

PS 499 Transit Maps: Past, Present and Future

Academic Year 2017/2018 (spring term)

Overview

Transit maps, showing public transport in urban areas, are important components of navigating a complex city network of buses, trains, trams, etc. Often, such maps are *schematized*, in other words, they are configured as abstract diagrams with topographical distortion, only showing individual routes and their intersections with few, if any, surface features (such as the famous London Underground map originated by Henry Beck in 1933). The intention is that these will be easier to use for journey planning than detailed topographical maps, but their creation and use is not trivial psychologically, and history is littered with numerous schematic maps that have failed for design or political reasons. This, coupled with their ubiquity, makes them a legitimate target for further study.

The aim of this module is to take a multidisciplinary approach to understanding transit maps, in particular, schematic maps, looking at the history and context in which they developed, the design techniques used, the psychological principles that underpin their usability, and the various methods that can be used to assess their effectiveness, both objective and subjective. As a result of taking this module, you will gain an understanding of how such maps assist the user, and how they should be designed and evaluated. The emphasis throughout will be on the concept of *evidence-based design*, with the intention that you will acquire transferable skills relevant to graphic design, information design, and human factors research, along with an awareness of how psychological concepts can inform design and usability issues.

This is also intended to be a practical hands-on module, and you are encouraged to engage with the subject matter and develop your own critical skills. You will also create and evaluate designs for assessment purposes and, therefore, will be taught (if necessary) basic experimental and graphic design techniques.

As a Result of Taking the Course

You will acquire an understanding of the context, history, design, and usability of transit maps, in conjunction with relevant psychological principles, methods of design & research, and be able to communicate this understanding in a variety of ways. Specifically, you will:

- Be able to design and implement evaluation/usability studies and show an awareness of the need for evidence-based design
- Be able to generate your own designs taking a goal-directed approach
- Be able to subject designs to critical analysis of strengths and weaknesses from the perspective of theories of effective design and also of competing designs.
- Have an awareness of how basic psychological concepts can inform design issues.
- Be able to express ideas in a variety of ways including posters, presentations, technical reports, classroom discussions, and essays.

Teaching Overview

This module has been front-loaded in terms of content to ensure that you have the necessary theoretical and practical skills and knowledge in order to start thinking about your assessments as soon as possible, with your presentations scheduled towards the end.

Teaching is organised in the form of ten lectures and two lab sessions. There are also four presentation sessions and an individual one-hour tutorial. These are scheduled as follows.

Week 1

Lecture 1, Thursday 18th January, 12:00, room 2.409

Introduction to 20th century design

Lecture 2, Friday 19th January, 14:00, room NTC 3.03

Transit maps history 1 – context and early design innovations

Week 2

Lecture 3, Thursday 25th January, 12:00, room 2.409

Transit maps history 2 – modern designs; hits, misses, controversies

Lab 1, Friday 26th January, 13:00, room 1.702

Creating a transit map – introduction to vector graphics and design techniques

Week 3 [*maps for coursework Reflection on Two Designs finalised by end of the week*]

Lecture 4, Thursday 1st February, 12:00, room 2.409

Usability testing – basic methods and landmark studies

Lab 2, Friday 2nd February, 13:00, room 1.702

Introduction to research methods and statistical concepts

Week 4 [*assignment week*]

[*poster for Reflection on Two Designs completed for the class*]

Presentation 1, Thursday 8th February, 12:00, room 2.409

Reflection on two designs – presentation and poster

Week 5

Lecture 5, Thursday 15th February, 12:00, room 2.409

Lecture 6, Friday 16th February, 14:00, room NTC 3.03

Psychology meets transit maps 1 & 2 – lower, higher and higher order cognition

Week 6 [*maps/methodology for coursework Usability Study finalised by end of the week*]

Lecture 7, Thursday 22nd February, 12:00, room 2.409

Journey into maps: a psychologist becomes an information designer

Lecture 8, Friday 23rd February, 14:00, room NTC 3.03

Framework for effective design

Week 7 [*assignment week*]

[city/objectives for coursework Design & Evaluation finalised by end of the week]

Presentation 2, Thursday 1st March, 12:00, room 2.409

Usability study – presentation on proposed research topic and methodology

Week 8

Lecture 9, Thursday 8th March, 12:00, room 2.409

Pushing the envelope – different directions in transit map design

Lecture 10, Friday 9th March, 14:00, room NTC 3.03

Transit maps in popular culture – navigation impossible?

