Human factors aspects of navigation systems in support of Intelligent Speed Adaptation (ISA) functionality

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IJF is also with Safety and Policy Analysis International
At 2:00 p.m. AEST, Tuesday 2 May 2000 something happened that gave us useable Sat Navs . . . and everything changed!

From Todd Humphreys, TEDxAustin, February 2012
Always connected sensors

• Always-connected sensors are proliferating . . . your smartphone has these sensors:
  – Video
  – Audio
  – Clock
  – GPS
  – Gyroscope
  – Accelerometer
  – Compass
  – Wifi
  – Bluetooth
  – (possibly) Sensors for temperature and pressure.

• These sensors can be easily used to work out where you are, when, and what you are likely to be doing . . . it already knows who . . .
Sat Navs – in-vehicle navigation systems

• In-vehicle device manufacturers are incorporating more and more functionality into navigation devices and smart phones
  – GPS, Bluetooth, Wi-Fi, cameras, music, touchscreen interfaces, compasses, motion sensors, and storage cards.

• After-market systems – portable nomadic devices - currently, but increasingly being incorporated into vehicles as OEM technology

• In-vehicle navigation systems are popular for wayfinding, but most models include points of interest (POI) such as school zones, railway crossings, fixed speed and red-light cameras, and also include speed limit information

Healy & Truong (2009) Intelligent Speed Assist (ISA) technology and navaid systems – Seizing the moment!
Sat Navs – in-vehicle navigation systems

• Sat Navs which integrate speed limit information or “passive” Intelligent Speed Adaptation (ISA) are designed so that a driver is warned via audible, visual and/or haptic alerts that the vehicle speed is in excess of the posted speed limit

• Typically, the audio warnings are limited in duration and can be de-activated

• Speed limits and vehicle speeds are shown visually only as a reminder to the driver, but can be difficult to see within the map display

• However, the evidence base for the decisions taken by device designers and manufacturers is unclear
  – There are no standards or agreed functional requirements

• How do we get Sat Nav manufacturers, suppliers and marketers to build in and then promote ISA systems across their range of products?
How can we tell if a Sat Nav has a useable ISA?

- Programs such as the Child Restraint Evaluation Program (CREP) and the Australasian New Car Assessment Program (ANCAP) are examples of road safety-based consumer rating systems that can successfully provide relevant safety information to consumers.
- There is a need to set requirements for functional performance of ISA devices (e.g., user interface, common features, critical specifications), on-road operational performance and quality of speed limit data (e.g., coverage, accuracy, up-to-datedness)
- A program that evaluates and rates Sat Navs and smartphones with ISA, based on the above requirements, will encourage better performing devices and will allow consumers to make an informed choice when purchasing ISA products.

How can we tell if a Sat Nav has a useable ISA?

• In the first part of this presentation, I want to review the outcomes of a trial assessment of four ISA devices (available on the Australian market in late 2011) against selected assessment criteria.

• The purposes of the trial assessment were to:
  – first, demonstrate the feasibility of a scoring system developed to support a system to assess ISA functionality, and
  – second, identify practical issues that may arise during the conduct of such assessments.

• The project was commissioned by the NSW Centre for Road Safety, of the then Roads and Traffic Authority

Trial assessment of Sat Navs with ISA

• Four devices assessed: 3 Sat Nav based ISA products and one smartphone based ISA product: the OttoMobile (for iPhone); the Navman Ezy30; the Navig8r M35; and the TomTom GO

• Devices were tested on-road in a scenario similar to how the devices would be commonly used

• Functionality was observed in use and default settings were checked via the device menus

• The routes were in Sydney, except for the OttoMobile which was tested in Melbourne
  – The route in Sydney passed through several speed zones (with speed increases and decreases at zone change points), including school zones and zoned high pedestrian areas, and included urban, suburban and motorway road types

Trial assessment of Sat Navs with ISA

• A comprehensive list of minimum functional specifications, critical features and minimum performance standards for Sat Navs claiming ISA functionality was developed.

• These criteria were categorised in terms of:
  – Feature Performance
  – Hardware Performance
  – Ease of Use/Human Factors
  – Mapping Performance (Coverage, Accuracy and Update Utility).

