BUS ROUTE GUIDANCE INFORMATION DESIGN

A Manual for Bus and Light Rail Transit Systems

Southwest Region University Transportation Center
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Rodger J. Koppa
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Texas Transportation Institute
The Texas A&M University System
College Station, Texas 77843

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OOPS!

We have (so far) found a few errors in the *Bus Route Guidance Information Design Manual*. Please make the following changes:

Page 7, last line: "page TBD" should be "page 20."

Page 24: The "PM" line is misplaced. Please redraw it four lines lower, between the 11:27, etc. line and the 12:02 line.

Page 25, last sentence: Add "For example," so sentence reads as follows:
For example, if route is coded yellow on system map, print in black on yellow paper.

Page 29, 3rd "bullet" under Remarks: "page 29" should be "page 31"
FOREWORD

This Design Guide for route guidance information was developed under funding from the Federal Transit Administration through the Southwest Region University Transportation Center Program. The suggestions and approaches presented in this booklet represent the authors' best understanding of current practice and the research literature. In some cases, where relevant research was not available, the authors have not hesitated to use their best judgement on approaches to information design, particularly in the area of color coding and its uses. References in the text to sources for the design approaches have not been given, in keeping with the use intended for this manual, a first resource in designing or redesigning guidance information, rather than as a research report. An annotated bibliography of the studies and other resources from which the design ideas in this Guide were drawn, is provided as an Appendix.

In the course of the development of this Guide, 100 transit companies and operations were contacted by mail and telephone. Ultimately, 65 of these operations very kindly sent route guidance materials for us to study. SmartMaps of Knoxville, Tennessee was very helpful to us at various stages in the development, as was Brazos Valley Transit, our local bus system.

The contents of this Design Guide, however, reflect the views of the authors, who are responsible for the facts and accuracy of the information presented herein. This Design Guide is disseminated under the sponsorship of the Department of Transportation, University Transportation Centers Program, in the interest of information exchange. The U.S. Government assumes no liability for the contents or the use thereof.

Rodger J. Koppa
Laura L. Higgins

College Station, February 1994
BUS ROUTE GUIDANCE INFORMATION DESIGN

This design guide is for bus systems or light rail systems in locales in which a substantial number of riders are expected to be infrequent users, tourists, or transients. Fulfilling route information needs for those who are not daily commuters are of primary concern, but even commuters have to start somewhere!

All the design suggestions in this booklet are for the least costly methods of imparting route planning and guidance information to the would-be rider: static signs and printed material. Transit operations may well have call-in services, sophisticated changeable message signs both in terminals and even on vehicles. Riders may even talk to drivers or operators! Even with such information available, the baseline of signs, maps, and timetables will almost always be used as well. Fare structures vary so widely that no attempt has been made to integrate fare information into these suggestions.

What Does the "Beginning" Rider Need to Know?

This question is at the heart of information design, together with a idea of who that beginning rider is:

- They are elderly
- They are children
- They are people of any age without a car in a strange town
- They are people of modest means
- They are people curious to try a "new" mode of transportation
- They are disabled or disadvantaged
- They have little or no familiarity with English

A given beginning rider may be any one of these or a combination of several. What needs do all these diverse kinds of people have in common?

1. "The primary need of all prospective riders is to be able to determine if transit provides a reasonable connection between a planned trip origin and destination"

2. Beginning riders need to have positive guidance in all aspects of route planning and during the actual trip. The powerful concept of positive guidance, developed under Federal Highway Administration auspices for highway drivers, has application to transit as well. Translated into transit terms, positive guidance means giving the rider the maximum amount of visual information that is:

- useful
- prioritized in importance
- uniform, consistent, and without surprises
- easily visible under as many riding conditions as possible
<table>
<thead>
<tr>
<th>INFORMATION TYPE</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
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<tbody>
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<td>Route Map/Timetable</td>
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<td>Single Route Sign</td>
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<td>Terminal Designation</td>
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<td>Bus Stop Designation</td>
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<tr>
<td>Exterior Bus Route/Direction</td>
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<td>Interior Bus Route/Location</td>
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<td>Remote Stop Location</td>
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</tbody>
</table>

**INFORMATION NEED:**

<table>
<thead>
<tr>
<th></th>
<th>A</th>
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<th>E</th>
<th>F</th>
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<th>H</th>
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<th>J</th>
<th>K</th>
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</thead>
<tbody>
<tr>
<td>1. Area Geography</td>
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<td>2. Places Served</td>
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<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
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<tr>
<td>3. Closest Approach</td>
<td>x</td>
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<td>x</td>
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<td>4. Identification/Location</td>
<td>x</td>
<td>x</td>
<td>x</td>
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<td>x</td>
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<td>5. Route Service Hours</td>
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<td>x</td>
<td>x</td>
<td>x</td>
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<tr>
<td>6. Schedules</td>
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<td>7. Trip Distances/Times</td>
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<td>Times</td>
<td>Times</td>
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<tr>
<td>8. Stop Designation</td>
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<td>x</td>
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<tr>
<td>9. Vehicle Identification</td>
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<tr>
<td>10. Enroute Guidance</td>
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<td>x</td>
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</tbody>
</table>
Information that fulfills these four descriptions will not let the rider "get lost." It is crucial that the rider always knows where he or she is going to go or is going.

Specific route guidance information that is needed include (at least) the following:

1. Area geography, the "lay of the land"
2. Places and areas served by the bus system
3. How far closest approach of the bus route(s) is from actual trip origin or destination
4. Identification and location of terminals, transfer points, stops, and routes
5. Hours of service on route(s)
6. Schedules and/or headways/waiting times
7. Trip distances and times
8. Designation of terminals, transfer points, stops with what routes are accommodated
9. Vehicle identification signs, route numbers
10. Guidance information enroute

Some of these needs must be met before the rider leaves their point of origin - their home, hotel, or terminal for another mode of travel. Other needs arise at the terminal, transfer point, or bus stop. Information is also needed during the travel period, when the rider is in the bus. When the rider disembarks from the bus, confirmatory information is required that the rider has actually accomplished the trip they planned.

These needs can be satisfied by appropriately designed information classified as:

A. Street Map
B. Wall Map Sign
C. System Map
D. Route Map and Timetable
E. Single Route Sign
F. Terminal Designation/Location Sign
G. Transfer Point and Bus Stop Designation/Location Sign
H. Exterior Bus Route and Direction Sign
I. Interior Bus Route/Direction/Destination Information
J. Bus Stop/Terminal Location Sign (Remote)

The relationship of needs to information is shown in matrix form in this Table.
**Option 2: Complete Color Coding**

A complete color code uses a different color or combination of colors for each item (e.g., route line) in the display.