Individual one-hour tutorials to discuss progress with assignments, my office, 3.707, time to be arranged

Week 9 [*assignment week*]

Presentation 3, Thursday 15th March, 12:00, room 2.409

Design and Evaluation – exhibition and presentation

Week 10 [*assignment week*]

[essay for Design & Evaluation submitted by Monday 19th March]

Presentation 4, Thursday 22nd March, 12:00, room 2.409

Usability study – presentation of preliminary findings

[Report for Usability Study submitted by Thursday 3rd May]

Detailed Syllabus

Lecture 1: Introduction to 20th century design

How context shapes design, and design shapes context. From Adam Smith and the Industrial Revolution to the three Ms of the 20th Century: mass production, mass transit and mass communication. The Arts & Crafts movement to Modernism, via Art Nouveau and Art Deco: The events that shaped them and their influence on the railways.

There is no set reading for this lecture, but there is a wealth of books and internet resources out there if you wish to find out more about these topics. You can also visit Frinton-on-Sea and see some of the architectural examples for yourself.

Lecture 2: Transit maps history 1 – context and early design

The special case of transit networks: their history and finance, the need to attract passengers and organise them efficiently. London as the ideal breeding-ground for schematic maps: Developments in publicity, signage and architecture as a background context to map design. Traditional approaches to railway cartography, the effects of network expansion, and the resulting search for simplicity. The development of early schematic maps; the first half of the 20th century.

Set Reading:

- ⦿ Ovenden, M. (2015). *Transit maps of the world (2nd ed)*. New York: Penguin.
Look through Zones 1 and 2 to see historic maps city by city.
- ⦿ Roberts, M.J. (2012). *Underground maps unravelled, explorations in information design*. Wivenhoe, Essex: Published by the author. **All of Part 1.**

Lecture 3: Transit maps history 2 – modern designs; hits, misses, controversies

Significant designs of the second half of the 20th century. Modern maps; trends in design, innovations, successes, failures, controversies, and the psychological issues that they raise. The effects of network expansion and inclusivity on design effectiveness.

Set Reading:

- ⦿ Ovenden, M. (2015). *Transit maps of the world (2nd ed)*. New York: Penguin.
Look through Zones 1 and 2 to see historic maps city by city.
- ⦿ Roberts, M.J. (2012). *Underground maps unravelled, explorations in information design*. Wivenhoe, Essex: Published by the author.
All of Parts 2, 3 and 6, but skip those sections that obviously do not apply.

Lab 1: Designing a transit map – introduction to vector graphics and design techniques
The development of printing and imaging technology and their influence on design. Use of vector graphics packages: bit-mapped versus vector graphics, basic package facilities. Step-by-step procedures for creating schematic maps.

There is no set reading for this class, but for one of the assignments, you will be expected to make use of computer vector graphics software to design a schematic map. If you have a design background then you will be familiar with Illustrator. This is fine, but is probably overkill for this assignment. I will be demonstrating Intaglio (www.purgatorydesign.com) which is an excellent inexpensive basic package for the Mac. You can download this ahead of time and start to explore it, or else any install any equivalent package on your own computer.

Lecture 4: Usability testing – basic methods and landmark studies

Methodologies for evaluating map design; journey planning, station finding, route choice, questionnaires, and map choice. Major published studies into map usability. Problems and pitfalls with usability testing. From prototypes to end product: an evidence-based program.

Set Reading:

- ⦿ Roberts, M.J. (2014). Schematic maps in the laboratory. *Schematic Mapping Workshop 2014*, University of Essex, April. **Download from** www.tubemapcentral.com/writing/academic.html
- ⦿ Roberts, M. J., Newton, E. J., Lagattolla, F. D., Hughes, S., & Hasler, M. C. (2013). Objective versus subjective measures of Paris Metro map usability: Investigating traditional octolinear versus all-curves schematic maps. *International Journal of Human Computer Studies*, 71, 363-386. **Download from** www.tubemapcentral.com/writing/academic.html

Lab 2: Investigating transit maps – introduction to research methods and statistical concepts

The logic of experimental methodology, independent and dependent variables, between-subjects versus within-subjects designs. Measuring performance, basic summary statistics, experimental error and confidence intervals.

