Presentation of “Next generation navigation: the importance of context and quality”

This item was submitted to Loughborough University's Institutional Repository by the/an author.

Additional Information:

- This is a copy of a presentation given at Transport Location and Route Guidance Seminar, Coventry 2002.

Metadata Record: [https://dspace.lboro.ac.uk/2134/1196](https://dspace.lboro.ac.uk/2134/1196)

Please cite the published version.
Next generation navigation: the importance of context and quality

Tracy Ross (t.ross@lboro.ac.uk)

Transport Technology Ergonomics Centre
Ergonomics & Safety Research Institute
Loughborough University
The REGIONAL Project

- UK government funding
- LINK IST Programme
- 1999 – 2002
- Vehicle navigation
- Incorporating landmarks
- Database and HMI

TTEC
Why should systems include landmarks?

• Landmarks are commonly used in current way-finding strategies

• Vehicle Navigation systems that utilise landmarks have been shown to improve:
  – safety
  – acceptability
  – effectiveness
Research rationale

Choose
  i.e. What landmarks to use
Use
  i.e. When to use them
Present
  i.e. How to display them

Advice to industry
Industry Requirements

For database development
• strong business case
• multiple potential uses
• available, accessible, accurate, easily maintainable data
• avoid field visits

For navigation system software
• ‘rules’ for use of landmarks
• ‘proof’ that any approach is the optimum.
• landmarks considered within the ‘big picture’
Study 1 – Context of use

- 36 subjects wrote directions to navigate 3 routes
  - Video of route
  - Cognitive map

- Written directions coded

- Sources of navigation information identified

- Context of use identified
Use of general navigation information

Frequency counts

General info category

- Direction sign (nav)
- Direction sign (object)
- Distance
- Environment
- Junction description
- Junction name/number
- Landmark
- Lane change
- Node geometry
- Path geometry
- Road marking
- Road type
- Street name/number
- Time
Use within the navigation task

![Chart showing frequency counts for different general information categories in navigation tasks. The categories include Direction sign (nav), Direction sign (object), Distance, Environment, Junction description, Junction name/number, Landmark, Lane change, Node geometry, Path geometry, Road marking, Road type, Street name/number, and Time. The chart uses colors to represent different actions: preview (red), identify (yellow), and confirm (blue).]
Information: main or secondary
Information used at Manoeuvre 1

- Time
- Information type
  - Direction sign (nav)
  - Direction sign (object)
  - Distance
  - Environment
  - Junction description
  - Junction name/number
  - Landmark
  - Lane change
  - Node geometry
  - Path geometry
  - Road marking
  - Road type
  - Street name/number
  - Time

Frequency counts:
- all subs
- cognitive map
- video
Information used at Manoeuvre 9

General info category

Frequency counts

- Direction sign (nav)
- Direction sign (object)
- Distance
- Environment
- Junction description
- Junction name/number
- Landmark
- Lane change
- Node geometry
- Path geometry
- Road marking
- Road type
- Street name/number
- Time

Legend:
- all subs
- cognitive map
- video
Information used at Manoeuvre 26

![Graph showing frequency counts for different information categories.](image)

- **Direction sign (nav)**
- **Direction sign (object)**
- **Distance**
- **Environment**
- **Junction description**
- **Junction name/number**
- **Landmark**
- **Lane change**
- **Node geometry**
- **Path geometry**
- **Road marking**
- **Road type**
- **Street name/number**
- **Time**

Legend:
- **all subs**
- **cognitive map**
- **video**

Frequency counts range from 0 to 40.
Predicting Landmark Value (V)

\[ V = (.340) \text{DEGOFINT} + (.255) \text{USEOFLOC} + (.134) \text{VISCAR} \]

Where:
DEGOFINT = Degree of Interaction
USEOFLOC = Usefulness of Location
VISCAR = Visual Characteristics

OTHER POTENTIAL FACTORS
Visual Effort for Scanning*
Pre-Warning*
Familiarity
Ease of Naming
Influence of Surroundings*
Similarity of Appearance
Level of Task Demand*
Study 2 – Effect of Landmark Value

