PS118
Applied Psychology

Human-Machine Interaction 2
Transit Maps as Information Design

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Notes About Reading (HMI-2)

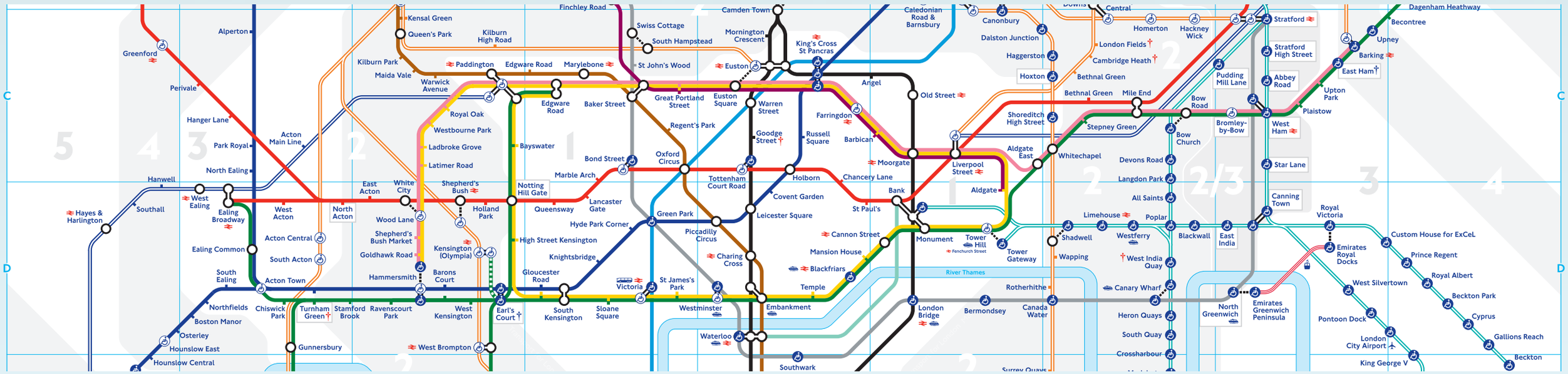
- **My research into *Information Design***
  - Transit maps as complex information design
    - Roberts, M.J. (2014). Schematic maps in the laboratory. Schematic Mapping Workshop 2014, University of Essex, April.
    - Roberts, M.J. (2014). What's your theory of effective schematic map design? Schematic Mapping Workshop 2014, University of Essex, April.
    - Roberts, M.J. (2017). From reasoning and intelligence research to information design. In N.D. Galbraith, E. Lucas & D. Over (eds.), The thinking mind: A festschrift for Ken Manktelow (pp. 178-190). Hove, UK: Psychology Press.
    - Roberts, M.J. (2019). Us versus them: Ensuring practical and psychological utility of measurements of schematic map usability. Schematic Mapping Workshop 2019, TU Wien, April.
    - Wu, H.-Y., Niedermann, B., Takahashi, S., Roberts, M.J., & Nöllenburg, M. (2020). A Survey on Transit Map Layout — from Design, Machine, and Human Perspectives. Computer Graphics Forum (Proceedings of EuroVis 2020), Vol. 39, No. 3.

Plan for the Second Lecture

- Transit maps as complex information design
  - Why transit maps?
  - How to create an effective transit map?
  - Psychology and transit maps
    - Applying psychology findings to prescribe design
    - Using psychology findings to critique design
- Usability testing
  - Applying psychology methodology to evaluate design
  - Pitfalls in usability testing

Why Transit Maps

- Transit maps, showing routes and connections, are displayed on public transport networks worldwide
- Have many advantages over apps
- Routes are often shown in diagrammatic form, usually distorting geography: *schematic maps*
- Schematic maps are diverse in approach and implementation (Ovenden, 2015)



Why Transit Maps

- Würzburg network

Das Liniennetz der Stadt Würzburg

Linienverzeichnis

Linie	Linienverlauf
Straßenbahnlinien	
Linie 1	Sanderau - Hauptbahnhof - Grombühl / Uni-Kliniken
Linie 2	Hauptbahnhof - Zellerau
Linie 3	Heuchelhof - Heidingsfeld - Hauptbahnhof
Linie 4	Sanderau - (Hauptbahnhof) - Zellerau
Linie 5	Rottenbauer - Heuchelhof - Heidingsfeld - Hauptbahnhof - Grombühl / Uni-Kliniken
Omnibuslinien	
Linie 6	Stadtmitte - Gartenstadt Keesburg
Linie 7	Sanderring - Zellerau - Sanderring
Linie 8w	Zollhaus Steinbachtal - Waldfriedhof
Linie 8s	Zollhaus Steinbachtal - Steinbachtal
Linie 9	Residenzplatz - Kulturspeicher - Festung
Linie 10	Sanderring - Hubland (Uni-Zentrum)
Linie 11	Busbahnhof - Veitshöchheim
Linie 12	Busbahnhof - Lindleinsmühle - Versbach
Linie 13	Busbahnhof - Unterdürrbach - Oberdürrbach - Grombühl / Uni-Kliniken
Linie 14	Busbahnhof - Gerbrunn
Linie 114	Busbahnhof - Frauenland / Wittelsbacher Platz - Hubland (Uni-Zentrum)
Linie 15	Busbahnhof - Sanderring - Randersacker - (Gerbrunn)
Linie 16	Stadtmitte - Frauenland - Lehmgrubensiedlung - Heidingsfeld
Linie 17	Busbahnhof - Sanderring - Höchberg
Linie 18	Busbahnhof - Zellerau - Höchberg
Linie 19	Busbahnhof - Veitshöchheim - Güntersleben
Linie 20	Busbahnhof - Aumühle - Lengfeld
Linie 21	Busbahnhof - Lindleinsmühle - Lengfeld
Linie 22	Busbahnhof - Zell - Margetshöchheim
Linie 24	Grombühl - Uni-Kliniken Bereich A - Schwarzenberg - Lindleinsmühle - Lengfeld / Gewerbegebiet Nord
Linie 25	Busbahnhof - Lengfeld / Gewerbegebiet Nord
Linie 26	Busbahnhof - Wöllrieder Hof - Pilzriggrund
Linie 27	Busbahnhof - Neuer Hafen / Dürrbachau
Linie 28	Busbahnhof - Mönchberg
Linie 31	Heidingsfeld / Reuterstraße - Reichenberg
Linie 33	Heidingsfeld / Reuterstr. - Winterhäuser Str. - Katzenberg - Heidingsfeld / Reuterstr.
Linie 34	Heidingsfeld / Reuterstr. - Sanderau - Frauenland - Uni-Zentrum - Gerbrunn - Wöllrieder Hof - Lengfeld
Linie 35	Sanderring - Käppele - Frankenwarte

Zeichenerklärung

- Straßenbahnlinien
- Buslinien
- 18 Liniennummer
- 11 Endhaltestelle
- Grombühl Stadtteil / Fahrtziel in der Stadt
- Gerbrunn Nachbarort im Landkreis Würzburg
- Grenzhaltestelle zu Großwabe
- Haltestelle

Ihr VVM-Service

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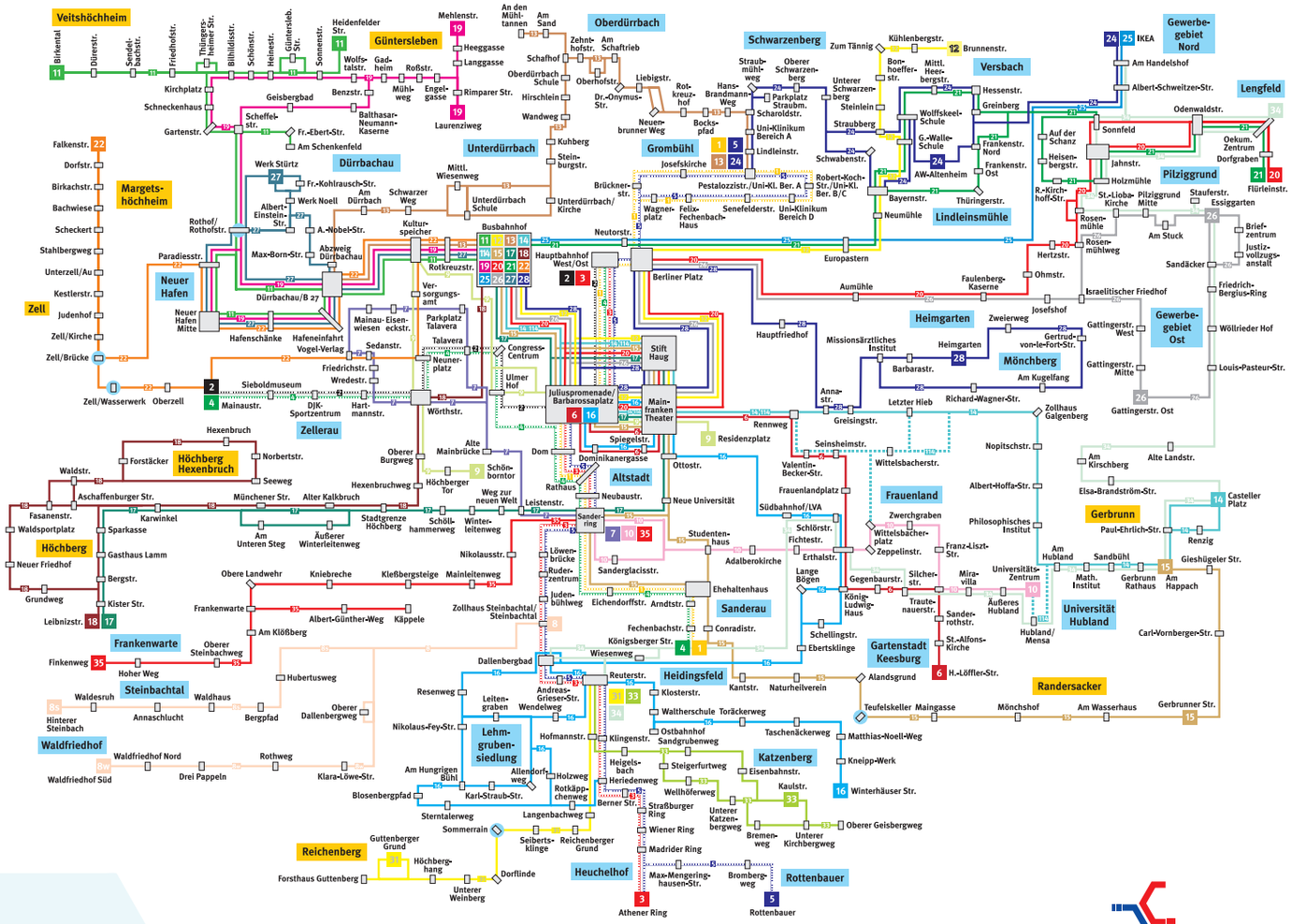
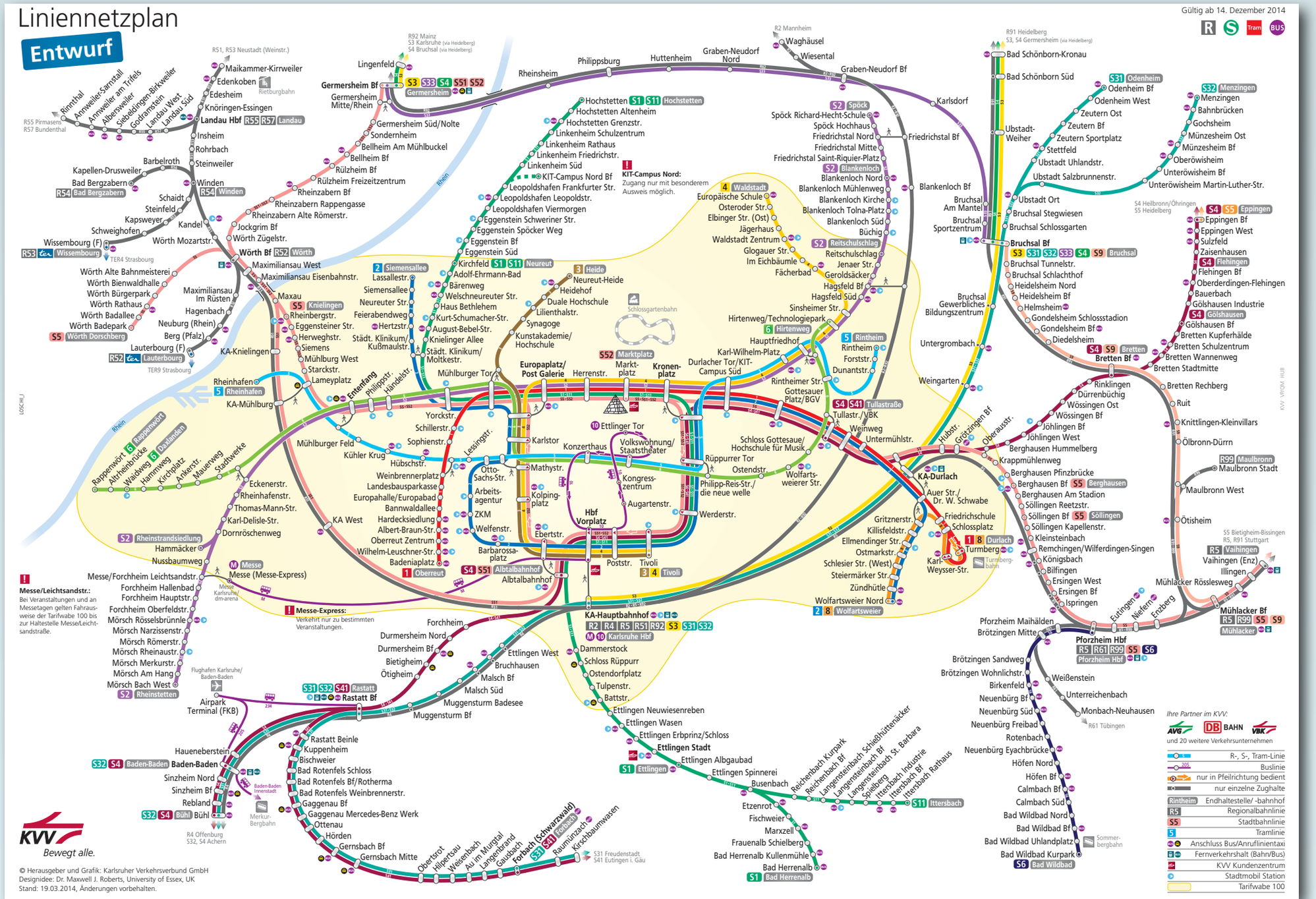
mail@vvm-info.de



Why Transit Maps

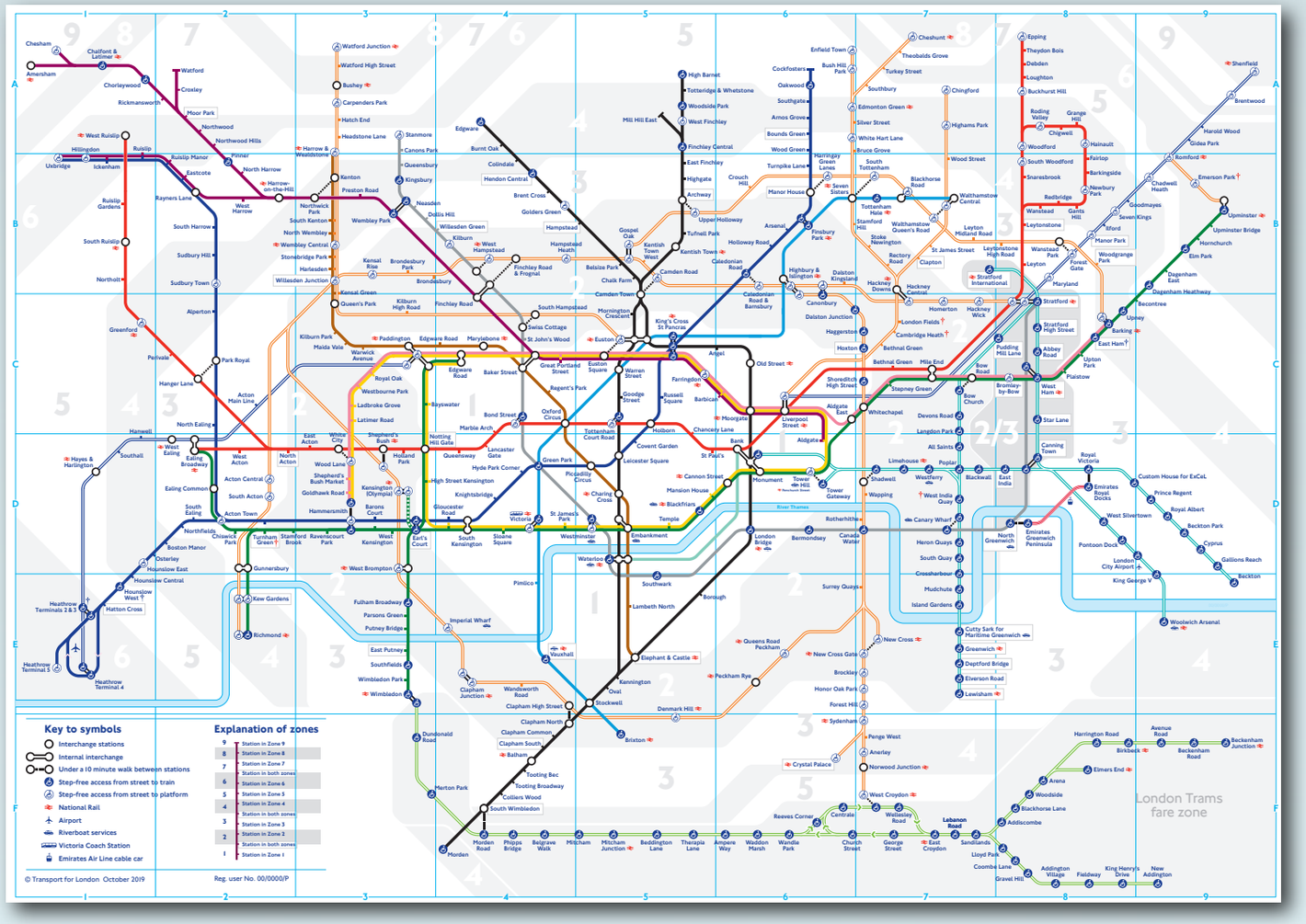
- Karlsruhe network



Why Transit Maps

- Most real life problems are multidisciplinary
    - Transit maps no exception
        - Information design and wayfinding
        - Graphic design
        - Marketing
        - Cartography
        - Computer science and data visualisation
        - Psychology; cognitive and social, human factors
        - Art and aesthetics
        - Architecture

Why Transit Maps



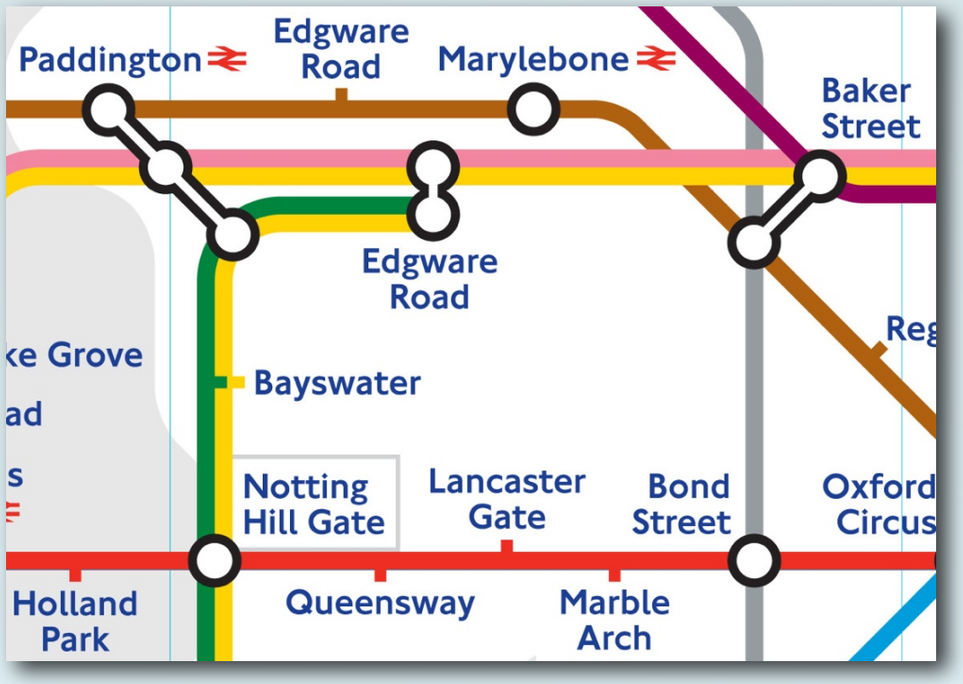
- Why does this look the way it does?
- How does this help?
- Could it be different?
- Could it be better (or worse)?