This color code groups every ten routes under a different line color to reduce the user's search field, and individually codes each route within the groups. The code uses a maximum of nine colors.

Each digit from 0 to 9 has a unique color:

<table>
<thead>
<tr>
<th>Digit</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>White</td>
</tr>
<tr>
<td>1</td>
<td>Red</td>
</tr>
<tr>
<td>2</td>
<td>Green</td>
</tr>
<tr>
<td>3</td>
<td>Yellow</td>
</tr>
<tr>
<td>4</td>
<td>Violet-blue</td>
</tr>
<tr>
<td>5</td>
<td>Orange</td>
</tr>
<tr>
<td>6</td>
<td>Violet</td>
</tr>
<tr>
<td>7</td>
<td>Brown</td>
</tr>
<tr>
<td>8</td>
<td>Lt. Blue</td>
</tr>
<tr>
<td>9</td>
<td>Black</td>
</tr>
</tbody>
</table>

For routes number 1 through 9, the route lines are printed in solid colors.

For routes 10 through 99, the first digit of the route number is indicated by slash-marked route lines (red slash marks for routes 10 through 19, green slash marks for routes 20 through 29, and so forth).

The second digit is indicated by equally spaced squares of solid color on the slash-marked lines. For instance, route number 14 is shown as a red slash-marked line (first digit=1) with squares of violet-blue (second digit=4). The color codes for route numbers 1 through 99 are shown here.

![Half-tone or "hash-marked" background color for first digit]

![Solid color for second digit]

**Note:** Always mark each route with its number. Do not identify routes by color only.

If fewer colors are used, this coding system can still be used. For example, if only four colors are used (red, green, yellow, and violet-blue) up to 24 routes can be color coded according to the chart by selecting codes as follows:

<table>
<thead>
<tr>
<th>Route</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>11</td>
<td>21</td>
<td>31</td>
<td>41</td>
</tr>
<tr>
<td>2</td>
<td>12</td>
<td>22</td>
<td>32</td>
<td>42</td>
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<tr>
<td>3</td>
<td>13</td>
<td>23</td>
<td>33</td>
<td>43</td>
</tr>
<tr>
<td>4</td>
<td>14</td>
<td>24</td>
<td>34</td>
<td>44</td>
</tr>
</tbody>
</table>
TERMINALS

TRANSFER POINTS

STOPS

COMPASS DIRECTIONS

Preferred:

OK:
Coding of Other System-Related Features

In this booklet we make specific recommendations for denoting terminals, transfer points, bus stops, direction of travel on a route, compass directions, and route designation. These are summarized on the facing page, with illustrations. But these coding conventions are not necessarily supported by research or evaluation. Other coding can and is being used throughout United States and abroad.

Research has established that a system must be consistent in the use of coding techniques. Sign should not have different coding than printed materials, other than whether or not different colors are used. If colors are specifically associated with routes or other features of a system, then colors must also be carried in a consistent manner throughout all route guidance material. If, for example, Route 6 is coded purple in a system map, and referred to as the "Purple Route" or "Purple 6", then the color is more than an aid to easy readability of a map; it has become part of the name.

Even if a system does not specifically associate color codes with routes or other features, you must be careful never to change colors from, say, the wall map in transfer points to printed maps. Unless the color and the route or feature are specifically associated by name, it is permissible to reproduce otherwise identical material in one color, preferably one not used for color coding. If all information on the sign or printed item is in one color, it will be obvious to most readers that the color is irrelevant to the information being presented.

Names of other verbal designations of terminals, transfer points, stops, and other system-relevant features must also be consistent from one item of information to another. If a stop is at the intersection of Church Street and Dekker Avenue, near the Public Library, all guidance information must say "CHURCH and DEKKER" as a minimum. If the extra information, PUBLIC LIBRARY, is placed only on certain kinds of information (e.g., a Route/Timetable), the stop must still be primarily designated by CHURCH and DEKKER - every time. The material would read:

CHURCH and DEKKER - PUBLIC LIBRARY.
LEGEND

<table>
<thead>
<tr>
<th>Style</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>•••••</td>
<td>ROUTE 1</td>
</tr>
<tr>
<td>•••••</td>
<td>ROUTE 2</td>
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<tr>
<td>•••</td>
<td>ROUTE 3</td>
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<tr>
<td>••••••••••</td>
<td>ROUTE 4</td>
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<td>••••••••••</td>
<td>ROUTE 5</td>
</tr>
<tr>
<td>☐</td>
<td>TERMINAL</td>
</tr>
<tr>
<td>○</td>
<td>TRANSFER POINT</td>
</tr>
<tr>
<td>4</td>
<td>BUS STOP - Major intersection</td>
</tr>
<tr>
<td>•</td>
<td>BUS STOP - Minor Intersection</td>
</tr>
<tr>
<td></td>
<td>showing route number</td>
</tr>
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<td></td>
</tr>
</tbody>
</table>
Map Legend

The map legend for the **system map** should list:

- the numbers of all routes shown on the map, with their color codes or line patterns.
- coding for any streets/highways
- symbols for landmarks
- symbols for stops, transfer points, terminals

The map legend for the **street map** should list:

- coding for streets/highways
- symbols for landmarks
- symbols for stops, transfer points, terminals

**Character Size:** Minimum character size should be at least as large as the minimum character size for the body of the map.

**Remarks:** Legend should be placed at an edge of the map where it will not obscure any relevant map information. If there is an existing "break" in the map with no relevant streets, route lines, etc. the legend may be inset there, space permitting. Otherwise, the legend should be placed outside the body of the map.

If the map is a schematic, state in the legend that the map is not to scale.

If only transfer points and not all stops are shown on a system map, state that fact in the legend.

Box the legend and label it "Legend".

Background color of the legend should be white. Symbols, etc. shown in the legend must follow the color scheme that is used in the body of the map.
Compare the legibility of these various typefaces by placing this page of the book 12 feet distant. At that distance, the letters look the same size as those on an eye chart 20/20 line. Walk toward the page and watch which line becomes clear first. You will see Helvetica and Gothic Book clearly before you see the others. Narrow letters such as Helvetica Narrow and Bold (thick stroke) letters are less legible than the normal typeface, and probably Palatino Italic is the hardest to see of all.
TYPEFACE RECOMMENDATIONS

"serifs" are fine end strokes on letters, such as those on this *times Roman* typeface:

Route 6 to Marvin Gardens

Studies have shown that letters without serifs are easier to read

- At a distance
- By people with visual impairments
- By children and those with limited education

This Design Guide is printed in the Helvetica typeface family. Helvetica is only one of a number of typefaces suitable for a transit system. Other typefaces to consider include Folio Book, News Gothic, Trade Gothic, Futura Medium, Spartan Gothic, and Optima. The letter styles used by traffic engineers for street signing are similar to those listed here.

