A clock-face method of outdoor scanning and tracking using sports cones: A case study of a client with post-stroke visual field loss

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The participant in this case study is a 65 year old male, who had a right posterior cerebral artery stroke. He undertook a compensatory scanning program though continued to experience collisions with objects in familiar and unfamiliar environments. He was later referred to Guide Dogs NSW/ACT, Australia for orientation and mobility (O&M) services. The second author (instructor) assessed and identified this client's functional field of vision using an outdoor clock-face method by placing sports cones of various colours on the ground in front of the client at specific distances. The clock-face method was also used to facilitate consistent and effective scanning and tracking training in environments of various complexities in which the participant needed to travel. Importantly, the scanning and tracking technique commenced at the client's feet, assisting him to avoid tripping and falling. Post-training, the client reported that he is more aware of his visual field deficit to the extent that he was surprised his visual field had not actually increased. He has not reported any falls or collisions post-training and experiences increased confidence travelling in the community.

The client was admitted to hospital in June, 2013 with a right posterior cerebral artery stroke. The effects of the stroke resulted in topographical disorientation, mild left visual-spatial inattention, a left side homonymous hemianopia, reduced complex attention, higher level balance issues, and a slight dysarthria.

The client spent three weeks in rehabilitation at the hospital. Rehabilitation included speech pathology, physiotherapy, and occupational therapy. The Occupational Therapist (OT) focused on the vision-related issues by providing static and dynamic compensatory scanning retraining (head over shoulder scanning), landmark identification at intersections, and verbal scripts before and while walking.

A referral was made by the OT to Guide Dogs NSW/ACT, Australia, the day before the client was to be discharged. The reason for the referral was that the client was still requiring assistance with orientation, tracking, and scanning in unfamiliar and such complex environments as shopping centres.

Homonymous hemianopia (HH) is one of the most common vision disorders following brain injury or stroke. Hemianopia is a visual field loss on the left or right side of the vertical midline of the visual field. The visual loss is contralateral, i.e., it is on the side opposite the brain lesion and it usually affects both eyes. Individuals with HH are often unaware of what they cannot see with the consequence of walking into objects, tripping over objects, or not seeing objects until they suddenly appear in the field of their vision. This has a detrimental effect on confident, safe, and independent mobility.

Management of individuals with HH is rehabilitation although no single rehabilitative method has achieved acceptance because of a lack of controlled research.

Frequently used assessment methods include the scanning light machine (Kingston, Katsaros, Vu, & Goodrich, 2010), confrontation tests (Kerr, Chew, Eady, Gamble, & Danesh-Meyer, 2010) and behavioural inattention convention sub-tests (Wilson, Cockburn, & Halligan, 1987). A common training method is left to right scanning or head over shoulder scanning in the visual deficit area (Bouwmeester, Heutink, & Lucas, 2007; Diamond, 2001). However, it appears that the major limitations of these assessment and training methods are that they lack functional application to O&M. For example, assessment methods track at near sight level only rather than at varying distances that is required for safe road crossing and walking in changing fast-moving environments. Second, assessments are usually performed in clinical settings rather than in the community so that assessment outcomes rarely provide information about a client's functional mobility in the outdoor environment. Finally, assessment and training methods infrequently provide clients with an understanding of their own vision loss; the way this impacts upon their ability to move through their environment safely; and the way they need to consistently compensate for their specific visual field loss. For example, clients often do not scan for hazards at their feet, for example, drop-offs; and many clients do not accurately and consistently scan their visual field with the consequence of not seeing objects like moving vehicles. These assessment and training limitations have serious implications for clients often compromising their own safety and the safety of others.

Having observed these limitations over many years, the instructor developed the "clock-face method" of tracking, scanning, and training by working with a large number of clients with visual field deficits commencing 2007. The goal was to create a program that enabled clients to understand their visual field loss and to consistently compensate for this loss when travelling.

After trialling a number of ways to assess and train a client with visual field loss in the outdoor environment, it was found that using sports cones of various colours placed on the ground was most effective.

Method

The clock-face O&M program involved a five step assessment and a three step training approach (comprising seven training sessions).

In total, 70 sports cones were placed at various clock-face locations. Specifically, 10 pink sports cones were placed at 12 o'clock; 10 yellow sports cones at 11 o'clock and 1 o'clock; 10 white sports cones at 10 o'clock and 2 o'clock, and 10 green cones at 9 o'clock and 3 o'clock (Figure 1). These specific coloured sports cones were chosen because they contrasted against a range of surfaces for example, grass and concrete.