• The assessments were rated: Good (Score=3), Acceptable (2), Marginal (1); and Poor (0).
Trial assessment of Sat Navs with ISA – first 8 criteria

<table>
<thead>
<tr>
<th>Criteria Description</th>
<th>Good</th>
<th>Acceptable</th>
<th>Marginal</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Must include school zones</td>
<td>Includes school zones</td>
<td>NA</td>
<td>NA</td>
<td>Does not include school zones</td>
</tr>
<tr>
<td>Must display current time</td>
<td>Displays current time</td>
<td>NA</td>
<td>NA</td>
<td>Does not display current time</td>
</tr>
<tr>
<td>Displays vehicle speed</td>
<td>Displays vehicle speed</td>
<td>NA</td>
<td>NA</td>
<td>Does not display vehicle speed</td>
</tr>
<tr>
<td>Displays current speed limit</td>
<td>Displays current speed limit</td>
<td>NA</td>
<td>NA</td>
<td>Does not display current speed limit</td>
</tr>
<tr>
<td>Displays correct speed limit for school zones when zone is active</td>
<td>Displays correct speed limit for school zones when zone is active</td>
<td>NA</td>
<td>NA</td>
<td>Does not display correct speed limit for school zones when zone is active</td>
</tr>
<tr>
<td>Provides driver with alert when speed limit is exceeded</td>
<td>Provides driver with alert when speed limit is exceeded</td>
<td>NA</td>
<td>NA</td>
<td>Does not provide driver with alert when speed limit is exceeded</td>
</tr>
<tr>
<td>School zones enabled as default</td>
<td>School zones enabled as default</td>
<td>NA</td>
<td>NA</td>
<td>School zones not enabled as default</td>
</tr>
<tr>
<td>Audible Alert volume</td>
<td>Easy to hear alerts over loud vehicle/traffic noise on default setting</td>
<td>Alerts sometimes difficult to hear over loud vehicle/traffic noise on default setting</td>
<td>Alerts sometimes difficult to hear over normal vehicle/traffic noise on default setting</td>
<td>Constantly difficult to hear alerts over normal vehicle/traffic noise on default setting</td>
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### Trial assessment of Sat Navs with ISA – results

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Green</th>
<th>Yellow</th>
<th>Red</th>
<th>Blue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Must include school zones</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Must display current time</td>
<td></td>
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<tr>
<td>Displays vehicle speed</td>
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</tr>
<tr>
<td>Displays current speed limit</td>
<td></td>
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</tr>
<tr>
<td>Displays correct speed limit for school zones when zone is active</td>
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</tr>
<tr>
<td>Provides driver with alert (audible/visual/haptic or combination) when speed limit is exceeded</td>
<td></td>
<td></td>
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<tr>
<td>School zones enabled as default</td>
<td></td>
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</tr>
<tr>
<td>Audible Alert volume</td>
<td></td>
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<tr>
<td>Redundant/back up location system</td>
<td></td>
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<tr>
<td>School zones - correct time/day of operation</td>
<td></td>
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<tr>
<td>Electronic variable signs</td>
<td></td>
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<tr>
<td>New speed zone alert</td>
<td></td>
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<td></td>
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<tr>
<td>Default application</td>
<td></td>
<td></td>
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<tr>
<td>Alerts are enabled as default</td>
<td></td>
<td></td>
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<tr>
<td>Default tolerance of alerts</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum alert tolerance</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum alert tolerance</td>
<td></td>
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<tr>
<td>Unit can only fit into limited number of vehicle models</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>School zones cannot be disabled</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Driver interaction required</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Overall score (max possible score 60, min possible score 0)</td>
<td>47</td>
<td>41</td>
<td>50</td>
<td>25</td>
</tr>
</tbody>
</table>

Legend:
- **Good**
- **Acceptable**
- **Marginal**
- **Poor**
- **Not Assessed**
Trial assessment of Sat Navs with ISA – conclusions

• In several criteria there are substantial differences between Sat Nav devices claiming ISA functionality
  – This demonstrates that the method has the potential to encourage manufacturers to improve ISA functionality

• There is scope for improvement for devices, as no Sat Nav device claiming ISA functionality obtained the maximum/minimum (or close to maximum/minimum) score
  – This demonstrates that the range of criteria are relevant

• In a practical sense, the assessments appeared repeatable, relevant and objective

Sat Navs with ISA – the next step

• There are currently no standards or assessments protocols that are complete and are directly relevant to the assessment of ISA devices.