The letter stroke width to height ratio should be 1:6 for dark letters on a white or light background. Since white letters on a dark background tend to "bleed" they are not recommended for route guidance information. Where such letters are used, the stroke to width ratio should be 1:7 to minimize bleeding. Letter height to width ratio should be between 5:3 and 3:2. Letter spacing should be at least 1 stroke width. Line spacing should be at least 3 stroke widths.

Use capital letters (upper case) for stop designations (usually street intersections), terminals, and other short labels. Use capital and lower case letters (with extenders) for extended legends and instructions.
BUS ROUTE GUIDANCE INFORMATION DESIGN

TYPE OF GUIDANCE INFORMATION: Street Map

APPLICATION: Information for distribution to passengers

TYPE OF PRESENTATION: Pictorial (small and medium cities)
Simplified Pictorial (large cities, regions)

FEATURES:
- Grid overlay to aid street location finding
  - Vertical axis - numbers
  - Horizontal axis - letters
- Provide street landmark location index
- Bus terminals - designate with box
- Transfer points - designate with 2 concentric circles
- Stops at major intersections - designate with a circle containing the route number
- Include compass directions at prominent location
- Pictorial maps - show all streets and highways
- Simplified maps - show major arterials, highways, landmarks all major routes followed by buses

PHYSICAL DESIGN CHARACTERISTICS:

Background Size: 36x36 inches (77x77 cm) maximum, unfolded

Character Sizes: 10 point type, minimum

Typefaces: See page 15 for route guidance. System logos, other non-route guidance related information may be in other legible typefaces

Other Codes, Colors, Distinguishing Features:
- One color:
  - Streets, highways on routes - black overlay
  - Different shading if two or more routes overlap
- Two colors:
  - Streets, highways on routes - colored, rest background
  - Terminals and transfer points - black
- More than two colors:
  - Streets, highways on routes - different colors
  - Terminals and transfer points - black

Remarks: If the serviced region is too large to display on one side of a page of maximum size while maintaining minimum typeface size requirements, divide map into sections, two to a side, with index on each page.
BUS ROUTE GUIDANCE INFORMATION DESIGN

TYPE OF GUIDANCE INFORMATION: System Map

APPLICATION: Information for distribution to passengers, visitor publications

TYPE OF PRESENTATION: Schematic (Exception: small systems with six routes or less may use pictorial maps (See p.17))

FEATURES: Bus terminals - box with terminal name inside
Transfer points - 2 concentric circles on route line and name of stop
Bus stops - Circle on route line containing route number and labeled with the name of the intersection. If bus stops at every corner, designate major intersections with this circle and route number and minor intersections with a small solid unlabeled circle on the route line.
Include compass directions at prominent location

PHYSICAL DESIGN CHARACTERISTICS:

Background Size: maximum 36 x 36 inches (77x77 cm), smaller the better

Character Sizes: 10 point type, minimum

Typefaces: See page 15 for route guidance. System logos, other non-route guidance related information may be in other legible typefaces

Other Codes, Colors, Distinguishing Features:

One color: Streets, highways necessary for clarity: medium to light gray Routes in black where no overlap or close proximity Routes in patterned black where overlap or close proximity Pattern guidance: see page 5

Two colors: Same as one color, except:
Routes in one color or patterned color (Pattern guidance: see page 5)
Bus Stops - same colors as routes
Terminals, transfer points - black
Landmarks, all other details on schematic in other color

More than two colors:
Routes - different colors and patterns (Color combinations: see page 9)
Bus Stops - same colors as routes
Terminals, transfer points - black

Remarks: Should show geographic location of routes and spatial relationships and intersections among these routes, with routes appearing as straight lines, angles and simple curves

Should look identical to Wall-Mounted System Map, except possibly number of colors used.
BUS ROUTE GUIDANCE INFORMATION DESIGN

TYPE OF GUIDANCE INFORMATION: Wall-Mounted System Map

APPLICATION: Bus Terminals, Bus Stop Shelters

TYPE OF PRESENTATION: Schematic (Exception: small systems with six routes or less may use pictorial maps (See p. 19))

FEATURES: Bus terminals - box with terminal name inside
Transfer points - 2 concentric circles on route line and name of stop
Bus stops - Circle on route line containing route number and labeled with the name of the intersection. If bus stops at every corner, designate major intersections with this circle and route number and minor intersections with a small solid unlabeled circle on the route line
Include compass directions at prominent location
Locator - circle with "YOU ARE HERE"

PHYSICAL DESIGN CHARACTERISTICS:

Background Size: Any size consistent with user capability to approach to easy viewing distance, but top edge should be no more than 70 inches (150 cm) from floor, and bottom edge no less than 41 inches (88 cm) from floor

Character Sizes: Subtend vertical 15 minutes of arc (0.00436 radian) at design closest viewing distance

Typefaces: See page 15 for route guidance. System logos, other non-route guidance related information may be in other legible typefaces

Other Codes, Colors, Distinguishing Features:

One color: Streets, highways necessary for clarity: medium to light gray
Routes in black where no overlap or close proximity
Routes in patterned black where overlap or close proximity
Pattern guidance: see page 5

Two colors: Same as one color, except:
Routes in one color or patterned color (Pattern guidance: see page 5)
Bus Stops - same colors as routes
Terminals and transfer points - black
Landmarks, all other details on schematic in other color

More than two colors:
Routes - different colors and patterns (Color combinations: see page 9)
Bus Stops - same colors as routes
Terminals and transfer points - black

Remarks: Should show geographic location of routes and spatial relationships and intersections among these routes, with routes appearing as straight lines, angles and simple curves
ROUTE 12
TO HOLLY SQUARE

<table>
<thead>
<tr>
<th>BUS STARTS at College and Church St.</th>
<th>BUS ARRIVES at Nagle St. and 17th St.</th>
<th>BUS ARRIVES at Inlow and Redbud</th>
<th>BUS ARRIVES at Holly Square Terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.M. 5:52</td>
<td>5:57</td>
<td>6:01</td>
<td>6:09</td>
</tr>
<tr>
<td>6:22</td>
<td>6:27</td>
<td>6:33</td>
<td>6:41</td>
</tr>
<tr>
<td>6:52</td>
<td>6:57</td>
<td>7:04</td>
<td>7:12</td>
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*Adapted from a design by SmartMaps*
BUS ROUTE GUIDANCE INFORMATION DESIGN

TYPE OF GUIDANCE INFORMATION: Route Map/Timetable

APPLICATION: Information for distribution to passengers, visitor publications

TYPE OF PRESENTATION: Schematic

FEATURES: Under each terminal, stop, transfer point list list times for that point in a column
Make up different Map/Timetable for each route direction or variation
Provide route number at top left corner of map
Bus terminals - box with terminal name inside
Transfer points - 2 concentric circles on route line and name of stop
Bus stops - circle on route line containing route number
Include compass direction of route; if direction changes, show new compass direction as well