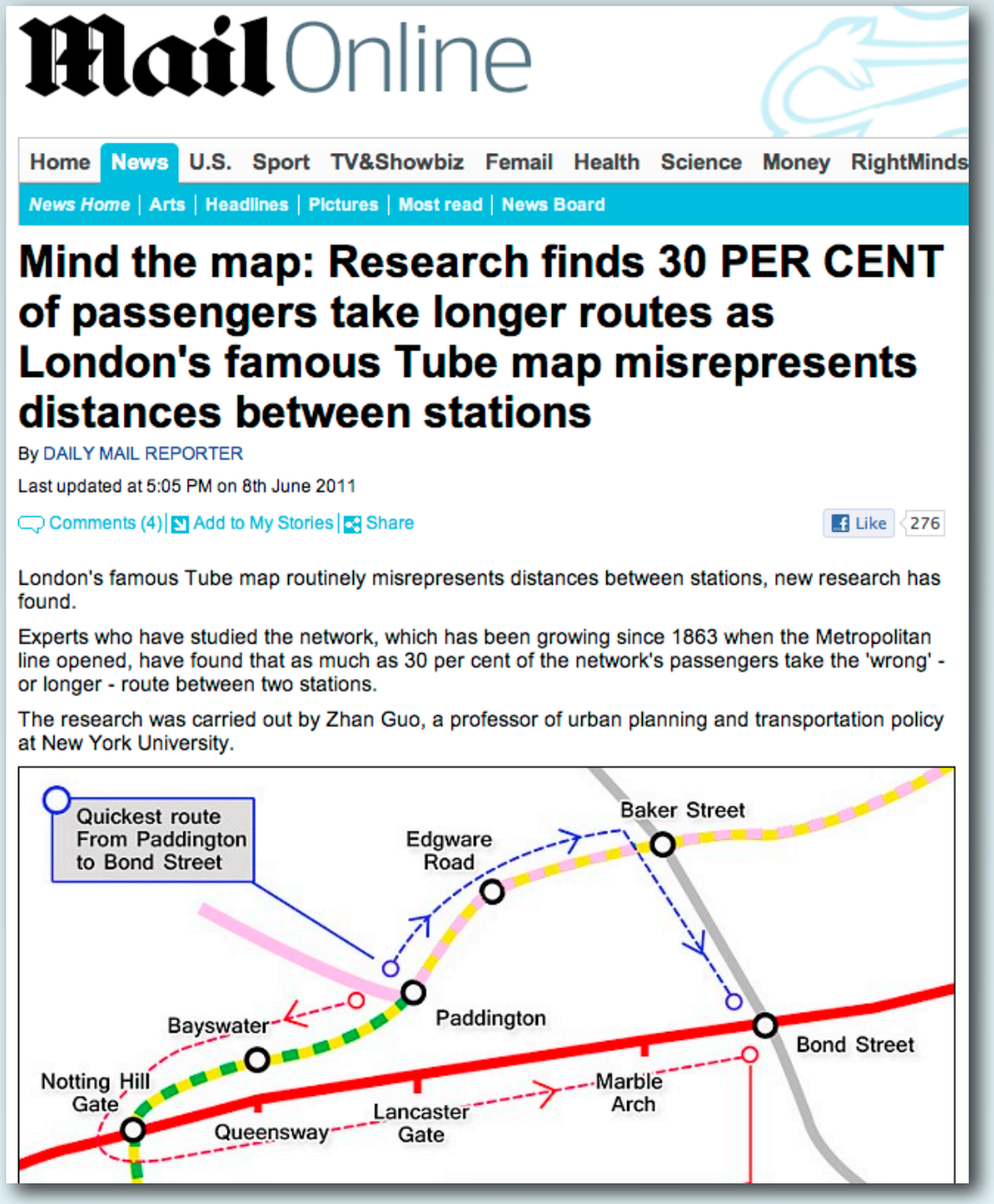
How to Create an Effective Transit Map?

- Advice from journalists
- Specifications from London Transport
- Guidance from designers
- Beliefs of the general public

How to Create an Effective Transit Map?

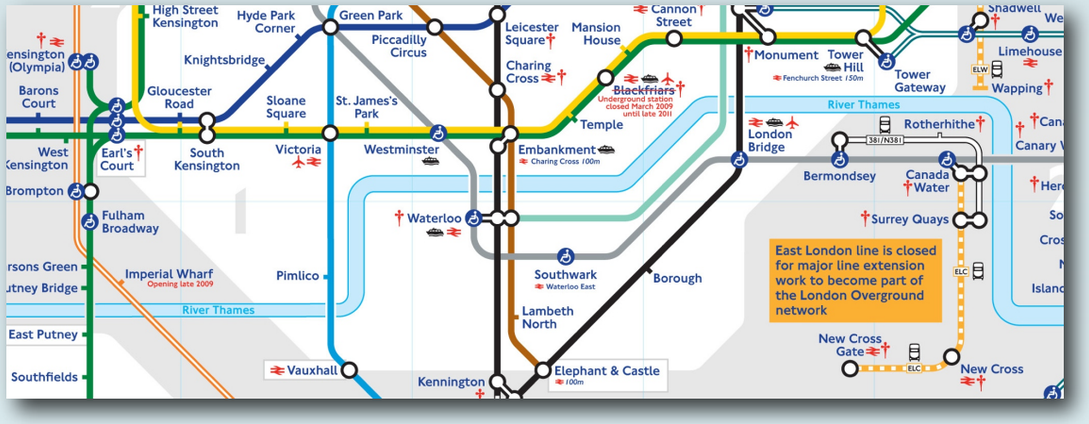
- Advice from journalists
  - Don’t distort geography

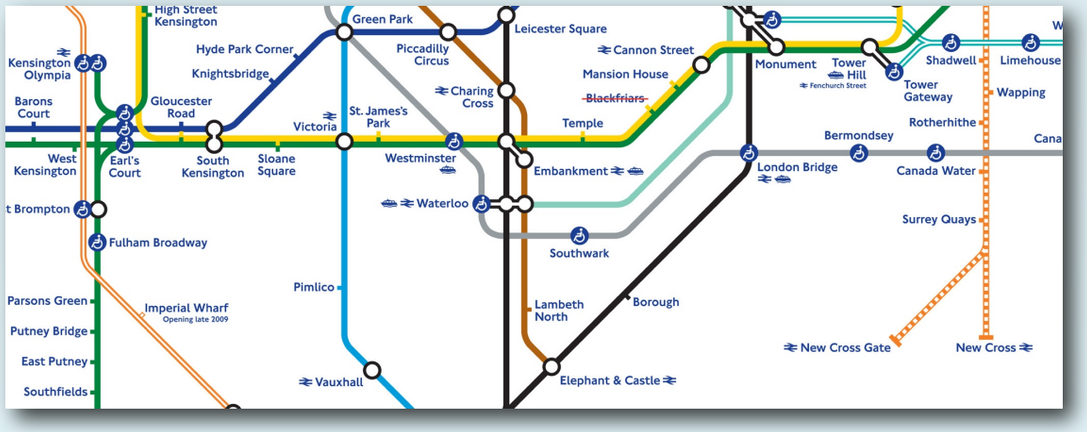


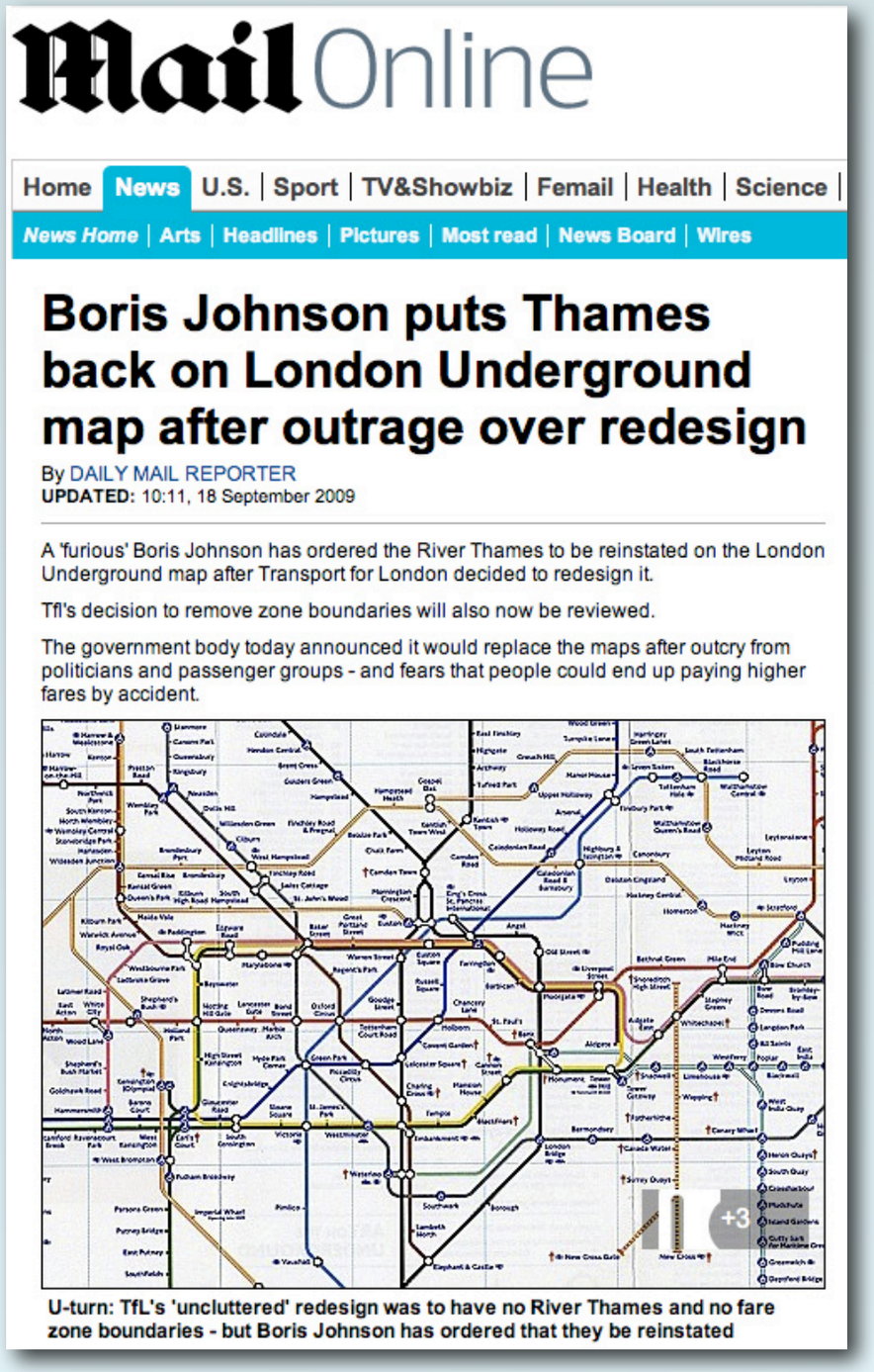


How to Create an Effective Transit Map?

- Advice from journalists
  - Don’t leave the river off







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Boris Johnson puts Thames back on London Underground map after outrage over redesign

By DAILY MAIL REPORTER
UPDATED: 10:11, 18 September 2009

A 'furious' Boris Johnson has ordered the River Thames to be reinstated on the London Underground map after Transport for London decided to redesign it.

Tfl's decision to remove zone boundaries will also now be reviewed.

The government body today announced it would replace the maps after outcry from politicians and passenger groups - and fears that people could end up paying higher fares by accident.

U-turn: TfL's 'uncluttered' redesign was to have no River Thames and no fare zone boundaries - but Boris Johnson has ordered that they be reinstated

How to Create an Effective Transit Map?

- Advice from journalists
  - Throw it all away

theguardian

Is it the end of the line for London's iconic tube map?

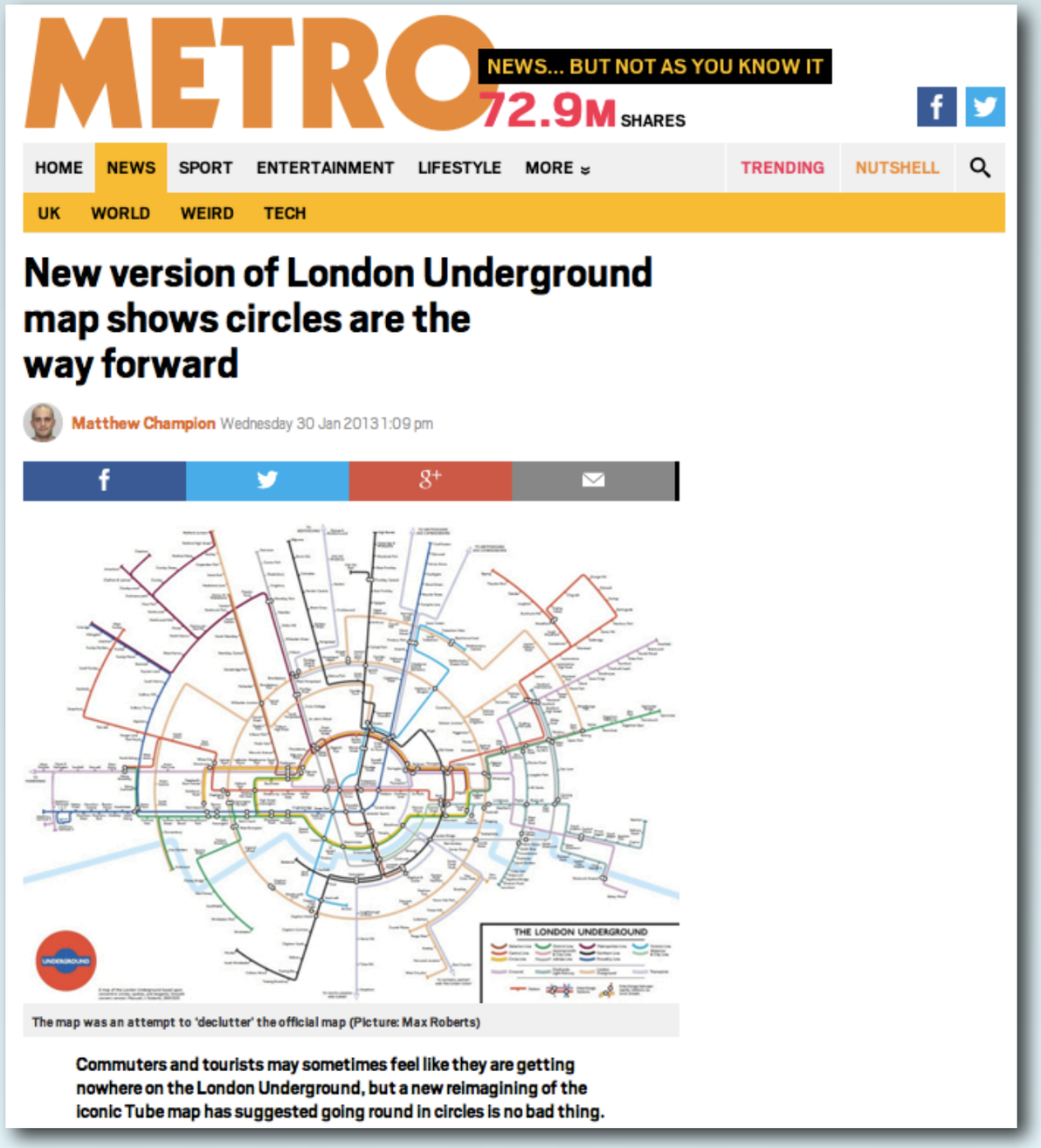
The expansion of the Oyster card brings yet more change for Harry Beck's classic design. It's time to go back to the drawing board

Jonathan Glancey
theguardian.com,
Thursday 26 November 2009 12.39 GMT

A thing of clarity and beauty ... detail from Harry Beck's 1931 tube map

How to Create an Effective Transit Map?

- Advice from journalists
  - And try something completely different!



