Scanning: from screen to scene

Using the 'windscreen wiper' technique to maintain a proper lookout by sight

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Whether in harbour, coastal waters, or deep sea, a collision threat can present itself at any time. Watchkeepers must scan effectively from the moment their vessel leaves the quay at the beginning of a voyage until it is back alongside at the end of the voyage – the key word here being 'effectively'. It is all too easy for watchkeepers to 'look' without 'seeing', or to pay attention to the wrong things. New research suggests that keeping an effective lookout is not something which is naturally acquired; it needs to be specifically taught. In particular, watchkeepers need to know how their vision works, and how to work with, not against, those capabilities to develop an effective scanning technique.

Heads up

Despite the assistance provided by electronic navigation aids, lookout by sight remains essential for the watchkeeper to generate a complete picture of their surroundings. It is therefore essential that watchkeepers utilise a sound visual scanning technique.

To establish a thorough sense of situational awareness requires the monitoring of all available navigation instruments within the bridge as well as the vessel's external environment. This is particularly true when attempting to detect small targets such as fishing or recreational vessels that may not be detected by radar. While it is important to scan the displays on the bridge, it is also important to focus outside the bridge to allow for the effective visual acquisition of other vessels. A 'head down' approach, where the watchkeeper's attention is mainly focused on the array of screens within the modern bridge rather than the world outside the windows, decreases situational awareness and should be avoided.

The LADDER project

Liverpool John Moores University is currently involved in research on this issue as part of the Maritime Research and Innovation UK (MarRI-UK) funded Lookout Awareness of Distractions: the creation of a Distraction Evaluation Ratio (LADDER) project. In this project eye tracking goggles were used to monitor the eye movements of watchkeepers as they perform their duties within a simulated ship's bridge. All participants had experience as OOW as a minimum. The data indicates a widespread weakness amongst watchkeepers in maintaining a visual lookout. The main issue is that there is a tendency for officers to adopt a 'head down' approach. The Electronic Chart Display and Information System (ECDIS) has proven to be particularly effective at drawing a watchkeeper's attention away from maintaining a visual lookout.

Participants in the data collection process flagged up that they have never explicitly received any guidance on how best to go about visually scanning for other vessels. This is borne out by the eye movement data, identifying that participants are not maintaining any kind of regular scan patterns in their visual lookout. This would not be a cause for concern if they were maintaining an effective watch regardless. However, their recorded eye movements suggest that this is not the case. Monitoring bridge equipment is an essential part of safe navigation; thus, due attention must be paid to it, but not at the expense of looking out of the window. Perhaps the time has come for watchkeepers to be presented with a number of standardised methods to assist them in maintaining a proper lookout by all available means.

> "Many bridge watchkeepers have never received any guidance on how best to go about visually scanning for other vessels."

Visual searching

In essence, maintaining a lookout is a 'visual search' exercise. To ensure that their attention is suitably focused to identify any potential hazards, watchkeepers need to establish their own 'visual search techniques'. These should be basic procedures allowing them to maintain an effective lookout across the necessary area whilst overcoming any potential distractors. If we dip our toe into the world of ophthalmology, we get some indications as to how to go about this.

Watchkeepers need to understand the significance of the central vision versus the peripheral vision fields of the human eye. Central vision extends from right in front of the eyes to approximately 2.5° either side. This 5° monocular field of view for each eye provides a total binocular field of view of 10° when both eyes are taken into account. In comparison, peripheral vision extends to approximately 100°-110° on either side of the eye.

The eye can only fully focus and recognise an object when the object viewed is in its central vision. Objects detected within the eye's field of central vision result in clear, sharply focused messages being sent to the brain. By contrast, any visual information that is processed through peripheral vision will be of less detail. Because the eyes can only fully focus on this narrow viewing area, effective scanning is best accomplished with a series of short, regularly spaced eye movements that bring successive sections of the area to be scanned into the central visual field.

However, that is not all there is to it. The vision must be focused for up to four seconds for an object to be registered in the brain's sensory memory. Only then is it transferred into the short-term memory where it is formally registered and integrated in to the watchkeeper's working memory where it contributes towards their situational awareness.

'Windscreen wiper' scanning

To scan effectively a watchkeeper must know how to make the best use of their eyes' natural capabilities – and train themselves to do this repeatedly. This is not a new idea; it was evidenced as far back as 1989, when video gamers who were trained to use efficient visual scanning patterns showed better performance than those who had received random pattern training or no training at all. Likewise, airline pilots have long since adopted scanning patterns involving a 'block' system as the most effective way of keeping a lookout.

This system is based on the premise that traffic detection can best be conducted by focusing on a series of fixed points in space. When the head is in motion, vision is blurred, and the brain will not register potential targets. Unless a series of fixations is made, there is little likelihood that a target will be effectively detected. To be most effective, an officer's vision should be shifted and refocused at regular intervals. A scan of the visual horizon should be broken down into approximately 10° 'blocks', to ensure that the field of central vision focuses on each sector in turn before moving on to the next, spending no more than four seconds on each.