PHYSICAL DESIGN CHARACTERISTICS:

Background Size: Scale to be no larger than standard page

Character Sizes: 10 point type, minimum; Route number 30 point type

Typefaces: See page 15 for route guidance. System logos, other non-route guidance related information may be in other legible typefaces

Other Codes, Colors, Distinguishing Features:
One color: Use black on white, or color consistent with system map color coding
Streets, highways necessary for clarity: medium to light saturation
Routes dark, stops in solid white circle with dark-colored route number

Two colors: Same as one color, except:
Routes in one color or patterned color (Pattern guidance: see page 5); bus stops in same color
Terminal and transfer points - black
Landmarks, all other details on schematic in other color

More than two colors:
Routes - different colors and patterns (Color combinations: see page 9); bus stops in same colors
Terminals and transfer points - black

Remarks: Should show geographic location of route and spatial relationships and intersections along the route, with route appearing as straight lines, angles and simple curves

Colors, symbols, names, etc. should be consistent with System Map, except possibly number of colors used.

If route is coded yellow on system map, print in black on yellow paper.
## ROUTE TO HOLLY SQUARE

**YOU ARE HERE**

- College St.
- Nagle St.
- Inlow St.
- 12th St.
- Main St.
- Anderson St.
- Redbud St.
- 3rd Ave.

**BUS ARRIVES** at Nagle St. and 17th St.

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TYPE OF GUIDANCE INFORMATION: Single Route Map

APPLICATION: Bus Stops, Transfer Points

TYPE OF PRESENTATION: Schematic

FEATURES: Horizontal orientation of route, stop progression from left to right
For location list times in a box under the stop designation
Make up different Map/Timetable for each route direction or variation
Provide route number at top left corner of map
Bus terminals - box with terminal name inside
Transfer points - 2 concentric circles on route line and name of stop
Bus stops - solid white circle on route line with route number
Include compass direction of route; if direction changes, show new compass direction as well
Locator - circle with "YOU ARE HERE"

PHYSICAL DESIGN CHARACTERISTICS:

Background Size: Depends on surfaces available at stop, but top edge should be no more than 70 inches (150 cm) from street level and bottom edge no less than 41 inches (88 cm) from street level

Character Sizes: Subtend vertical 15 minutes of arc (0.00436 radian) at design closest viewing distance

Typefaces: See page 15 for route guidance. System logos, other non-route guidance related information may be in other legible typefaces

Other Codes, Colors, Distinguishing Features:
One color: Streets, highways necessary for clarity: medium to light gray
Routes in black, stops in solid white circle

Two colors: Same as one color, except:
Routes in one color or patterned color (Pattern guidance: see page 5); bus stops in same color
Terminal and transfer points - black
Landmarks, all other details on schematic in other color

More than two colors:
Routes - different colors and patterns (Color combinations: see page 9); bus stops in same colors
Terminals and transfer points - black

Remarks: Should show geographic location of route and spatial relationships and intersections along the route, with route appearing as straight lines, angles and simple curves
Colors, symbols, names, etc. should be consistent with System Map, except possibly number of colors used.
BUS ROUTE GUIDANCE INFORMATION DESIGN

TYPE OF GUIDANCE INFORMATION: Bus Stop Designation/Location

APPLICATION: Bus Stops and Transfer Points

TYPE OF PRESENTATION: Static Signage

FEATURES: Sign 1: Transit system logo/symbol/name
Identification - Names of streets or landmarks
Route - Numbers of routes serving stop

Sign 2: Location - Route map/times (See page 27)

PHYSICAL DESIGN CHARACTERISTICS: Sign 1

Background Size: Background size consistent with area required for character sizes to meet requirements (below)

Character Sizes: • Transit Identifier and Route Number(s) must be legible to person with 20/60 vision, daylight conditions, at distance of 200 ft (51.5 m) (vertical character dimension must subtend at least 15 minutes of arc (0.00436 radian)
• Names of streets or landmarks must be legible to person as defined above at distance of 75 feet (19.5 m)

Typefaces: Transit Identifier:
Other Information: See page 15

Other Codes, Colors, Distinguishing Features:

Remarks: • Signs should be mounted to be conspicuous against other signs, advertising, and other visual clutter. Consideration must also be given to local ordinances and for protection against vandalism.

• If the stop is a transfer point, route map signs should be installed for each route (sign 2), but only a single sign 1 need be installed

• If more than 3 routes share a bus stop, the stop is a terminal (See page 29)

• Sign 1 should be visible to passengers inside buses; they will then be able to plan transfer to other routes prior to leaving bus.
BUS ROUTE GUIDANCE INFORMATION DESIGN

TYPE OF GUIDANCE INFORMATION: Bus Stop Designation/Location

APPLICATION: Terminals (3 or more Route Intersections or Origins)

TYPE OF PRESENTATION: Static Signage

FEATURES: Sign 1: Transit system logo/symbol/name Identification - Names of streets or landmarks designation as "Terminal"
Route - Numbers of routes serving Terminal

Sign 2: Location - Route map/times (one for EACH route)
(See page 27)

PHYSICAL DESIGN CHARACTERISTICS: Sign 1

Background Size: Background size consistent with area required for character sizes to meet requirements (below)

Character Sizes: • Transit Identifier and Route Number(s) must be legible to person with 20/60 vision, daylight conditions, at distance of 200 ft (51.5 m) (vertical character dimension must subtend at least 15 minutes of arc (0.00436 radian)
• "Terminal" and names of streets or landmarks must be legible to person as defined above at distance of 75 feet (19.5 m)

Typefaces: Transit Identifier:
Other Information: See Page 15

Other Codes, Colors, Distinguishing Features:

Remarks: • Signs should be mounted to be conspicuous against other signs, advertising, and other visual clutter. Consideration must also be given to local ordinances and for protection against vandalism.
• If buses for different routes stop at designated locations in or around Terminal, Route Maps/Times should be posted at those locations PLUS at a central location in Terminal.
• Sign 1 should be visible to passengers inside buses; they will then be able to plan transfer to other routes prior to leaving bus.
• If not feasible to place Sign 1 to be visible to passengers inside buses, place signs with name of Terminal and "Terminal" above Route Maps/Times signs at location where buses stop.
ROUTE 6
TO HOLLY SQUARE
BUS ROUTE GUIDANCE INFORMATION DESIGN

TYPE OF GUIDANCE INFORMATION: Bus Route and Direction

APPLICATION: Outside of Bus - Front/Rear/Sides

TYPE OF PRESENTATION: Alphanumeric signage

FEATURES: Route - Number display
Direction - If route is unidirectional or circular, no direction is required. If route is bidirectional, and not circular, show end stop.