Set Reading:

- ⦿ Roberts, M.J., & Vaeng, I.C.N. (2016). Expectations and prejudices usurp judgements of schematic map effectiveness. In: P. Lloyd & E. Bohemia (eds.), *Proceedings of DRS2016: Design + Research + Society — Future-Focused Thinking, Volume 8*, pp 2343-2359, DOI 10.21606/drs.2016.123. **Gives an idea of the format/scope of your own usability study. Download from www.tubemapcentral.com/writing/academic.html**
- ⦿ Lloyd, M.J., Rodgers, P., & Roberts, M.J. (2017). Metro map colour coding: effects on usability in route tracing. Unpublished manuscript. **Another example of a brief paper, but with a larger sample size than expected for your own study. Download from <https://www.cs.kent.ac.uk/people/staff/pjr/Diagrams2017.pdf>**
If you have no background in experimental design and statistics, then it is very important that you buy and read the following book, which gives a good overview of the underlying logic behind data collection and analysis.
- ⦿ Robson, C. (1994). *Experiment, design and statistics in psychology*. London: Penguin. **Out of print, but easy to obtain.**

Lecture 5 & 6: Psychology meets transit maps 1 & 2 – lower, higher, and higher order cognition

Making sense of transit maps through the eyes of a cognitive psychologist. Topics include: low level cognition (visual perception and visual attention); inference; route choice strategies; problem solving strategies; expert-novice differences; intuitive scientific theories; intelligence and intelligence testing; working memory capacity; metacognition; expectations and prejudices; and aesthetic judgement.

Set Reading:

- ⦿ Roberts, M.J. (2016). From reasoning and intelligence research to information design: Understanding and optimising the usability and acceptability of schematic transit maps. In N.D. Galbraith, E. Lucas & D. Over (eds.), *The thinking mind: A festschrift for Ken Manktelow* (pp. 178-190). Hove, UK: Psychology Press
Download from www.tubemapcentral.com/writing/academic.html

Lecture 7: Journey into maps – a psychologist becomes an information designer

An autobiographical account of the module co-ordinator as told by his design work, and what he discovered along the way: origins of his interest, early investigations, seeking direction, developing usability testing and exhaustive exploration methodologies.

No set reading for this lecture, plenty for the next one!

Lecture 8: Framework for effective design

How to design a transit map: suggestions from journalists, London Transport, designers, computer scientists and the general public. Towards a framework for effective design, incorporating simplicity, coherence, harmony, balance, and topographicity.

Set Reading:

- ⦿ Forrest, D. (2014). Causes and consequences of scale change in schematic maps: are users aware and do they care? *Schematic Mapping Workshop 2014*, University of Essex, April.

Download from https://sites.google.com/site/schematicmapping/Forrest_ScaleChange.pdf

- ⦿ Roberts, M.J. (2012). *Underground maps unravelled, explorations in information design*. Wivenhoe, Essex: Published by the author.

All of Parts 4, 5 and 7, but skip those sections that obviously do not apply.

- ⦿ Roberts, M.J. (2014). What's your theory of effective schematic map design? *Schematic Mapping Workshop 2014*, University of Essex, April.

Download from www.tubemapcentral.com/writing/academic.html

Lecture 9: Pushing the envelope – different directions in transit map design

Automated schematic map creation. Maverick designs; official maps that shun orthogonality, and unofficial designs that seek to improve on official versions, including some of the stranger and more interesting maps from the internet, and designs that come with usability claims. Alternative information emphasis and exporting the transit map metaphor to new domains.

No set reading for this lecture, you are now fully-equipped to evaluate the discussed material.

You should explore the internet to investigate the alternative designs that have been posted, especially for larger networks other than London, whose maps are featured in the lecture. Also investigate different manifestations of the transit map metaphor, there must be hundreds of these.

Lecture 10: Transit maps in popular culture – navigation impossible?

Taking transit maps in unexpected directions, and maps of fictional landscapes. Maps as art, exploring different media and decorative designs. Map imagery used in publicity, advertising, and parody, and familiar iconography in unfamiliar settings.