METRO
NEWS... BUT NOT AS YOU KNOW IT
72.9M SHARES

HOME | NEWS | SPORT | ENTERTAINMENT | LIFESTYLE | MORE | TRENDING | NUTSHELL

UK | WORLD | WEIRD | TECH

New version of London Underground map shows circles are the way forward

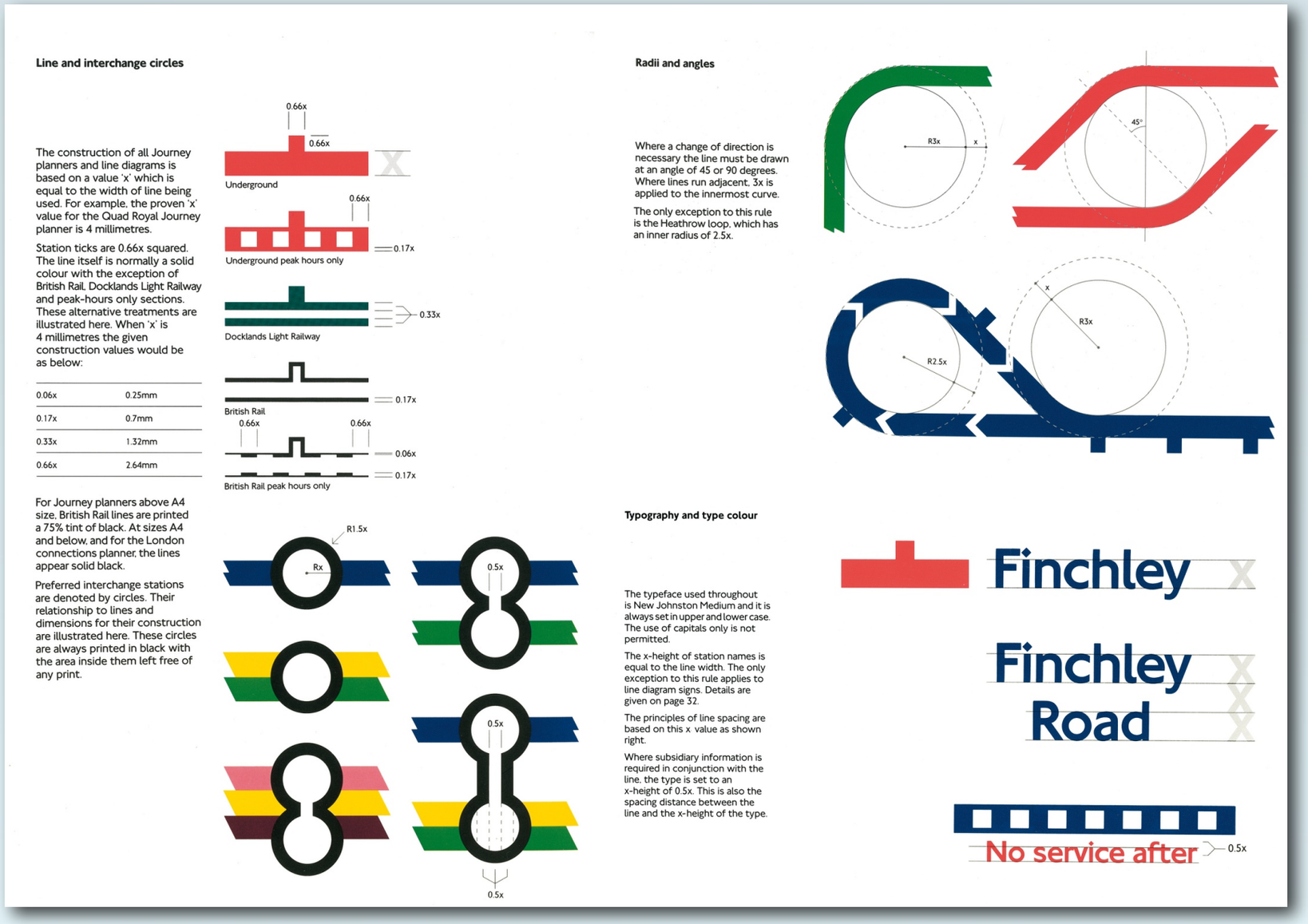
Matthew Champion Wednesday 30 Jan 2013 1:09 pm

The map was an attempt to 'declutter' the official map (Picture: Max Roberts)

Commuters and tourists may sometimes feel like they are getting nowhere on the London Underground, but a new reimagining of the iconic Tube map has suggested going round in circles is no bad thing.

How to Create an Effective Transit Map?

- Specifications from London Transport
  - 1993 London Regional Transport style guide compiled by Henrion, Ludlow, & Schmidt



Line and interchange circles

The construction of all Journey planners and line diagrams is based on a value 'x' which is equal to the width of line being used. For example, the proven 'x' value for the Quad Royal Journey planner is 4 millimetres.

Station ticks are 0.66x squared. The line itself is normally a solid colour with the exception of British Rail, Docklands Light Railway and peak-hours only sections. These alternative treatments are illustrated here. When 'x' is 4 millimetres the given construction values would be as below:

0.06x	0.25mm
0.17x	0.7mm
0.33x	1.32mm
0.66x	2.64mm

For Journey planners above A4 size, British Rail lines are printed a 75% tint of black. At sizes A4 and below, and for the London connections planner, the lines appear solid black.

Preferred interchange stations are denoted by circles. Their relationship to lines and dimensions for their construction are illustrated here. These circles are always printed in black with the area inside them left free of any print.

0.66x
0.66x
Underground

0.66x
0.17x
Underground peak hours only

0.33x
Docklands Light Railway

0.17x
British Rail

0.66x
0.66x
0.06x
0.17x
British Rail peak hours only

R1.5x
Rx
0.5x
0.5x
0.5x

Radii and angles

Where a change of direction is necessary the line must be drawn at an angle of 45 or 90 degrees. Where lines run adjacent, 3x is applied to the innermost curve.

The only exception to this rule is the Heathrow loop, which has an inner radius of 2.5x.

R3x
x
45°
x
R3x
R2.5x

Typography and type colour

The typeface used throughout is New Johnston Medium and it is always set in upper and lower case. The use of capitals only is not permitted.

The x-height of station names is equal to the line width. The only exception to this rule applies to line diagram signs. Details are given on page 32.

The principles of line spacing are based on this x value as shown right.

Where subsidiary information is required in conjunction with the line, the type is set to an x-height of 0.5x. This is also the spacing distance between the line and the x-height of the type.

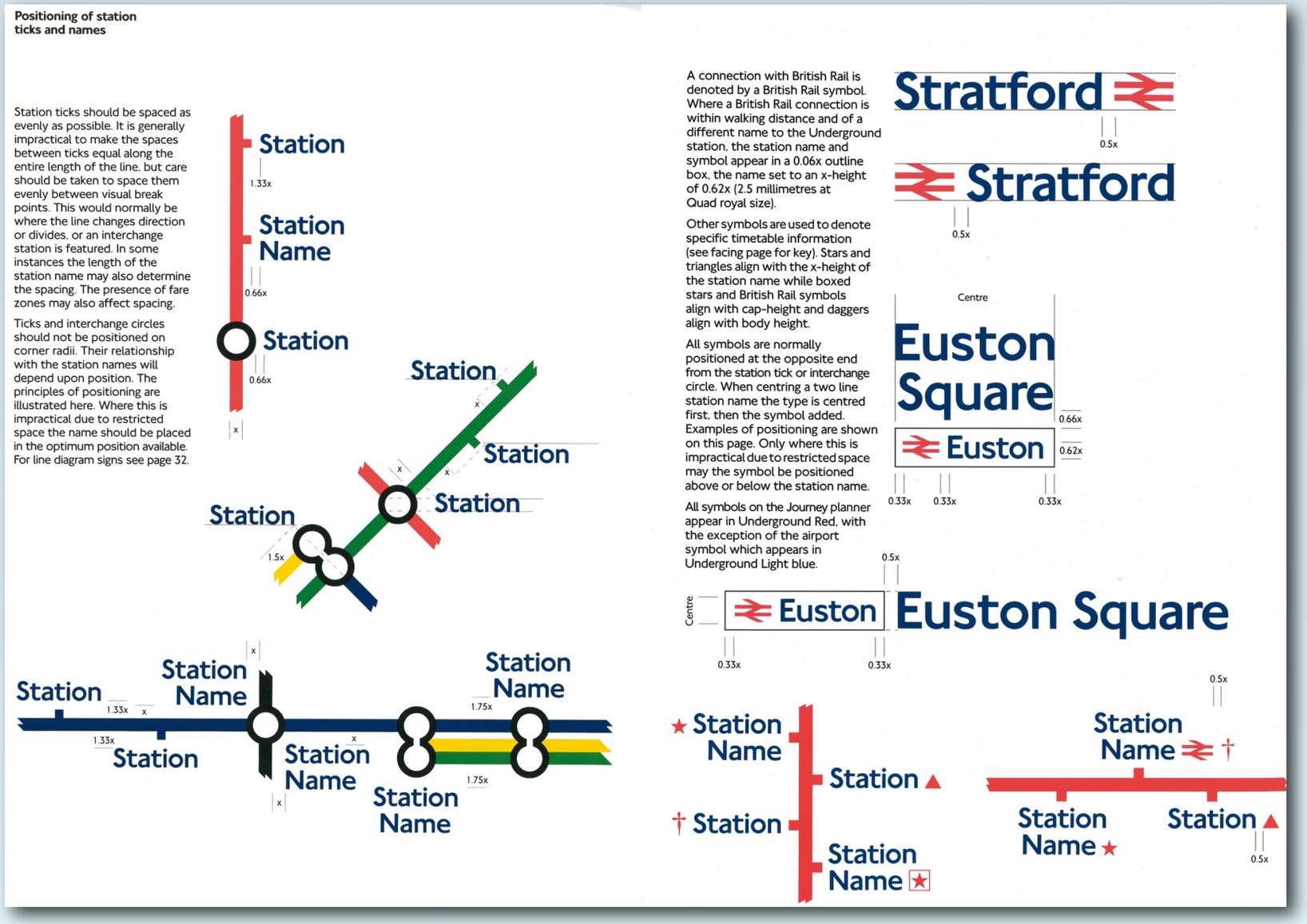
Finchley

Finchley
Road

No service after
0.5x

How to Create an Effective Transit Map?

- Specifications from London Transport
  - 1993 LRT Style guide: lots of minutiae but nothing about the overall configuration



Positioning of station ticks and names

Station ticks should be spaced as evenly as possible. It is generally impractical to make the spaces between ticks equal along the entire length of the line, but care should be taken to space them evenly between visual break points. This would normally be where the line changes direction or divides, or an interchange station is featured. In some instances the length of the station name may also determine the spacing. The presence of fare zones may also affect spacing.

Ticks and interchange circles should not be positioned on corner radii. Their relationship with the station names will depend upon position. The principles of positioning are illustrated here. Where this is impractical due to restricted space the name should be placed in the optimum position available. For line diagram signs see page 32.

Station
1.33x
Station
Name
0.66x
Station
0.66x
x
x
Station
x
Station
x
x
Station
Station
1.5x
Station
Station
Name
x
Station
1.33x
x
1.33x
Station
Station
Name
x
Station
Name
1.75x
1.75x
Station
Name

A connection with British Rail is denoted by a British Rail symbol. Where a British Rail connection is within walking distance and of a different name to the Underground station, the station name and symbol appear in a 0.06x outline box, the name set to an x-height of 0.62x (2.5 millimetres at Quad royal size).

Other symbols are used to denote specific timetable information (see facing page for key). Stars and triangles align with the x-height of the station name while boxed stars and British Rail symbols align with cap-height and daggers align with body height.

All symbols are normally positioned at the opposite end from the station tick or interchange circle. When centring a two line station name the type is centred first, then the symbol added. Examples of positioning are shown on this page. Only where this is impractical due to restricted space may the symbol be positioned above or below the station name.

All symbols on the Journey planner appear in Underground Red, with the exception of the airport symbol which appears in Underground Light blue.

Stratford
0.5x
Stratford
0.5x
Centre
Euston
Square
0.66x
Euston
0.62x
0.33x
0.33x
0.33x
0.5x
Centre
Euston
Euston Square
0.33x
0.33x
★ Station
Name
Station ▲
† Station
Station
Name ★
0.5x
Station
Name †
Station
Name ★
Station ▲
0.5x

How to Create an Effective Transit Map?

- Guidance from designers
  - Compiled by Ovenden (2008)

Good practice in diagram design

This list of concepts is sometimes abbreviated throughout the book as "Good design practice"

- **Remove unnecessary topography** (though leaving important waterways or green spaces – often stylised – is sometimes considered useful for a vague orientation). Vignelli says he *"I would even love to had dropped all surface geography from the New York Subway diagram".*
- **No streets are shown** (though occasionally key highways like arterial roads may be acceptable).
- **Straighten-out lines** (avoid changing direction of a line unless totally necessary - Roberts says *"an unnecessary change of direction is a design flaw"*).
- **Use only horizontal and vertical lines and one diagonal angle**. (Spandonine says: ...*"to use any more is both pointless and untidy"*
- **45 degrees is the most common angle for all diagonals** (though 20, 30, 35, 60 and 65 have also been utilized to good effect).
- **Create at least one simple axis** (north-south or east-west if relevant, though stylised 'circle' lines are also utilized as perfect spheres).
- **Compress the suburbs** (or areas where stations are spaced far apart geographically).
- **Enlarge central area** (or areas where stations are in close proximity geographically. Beck said: *"I tried to imagine that I was using a convex lens.....to present the central area on a larger scale").*
- **Do not change line direction under a station marker** (especially at correspondences). Foale says: *"The eye can cope with sections of line passing under things but if a direction change occurs while the line is beneath a symbol or another line, it can be quite confusing"*
- **Do not change line direction more than once between stations.** (It hampers clarity).
- **Leave adequate space for the text of the station name** (it's as crucial as plotting the lines) Foale says; *"the space for text is as important as the trajectory of the lines".*
- **Station names should NEVER crash over lines.**
- **Station names must be close to station marker** (and clearly relate to only one station).
- **Equalise station spacing wherever possible** (it looks neater).
- **Line width should be in aesthetic balance** (with the overall space and point size of station names.
- **All lines the same width** (unless they are part of another service i.e. Tram/mainline rail etc).
- **Station markers should be universal** (except at interchanges)

Simplification, legibility and common sense are the prime ingriedients of great design. A detail from the Lyon diagram by the Lattitude agency demonstrates how a 20 degree angle can be just as effective as 45.

- **Make a clear distinction between ordinary stations and interchanges** (this greatly helps passengers planning journeys).
- **Interchange station markers should be universal** (though at extremely complex or lengthy interchanges a white-line connector or variation of this symbol may be necessary as long as it fits into the overall style of the others)
- **Station markers should be ticks or 'blobs'** (dots, open circles and 'blobs' are the most common. Ticks come second. Avoid 'line breaks' as these can be extremely confusing).
- **Stations names should all be horizontal** (if at an angle, all should follow same angle; mixing horizontal names with angled ones looks bad).
- **Background colour is generally white** (pastel shades can be used if they do not clash with the line colours. Very dark backgrounds (black, dark blues etc) can work with the same proviso but primary colour backgrounds should be avoided).
- **Simplify complex interchanges/service patterns** (badly drawn correspondences will let down the entire diagram).
- **Keep all station names the same size** (though in systems where terminal stations play a key role, there may be a good reason to enhance their appearance in bold/caps/reversed out etc).
- **Keep all stations on the same side of the line** (this is rarely possible all over but looks neat on a long simple line).
- **Use upper and lower case text** (it is more humane).
- **Stay within corporate identity** (the in-house operator style should permeate every feature of the diagram - anything that does not fit will look hideously out of place when the diagram is on display in situ).
- **All text must be in the operator's house font** (never condense/alter a font to squeeze text in to a badly designed space).
- **Station names to read EXACTLY as on the platform signage** (this avoids passenger confusion. Abbreviations on the map to squeeze-in text are unacceptable – however heritage signage may still show abbreviations, in this case use the full name on the diagram). Woods says *"it's amazing how many official maps spell their own station names incorrectly"*
- **Diagrams do not need to be totally abstract** (with modern computer graphics and good design most diagrams can give reasonable reflection of at least the key features of city geography without losing all points above). Roberts says: *"preserve spatial relationships where possible"*
- **REMEMBER: Someone else may re-design your diagram at a later stage!** Beck said: [the diagram] **"***...must be thought of as a living and changing thing, with schematic and spare-part osteopathy going on all the time".*

How to Create an Effective Transit Map?

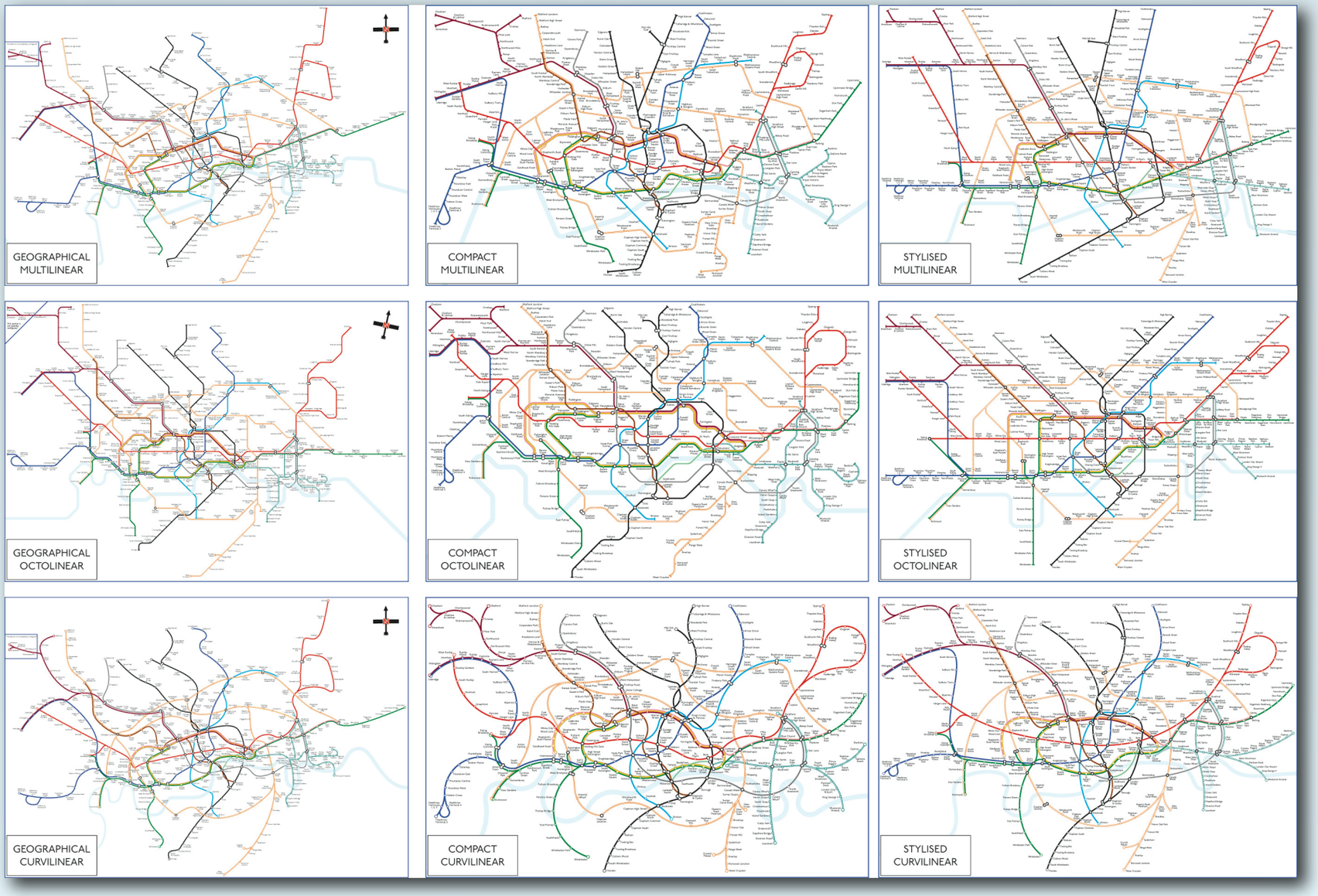
- Guidance from designers
  - Compiled by Ovenden (2008)
    - A sensible collection on the surface?
    - A large list, many criteria to take account of
      - Might be issues with prioritisation
    - Are all of these necessary for usability …

