planar displays which use the spatial distribution of shapes, patterns, textures, and colours to convey information
- e.g. maps, graphs, tables, diagrams
- this definition also covers pictures and photographs
- but we will focus on *systematic* graphics
- a particular graph is a representation which is a member of a system of representations,
- because we can say:
  - what other graphs are members of the system(s) it belongs to
  - how these other graphs' meanings differ

Examples of systematicity

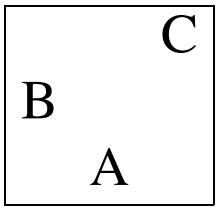
Alphabetical Table

	A	B	C
A	0	2	4
B	2	0	5
C	4	5	0

Long./Lat. Table

	B	A	C
C	5	4	0
B	0	2	5
A	2	0	4

Map



We might think of these as three different systems (or at a coarser grain, as one). Compare this systematicity with a photo or drawing. Even with a press-photo made up of dots, we can't say what systematic significance it would make to change some dots from one shade to another.

Graphics and Syntax

- This means that graphs and charts have a *syntax*, which is heavily bound up with their *semantics*
- Just like language … (we'll see more of this later)
- Nelson Goodman (*Languages of Art*, 1968) claims that this is true even of purely "pictorial" images
- He develops a notion of *density*: a language can be more or less dense, syntactically or semantically — roughly this means that more of the properties of the symbols have some relevance to interpretation (compare what we said about alphabetic characters in the lecture on representation)
- Things we think of as graphics are more dense
- What we think of as pictures are so dense as to be *replete*: most of their properties are relevant to the identity of the symbol — but then syntax more or less disappears …

Craft Graphics

Given a set of relational data we want to communicate, and we have decided to draw a graphic (we'll come back to choices between graphics and text), there are two practical issues:

- how to decide what type of graphic to use
- how to design an example of the type

Types of graphic

- tables present absolute figures
- line-graphs present trends of (pseudo-)continuous quantities
- histograms present frequency counts
- pie-charts normalise data to a fixed 360 degrees

Think of the purposes which each presentation can serve. How much work does the ‘reader’ have to do?