No set reading for this lecture, which rounds the course off with some of the more entertaining explorations of transit maps. Again, look on the internet to see whether you can find your own examples of extreme approaches to information design, and maps as art, advertisements, and parodies that use transit map imagery.

Assessment and Assignment Guide

Assessment for this module reflects its inherent applied nature, and will comprise a number of coursework components, with no exam assessment. Some of these components will be developed in conjunction with classroom presentations, so that (1) you will experience putting forward your ideas in public for scrutiny and feedback from your peers, and (2) you will benefit from seeing the diversity of ideas that are held by the group.

1) *Classroom participation (5%)*

To encourage engagement and attendance, 5% of the final mark will be awarded on the basis of your performance in class, for example by asking questions, offering comments and opinions, answering questions posed by the lecturer, or offering answers to questions posed by other students. The mark will be calculated on the basis of weekly performance, where a score of 5 is awarded if you make some sort of contribution to every lecture, and zero if you make no contribution.

2) *Reflection on Two Designs: presentation and poster (15%)*

Awarded on the basis of the poster

The presentation is a necessary pre-requisite for awarding marks for the poster.

You will select two transit maps (sanctioned by the module co-ordinator), one strongly liked, one strongly disliked, and reflect on the aspects of design that led them to these reactions. This exercise is carried out before some of the theoretical approaches have been discussed in lectures, and is intended to get you thinking and reflecting early. The mark for the poster will be awarded on the basis of clarity and critical/analytical thinking demonstrated. The presentations will highlight to you diversity of lay-theories of effective design that you and your peers hold.

Some notes and suggestions

- Any genre of map is a legitimate target, new or obsolete, official or unofficial, and you might consider pairs of maps from different networks, or else the same network mapped in two different ways. Search the internet for inspiration, there are many interesting designs out there, good and bad.
- Maps of complex networks tend to be harder to understand and less attractive than for simple networks, and so choose carefully. In particular, try to choose a pair of designs with similar quantities of stations, so that you are discussing their design and not network size.

- You have not yet covered relevant material on map design on this course, but in addition to your personal hunches, your academic career should have equipped you with at least some knowledge, theories, and analytical skills that might be relevant to assessing transit maps.
- The more principled, systematic and wide-ranging you can make your assessment, the better. For the poster, it is acceptable to write in bullet points, and you shouldn't need more than 4-500 words for comparing the essential differences between the two maps and identifying why they evoked different responses

The assessment date for this component (presentation/poster) is Thursday 8th February in the class

3) Design and Evaluation: presentation/exhibition and 3000 word illustrated essay (40%) references and figures not included in word total.

Awarded on the basis of the essay

The presentation/exhibition is a necessary pre-requisite for accepting the essay

Each of you will be asked to create a schematic map for a medium-sized network such as Mexico City, St. Petersburg, or Washington DC. Designing a map is a particularly effective way of learning to appreciate the difficulties of this task, gaining insights into the design process, its inherent problem solving component, and the understanding of potentially conflicting criteria for effective design. The map should be novel and its conceptualisation should be goal-directed: you should have a clear idea of why you have selected your own design rules and priorities and what you hope to achieve, which will often be to remedy a perceived weakness with an existing design, or to explore a novel concept.

The maps will be exhibited during one of the classroom slots and each of you will deliver a presentation detailing: (1) its underlying concept; (2) any difficulties in relation to its creation with respect to the aims and objectives; and (3) an evaluation of its success. You will be encouraged to comment on each other's designs. The evaluation of the success of the design should at the very least incorporate: (1) the degree of satisfaction of the your own objectives; (2) the *framework for effective design*; and (3) a comparison with current or past official designs. For the essay, you will be encouraged to illustrate your points and explain the design process using variants and out-takes of your own attempts.

The mark for the essay will reflect the extent to which the creation of the design incorporated a goal-directed approach, the depth and sophistication of engagement with the success evaluation task, and the understanding of the importance of the various usability criteria (and their potential conflict) in attempting to create and critique a design. It should be noted that the your creation is intended to be a starting point for discussion. Marks will not be awarded for the quality of the map itself, instead, the quality of discussion of its success.