• Any product functionality assessment system developed to assist consumers will therefore need to develop its own standards and protocols.

• Human factors research is not conclusive about the best ways to convey speed limit information and speeding alerts to drivers.

• However, there are some human-machine-interface methods that should be avoided, particularly in terms of poor interface design concerning the presentation of speed limit information and speeding alerts to drivers.

Typical examples of speed information displays in Sat Navs.
But the future is already here . . . governments, technology and the ‘speeding’ problem

• In the second part of my presentation I want to alert you to recent developments . . .
• From the government perspective, repeated trials show that ISA works
• The National Road Safety Strategy 2011-2020 supports ISA . . . proposed actions include
  – “Facilitate the implementation of ISA system”
  – “Examine the scope to require advisory ISA in all government fleets”
  – “Examine use of ISA for recidivist speeders and P-plate drivers”
  – “Initiate discussions with insurers to encourage voluntary fitting of ISA”
• States and Territories are working on digital speed limit maps
• Roll out of ISA for government fleet vehicles is commencing (slowly)
But the future is already here . . . the public, technology and the ‘speeding fines’ problem

• The challenge is that the public think they are all ‘good’ drivers, but most will exceed the speed limit

• Drivers faced with multiple “speed” concepts - speed limits, advisory speed signage, maintaining traffic speed, drive to the conditions

• Drivers want solutions to their ‘speeding fines’ problem
The ‘speeding’ and the ‘speeding fines’ problems

• For ISA, it is the private sector that is meeting the needs for
  – speed compliance
  – and the ‘speeding fines’ problem

• Private sector involvement has been through Sat Navs as stand-alone portable navigation devices . . . but now it is smartphones
  – 52% of Australians now own a smartphone (May 2012)
  – Market growth of 40%, year on year
  – Estimated 60% of Australians will have a smartphone by end-2012.
  – The cost of smartphones is projected to go below $50

• In 2015, nearly 90% of all mobile phone users will have a smartphone as their primary mobile device.
The shift is from Sat Navs with ISA as a stand-alone portable navigation device (currently $90-300) . . .
to “Nav” on smartphones with ISA and mapping apps, at an estimated cost of $15-65
Speed camera locations are already provided in Point Of Interest functions, and alerts for mobile speed camera locations can be quickly disseminated - FREE
These applications are not well received by road safety and police, being viewed as supporting evasion.
Nonetheless, these apps are commonly available and commonly used by drivers.
Free Nav on all smartphones soon

Apple Maps
iPhone IOS 6

Google Maps 6
Android

Nokia Drive
Window Phone 8
The private sector is moving to supply compliance technology to drivers, in ways that are moving towards acceptability.
Example – Speed Alert’s published camera / hazard locations
Example – Speed Alert’s user-based ISA, allowing flexible levels of alerts to be set by a driver.
Free apps, such as the Speed Alert ISA app, are supported by sale of Point Of Interest functions, such as location of outlets for fast food, petrol companies (service stations), etc.
Rewards – PHYD Insurance is the “killer” app for gaining widespread adoption of ISA

• Some trial applications of reward-based systems for speed compliance (fun theory, “speed camera lottery”, etc.)
• Pay How You Drive Insurance (PHYD) / Usage Based Insurance (UBI) is already available in the US and in Europe
• @ 2 million PHYD/ UBI customers
• Projected 100 million PHYD/ UBI customers / users by 2021

PHYD / UBI – in Australia
• AAMI & Institute of Transport & Logistics Studies (ITLS) showed PHYD insurance effective
• National Road Safety Strategy 2011-2020
  “Initiate Discussions with insurers to encourage voluntary fitting of ISA”
Thank you