Scanning the visual field is a key factor in collision avoidance and should be a continuous process used by the watchkeeping officer to cover all areas visible from the bridge. In application, the window is to be divided into blocks, each of which is to be methodically scanned for traffic in sequential order. This should be performed as follows (Fig.1):

1. Start in the centre block of the visual field (towards the bow of the vessel).
2. Vision is moved to the port side of the vessel, focusing for a period of no more than four seconds on each 10° block.
3. After reaching the last block on the port side, vision should resume its journey back to the centre block, again scanning each 10° block on the port side for no more than four seconds in each block.
4. Repeat on the starboard side of the vessel. Vision is moved from the centre block of the visual field to the starboard side in blocks of 10°, focusing for a period of no more than four seconds on each 10° block.

Searching in sectors of 10° and focusing in each sector for no more than four seconds means spending a total of 84 seconds (1 min 24 seconds) for a 210° field of view – a maximum of 168 seconds (2m 48s) to scan back and forth across the arc using the method described.

Having scanned each 10° block to starboard outwards to the beam of the ship and then back to the bow, the same approach should be followed for the instrument panels within the bridge (Fig. 1):

5. After having scanned each 10° block of the window, vision should be switched to the instrument panel within the bridge. Starting in the middle (in line with the bow), the equipment should be scanned to port employing the same block approach that was utilised to look out of the window.
6. Then in blocks back to the centre.
7. From the centre (in line with the bow), the equipment should then be scanned to starboard, employing the block approach.
8. Then in blocks back to the centre.
9. Once an appropriate amount of time has been spent viewing the instrument panels inside the bridge, the external scan process should be resumed.

The eyes may require several seconds to refocus when switching between items on the bridge and outside of the window. Vision should initially be focused on the centre block of the visual field until the eyes have refocused, before commencing the external scan.

The watchkeeper should remain constantly alert to all traffic within their field of vision. This means periodically scanning the entire visual field outside the vessel by going out on to the bridge wing to look astern. In addition, watchkeepers should take into account blind spots caused by fixed structures within the bridge such as posts or window struts, and take appropriate action to avoid these masking their view of other vessels.

Very few tasks can be accomplished through a 'by-chance' approach without the provision of any type of training. Maintaining a 'proper lookout' as required by the Standards of Training, Certification and Watchkeeping (STCW) Code is no different. It is hoped that the 'windscreen wiper technique' proposed here will go some way to addressing the 'head down' approach adopted by many watchkeeping officers.

This research is part of a project funded by Maritime Research and Innovation UK (MarRI-UK) studying Lookout Awareness of Distractions. A key part of this project is the creation of a Distraction Evaluation Ratio (LADDER).

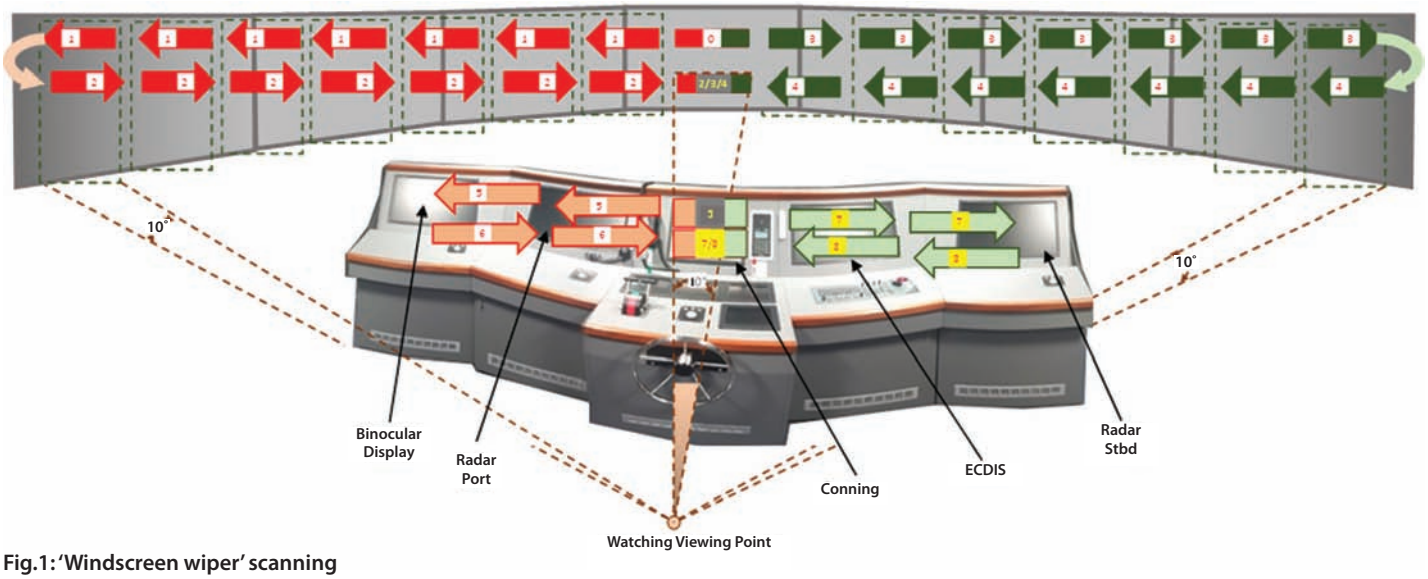

Fig.1: 'Windscreen wiper' scanning