      … or might some merely affect attractiveness?
      Do not change line direction more than once between stations

      … or could breaking some of them yield benefits?
      Stations names should all be horizontal

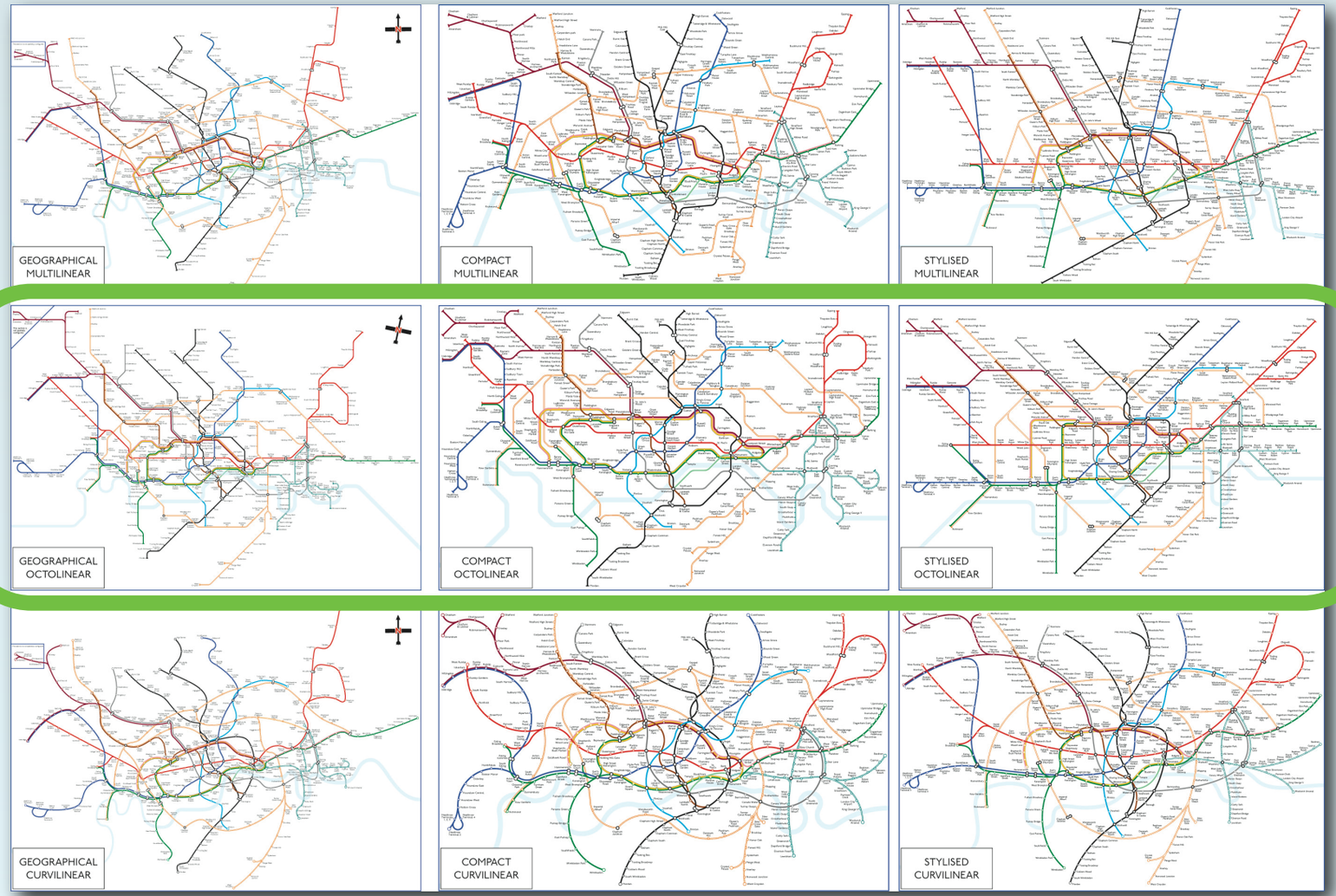
How to Create an Effective Transit Map?

- Beliefs by the general public
  - Roberts, Gray, & Lesnik (2017): 649 people rated nine different Underground maps for usability



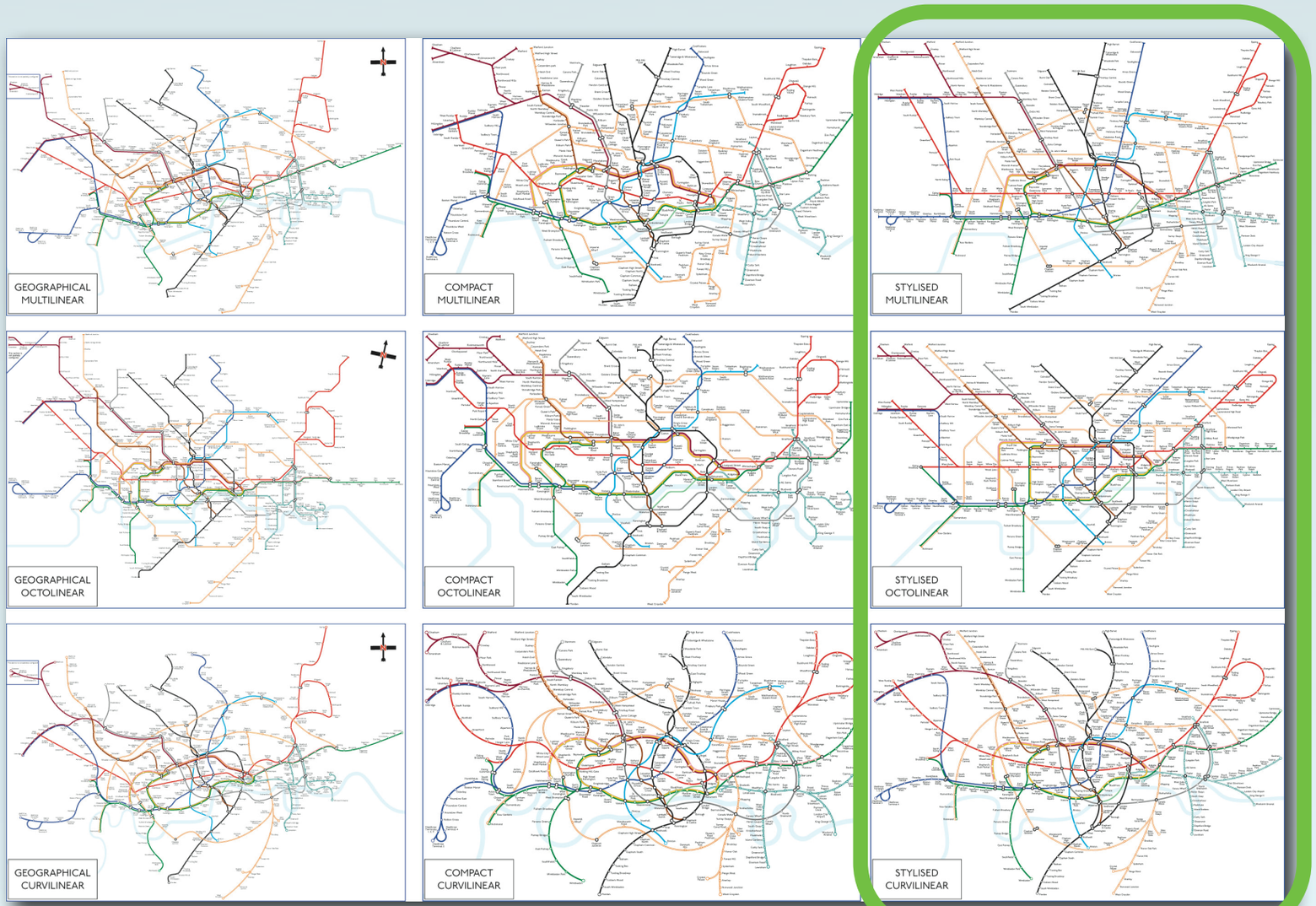
How to Create an Effective Transit Map?

- Beliefs by the general public
  - Roberts, Gray, & Lesnik (2017)
    - Half of the sample gave highest ratings to maps that used ***London design rules*** (horizontal, vertical 45° diagonals)



How to Create an Effective Transit Map?

- Beliefs by the general public
  - Roberts, Gray, & Lesnik (2017)
    - Half of the sample disagreed, highest ratings to maps that had the ***simplest line trajectories,*** very little overlap



How to Create an Effective Transit Map?

- Very little agreement within/between different sources
- Disorderly collection of suggestions that includes intuitive beliefs, prejudices and rules of thumb
- Very few of these based on research, or even logic
- ***We need evidence-based theories of design***

Psychology and Transit Maps

- *"I would like to make X better, can you help me?"*

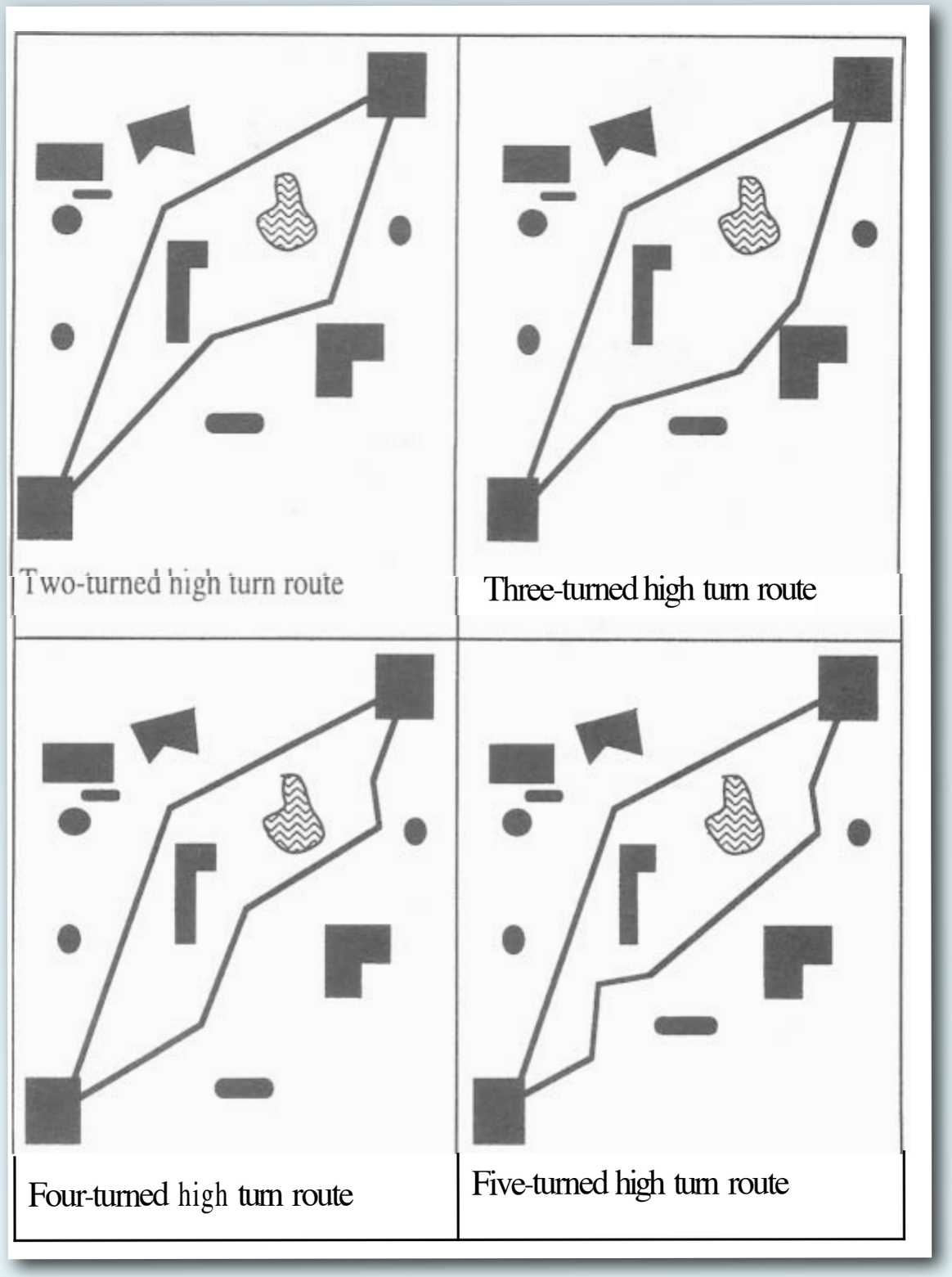
  "I have a problem with X, can you help me?"

- Three strategies, from last week:

1. Look at basic theories and findings:
   what does the textbook prescribe?
2. Use basic theories and findings to critique
   practice, what does the textbook suggest?
3. Use tools/methodologies that psychologists happen
   to have learnt in order to answer specific questions

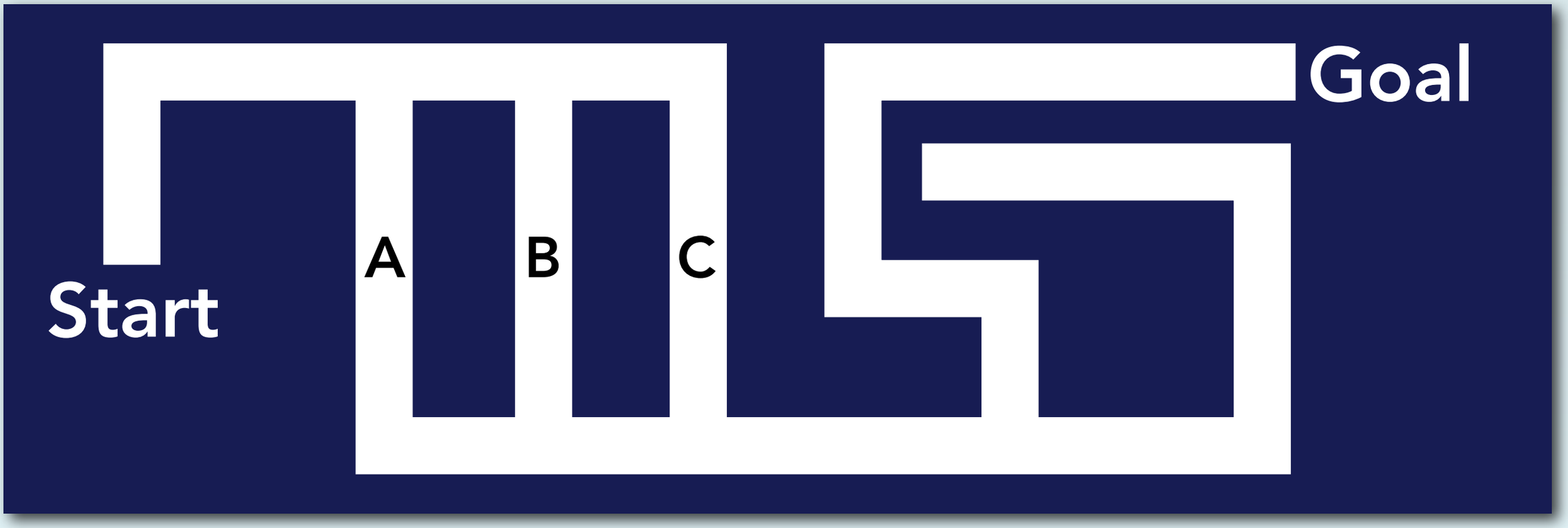
Psychology Findings to Prescribe Design

- Path choice research
  - Bailenson, Shum, & Uttal (2000): preferred route has fewest turns
    - E.g., all routes same distance, as number of turns increases, popularity of route decreases



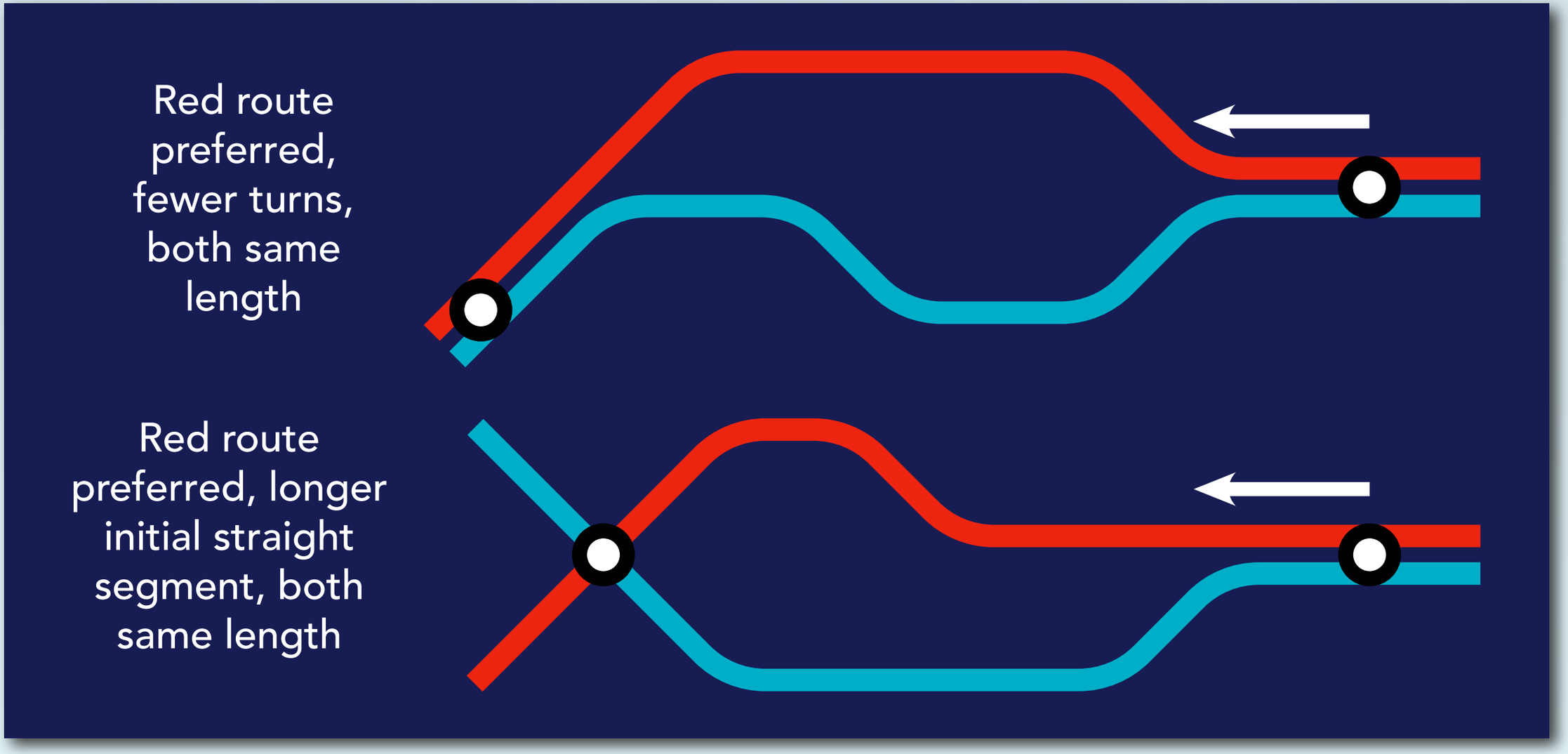
Psychology Findings to Prescribe Design

- Path choice research
  - Christenfeld (1995): preferred route has greatest distance before the first change of direction
    - E.g., route C preferred in this maze, even though in full view



