3D Nautical Charts: Cognitive Off-Loading Using an Egocentric Presentation Mode

Dr Thomas Porathe
Maritime Human Factors Group
Dep. Of Shipping and Marine Technology
Chalmers University of technology
Göteborg, Sweden
There is a certain type of accidents characterized by a sudden loss of situation awareness
Cosco Busan, collision with the San Francisco-Oakland Bay Bridge, 2007
PILOT: what are these red *?

CAPT: this is on bridge.

CREW: bridge is **.

PILOT: oh I couldn't figure out what the red light was.
08:27:45 PILOTVHF 

trafic romeo did you call.

08:27:48 VTS unit romeo traffic uh AIS shows you on two three five heading what are your intentions over?

08:27:57 PILOT VHF well I'm comin' around I'm steering two eighty right now.
PILOT: this is the center of the bridge right?
CREW: yeah yeah.
What went wrong?
The Human Factor
The Human Factor

Is subject to attention narrowing ("tunnel vision")
The Human Factor

Is subject to attention narrowing ("tunnel vision")
Falls asleep
Forgets
Misunderstands
Slips
Make mistakes
Make short cuts
...

Chalmers University of Technology
Dep. Of Shipping and Marine Technology thomas.porathe@chalmers.se
The bad news

• Human error continues to be a dominant factor in approximately 80 to 85% of maritime accidents;

• Failures of situation awareness and situation assessment overwhelmingly predominate, being a causal factor in the majority of those accidents attributed to human error;

• Human fatigue and task omission seem closely related to failures of situation awareness and the human errors and accidents that result.

(Baker & McCaffery, 2005)

Situation Awareness (SA) Integration

Motion & vibrationes

Perception

Analogue & digital data

Time

1, 2, 3
Bev Doolittle (1984). *The Forest has Eyes*
Information design – solving problems

“Solving a problem simply means representing it so as to make the solution transparent.”

(Simon, 1996)

“Solving a problem simply means representing it so as to make the solution transparent.”

(Simon, 1996)
Mental Rotations

Mental Rotations

Mental Rotations

Africa in its canonical orientation
Enterprises navigating in high speed generally use maps head-up.

Fighter airplanes and helicopters

Rally and orienteering
North-up mode

Head-up mode

3-D egocentric mode

TomTom Navigator
HP Edition
Experimental results
Two studies

The University group

45 participants
Age: 16 - 63
21 women
24 men

The Bridge Officer group

30 participants
Age: 22 – 54, all men
18 combat boat drivers,
6 Experienced, active
bridge crew members
6 Cadets
<table>
<thead>
<tr>
<th>Independent variables</th>
<th>Dependent variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Map types (Paper, North-up, Head-up, 3-D)</td>
<td>Time on track</td>
</tr>
<tr>
<td>Gender</td>
<td>Number of groundings</td>
</tr>
<tr>
<td>Age</td>
<td>Subjective ranking of user-friendliness</td>
</tr>
<tr>
<td>Navigational experience</td>
<td>Score on figure rotation test</td>
</tr>
<tr>
<td>Self taxed sense of direction</td>
<td></td>
</tr>
</tbody>
</table>
Perceived user-friendliness

We will redo this experiment with Chinese mariners at Dalian Maritime University in November 2011.
AIS targets

Unidentified radar returns

Dynamic NoGo areas

The bridge perspective

The entrance to Mariehamn, Åland

Traffic separated seaways
Visual iconicity
Welcome to the Port of Göteborg

M/S Breeze

Please follow the white leading line to your berthing place:

Requested course: 121 deg.
Requested speed: 7.5 kn.
Welcome to the Port of Göteborg

M/S Breeze

Please follow the white leading line to your berthing place:

Requested course: 121 deg.
Requested speed: 7.5 kn.
Meeting with M/S Stena Germanica, Port to port, 2.5 min
Welcome to the Port of Göteborg

M/S Breeze

Please follow the white leading line to your berthing place:

Requested course: 121 deg.
Requested speed: 7.5 kn.
Tethered view
The 3D chart as a HUD in the windscreen
BLAST
(Bringing Land And Sea Together)

1. Lead Partner – Norwegian Hydrographic Service
2. Norwegian Coastal Administration
3. National Survey and Cadastre (KMS)
4. Danish Coastal Authority
5. Local Government Denmark
6. National Space Institute
7. Aalborg University
8. Federal Maritime & Hydrographic Agency
9. Jeppesen GmbH
10. T-Kartor AB
11. Malardalen University
12. Natural Environment Research Council
13. Seazone Solutions Ltd.
14. UK Hydrographic Office
15. Agency for Maritime and Coastal Services
Kongsberg Polaris simulator
Antwerp maritime academy
Onboard the Belgian hydrographic survey ship “Ter Streep”
Eastern outer breakwater with wind farm
The Westhoofd quay from the corner of the military dock
2009 - 2012

- Danish Maritime Safety Administration (project leader)
- Norwegian Coastal Administration
- Moere Romsdal County, Norway
- Swedish Maritime Administration
- Swedish Transport Agency
- SSPA, Sweden
- Chalmers University of Technology Sweden
- Maritime University Szczecin, Poland
- National Institute of Technology, Poland
- Gdynia Maritime University, Poland
- Maritime Institute in Gdansk, Poland
- Maritime Office Gdynia, Poland
- Kymenlaakso University, Finland
- Finnish Maritime Administration
- Helsinki University of Technology, Finland
- Estonian Maritime Administration
Distributing search patterns using ECDIS

Thomas Porathe
Chalmers University of Technology

Fredrik Forsman,
Swedish Sea Rescue Society

Ole Borup,
Danish Maritime Safety Administration

World Maritime Rescue Congress
Shanghai 24-28 August 2011
A 14 min. long video cut down to 1.5 min.
The 3D chart as a HUD in the windscreen

My dissertation can be downloaded free from:

www.diva-portal.org  Search for author "Porathe"