- 48 subjects (3 x 16)
- Good vs Poor vs No Landmarks (verbally)
- Left turn…

[before the pedestrian lights]  [before the phone box]

V=79  V=50
Number of glances to display

Mean no. of glances - all target manoeuvres

<table>
<thead>
<tr>
<th>Landmark category</th>
<th>Mean no. of glances</th>
</tr>
</thead>
<tbody>
<tr>
<td>good</td>
<td>5.2</td>
</tr>
<tr>
<td>poor</td>
<td>4.5</td>
</tr>
<tr>
<td>none</td>
<td>8.8</td>
</tr>
</tbody>
</table>
Number of glances

Estimated Marginal Means

Landmark category
- good
- poor
- none

Manoeuvre number

TTEC
Percentage moving time

Mean % - all target manoeuvres

Landmark category

- good: 10.5%
- poor: 9.0%
- none: 16.6%
Percentage moving time

Estimated Marginal Means

Landmark category
- good
- poor
- none

Manoeuvre number

TTEC
Approach confidence

1 = low; 2 = medium; 3 = high
Approach confidence

1 = low; 2 = medium; 3 = high
Confidence changes

Estimated marginal means

Landmark category

1 = low; 2 = medium; 3 = high
Driving errors

1 = minor; 5 = serious; 10 = dangerous
Navigation errors

i.e. 25% for poor/none; 10% for good
<table>
<thead>
<tr>
<th></th>
<th>Good landmarks</th>
<th>Poor landmarks</th>
<th>No landmarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of glances</td>
<td>**</td>
<td>***</td>
<td>*</td>
</tr>
<tr>
<td>Glance duration</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>% time looking at display</td>
<td>**</td>
<td>**</td>
<td>*</td>
</tr>
<tr>
<td>Workload</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Driving errors</td>
<td>***</td>
<td>*</td>
<td>**</td>
</tr>
<tr>
<td>Navigation errors</td>
<td>***</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Approach confidence</td>
<td>**</td>
<td>*</td>
<td>**</td>
</tr>
<tr>
<td>Confidence at Preview 1</td>
<td>**</td>
<td>*</td>
<td>***</td>
</tr>
<tr>
<td>Confidence at Preview 2</td>
<td>**</td>
<td>*</td>
<td>***</td>
</tr>
<tr>
<td>Confidence at Final</td>
<td>***</td>
<td>*</td>
<td>**</td>
</tr>
<tr>
<td>Confidence post-manoeuvre</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Study 3 - effect of incorrect information

- 18 participants drove three routes
- 10 traffic lights  (control - all correct)
- 10 pubs   (no. 7 - wrong name)
- 10 petrol stations   (no. 7 - wrong name)
- Driver confidence at each manoeuvre
  (1=low, 2=medium, 3=high)
Change in confidence levels

Line graph to show the overall confidence levels for the 3 routes

 Errors occurred here

1 = low; 2 = medium; 3 = high
Main effects on confidence

• Prior to vs post error
  – Traffic lights 2.83
  – Petrol Stations 2.85 to 2.63 (down 0.22)
  – Pubs 2.79 to 2.29 (down 0.50)

• Pre-error confidence range = 2.5 – 3.0
• Manoeuvre at which the error occurred:
  – 2.0 for petrol stations
  – 1.5 for pubs

• Post error, 3 manoeuvres to regain confidence
Did drivers notice (n=16)?

Graph to show how many people noticed the incorrect naming of the landmark

Number of people

Petrol Station

Pub

Type of landmark
Explanation of findings

• Petrol stations
  – designed to be easily spotted by drivers
  – very different to surrounding objects
  – likely to occur singly

• Pubs
  – pubs are often clustered together
  – there may be other potential manoeuvres nearby
  – difficult to pick out from the surroundings
Future Plans

• Application of results to other areas
  – Pedestrian navigation
  – Location based services

• Information reliability – does the effect differ?

• Context specific information

• Adapting to the user