Psychology Findings to Prescribe Design

- Path choice research
  - Combined findings suggest route choice biases



- ***Design maps to encourage choices, manage demand***

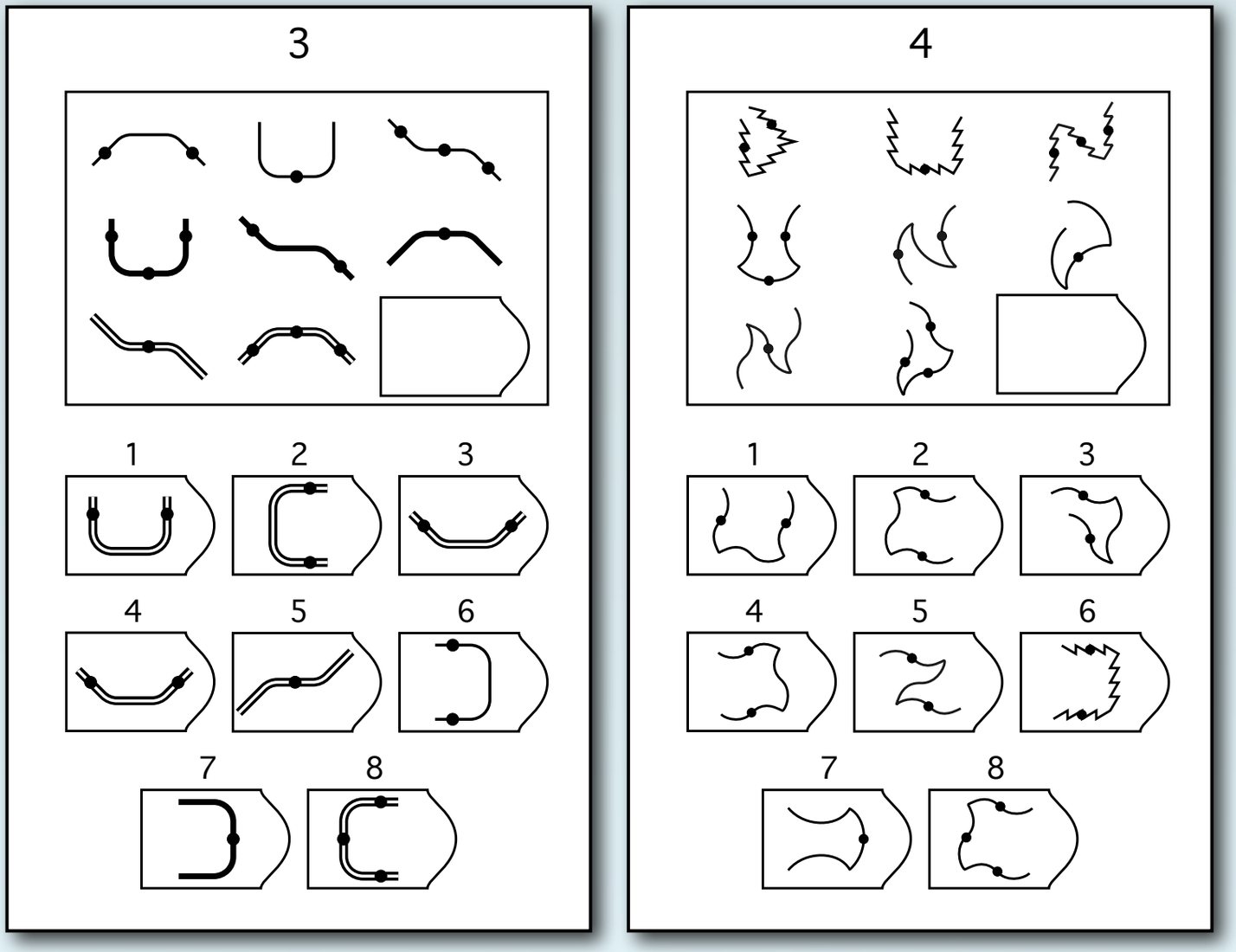
Psychology Findings to Critique Design

- Intelligence test item difficulty: Roberts (2005, 2017)
  - Observation: simplified line trajectories no longer a London Underground design priority post-1988
  - Could this be a bad thing? Why? [1987 vs. 1990]

Psychology Findings to Critique Design

- Intelligence test item difficulty: Roberts (2005, 2017)
  - Visual complexity makes Raven's Matrices difficult by concealing underlying item structure and logic

Visually simple, easier to solve



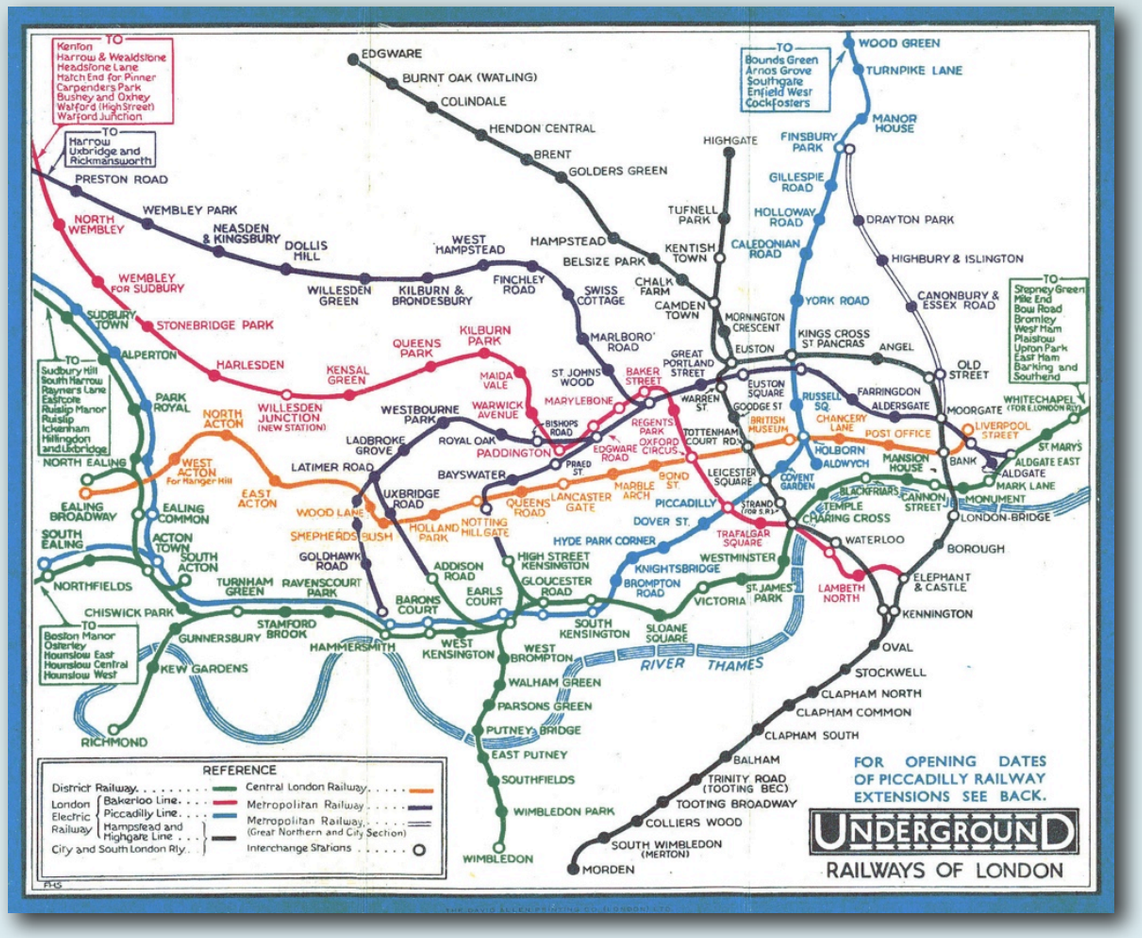
Visually complex, harder to solve

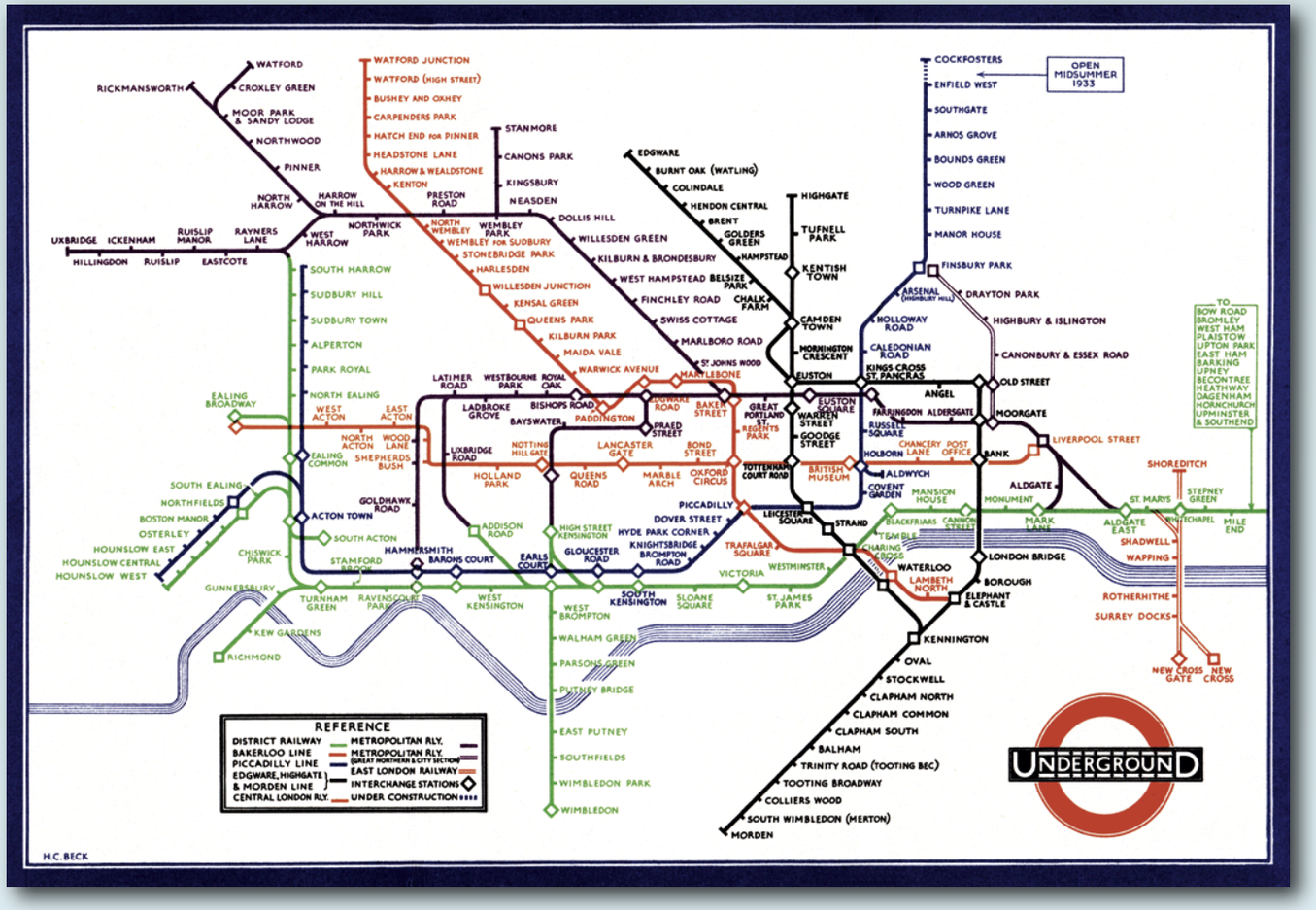
Psychology Findings to Critique Design

- Intelligence test item difficulty: Roberts (2005, 2017)
  - A poorly designed transit map
    is like a difficult intelligence test!
    - Complex line trajectories hide map elements
      and their relatedness in much the same way
    - Underlying network structure buried in the
      disorder, harder to understand and learn

Psychology Findings to Critique Design

- Intelligence test item difficulty: Roberts (2005, 2017)





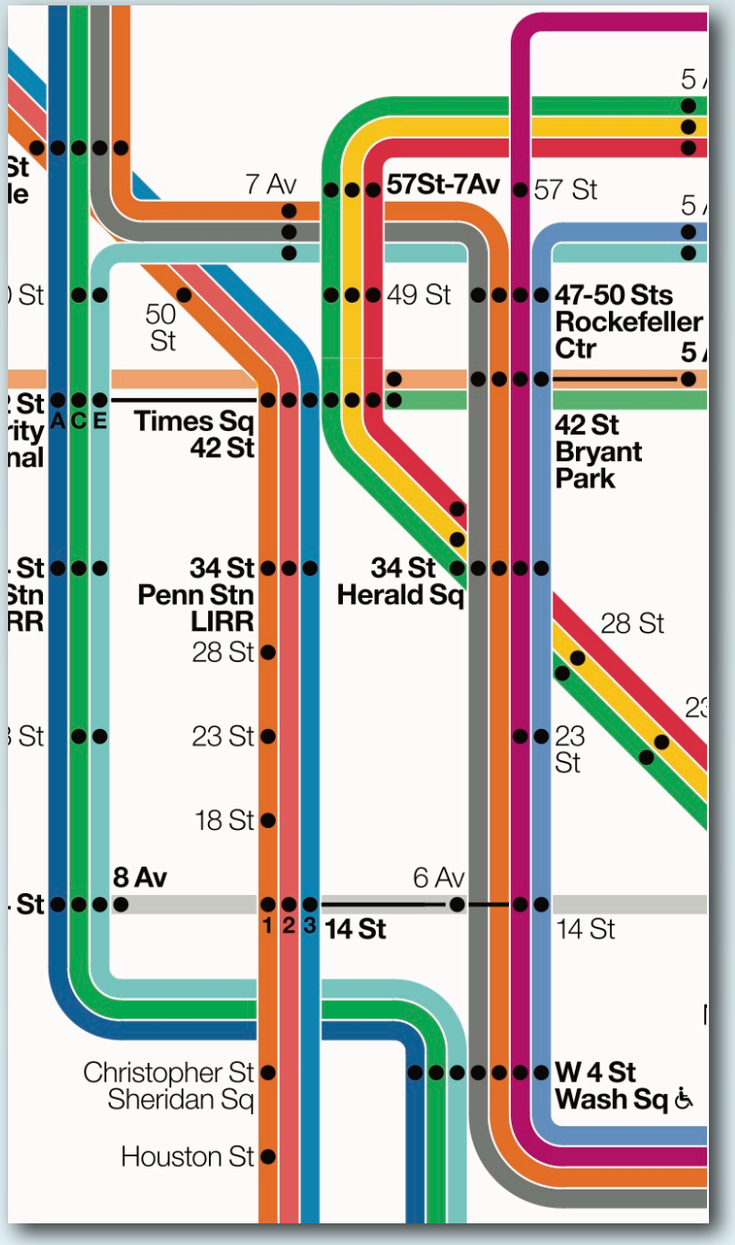
- Diagram is *pre-organised:* elements easy to identify
- Network structure easier to understand
- Cognitive load of journey planning reduced

Psychology Findings to Critique Design

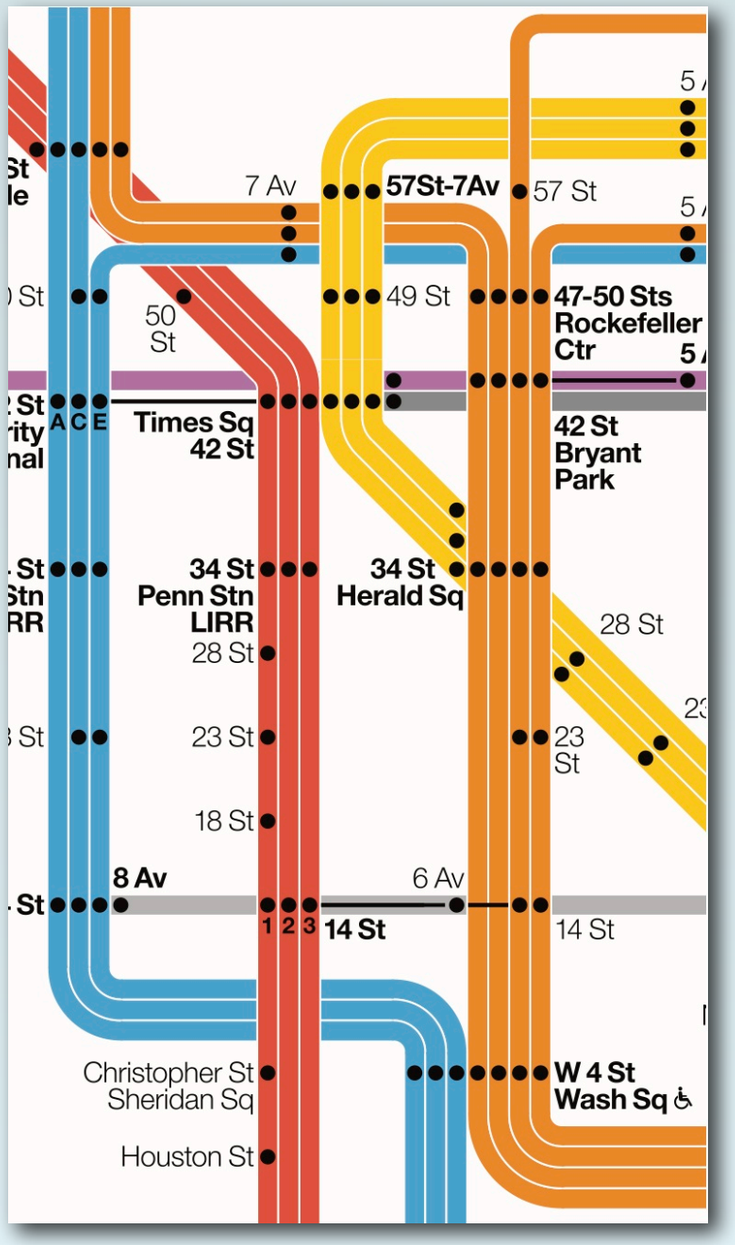
- Intelligence test item difficulty: Roberts (2005, 2017)
  - Crucially, this is an argument by analogy
  - ***Could be a false analogy***
  - These sorts of assertions need to be tested empirically to confirm theoretical hunches

Psychology Methodology to Evaluate Design

- How should maps be colour-coded?
  Lloyd, Rodgers, & Roberts (2018): New York City Subway