(1) Functional assessment to identify the clients field of vision

Step 1. A verbal explanation

First, the procedure of the functional assessment was explained to the client. The explanation included a description of the way the sports cones would be configured in an open area (a large playing field located nearby). That is, the cones would radiate outwards at 180 degrees from the client's standing position in a clock-face pattern representing his complete visual field (Figure 1). This configuration was also drawn for the client on an A4 size piece of paper. This drawing assisted the client to understand the concept of the 180 degree visual field and to understand the clock-face in relation to where he was going to stand. The client was asked whether or not he understood the concept of a clock-face before proceeding to step 2. After the client confirmed his understanding of the 'clock-face' concept, the instructor and client walked to the large playing field to commence the functional assessment.

Step 2. Placement of the sports cones

Prior to the instructor placing the coloured sports cones on the ground the client confirmed that he was able to identify each colour and see each colour against the ground surface.

With the client standing in position, 10 pink sports cones were placed one metre apart directly in front of the client's midline (centre of body) at the 12 o'clock position. This process was repeated with the green sports cones placed at the 9 o'clock position

Figure 1. Demonstration of the visual field using sports cones. Pink cones are placed at 12 o'clock; yellow cones at 11 o'clock and 1 o'clock; white cones at 10 o'clock and 2 o'clock; and green cones placed at 9 o'clock and 3 o'clock. Each sport cone was placed 1 metre apart from each other with the furthest cone placed 10 metres from where the client is standing.

(direct left when the arm is extended out to the left-side) and the 3 o'clock position (direct right when the arm is extended out to the right-side). Ten white cones were placed at 10 o'clock and 2 o'clock. At the 11 o'clock and 1 o'clock positions, 10 yellow cones were placed. This pattern of colour allowed the client to recognise the width of his left and right visual fields when looking straight ahead at 12 o'clock (Figure 1).

Step 3. Assessing the client's scanning and tracking ability

Once the cones were placed on the ground and the pattern explained to the client, the client was positioned so that he was standing and facing the row of pink cones at midline (12 o'clock). The client was made aware of midline in relation to his posture and alignment.

The client was asked to count aloud the number of pink cones commencing from his feet ('1, 2, 3, 4, 5, 6, 7, 8, 9, 10') and then to count backwards starting from the tenth cone ('10, 9, 8, 7, 6, 5, 4, 3, 2, 1'). This demonstrated that the client was able to track and scan effectively. It also gave a functional indication of the client's level of acuities with near and far distance vision.

Step 4. Assessing the client's peripheral field of vision

First, the client was asked to describe what he could see when continuously focusing on his midline. The client described all of the different coloured cones on the right side from 12 o'clock to 3 o'clock (Figure 2).

Second, the client was asked to continue focusing on his midline and raise his hand when he could see the instructor in his field of vision. The instructor was positioned two metres away from the client at the nine o'clock green cones. After giving this directive, the instructor then walked from the left side to the right-side green row of cones at three o'clock. The position where the client first saw the instructor was at 12 o'clock and marked by an additional blue cone for contrast with the other colours (the blue cone at which the arrow is pointing in Figure 2). This exercise can be repeated at varying distances to identify near and distance vision issues for example, at two and eight metres. It was identified that the client could not see any of the cones on his left-side from 9 o'clock to 12 o'clock (Figure 2).

Step 5. Discussion with the client about his visual field deficit

The instructor discussed with the client his complete left side visual field deficit and explained the sections of his visual field (9 o'clock to 12 o'clock) that needed to be considered when scanning and tracking. This explanation was also described through a diagram that assisted the client's understanding. Functional implications of the deficit field were discussed for example, scanning for obstacles at his feet on his left side to avoid tripping over them; and viewing cars approaching from his left periphery for safe road crossing (Figure 3).

(2) Training

Once the assessment was completed, the three step training program commenced. One training session occurred each month over a seven month period with each session taking 1-1.5 hours to complete. This particular training schedule was requested by the client.

