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

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Additional Information:

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

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Next generation navigation: the importance of context and quality

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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

TTEC
Use of general navigation information

Frequency counts

- **all subs**
- **cognitive map**
- **video**

**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

Frequency counts

General information 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
Information: main or secondary

The diagram illustrates the frequency counts of different information categories, categorized as main, secondary, or all information. 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
- Time

The y-axis represents frequency counts, while the x-axis lists the general information categories. The graph provides a visual representation of how often each category is included as main, secondary, or all information.
Information used at Manoeuvre 1

![Graph showing frequency counts of different types of information used.](image)
Information used at Manoeuvre 9

- 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

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

- Direction sign
- 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
Predicting Landmark Value (V)

\[ V = (0.340) \text{DEGOFINT} + (0.255) \text{USEOFLOC} + (0.134) \text{VISCAR} \]

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

- Good: 5.2
- Poor: 4.5
- None: 8.8

Landmark category
Number of glances

Estimated Marginal Means

- Landmark category:
  - good
  - poor
  - none

Manoeuvre number
Percentage moving time

Mean % - all target manoeuvres

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

Estimated Marginal Means

Manoeuvre number

Landmark category

- good
- poor
- none
Approach confidence

Mean approach confidence

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

Estimated marginal means

1 = low; 2 = medium; 3 = high

Landmark category
- good
- poor
- none
Confidence changes

Estimated marginal means

Landmark category
- good
- poor
- none

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

Average Confidence rating vs. Manouevre Number

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

<table>
<thead>
<tr>
<th>Type of landmark</th>
<th>Number of people</th>
</tr>
</thead>
<tbody>
<tr>
<td>Petrol Station</td>
<td>8</td>
</tr>
<tr>
<td>Pub</td>
<td>18</td>
</tr>
</tbody>
</table>
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