# Teaching Information Visualization

Robert Spence

Imperial College London

**ABSTRACT**

My approach to the teaching of Information Visualization is based on a number of premises: (1) that the subject is equally relevant to museum curators as well as fraud investigators, and is not a branch of computer science; (2) that visualization is 'the formation of a mental model of something' and not something one sees on a display – it is a perceptual and cognitive activity; and (3), following from (2), information visualization has, in one sense, fundamentally nothing to do with computers, notwithstanding the crucial component that computation can form in a visualization tool.

My teaching of information visualization has been developed over more than 15 years of presenting short (e.g., two week) courses to graduates of many disciplines who are embarking on careers such as interaction/visual design. For these graduates course prerequisites are non existent. In these courses I take the view that the best way to learn information visualization is to *do it* rather than prepare for a conventional examination. Design exercises begin twenty minutes after the start of the course and proceed towards group projects that require realistic design but specifically no implementation: the students are the 'experts' presenting a design to a 'client'.

**Keywords**: visualization, mental model, representation, presentation, interaction.

**Index Terms**: H.1.2 [User/Machine Systems] Information visualization

## 1 INTRODUCTION

My approach to the teaching of information visualization departs from convention in a number of fundamental ways and may therefore be of interest to fellow teachers. I shall discuss separately the various primary assumptions that guide my approach.

### Definition

Students expect clear definitions on which to build their understanding. The definition of visualization provided by most good dictionaries can be summarized as

**Visualize**: to form a mental model of something

and is therefore a cognitive and perceptual activity. I reject use of the term 'visualization' to describe what one sees on the screen of a visualization tool, despite this commonplace use.

### Computer Science

In view of the above definition, and despite the outstanding support to visualization made possible by computation, I do not regard information visualization as a branch of computer science: indeed, for the courses I teach there are no prerequisites, in computer science or any other discipline, and students are not restricted by their first degree. They come from disciplines as varied as journalism, economics, psychology and engineering and are often training to be interaction/visual designers in industry. Concepts such as context, exploration and interaction are just as relevant to the museum curator as they are to the fraud investigator – in both cases the user is attempting to develop a mental model of something, whether that something is Picasso or an audit trail.

### Design exercises

My view is that the best route to an understanding of most human-computer interaction topics is to *do it* rather than prepare for a conventional examination. My courses therefore contain a significant component of design exercises. The first (to represent, on the London 'Tube' map, the frequency of arrival of trains at a station and the time taken to travel between stations) takes place only 20 minutes after the course has started, while the last is a group project typically involving three students working for about a week.

All designs are presented and justified in front of the entire class. None involve any programming or the use of computers.

Brief details of exercises typically provided are:

**Exercise 1**: Modification of the 'Tube' map (see above);
**Exercise 2**: For any chosen interactive artifact, identify the extent to which each stage of Norman's Action Cycle is supported;
**Exercise 3**: Represent the provided scores of 5 students in 8 examinations;
**Exercise 4**: Select a web page and critique it with particular relevance to navigation support;
**Exercise 5**: Group project. Topics have included:
Design a Picasso exhibition
Design a website for the sale of cameras
Design an interactive guide for a garden centre
Design an exhibit that allows visitors to gain an understanding of the migration of peoples or animals over an interesting period.

My philosophy underpinning the design exercise is based on the well-established industrial model wherein the outcome of a creative design activity is presented, without implementation, to the commissioning client prior to its critique and before the expensive stage of implementation.

Although the instructor may assess each student's/group's response to a design exercise, the major activity following design is to paste all designs on a wall and have each student/group defend, in about two minutes, their design rationale: a question and answer period follows.

## 2 SYLLABUS

The syllabus is based on the commonly accepted Information Visualization Reference Model (Figure 1) and follows, quite

closely, the chosen text [1] for the course. It focuses on three fundamental processes within the model: Representation, Presentation and Interaction.

Lectures on Representation use a selection of techniques to illustrate important concepts such as object and attribute visibility as well as the work of Bertin and of Cleveland and McGill.

Lectures on Presentation are based on the three relevant resources available to the interaction designer: space, time and the human visual system. Techniques such as overview-and-detail, focus+context and semantic zoom are discussed.

The lectures on Interaction have not been so easy to develop to my satisfaction. There is no appropriate theory of interaction so I have most recently chosen to base my discussion of many aspects of interaction on the framework of Norman's Stages of Action [2]. Using this framework my lectures illustrate the relevance of Norman's Stages to visualization tool enhancement, dynamic exploration and involuntary browsing.

The design of an interactive visualization tool depends to a significant degree upon an understanding of relevant features of the human visual system. Therefore, appropriately intermingled with all my lectures are discussions of such topics as change blindness, saccadic blindness, inattentional blindness and preattentive processing.

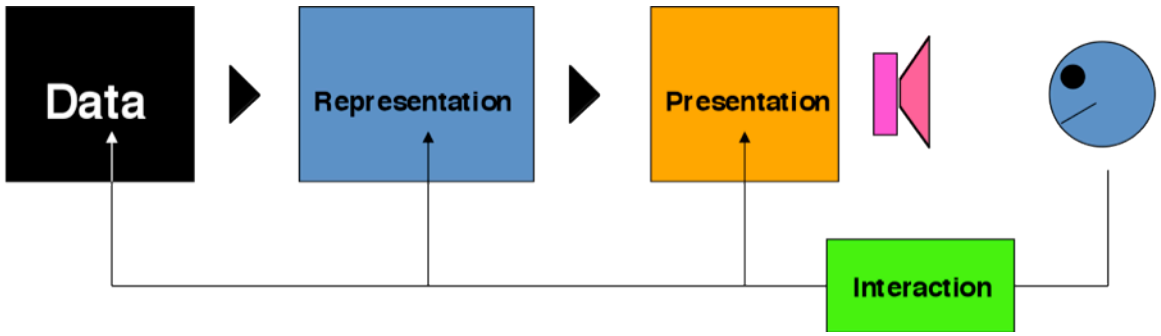


Figure 1 Information visualization reference model

## REFERENCES

[1] R. Spence, Information Visualization: an introduction, Springer, 2014

[2] D.A. Norman, The design of everyday things, Doubleday, New York, 1988.