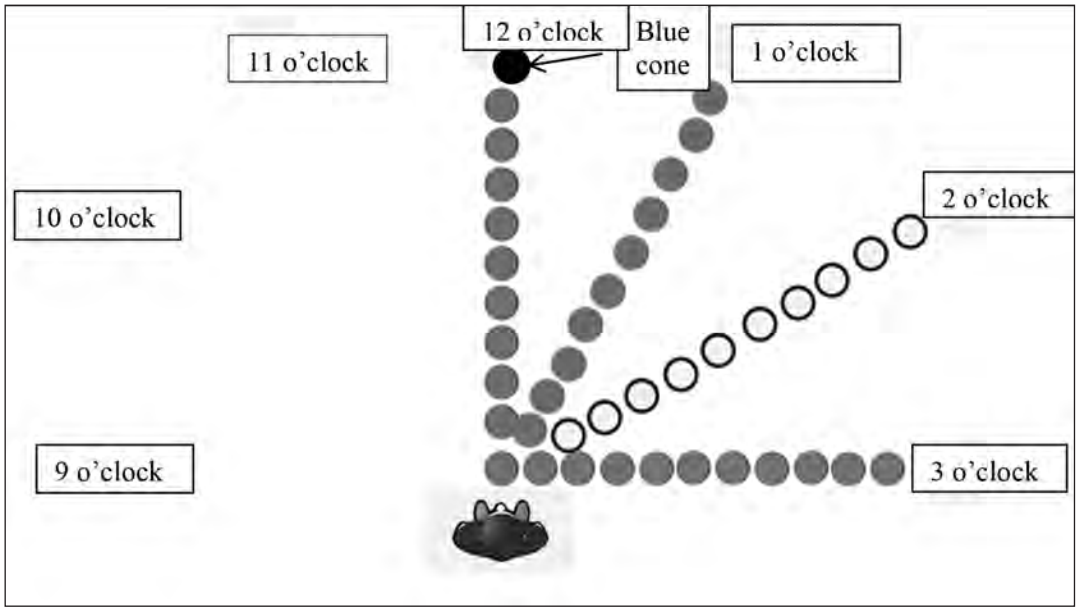

Figure 2. Visual field deficit 9 o'clock to 12 o'clock (aerial view).

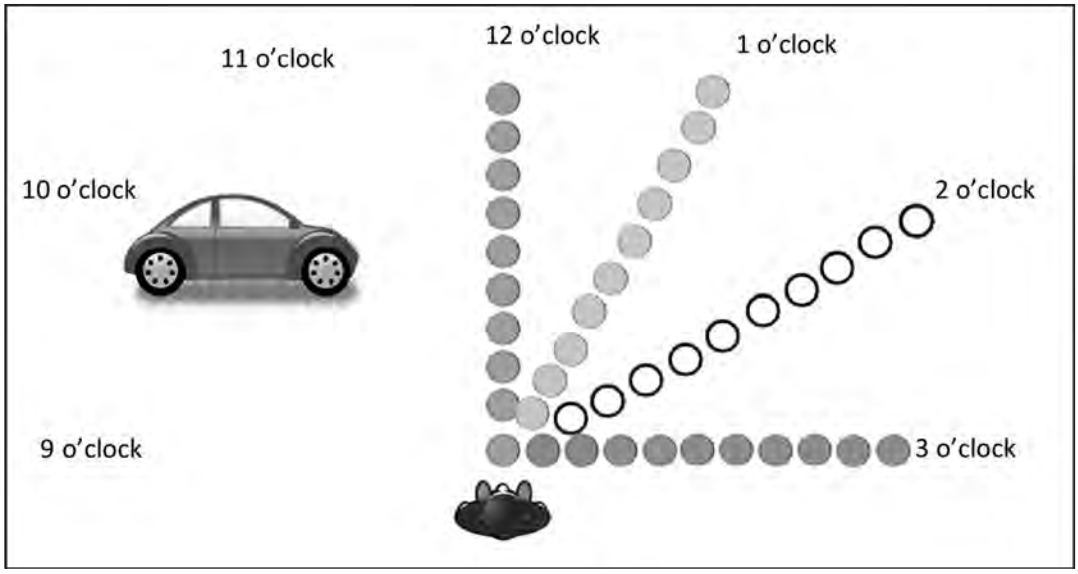

Figure 3. Visual field deficit from 9 o'clock to 12 o'clock.