Route coding



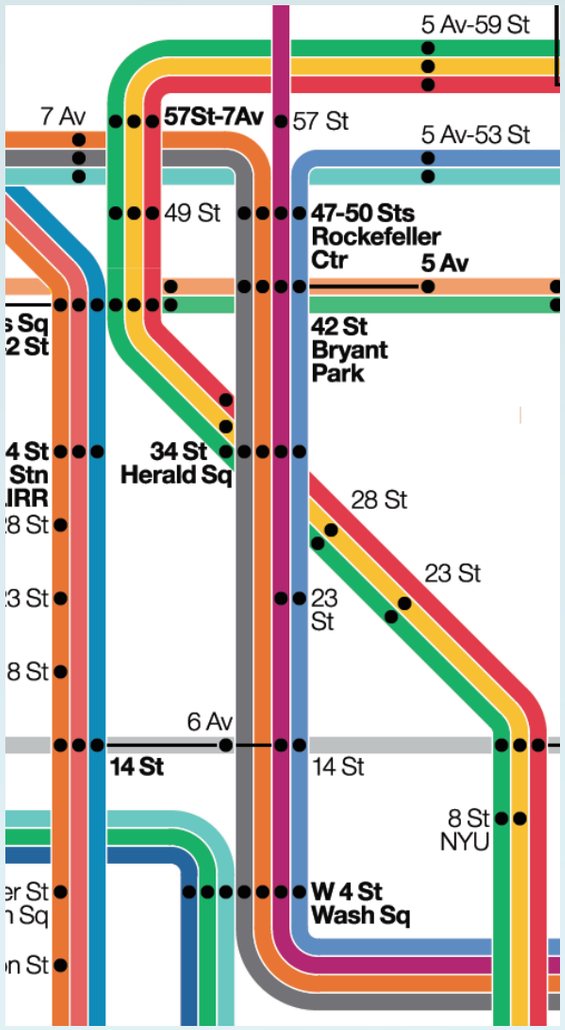
Trunk coding

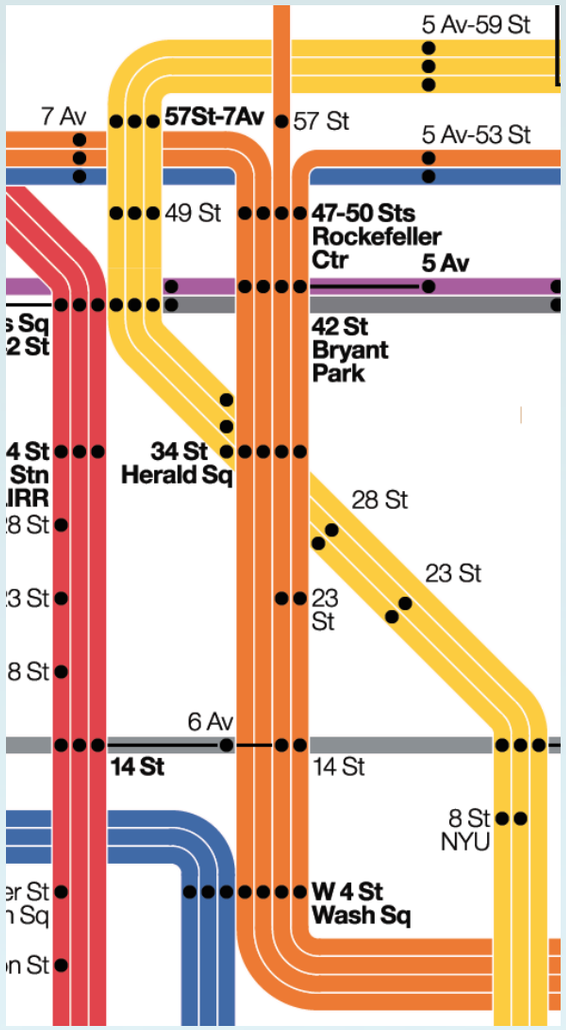
Psychology Methodology to Evaluate Design

- How should maps be colour-coded?
  Lloyd, Rodgers, & Roberts (2018): New York City Subway
  - 191 Ss tested on one map each, given 17 trials
    - Direct-line verification task:
      can you travel from station X to station Y
      without changing trains
    - Dependent variable: percentage errors
- Substantial differences in errors between versions
- Differences depend on the
  precise *navigational hazard*

Psychology Methodology to Evaluate Design

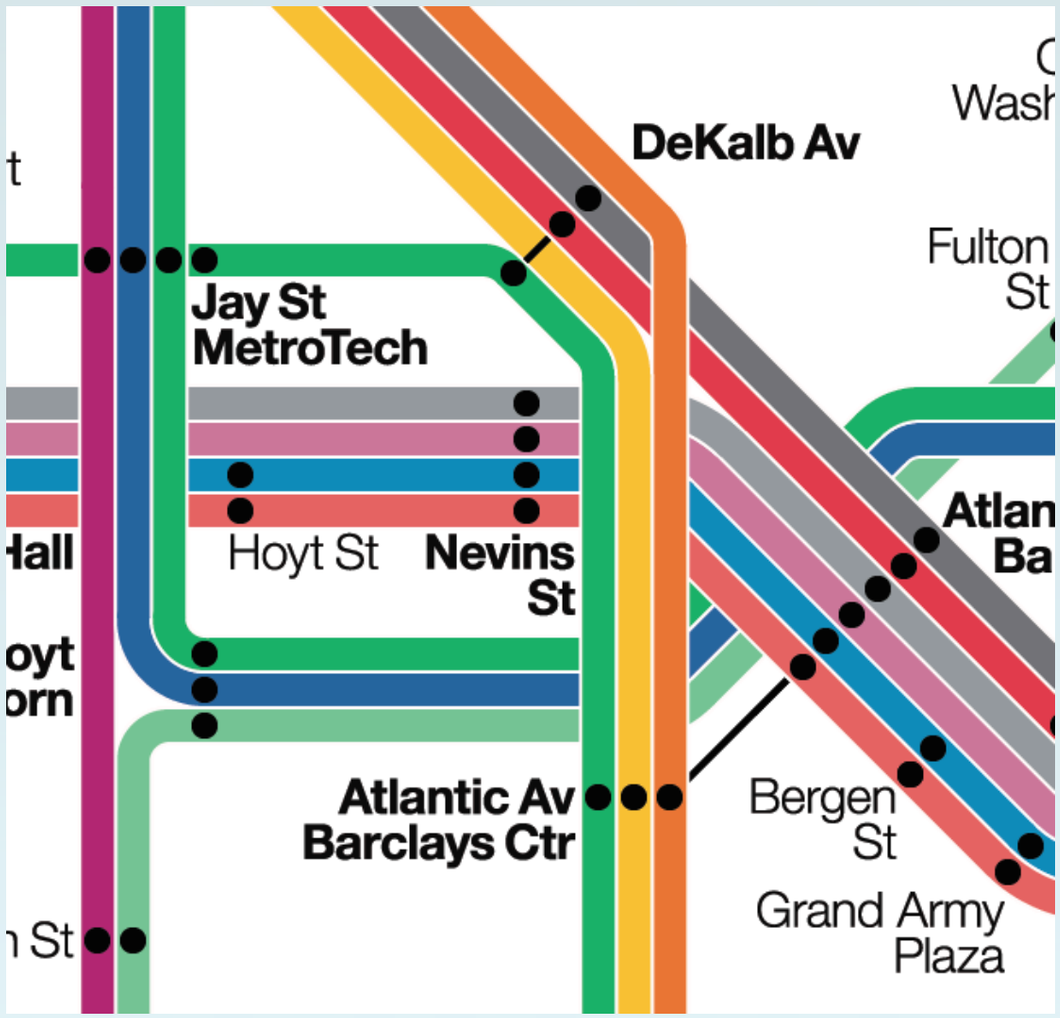
- How should maps be colour-coded?
  Lloyd, Rodgers, & Roberts (2018): New York City Subway
  - Navigational Hazard Type 1a:
    Long stretches of parallel lines

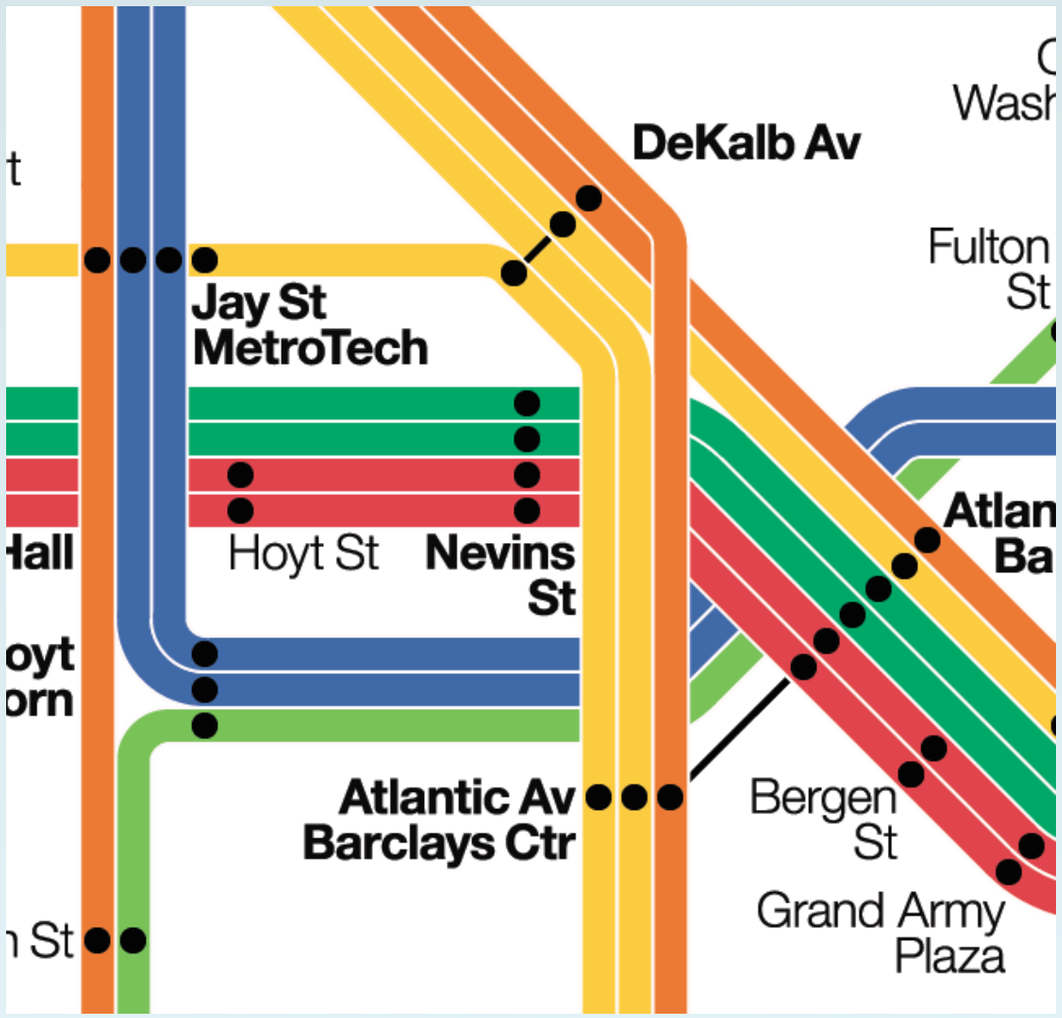




Psychology Methodology to Evaluate Design

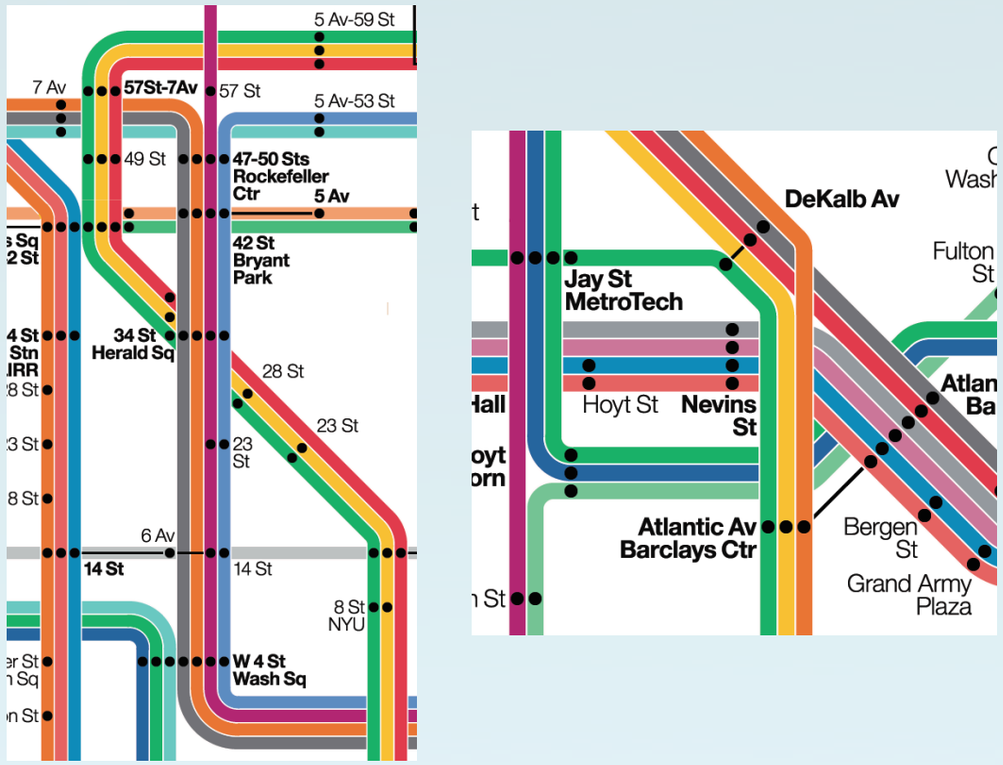
- How should maps be colour-coded?
  Lloyd, Rodgers, & Roberts (2018): New York City Subway
  - Navigational Hazard Type 1b:
    Lines passing under others

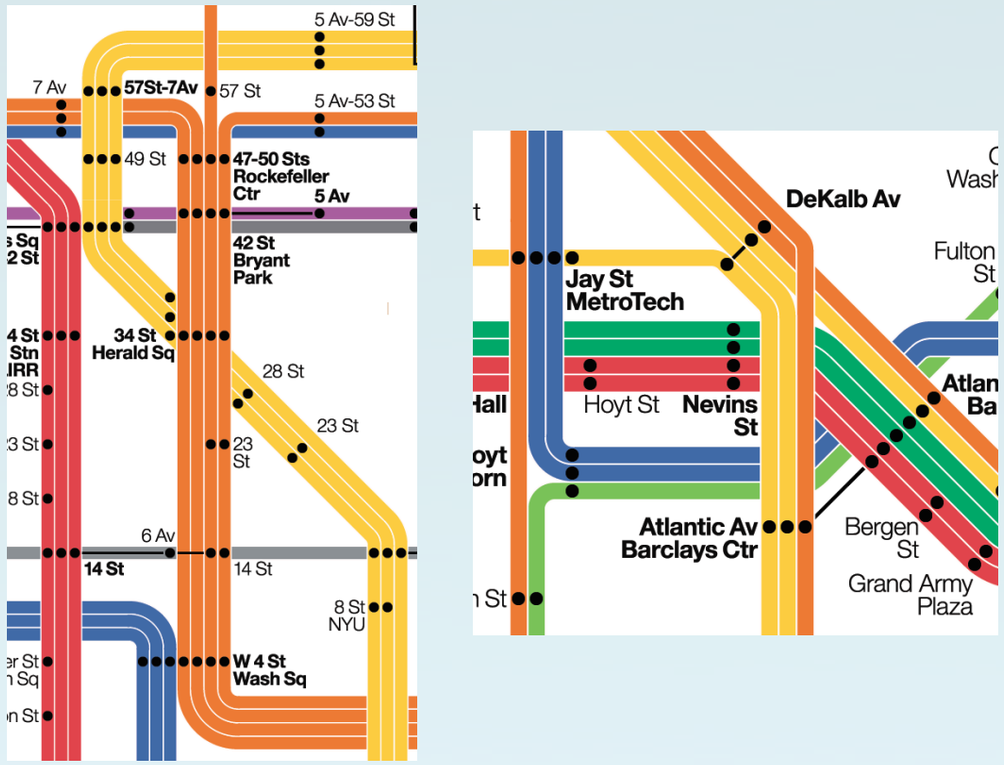




Psychology Methodology to Evaluate Design

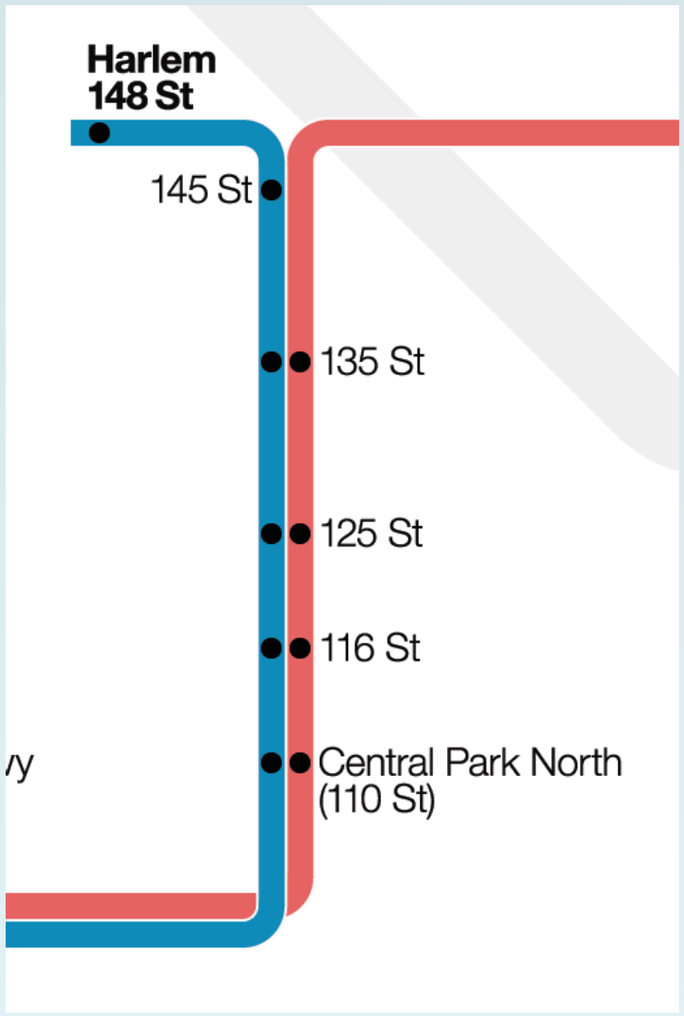
- How should maps be colour-coded?
  Lloyd, Rodgers, & Roberts (2018): New York City Subway
  - Navigational Hazards Type 1a and Type 1b:
    no difference in colour-coding (CC)
  - Route CC: 78% correct, Trunk CC 80% correct