PHYSICAL DESIGN CHARACTERISTICS:

Background Size: Background size and dimensions consistent with area required for character sizes to meet requirements (below)

Character Sizes: Route Number(s) must be legible to person with 20/60 vision, daylight conditions, at distance of 200 ft (51.5 m) (vertical character dimension must subtend at least 15 minutes of arc (0.00436 radian))

Typefaces: See page 15

Other Codes, Colors, Distinguishing Features:

Remarks: Placement should be high on the bus body, above window line
Display may be by changeable message sign
ROUTE 6

TO HOLLY SQUARE

ROUTE 12 TO HOLLY SQUARE

College

17TH ST.

Negle St.

Inlow

To Route 6

3rd Ave.

REDBUD

Main

Anderson

HOLLY SQUARE
BUS ROUTE GUIDANCE INFORMATION DESIGN

TYPE OF GUIDANCE INFORMATION: Bus Route, Direction, Destination

APPLICATION: Inside Bus

TYPE OF PRESENTATION: Alphanumeric, schematic signs, auditory displays
Front and rear of bus, over window line
Route map: Front, Back, Center of Bus, each side

FEATURES: Route - Number display
Direction - If route is unidirectional or circular, no direction is required.
   If route is bidirectional, and not circular, show end stop.
Destination (next stop) - changeable message sign or illuminated stop markers on route map (if technology available) otherwise by operator or automated announcement

PHYSICAL DESIGN CHARACTERISTICS:

Background Size: Background size and dimensions consistent with area required for character sizes to meet requirements (below)

Character Sizes: Route number and direction must be legible to person with 20/60 vision, daylight conditions, at distance of 20 ft (5.2 m) (vertical character dimension must subtend at least 15 minutes of arc (0.00436 radian))

Typefaces: See page 15

Other Codes, Colors, Distinguishing Features:

Remarks: Display may be by changeable message sign or other dynamic presentation
Display of all information except route map may be by auditory announcement with the following recommended format (example):

ROUTE 20 TO HOLLY SQUARE
NEXT STOP MARVIN GARDENS
BUS ROUTE GUIDANCE INFORMATION DESIGN

TYPE OF GUIDANCE INFORMATION: Bus Stop/Terminal Location

APPLICATION: On Street, remote from Stop or Terminal
Use at least every other block, all major streets or arterials,
six block radius
Mount in conjunction with street signs at intersections

TYPE OF PRESENTATION: Static signage

FEATURES: Transit Logo or Identifier
Direction of Stop of Station
Distance of Stop or Location
Routes served

PHYSICAL DESIGN CHARACTERISTICS:

Background Size: Consistent with area required for character sizes as specified below

Character Sizes: 4 inches (9 cm): Transit Logo/Identifier
2 inches (4.5 cm): Distance (in blocks)

Other Codes, Colors, Distinguishing Features:

Arrows

Remarks: Background should be different color than street signs
APPENDIX

Bibliography of Resources
Bus Route Information and Mapping -- Bibliography

The following sources address various elements of bus route information, instructional text and graphics, map design and map learning, and cognitive mapping. They will serve as the basis for a preliminary manual on the design of bus route information for the elderly, and provide possible topics for future research in the areas of mapping and information displays.

**Bus Route Information**


A "legible" bus system is defined as one in which a passenger can plan and execute a trip without outside assistance and without fear of getting lost. Two types of information that have been studied are route maps and timetables. This article reviews some of the studies performed by the author and by others concerning map color-coding and schematization, maps versus lists of bus stops, timetable formats, and information displays at bus stops and on buses. Suggested improvements include breaking a large bus system into smaller systems with their own area-maps, improving in-transit information on bus stop signposts and increasing the information presented on the outsides and insides of buses.


The overall purpose of the Transit User Information Project has been to identify the necessary components (both currently used and potential) of an effective transit information program which will provide the appropriate types and levels of information for persons to successfully use a transit system. A major output of this project is a handbook of transit user information aids which will provide transit operators with guidelines for developing an effective set of information aids. This handbook is based on an extensive inventory of currently used user information aids, interviews with a selected sample of transit operators, development of new potential information aids (form, design, etc.), and evaluation of existing and proposed transit user information aids through a series of laboratory group activity sessions. The laboratory evaluation was a means of objectively studying the impacts of the alternative techniques for providing transit information. As stated in the proposal for this project, the evaluation goals are "to determine what user information aids and dissemination techniques work best to satisfy existing and potential rider needs, physical and psychological, in specific test situations considering
multiple influence forces". In short, the laboratory sessions have been a primary mechanism for testing how accurately information aids and techniques reflect the perceived information needs of transit users. More specific objectives of the laboratory evaluations have been to test: 1. degrees of information levels required by specific information aid types to supply necessary information; 2. the level of information and design content at which complexity and mass becomes unclear, confusing, and counterproductive to purpose; 3. importance of specific information aids and dissemination techniques and their ability to satisfy rider needs and stimulate ridership; 4. user information's ability to satisfy certain psychological, as well as physical, components of the urban transportation trip, specifically: treatment, predictability, individualization, security, and accessibility; and 5. the effect that brief exposure to information aids may have on attitudes and/or propensity to ride transit. (Author)


An information leaflet was devised during the course of an experiment in the generation of passenger traffic in an existing bus network. The requirements to be met by the leaflet were investigated and are set out in detail in the Report. The ways in which these requirements dictated the design of the leaflet are discussed and a copy of the final design is included at the back of this Report. Production costs of the leaflet are quoted and the successful methods adopted for distribution are described.

Following the distribution of the leaflets, a survey of a sample of recipients was made in order to assess the comprehensibility of various features incorporated in the leaflet. The numerical and statistical results of the survey are given in detail, and conclusions are drawn on the comprehensibility of the various features that figured in the leaflets. (Author)


TRRL has studied the effects of distribution of bus service information leaflets, to determine whether expenditure on such activities can be justified by resultant increases in traffic. A well-established network of eight rural services in South and West Yorkshire was chosen for the study.

Principal findings were that the extra revenue attributable directly to the information leaflet was some four times the cost of production and
distribution. Patronage on the bus services in the area covered by the information leaflet was up by 13 per cent four weeks after distribution and was still detectably above the pre-distribution level 17 weeks after distribution. Additionally, extra rural interchange traffic was generated at points where the services connected. (Author)

Ellson, P.B. and Tebb, R.G.P., Leaflets giving information about existing urban public transport services: requirements, design and comprehensibility. TRRL Laboratory Report 990, Transport and Road Research Laboratory; Berkshire, Great Britain, 1981.