Step 1. Turning the feet and shoulders: Motor learning and memory consolidation to assist scanning and tracking

The client was requested to stand and face the row of pink cones at the 12 o'clock position. Directional turns using the feet were taught as a motor skill to assist with scanning. Directional turns were taught by instructing the client to pivot his heel on the ground and rotate the left foot to the left, in

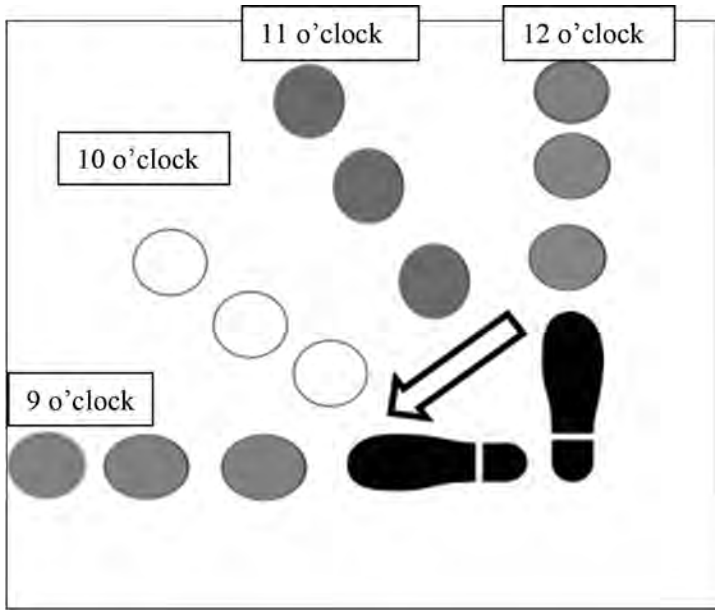

Figure 4. Directional turns with feet at 9 o'clock (green row of cones), 10 o'clock (white cones), 11 o'clock (yellow cones), and 12 o'clock (pink cones).

the directions of 11 o'clock, 10 o'clock, and 9 o'clock (Figure 4). This was then repeated for the right foot at the positions of 1 o'clock, 2 o'clock, and 3 o'clock. At each position the client was asked to scan the environment and describe what he could see. The process is repeated as many times as required. In this case, the instructor demonstrated the movement once and the client only needed a single demonstration to understand and perform directional turns.

While instructing the client to turn his feet, the instructor applied light pressure on the client's shoulders to assist him rotate his body into the correct position (Figure 5). This shoulder/body positioning was repeated five times. Repeated shifting of the feet, body, and shoulders appeared to aid motor learning and memory consolidation. This process assisted the client to scan to his deficit visual field. The client repeated the feet/body/shoulder movements until he did not require any prompting to scan his deficit visual field.

Step 2. Systematic visual scanning and tracking

The instructor asked the client to count each row of cones starting from his feet and then counting backwards as described in Step 3 of the Assessment. The systematic pattern of scanning was taught to the client starting at the 12 o'clock position and then at the 11o'clock, 10 o'clock, and 9 o'clock positions. This process was then repeated for the right side (12 o'clock, 1 o'clock, 2 o'clock, and 3 o'clock positions). This pattern of scanning allowed the client to become aware of both his complete left and right visual fields. The instructor then asked the client to count the row of cones at a random position such as 11 o'clock, 2