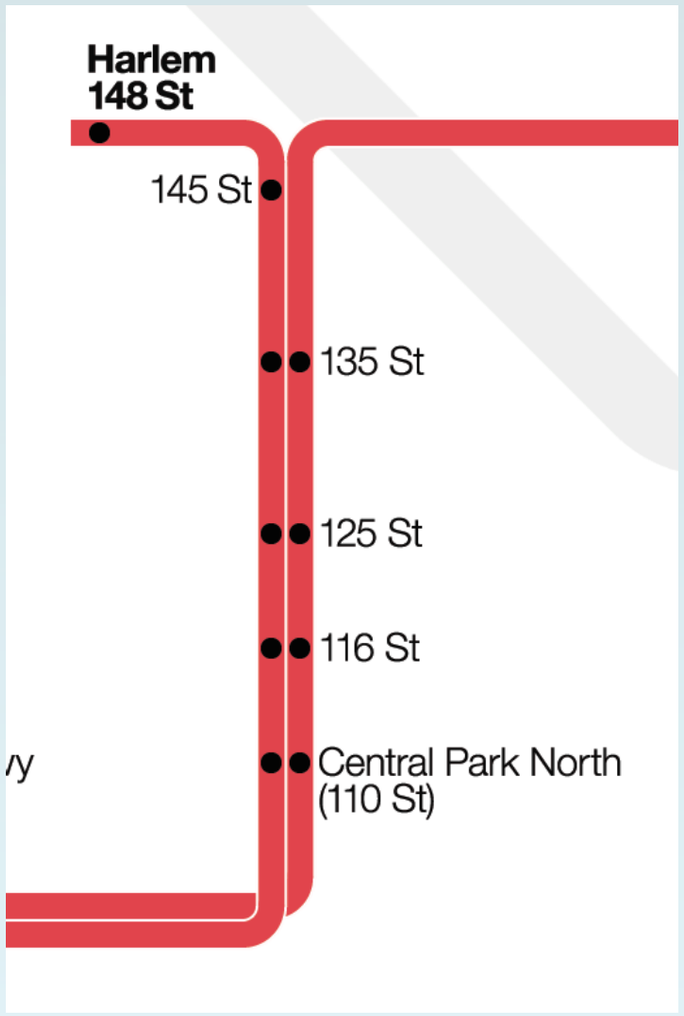




Psychology Methodology to Evaluate Design

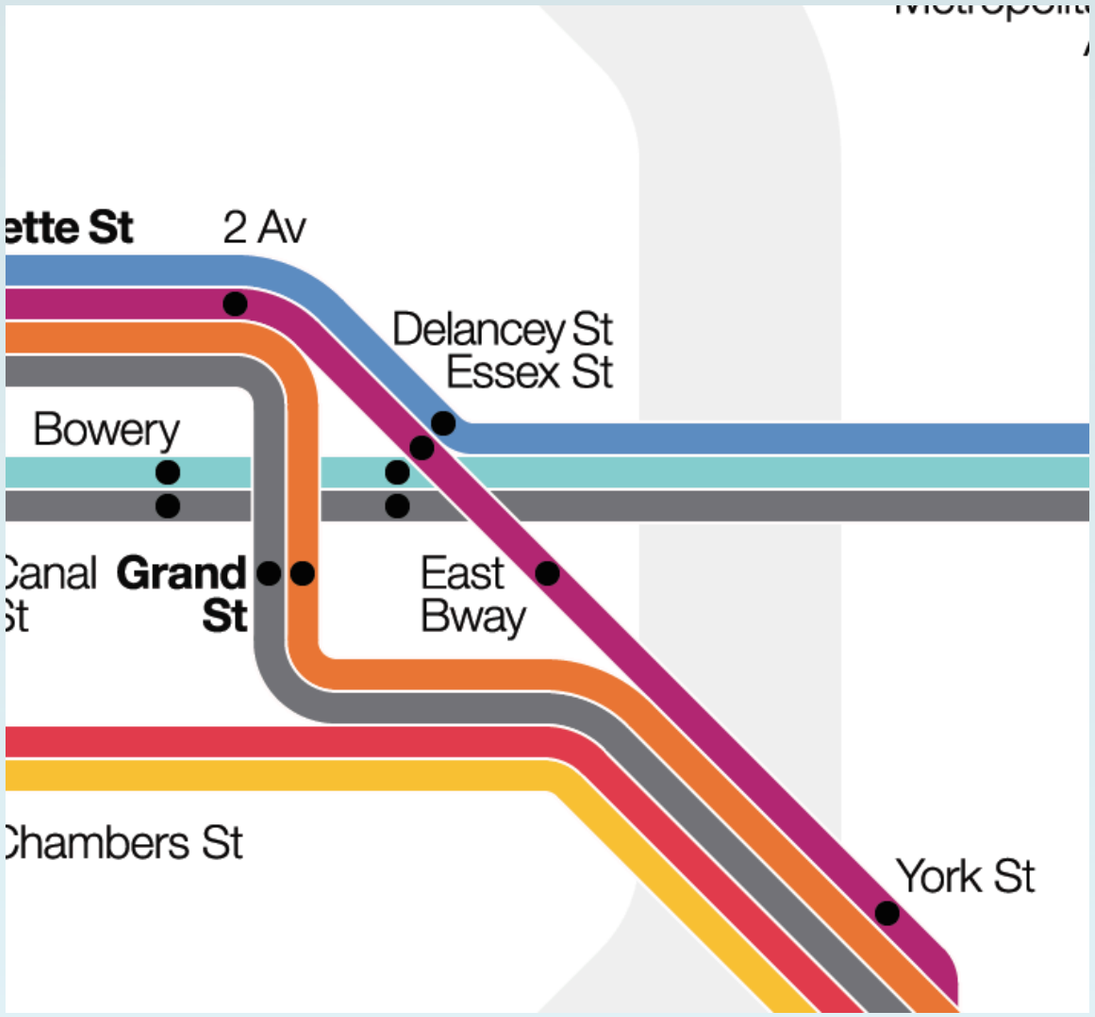
- How should maps be colour-coded?
  Lloyd, Rodgers, & Roberts (2018): New York City Subway
  - Navigational Hazard Type 2a: Lines flipping

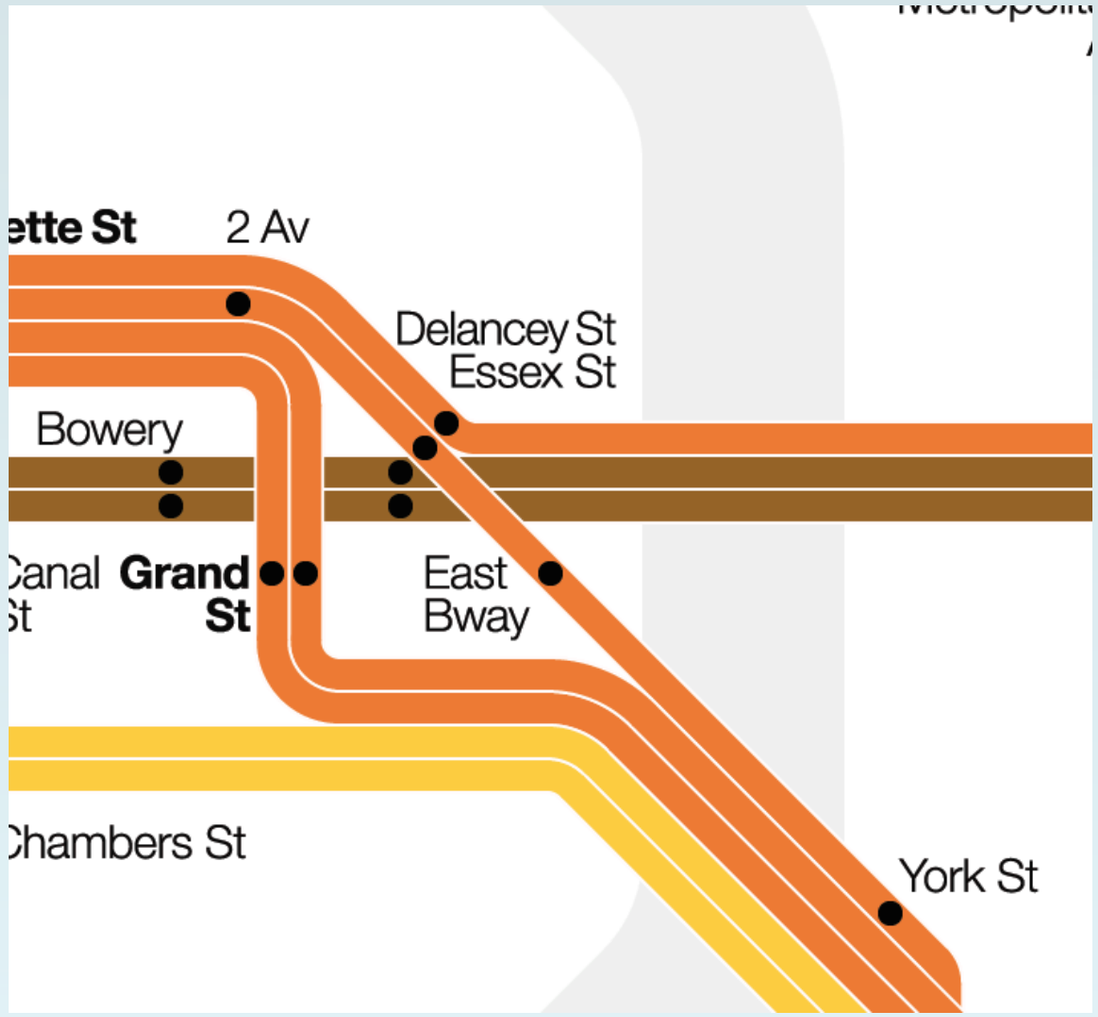




Psychology Methodology to Evaluate Design

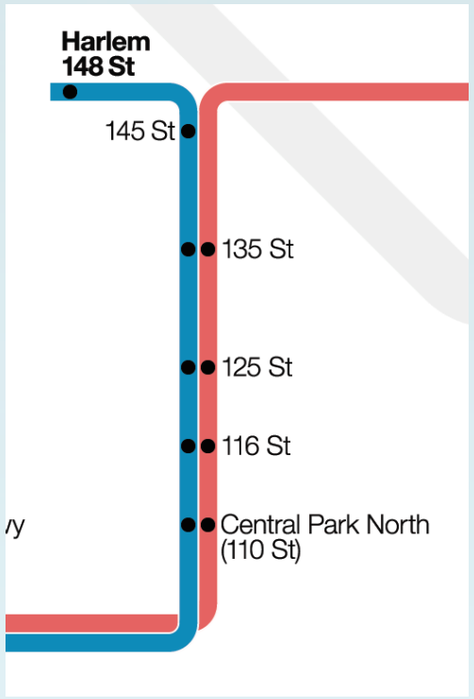
- How should maps be colour-coded?
  Lloyd, Rodgers, & Roberts (2018): New York City Subway
  - Navigational Hazard Type 2b: Lines branching

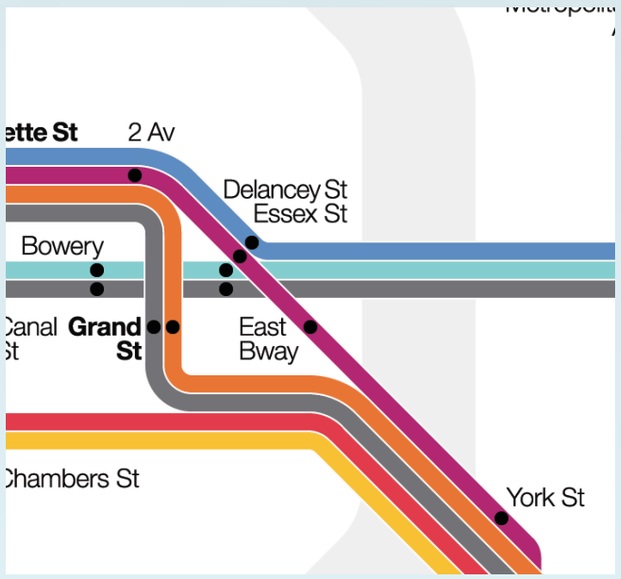


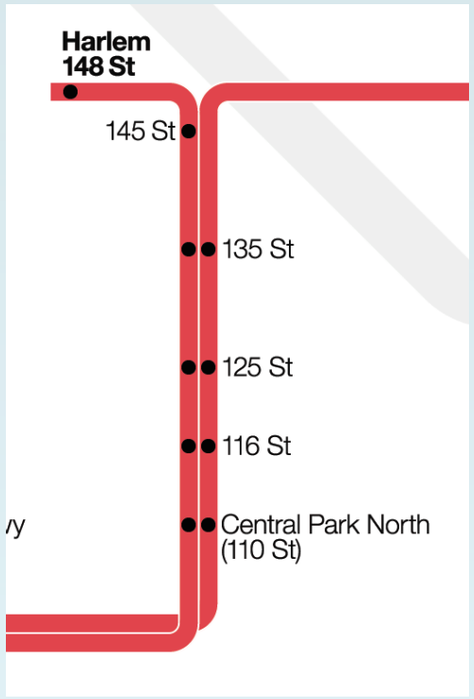


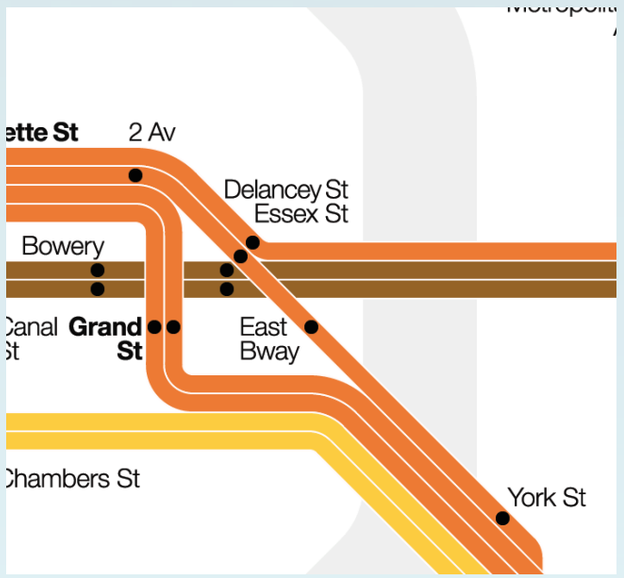
Psychology Methodology to Evaluate Design

- How should maps be colour-coded?
  Lloyd, Rodgers, & Roberts (2018): New York City Subway
  - Navigational Hazards Type 2a and Type 2b:
    big advantage for Route CC
  - Route CC: 81% correct, Trunk CC 63% correct







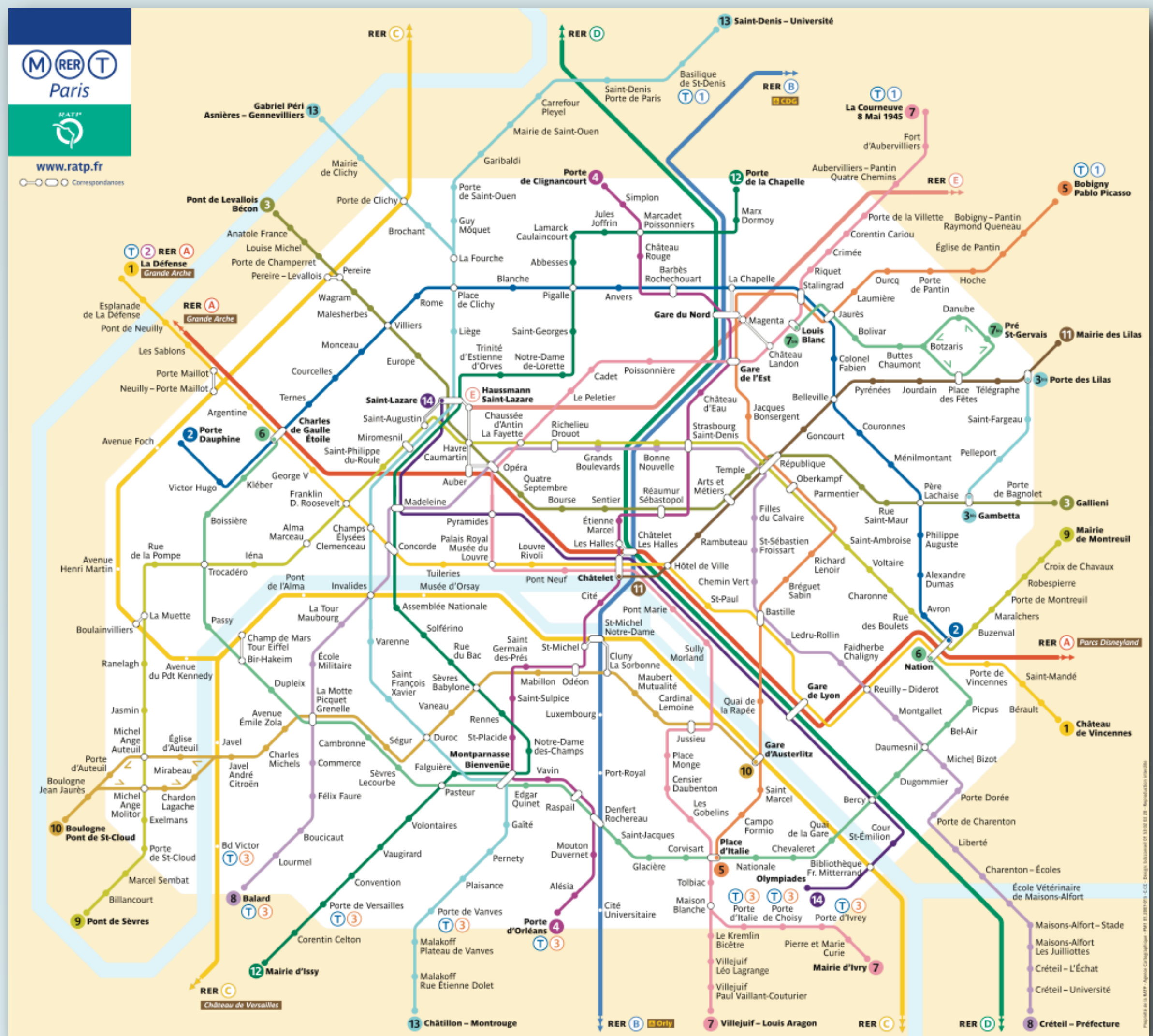


Psychology Methodology to Evaluate Design

- How should maps be colour-coded?
  Lloyd, Rodgers, & Roberts (2018): New York City Subway
  - In general
    - Eye can track parallel lines well, even over long distances or under obstacles
    - Wherever parallel lines deconfigure, this requires visual attention and the lines are harder to follow, Route Colour Coding offers assistance
- BUT
  - Tracking the lines is just one element of planning a journey
  - ***More research is needed before recommending Route CC***

Psychology Methodology to Evaluate Design

- Are London design rules ***always*** the best ones to use?
  Roberts, Grey, & Lesnik (2017): Paris Metro



Official map: London rules

Unofficial map: curvilinear

Psychology Methodology to Evaluate Design

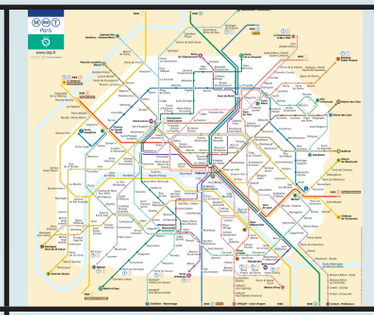
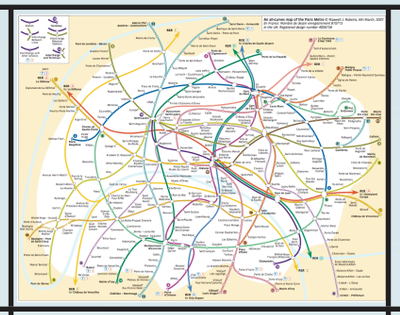
- Are London design rules ***always*** the best ones to use?
  Roberts, Grey, & Lesnik (2017): Paris Metro
  - Official map simplifies poorly,
    line trajectories too complicated?
  - London design rules (only horizontal, vertical
    and 45° diagonal lines) wrong for Paris network?
  - Paris Metro lines are too dense, too
    interconnected, too complicated
  - Adopt curvilinear design rules, smooth away
    harsh zig-zags, reveal network structure?