Some notes and suggestions

- Think carefully and clearly about your design goals throughout the process. The more deeply and comprehensively you can place your aims and achievements within the framework for effective design the better.
- Some aspects of the framework are single-faceted, such as simplicity and balance, but even for these, you have your entire design to consider. Was simplicity achieved everywhere? Are there topographical distortions in particular places that concern you? If *Coherence* or *Harmony* are your goal, remember that these are multi-faceted, so be clear as to which specific aspects of coherence or harmony you wish to address; all of them, or some of them, and relate your success back to these.
- This is your opportunity to be creative, if your goal is to experiment with unusual design rules or objectives, feel free. The marks are awarded for how well you can justify your goals from a usability/psychological perspective, and how well you discuss your achievements of them.

The map will be exhibited and the presentation delivered on Thursday 15th March in the class.

The deadline for the essay is Monday 19th March

4) Usability Study: presentation (x2) and 3000 word APA formatted report (40%)
abstract, references, figures and tables not included in the word total.

Awarded on the basis of the report

The presentations are necessary pre-requisites for accepting the report

Each of you will be asked to conduct a small-scale empirical study (e.g. comparing two maps, $N = 16$), investigating any subjective or objective element of transit map usability or engagement. Combined projects will also be permitted. Choice of maps and experimental methodology will be sanctioned by the module co-ordinator, and designs might comprise those already available and/or your own attempts. The first presentation will describe the choice of experimental methodology for the purpose of feedback from the class. The second presentation will be a preliminary overview of your findings. This exercise is intended to give you practical experience of human-factors research and, collectively via the presentations, will give you an overview of the range of evaluation techniques possible, along with their pitfalls. The mark for the report will reflect clarity and formatting, justification of the research and methodology in the introduction section, reporting of methodology and results, and sophistication of interpretation of findings in the discussion section.

Some notes and suggestions

- A good way to address report writing is to find a published paper of similar scope and ambition, and take a look at the format, structure and language used. There are two good short published papers that will guide you, pay close attention to them.
 - ⦿ Roberts, M.J., & Vaeng, I.C.N. (2016). Expectations and prejudices usurp judgements of schematic map effectiveness. In: P. Lloyd & E. Bohemia (eds.), *Proceedings of DRS2016: Design + Research + Society — Future-Focused Thinking, Volume 8*, pp 2343-2359, DOI 10.21606/drs.2016.123. *Download from www.tubemapcentral.com/writing/academic.html*
 - ⦿ Lloyd, M.J., Rodgers, P., & Roberts, M.J. (2017). Metro map colour coding: effects on usability in route tracing. Unpublished manuscript. *Download from <https://www.cs.kent.ac.uk/people/staff/pjr/Diagrams2017.pdf>*
- A report such as this has a straightforward simple structure. It doesn't necessarily need a long literature review, and the word limit precludes this. In the introduction, you need to tell the reader *what issue are you addressing, and why it is important* followed by *what have previous researchers discovered about this topic, and what is lacking about these findings that mean that further research is necessary* finishing with *an overview of the research you propose and how it will fill the gaps in the findings that you identified*. The discussion gives an overview of your findings, their direct implications for the issues that you raised in the introduction, and wider implications for the topic (of map design) in general, or even wider implications such as usability in other domains, or cognitive psychology in general. If you think that harsh critics might disagree with your interpretations, anticipate complaints and rebut them if you can.
- In general, a good, balanced technical report should be 1/3 introduction, 1/3 method-results together, and 1/3 discussion.

The first presentation will be delivered on Thursday 1st March in the class

The second presentation will be delivered on Thursday 22nd March in the class

The deadline for the report is Thursday 5th May

Absence from assessment classes

If you are absent for a presentation you will be given an opportunity to give it in subsequent weeks. If this is not possible, e.g. due to absence during the final weeks, a presentation to a specially-convened audience will be scheduled. If the module is failed, then missed assessments, and/or substandard assessments may be submitted (again) at the discretion of the exam board.

Recommended Reading

Core Texts

- Ovenden, M. (2015). *Transit maps of the world* (2nd ed.). New York: Penguin.
- Roberts, M.J. (2012). *Underground maps unravelled, explorations in information design*. Wivenhoe, Essex: Published by the author.