Leaflets giving travel information were needed for use in a further experiment on the generation of passenger traffic on an existing group of public transport services. The group comprised all buses and trains serving and urban area. The requirements to be met by the leaflet were investigated and are set out in detail in the Report. One requirement was that they should fit into standard display cases at bus stops in the area.

The ways in which this and other requirements dictated the design of the leaflet are discussed. Production costs are indicated, and the methods adopted for free distribution are described and are shown to have been assessed.

After issue of the travel information, a survey was made to assess the comprehensibility of various features incorporated in the leaflet. The numerical and statistical results of the survey are given detail, and conclusions are drawn from these and from previous survey results. Details of the effect of the information dissemination on traffic levels and modal choice are given in a companion report, LR 991. (Author)


Elements of a passenger information program are discussed. Four categories of information aids include visual communication (wall maps, directional signing, route and timetable displays), oral communication (telephone information services, transit personnel), distributed information (maps, brochures), and automatic passenger interactive systems (electric guidance maps, computer-generated trip information).

The type and content of passenger information aids should reflect user needs, the complexity of the transit system, and the size of the transfer facility. Factors to be considered in designing information aids include rehearsal, simplicity, continuity, consistency, and repetition. More
research is needed in the areas of transit signing, changeable message signing, and interactive information systems.


The purpose of this study was to design the best graphic method for presenting on-street bus transit information to public transit users. Phase I of the study tested six existing graphic formats: three "basic" route coverage designs and three "detailed" designs (including transfers, schedules, landmarks, and fare information). Phase II compared the existing "Guide-a-Ride" detailed format with the "Simplified" and "Topographical formats" developed for this study. User performance was measured using sample route-finding problems on written questionnaires. Phase I results indicated that "basic" designs, with less detail, produced better performance. In Phase II, the three formats produced approximately equal performance, with the exception of the timetables. Here, the Topographic format, which shows bus arrival times (in hours and minutes) in vertical columns showed significantly better performance in most trials.

Sperling, D., Goralka, R. Demand for intercity bus by the rural elderly. Transportation Research Record 1202, Transportation Research Group, University of California, Davis, California, 1990.

What role could and should the intercity bus play in serving the growing elderly population in rural areas? Telephone and on-board surveys were conducted in a corridor in Northern California to learn who used intercity buses and who did not, and why. It was found that only a tiny number of elderly riders were "captive"; the remainder had similar demographic, socioeconomic, and auto accessibility characteristics to those who did not use intercity buses. This finding implies that the potential for expanding ridership may be significant, but also implies that the intercity bus does not provide an essential public service to elderly people. To understand and predict ridership, future studies of intercity bus demand should focus on the particular circumstances and lifestyles of individuals living in differing sociocultural environments, not on traditional demographic, socioeconomic, and auto accessibility indicators. (Author)

Four commonly used styles of timetable, each conveying the same travel information and containing identical alphabetical and numerical material, were compared.

Ninety-six people were given one of the four timetables, and asked to complete a questionnaire which required them to consult the timetable and use its information in a number of ways.

The results indicated that the most important factor in ease and speed of reading the timetables was the twelve-hour clock system. Subjects completed the questionnaire significantly faster and made significantly fewer errors when consulting a timetable which used the twelve-hour (am/pm) system. (Author)

Map Design and Map Learning

A subway rider's cognitive map of the subway system is highly dependent on the graphic and/or verbal information provided to him. The effectiveness of a map or guidebook can be judged by how well its information can direct the user's actions to successfully travel from origin to destination. To test the effectiveness of the New York Metropolitan Transit Authority's subway guide, volunteer subjects were asked to use this guide to travel assigned routes through the subway system. Poor performance by most of the subjects, along with their comments on an accompanying questionnaire, indicated a need to redesign graphics and organization of information in the guide as well as to increase the amount of information displayed at stations and concourses.


The effects of two map-related variables on trip-planning performance were investigated. Presence or absence of color-coding and level of street detail were varied to produce four styles of transit maps: (1) color-coded routes, high street detail; (2) no color-coding, high detail; (3) no color-coding, low street detail (only streets that intersect bus routes are depicted); (4) no color-coding, low street detail (only major city streets
depicted). Starting and two destination points were presented on a street map, and subjects planned a bus trip through these points using one of the four transit maps. Color coding in a high-detail map was shown to improve planning accuracy, reduce frustration, and improve the users' confidence in the correctness of their plan. In the absence of color coding, lower levels of street detail produced better accuracy than high street detail. There was no significant difference in trip planning time between the four map types.


This experiment investigated the impact of a fisheye view on graphical presentations for topographic networks. Subjects selected optimal routes between stations on a fictional subway network, using either a scrolling view or a fisheye view. Performance using a fisheye view was superior when the destination station was not visible in the initial display; performance with scrolling was superior when both stations were visible and when more complex itineraries were required. Scrolling performance improved over time with two-station routes; the fisheye performance improved in the (later) itinerary task. (Author)


To study the effectiveness of map style and map complexity on street map-following performance, drivers utilized one of six informal street maps to drive to a destination in an unfamiliar location. Using a 2x3 factorial, 78 undergraduates were randomly assigned to one of six map design conditions: two levels of style (written verbatim or graphic illustration) and three levels of complexity. The low-complexity map contained a direct route, including relational (left-right) directions. The medium complexity map contained a direct route, relational directions, five adjacent streets, and major mileage estimates. The high-complexity map contained a direct route, relational directions, 16 adjacent streets, major mileage estimates, and seven landmarks. Map style significantly affected driving time, as written verbatim maps resulted in less total driving time than graphic maps. Subjects with higher cognitive abilities (as measured by the Wonderlic Personnel Inventory) took less time to reach the final destination than did those with lower cognitive abilities. Neither the effects for map complexity nor the style by complexity interaction were significant. Also, male and female performance did not significantly differ. (Author)

To create better aids for everyday surface navigations, people's navigational preferences, habits, experiences, abilities, and route-selection strategies were examined. Self-described good navigators like and use maps, and they differentially value landmarks, such as rivers, railroads, and houses, whereas poor navigators tend not to use maps, prefer verbal instructions, and tend to rate all landmarks as equally valuable for route-finding.

Routes selected by people with varying degrees of familiarity with an area were compared with routes generated by standard graph-search procedures. A shortest-path, breadth-first route characterized half of the "expert" routes, whereas none of the graph-search procedures matched "intermediate" and "novice" routes. A good predictor of whether people chose a particular road was whether the sum of $A+B+C$ (where $A$ equals the straight-line distance from the start to the road, $B$ equals the distance traveled on the road, and $C$ equals the straight-line distance from the departure point on the road to the destination) did not exceed the straight-line distance between start and destination by more than about 20%.