Psychology Methodology to Evaluate Design

- Are London design rules ***always*** the best ones to use?
  Roberts, Grey, & Lesnik (2017): Paris Metro
  - Journey planning task: complex cross-city journeys requiring two interchanges
  - Times to plan journeys and estimated journey duration are the usability measures
  - N = 80, comparing Paris Metro maps, London design rules (official) map versus unofficial curvilinear
  - Within-ss, each person used both maps, four journeys per map

Psychology Methodology to Evaluate Design

- Are London design rules ***always*** the best ones to use?
  Roberts, Grey, & Lesnik (2017): Paris Metro
  - Better journey planning times for curvilinear map
  - 75% of people performed best with the curvilinear map

			
Planning Time Seconds	50.0	40.2	$p <$ 0.01
Journey Quality Minutes	57.9	58.2	$p >$ 0.05

- ***London design rules do not guarantee the best map***

Pitfalls in Usability Testing

- Usability testing in *every* discipline has pitfalls in interpreting/generalising findings
  - We can only compare *specific* maps, general principles are harder to identify
  - The greater the attempt to match maps, the more the un-matched aspects attract attention
  - Double-blind experiments are easy, Double-blind design is harder
  - Is usability being measured in the right way? What do users want/need from maps?

Pitfalls in Usability Testing

- **We can only compare *specific* maps, general principles are harder to identify**
  - Maps differ in obvious ways (symbols, shape) and less obvious ways (design priorities)
  - Roberts et al. (2017) NOT comparing like with like
    - Official map in which there is no obvious design priority for simple line trajectories
    - Curvilinear map in which the design priority is *definitely* to simplify line trajectories
- Cannot make a ***general*** claim that curvilinear is ***always*** better than London design rules, even for Paris

Pitfalls in Usability Testing

- **We can only compare *specific* maps, general principles are harder to identify**
  - Solution (a): be careful about the conclusions that can be drawn: Roberts et al. (2017)

    ✓ This exact version of Paris curvlinear map tested is easier to use than this exact version of the official map that was tested

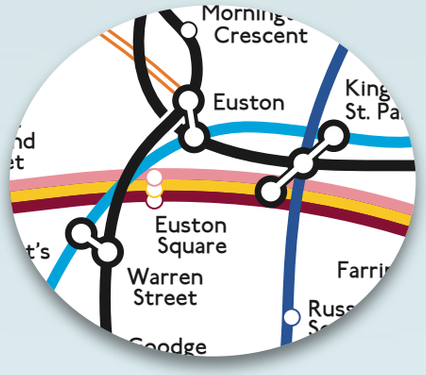
    ✓ London design rules are not guaranteed to yield the map that is easiest to use

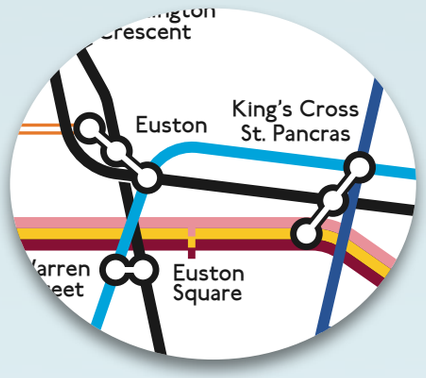
    ✗ The best design of map for Paris will always be curvilinear

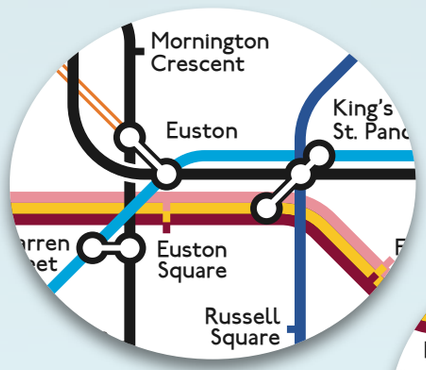
  - Solution (b): design own maps for research, carefully matched, vary only by hypothesis under test

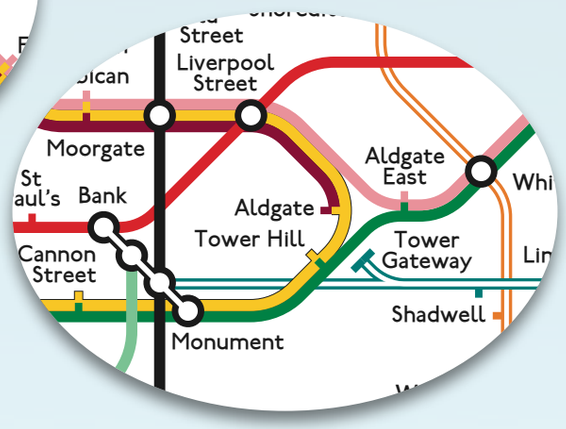
Pitfalls in Usability Testing

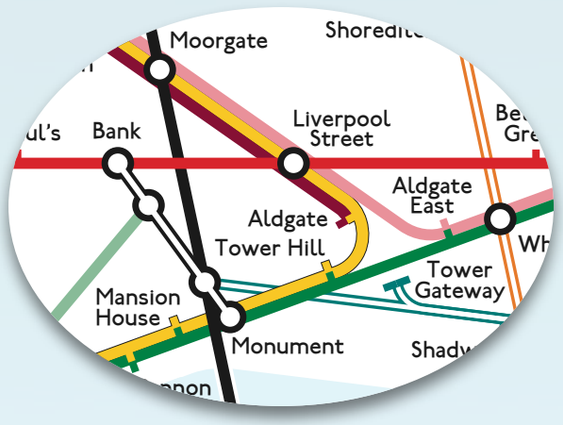
- **The greater the attempt to match maps, the more the un-matched aspects attract attention**
  - For example, different design rules create/offer different problems/solutions for the same network

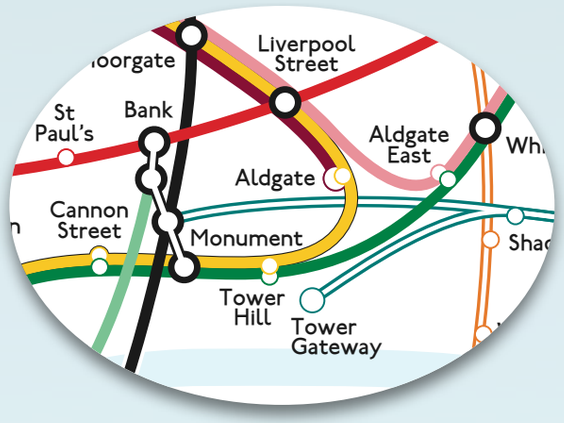












Pitfalls in Usability Testing

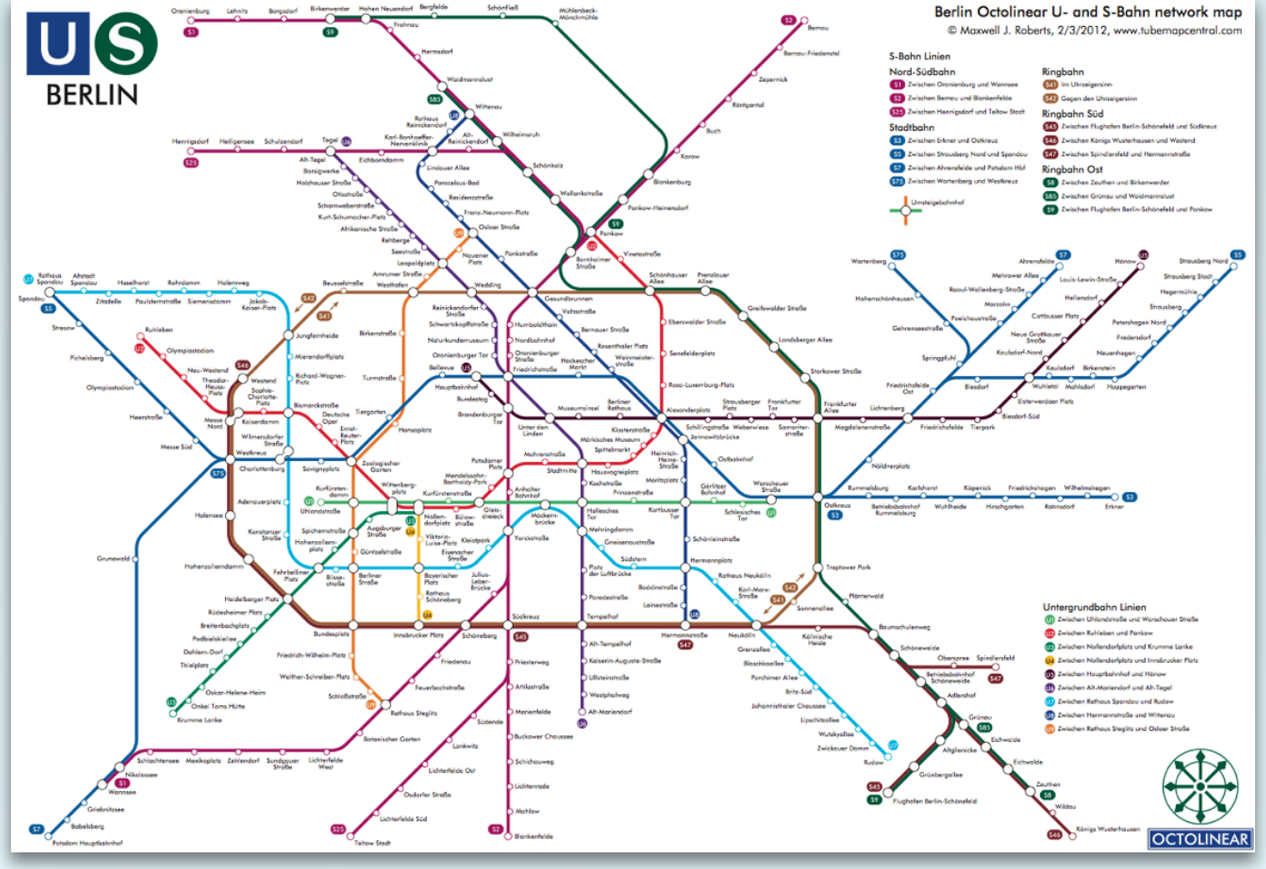
- **The greater the attempt to match maps, the more the un-matched aspects attract attention**
  - Perfectly matched maps impossible, so strong prescriptions for design impossible?
  - Solution (a): investigate specific aspects of maps (micro-features) rather than global design?
    - Questions concerning suitability of design rules for particular networks harder to answer
- Solution (b): design carefully to minimise problem, self-awareness necessary

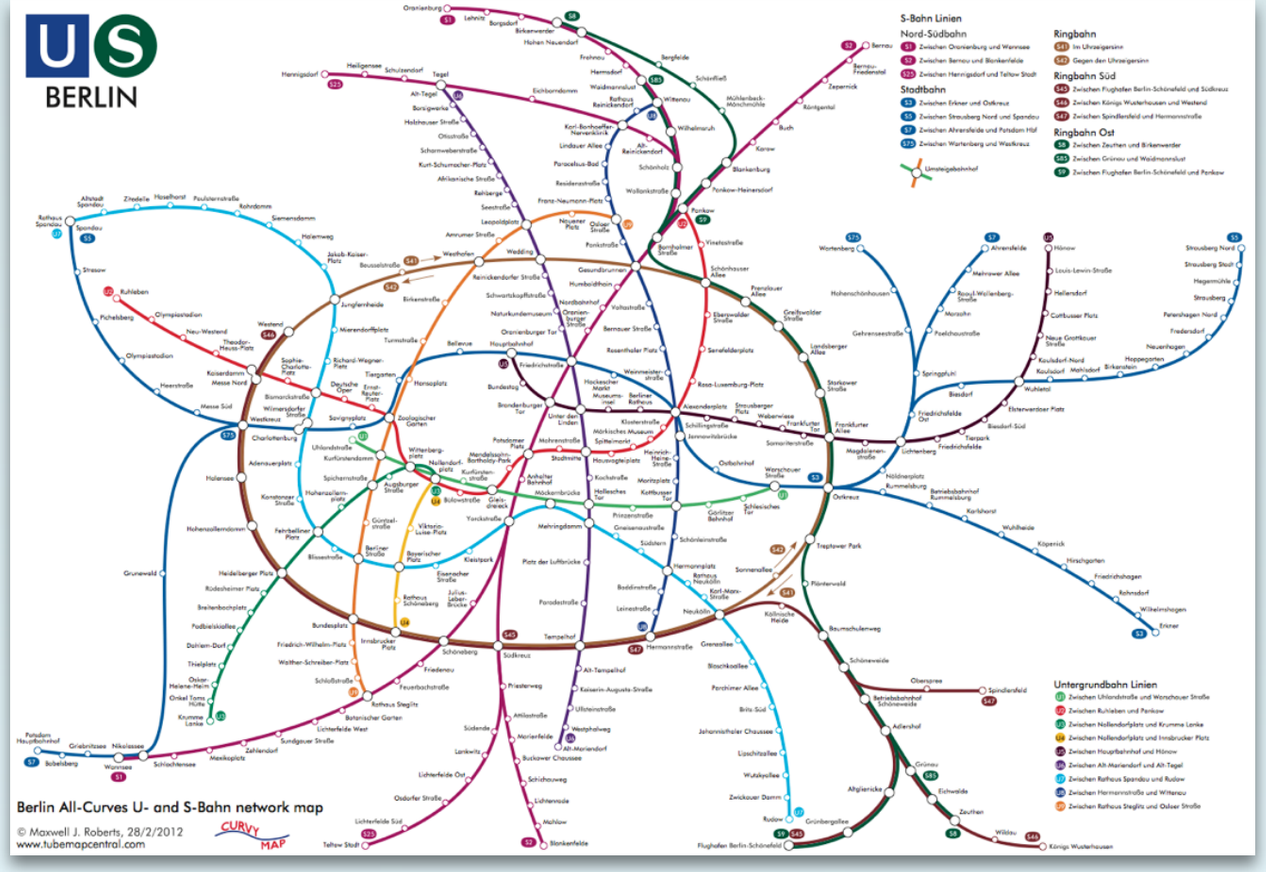
Pitfalls in Usability Testing

- **Double-blind experiments are easy, Double-blind design is harder**
  - Creating a map is a multi-step process, many problems to solve
  - All researchers will have theories of effective design, impossible to be neutral

Pitfalls in Usability Testing

- **Double-blind experiments are easy,**
  Double-blind design is harder
  - I know that I don't believe that London design rules are always best
  - Will that affect how hard I try?





Pitfalls in Usability Testing

- **Double-blind experiments are easy,**
  Double-blind design is harder
  - Impossible to rule out the possibility that maps created for research might be subject to biases
  - Solution (a): Automated design, a long way off
  - Solution (b): replicating findings independently, including new maps created using same priorities

Pitfalls in Usability Testing

- **Is usability being measured in the right way? What do users want/need from maps?**
  - Roberts *et al.* (2017) objective versus subjective measures of map usability
    - Curvilinear Paris best for 75% of Ss but only 40% chose it, no evidence for relationship with planning time advantage
    - In general, ZERO correlation between objective and subjective measures
    - People often choose maps that they find hard to use, reject maps that they find easy to use
- The *usability gap* between objective and subjective measures is robust and prevalent

Pitfalls in Usability Testing

- **Is usability being measured in the right way?**
  What do users want/need from maps?
  - Solution (a): explain away usability gap as user-error
    - Prejudices based on expectations created by prevalence of certain types of design
    - Non-experts generally judge a domain by superficial surface features
    - Massive literature on the fallibility of human judgement in a variety of contexts, especially metacognition
    - Response times are particularly difficult to self-monitor, no awareness of time differences between maps
- Too adversarial, map acceptability is an important criterion

Pitfalls in Usability Testing

- **Is usability being measured in the right way? What do users want/need from maps?**
  - Solution (b): try to bridge usability gap by reconciling differences
    - Measures of usability should have real-world utility
      - Practical utility
        - The measure has obvious correspondence with real-world usability issues
      - Psychological utility
        - The measure has correspondence with users' beliefs about real-world usability issues

Pitfalls in Usability Testing

- **Is usability being measured in the right way? What do users want/need from maps?**
  - Measures of transit map usability
    - Numbers of journey planning errors
      - Practical and psychological utility obvious
    - Numbers of inefficient journeys planned
      - Practical utility obvious
      - Psychological utility depends on people's motivation
  - Journey planning time (= a *proxy* for general non-usability)
    - Practical utility not obvious: planning time differences between maps are small compared with travel times
    - And psychological utility is zero, gives the usability gap

Pitfalls in Usability Testing

- **Is usability being measured in the right way? What do users want/need from maps?**
  - Roberts (2018): ***nothing*** seems to make users interested in journey planning times
    - Salience (1): visible timers
    - Salience (2): self-estimates of times
    - Importance (1): deadline tasks/time-outs
    - Importance (2): false timers/deadline tasks

Pitfalls in Usability Testing

- **Is usability being measured in the right way?**
  What do users want/need from maps?
  - Roberts, Newton, & Canals (2016): compared Berlin maps: straightforward versus concentric circles
    - Users desired maps in which competing options can be assessed and easily chosen between?

Pitfalls in Usability Testing

- **Is usability being measured in the right way? What do users want/need from maps?**
  - Solution (c): be prepared to be creative with measures of usability

Conclusions

- Information design is a psychological issue, but there is competition, psychologists must prove their worth
- Psychological theories and findings can give guidance on improved design that assists the user
- Psychological methodology can provide powerful tools to help answer key questions
- *BUT BE CAREFUL, it is easy to be overconfident*
    - The real world is complex, reductionistic methodology can over-simplify, with crude/wrong generalisations
    - Simplistic prescriptions might be rejected by users and treated with suspicion by other practitioners
    - Be creative and be prepared to try and build bridges

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