All of the material taught on this course is at least touched on in my book. However, for more details on particular topics, there are other books that will be important sources and you should consult these as well for extra information. There is also specific reading allocated to each lecture.

Further Reading

Cognitive psychology

- Eysenck, M.W., & Keane, M.T. (2010). *Cognitive psychology: A student's handbook*. Hove: Psychology Press.

- Mackintosh, N. J. (2011). *IQ and human intelligence*. Oxford: Oxford University Press.

Research methodology

- Roberts, M.J., & Russo, R. (1999). *A student's guide to Analysis of Variance*. London: Routledge.

- Robson, C. (1994). *Experiment, design and statistics in psychology* (3rd ed). London: Penguin. [Out of print, but easy to obtain.]

Human factors, information design, & usability

- Katz, J. (2012). *Designing information: Human factors and common sense in information design*. Hoboken, NJ: John Wiley.

- Norman, D.A. (1998). *The design of everyday things*. Cambridge MA: MIT Press.

- Shaw, P. (2011). *Helvetica and the New York City Subway system: The true (maybe) story*. Cambridge, MA: MIT Press.

History of design

- Cramsie, P. (2010). *The story of graphic design*. London: British Library.

- Eskilson, S.J. (2007). *Graphic design: A new history*. London: Lawrence King Publishing.

- Woodham, J.M. (1997). *Twentieth Century design*. Oxford: Oxford University Press.

General cartography and map design

- Keates, J.S. (1997). *Understanding maps*. Harlow: Longman.

- Tyner, J.A. (2010). *Principles of map design*. New York: Guilford Press.

Transit maps and their history

- Dobbin, C. (2012). *London Underground maps: Art, design, cartography*. London: Lawrence King Publishing.

- Dodd, J. (2016). *Maps of London's Transport: Design variety in the first half of the Twentieth Century*. Harrow Weald: Capital Transport Publishing.

Dow, A. (2005). *Telling the passenger where to get off: George Dow and the development of the diagrammatic railway map*. Harrow Weald: Capital Transport Publishing.

Garland, K. (1994). *Mr Beck's Underground map*. Harrow Weald: Capital Transport Publishing.

Leboff, D., & Demuth, T. (1999). *No need to ask: Early maps of London's Underground*. Harrow Weald: Capital Transport Publishing.

Lloyd, P.B. (2012). *Vignelli: Transit maps*. Rochester, NY: RIT Cary Graphic Arts Press.

Ovenden, M. (2009). *Paris Underground: The Maps, Stations, and Design of the Metro*. New York: Penguin.

Roberts, M. J. (2005). *Underground maps after Beck*. Harrow Weald: Capital Transport Publishing.

Additional Resources and Final Suggestions

Online materials, including copies of lectures are available on my personal web pages: www.tubemapcentral.com where you will also find more articles, maps, links to other websites and other books. The specific link to the course materials page is: <http://www.tubemapcentral.com/speaking/university.html>

For designing the map, **ANY** suitable computer graphics package may be used. The main criterion is that it is a **VECTOR GRAPHICS** package. *Adobe Illustrator* is the most well-known, but it is expensive. My own preferred packages are *Canvas* and *Intaglio*. I will be using Intaglio to demonstrate general principles, and copies will be available on departmental computers. It may be purchased for a personal computer at a low cost (www.purgatorydesign.com). Alternatively, there are a number of free packages available for download on the internet, and any of these will be adequate for the purpose of designing a schematic map for a medium-sized network.

The humble transit map somehow captures public attention in a way that no other item of information design is able to. Strange new creations go viral, and ham-fisted official attempts prompt a public outcry. Publish any new map on the internet, and you can expect a bizarre combination of praise and adoration alongside simultaneous insults and condemnation. Search for maps on the internet for yourself, read the articles, look at the comments. From the perspective of a psychologist, think about the diversity of opinions, their origins, why they are held so strongly, the extent to which they are they defensible, the empirical work necessary to test whether they are valid. Everyone has an opinion about design, but where is the evidence? Design effectiveness and acceptability are areas where psychologists can potentially make a massive difference, not just for transit maps but for any situation where complicated information must be packaged so that the user can understand and make use of it quickly and without making errors.

MJ Roberts, 26th January 2018