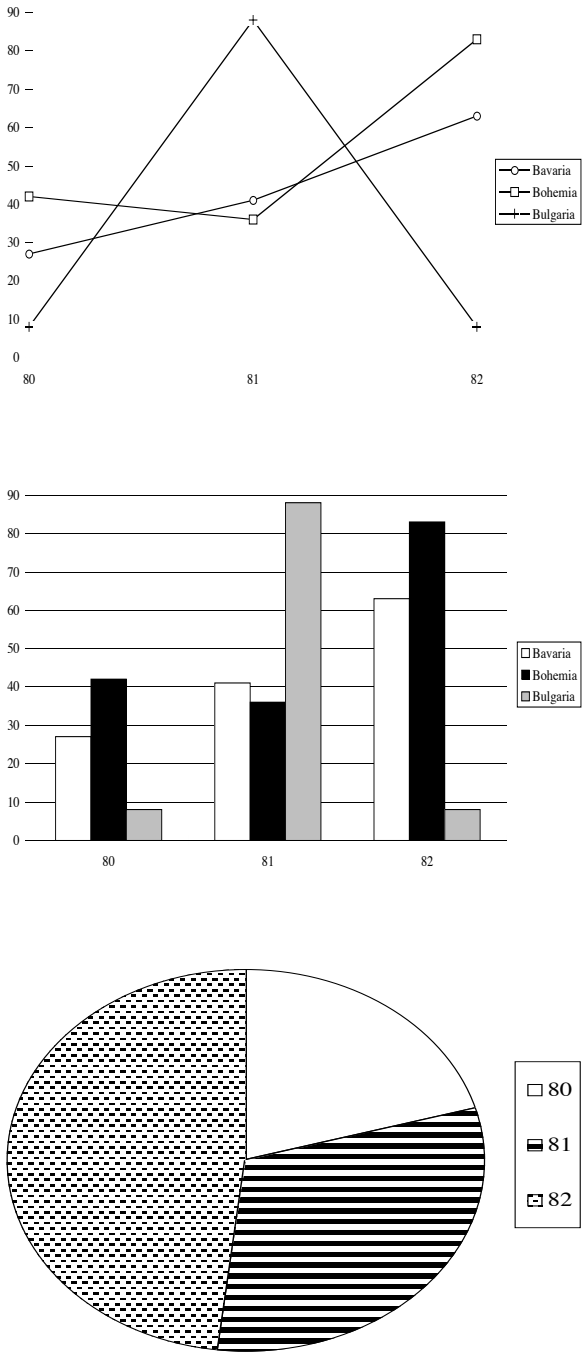


Figure 1: Some kinds of graphic

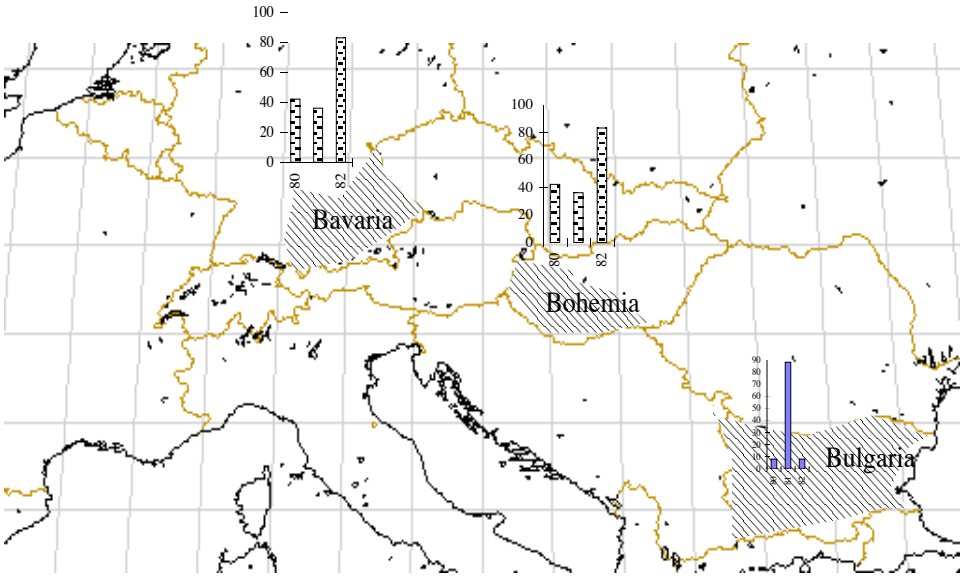


Figure 2: Combinations of kinds of graphic

Design within a type: e.g. line-graphs

Typically:

- time goes on the horizontal axis
- a continous, dependent variable goes on the vertical axis
- lines of different colour/texture joining different icon-types are assigned to discrete categories
- a legend, and axis-labels define the correspondences
- a caption provides the information necessary to turn the message into sentences

Reference: Tufte, E. R. (1991) *Envisioning Information*. Graphics Press: Cheshire, Conn.

Graphical semantics

But how do graphics mean at all?
Let's start with tables:

- there is a correspondence between tables and texts
- a table can be turned into texts, one sentence per cell
- the caption and row/column labels give the relation
- cell content gives the value
- each table can generate many texts by different orderings
- **but** not all texts correspond to a table—incompleteness
- empty-cell conventions
- tables are spatialised language

How about line-graphs?

- most of the observations of tables carry over
- but there is a constraint on ordering on the axes
- since indefinitely many quantities can be read off, corresponding texts are indefinitely long
- histograms are a half-way house—one continuous and one discrete axis
- maps are a special kind of graph + icons

How does this compare with sentential languages?

- just because we can convert table to language doesn't mean they are the same
- in sentences:
  - space (or time) represents concatenation into strings
  - strings are then assigned syntactic structure
  - finally, syntactic structure is semantically interpreted
  - space is only *indirectly* interpreted through syntax
- in graphics:
  - space is interpreted directly
  - e.g. distance from the vertical axis means year
  - there is no intervening syntax

Consequences?

- graphics
  - can only represent a limited number of relations
  - X-axis, Y-axis, hue, saturation, texture, icons ...
  - every datum represented completely (with a little fudge possible)
- texts
  - can represent indefinitely many dimensions through indefinitely many syntactic relations between indefinitely many words
  - any incompleteness is possible

But some ‘graphics’ are perhaps like language?

Node-and-link formalisms:

- can be concretely interpreted:
  - e.g. circuit diagram, with component types (resistor, capacitor, battery, . . .) and ‘wires’
  - these concrete interpretations are like maps—directly interpreted
- can be abstractly interpreted:
  - e.g. visual programming languages
  - the links are interpreted differently depending on what nodes they join
  - i.e. they have a syntax, and are interpreted indirectly
  - links are like concatenation in a sentential language

Consequences?

- in a circuit diagram
  - each node stands for one and only one component
  - different nodes stand for different components
  - if there is no link between A and B, then there is no wire between A and B
- in an abstractly interpreted node-and-link diagram:
  - nodes may denote the same thing as other nodes
  - absence of a link does not mean absence of relation

Expressiveness is purchased at the cost of complexity of inference.

Expressiveness

- Graphics are generally less (often much less) *expressive* than language
- This means, at least, that they capture abstraction less well
- It's easy to *say* "The evening star may or may not be the morning star" — more difficult to draw a diagram that leaves the identity question open
- Diagrammatic systems typically force the issue of identity and many other properties (think of triangles), but can vary in how much they enforce
- Expressiveness is typically added by the use of *conventions*, and often systematicity, and takes us closer to a linguistic system
- (see Stenning et al. book for further discussion)

Semantic studies for psychological questions

In summary:

- systematic graphics—are like languages in being systematic
- principles for choosing types, and designing examples
- relations between graphics and texts—not symmetrical
- graphics (in the extreme) are directly interpreted—languages through syntax
- except some ‘graphics’ are indirectly interpreted
- which makes them more expressive and more like language