Design of Amsterdam's new public transport maps began with a study of other maps to identify elements that improved clarity and ease of use. For a pocket-sized leaflet, a schematized map was designed which used 30-, 60-, and 90-degree angles to portray routes and used only the well-known canals and other bodies of water as landmarks. Preliminary tests showed improved rate of route-finding work over the old, more detailed map as people learned how to use the leaflet.

A larger map, showing all public transport in Amsterdam (train, metro, bus, etc.) was designed for placement in public transit shelters. Both the leaflet and the large map use color coding, and the large map includes more landmarks, such as main roads and city parks. User reactions to both forms of the map were favorable.
Network maps emphasize the stages and relationships of travel routes rather than the physical layout of the terrain they cover. This arrangement may present a distorted view of a geographical area, but simplifies the pertinent transit information. Examples of well-known network maps include those for the London Underground, the Teito Rapid Transit Authority in Tokyo, and the TWA network diagram.

Timetable information is complex and may be better understood and used if user aids are incorporated into the format. Analogue clock faces instead of 24-hour digital times, spacing and breaks that aid visual searching, and a printed example of timetable use are some ways of improving timetable legibility.

**Instructional Text and Graphics**


A study was conducted to compare the relative comprehensibility of pictorial information and printed words in instructions. Six picture-word formats were examined using 24 procedural problems on three types of tasks. The formats were print-only, pictorial-only, pictorial-related print, print-related pictorial, pictorial-redundant print, and print-redundant pictorial. The results showed pictorial information important for speed but print information necessary for accuracy. Comprehension of instructions on all three tasks was most efficient with the pictorial-related print and pictorial-redundant print formats but could not be shown to be simply a function of number of visual information channels used or the degree of redundancy between channels. The type of information displayed in the visual channels was found to be important. (Author)


Problems of display design studies include (1) selecting criteria for evaluating displays, (2) considering the task that the user is expected to perform using the display, and (3) determining the design and objectives of an experiment. A literature search was conducted for studies that evaluate color coding in displays based on its compatibility with human perceptual-cognitive processing capabilities. Performance on identification and search tasks compared the use of color as the only identifying attribute of a target with the use of color as one of several
attributes of a target; further, when color was one of several target attributes, distinctions were made between the uses of color as an independent or a redundant attribute.

Based on the generally favorable performance of color coding in the literature data, experiments were conducted to test color coding versus achromatic coding in three simple tasks and one complex task. Results indicated that while color is as effective as other, achromatic coding techniques, it is not significantly more effective. Color is recommended to call attention to a particular signal in a display or to identify less than ten (preferably six or fewer) values or categories.


Research published in the last decade on color as a coding device is discussed. The method of absolute judgment yielded similar findings with respect to identifications of surface and luminous hues. These findings suggest that reliable unidimensional hue code should not contain more than about eight optimally spaced stimuli. Variations in purity and luminance in addition to wavelength can significantly increase the number of usable code categories. However, criteria for code selection in a given situation should depend not only upon the number of visual objects to be differentially identified but also upon the type of task for which the code functions. In particular, color codes do not appear to be suited for situations that demand rapid and precise identification, whereas they are valuable in decreasing search-time with locate-type tasks. (Author)


The initial visual impression given to a reader by an information display has been shown to affect the reader’s assessment of the complexity and the value of the information as well as his or her reading speed and accuracy. Legibility of printed information and the effectiveness of text structuring can be measured by reader eye movements, rate of work, and, to some extent, readers’ preferences. Legibility considerations include recognition of individual letters, numerals, and punctuation marks; character variations such as typeface, upper versus lower case letters, and character size and weight; page and line formats; and the type of paper and ink used. Modern technology has brought new kinds of equipment and methods for producing information displays, and research is needed to apply existing knowledge about legibility to these new mediums.

Studies have been conducted which indicate that redundant coding is effective in facilitating the locating of a target among other objects. This study examines that hypothesis for a range of the shape and color variables. All possible combinations of four shapes and four colors were used as targets in the experiment. The times to locate six each of the targets among 36 background objects for 16 displays in each of three coding conditions of the experiment were determined for 24 subjects. The targets could be differentiated from the background objects on the basis of color only, shape only, and redundant color/shape. The results indicate a difference among the coding conditions, the colors, and the shapes, and in the code-by-shape and code-by-color interactions. An important finding is that the redundant code and the color code conditions did not differ. The data are examined for possible explanations of this result and some implications are suggested. (Author)


Visual search performance was investigated as a function of color-coded and uncoded information location, number of categories coded, number of objects per category, and background clutter. Thirty-three subjects searched 12 areas of modified sectional aeronautical charts for a total of 48 checkpoints. Identification of checkpoints was established with labels plus geographical context information. Color served as a partially redundant code for information location. In general, the findings indicate that color coding for information location is most when: (1) many categories of information can or must be coded, (2) colors highly discriminable in peripheral vision are used, and (3) the number of objects per category is kept reasonably small. (Author)


Letter size is the legibility factor which most influences display design. Ten minutes of arc is the visual angle recommended by two writers for easy reading, and other studies indicate preferred letter subtending 12, 15, even 23 minutes of arc, with additional safety factors for low luminance, long viewing distances, and other poor visual conditions. MIL-STD-1472B recommends 12 to 37 minutes of arc, depending on the criticality of the material being read and on viewing conditions.

This study was conducted to compare the distribution of legibility measures with current standards. Visual angle measurements were
obtained from subjects' self-reported farthest reading distance from a display. Minimum visual angles ranged from .5 mrad (1.7 minutes of arc) to 12.7 mrad (43.7 minutes of arc) under good viewing conditions, with a mean of 1.9 mrad and a median of 1.7 mrad (both close to 6 minutes of arc). Additional measures, varying the display material, illumination, and viewing distance supported the current standards for letter size.


Twelve experimental subjects performed both visual search and class counting tasks, viewing displays containing 20, 60, or 100 items. Each item consisted of a vector, letter, and 3-digit number grouped together, and was presented as white-on-black in some displays, or 1 of 5 colors. The color code was redundant with the 5 class-designator letters that were used. Average search and counting time, and counting errors, increased with increasing display density (number of items). None of these measures varied significantly among the 5 different target classes (colors). Addition of the redundant color code resulted in an average time reduction of 65% in the visual search task and 69% in the counting task, with a reduction of 76% in counting errors. (Author)

**Cognitive Mapping**


A theory about the acquisition and use of cognitive maps of large-scale everyday environments is presented. The basic assumptions of the theory are (1) people's behavior in social and physical environments is determined by action plans, and, if the execution of such action plans requires traveling, plans for how to travel, termed travel plans, are formed and executed; (2) the cognitive maps of large-scale and medium-scale environments acquired are adapted to facilitate movement and travel, and contain information about destinations for travel, spatial information, and travel instructions; (3) cognitive maps are initially acquired in connection with the formation of travel plans and , at the later stages of acquisition, the execution of travel plans (requiring active monitoring) constitutes a more important set of conditions for acquisition. The principles of internal representation of the cognitive map are also discussed. (Author)

Verbal description, verbal description with imagery instruction, videotape observation, and map study were compared as different means for providing elderly adults with information needed for a series of spatial tasks in a large-scale environment. Verbal description and map study led to greater efficiency on a route execution task, but the four means did not lead to differences on scene recognition, route planning, or map placement tasks. A simple classification of behaviors revealed that walking while scanning and standing while scanning were most common during route execution. Standing without scanning during route execution was correlated with poor performance in that task. Psychometric measures of spatial abilities, imagery abilities, and internal-external locus of control did not correlate highly with performance measures from the environmental tasks. (Author)


This study evaluates the claim that memory for spatial information is automatic. Young and older adults studied a map containing 12 structures. Half of the people in each age group were asked to remember both the structures and their locations (intentional learning) and the remaining half were led to believe they would be tested only on the structures (incidental learning). Both age and test expectations affected memory for the locations of structures, with older people and people in the incidental groups performing more poorly. It was concluded that memory for spatial information is not automatic. (Author)


The experiences of learning a city by direct experience or navigating through it and studying a map of it provide people with different types of information. Navigation is thought to provide procedural knowledge, which is stored as verbal coding, and map reading is thought to provide survey knowledge, which is stored as imagery coding. Subjects who learned a city primarily through years of navigation and subjects who learned a city by studying a cartographic map for several minutes were asked to perform the simple experimental task of locating familiar landmarks relative to reference points. Distortions in the cognitive maps of subjects were analyzed to determine significant differences in patterns of distance and direction errors. Patterns of absolute distortion are explained by theories
related to the use of alignment and rotation heuristics for encoding information and an implicit scaling process for decoding information. Subjects who learned the city from studying a cartographic map were significantly more accurate and faster at performing the experimental task than subjects who learned the city through direct experience or navigation. Both groups were significantly more accurate when making their judgments with centrally located reference points than with peripherally located reference points. These results provide knowledge of processes used in cognitive mapping and the distortions caused by these processes. Ultimately such studies lead to an understanding of spatial decision-making behavior. (Author)


Aggregate cognitive maps of urban areas differ from cartographic maps for reasons other than differences in the mobility and idiosyncratic experiences of individuals. Systematic distortions in aggregate urban maps may be caused by the cognitive processes used to code spatial information into memory or to retrieve it from memory and by the way these processes relate to a particular urban area. A purpose of this study was to determine the extent to which systematic distortions are present in aggregate urban cognitive maps and to investigate the causes of such distortions. Subjects from three neighborhoods were asked to provide estimates of distances and directions between 105 pairs of landmarks. Differences between these estimates and true distances and directions were analyzed to determine if the patterns of distortions were significantly different among the three neighborhoods. Differences for the three samples appeared to be related to the scale and orientation of the aggregate cognitive maps. Regressions with aggregate data for the three neighborhoods using cognitive distance as the dependent variable and actual distance as the independent variable indicated a tendency to overestimate shorter distances more than longer distances. Subjects' cognitive locations for landmarks and the actual locations were mapped in the same space using multidimensional scaling and Euclidean regression. The aggregate cognitive maps appeared to be rotated to align major transportation axes with canonical direction axes. Systematic distortions appear to be related to a rotation heuristic and to key reference points used by the subjects to code and access spatial information. (Author)


As the perceived magnitude of a stimulus is related by power function to the physical magnitude, the remembered visual areas and length are also related by power function to the actual areas and length. The main
The purpose of this study is to examine whether the power law is also applicable to remembered areas in a natural environment, e.g., a school campus, and to its old memory. Thirty-one junior high students and seven university undergraduates who graduated from the same junior high school seven years before were asked to draw a layout of the school campus. The areas of the school facilities and field, and other features of drawings such as the number of recalled facilities and objects, and direction of the sketch were assessed. Analysis showed that the areas remembered by the junior high subjects followed the power law while those remembered by the undergraduates did not. The divergence of exponents observed for undergraduates was accounted for by reconstruction by schema. (Author)


This study examines age differences in the relationship between memory for items and memory for the spatial location of items. Young (*M* age = 17 years) and elderly (*M* age = 68 years) adults studied a spatial display that included 16 items in specific locations. The items were either small objects or the one-word verbal label for each. Two tests followed to independently assess free recall of the items and the accuracy of spatial relocation. The young adults were more accurate on both tests. This finding was consistent for both verbal and visual items. The age differences in memory are explained in terms of age differences in encoding and rehearsal strategies. This study resolves, in part, the conflicting results regarding age differences in spatial memory accuracy reported by Perlmutter, Metzger, Nezworski, and Miller (1981) and by McCormack (1982). (Author)


Theories which explain mental imagery are discussed and are related to cognitive maps. An experiment was conducted to illustrate that people can code information about maps as visual images and use map images for a map-reading task. Subjects were shown maps which were rotated at various angles from north-at-the-top. The time needed to decide if a map was a correct or mirror representation was recorded. The results support the notion that people did this task by forming and rotating map images. (Author).

This study examined how college students give directions from maps, either with maps perceptually available, or after maps had been memorized. Six aspects of direction giving were coded: use of landmarks, use of relational terms, use of cardinal directions, use of mileage estimates, and frequency of omission and commission errors. In accord with predictions, males used more mileage estimates and cardinal directions than did females and made fewer errors. Use of cardinal directions and mileage estimates were rarer, in relation to opportunities to use them, than use of landmarks and relational terms. Correlations among the dependent variables suggested that use of relational terms and use of cardinal directions may trade off, with speakers using one or the other but not both. An individual's choice of direction-giving "method" seems to be a stylistic preference rather than a measure of ability in that method.


Four studies were conducted concerning the presentation of route-directing information to drivers. The first study, designed as a drug trial, tested the effects of anticholinergic drugs on navigation performance; while subjects showed little difference in performance due to drug effects, all subjects (drug, placebo and untreated groups) had difficulty navigating with the provided maps. The second study investigated retroactive inhibition of route memory by the reorientation encountered while traveling the route. Subjects who memorized a route map and then attempted to recall the route while seated in a stationary car recalled the information more accurately than subjects who attempted to recall the route while traveling along it in the car. The third study investigated spatial memory interference with both verbal logical reasoning and graphic (spatial) logical reasoning. Results indicated that spatial memory interferes with spatial reasoning but not with verbal, or "linear" reasoning. The fourth study tested subjects' matching performance with a set of target maps, and showed that subjects tended to learn and memorize a map as a linear series of junctions and turns, instead of as a spatial map.