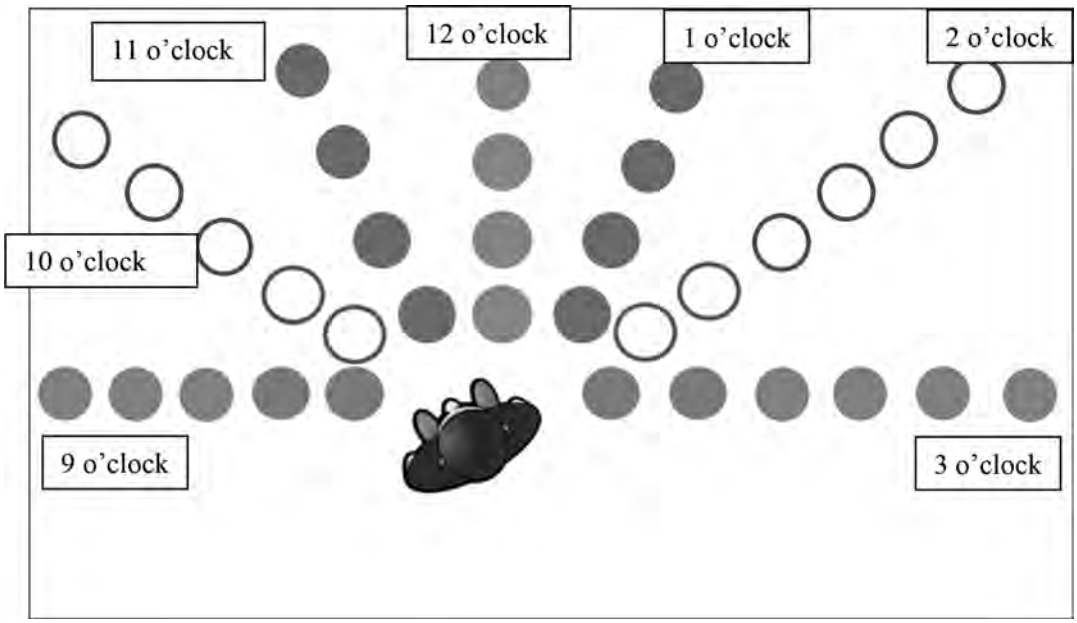

Figure 5. Directional turns using the feet, body, and shoulders. The client's deficit visual field area is from 9 o'clock to 12 o'clock.

o'clock, and 9 o'clock. Successful responses appeared to indicate that motor learning and memory consolidation had taken place, and that the clock-face method of scanning the visual field was understood.

Step 3. Scanning to locate an object, obstacle, or hazard

Immediately after step 2 the client was requested to either face another direction or close his eyes while the instructor placed a red sports cone on the ground amongst the other coloured cones. This activity was performed three times. The instructor placed the cone quietly so that the client could not use auditory clues to assist him locate the cone. To locate the red cone the client then turned back to the sports cones and scanned and tracked in the pattern described in step 2 (Training). The client was reminded to scan by looking down at his feet first. Scanning from the feet is important for safe mobility in the event that an obstacle or hazard is present for example, a drop off.

After the third time, the 70 sports cones were taken away, and the scanning procedure was repeated three times with the red sports cone placed at the client's feet at 9 o'clock, two metres away at 10 o'clock; and five metres away at 11 o'clock. Removing the sports cones ensured that the client did not rely on the cones and could correctly track and scan across the environment. The red sports cone was placed in the client's visual field deficit to determine his scanning effectiveness. Once the client was able to consistently locate the object consecutively three times, then the scanning method was applied in increasingly complex environments. Complex environments where training occurred included the client's farm, the local shopping centre, and at a local sporting oval. For example, during training in the shopping centre, the client walked to

the centre's doors, stood still, and scanned from his feet outwards 180 degrees in the same pattern used with the 70 sports cones. After scanning, the client decided whether or not it was safe to walk without colliding with a pedestrian. Once the client had made the decision to walk he was then required to scan every 5 seconds or so to check his left visual field. He was required to both scan and locate items at the same time.

Post-training scanning review

A scanning and tracking review was completed by the instructor with the client seven months after training. The instructor laid the 70 cones out on a tennis court near the client's home. The client initiated counting all of the cones in each row scanning from left to right. Next, one to three of the cones in three of the rows were removed and the space between some of the cones were reduced or increased. The client was able to identify which rows had changed formation in 10 seconds. The client appeared to be scanning effectively.

The instructor then walked from the left side to the right with the client looking straight ahead. The client was able to detect the instructor between 9 o'clock and 10 o'clock. The client could see the instructor clearly when the instructor stood at the 11 o'clock, 12 o'clock, 1 o'clock, 2 o'clock, and 3 o'clock positions. This result was an improvement from the client not being aware of the left side of his visual field at the initial assessment seven months prior. The result from his perimetry visual field test conducted by his optometrist indicated that there were no changes to his visual field from a left-sided homonymous hemianopia.

Post-training client interview

The client and his wife were interviewed separately to gain their perspective on the process and the outcome of the clock-face method of scanning and tracking. They were each asked nine questions. The answers provided by both the client and his wife were consistent in their content and meaning.

The client reported: (i) the overall assessment and training experience using the sports cones as a positive and practical experience (ii) that in his opinion the training was "accurate" in identifying his visual field deficit, and that the sports cones were like "pathways" assisting him to scan effectively (iii) that he did not find the method of scanning and tracking complicated to learn. The clock-face concept drawn on a piece of paper had helped him understand his sight loss and the method used for scanning and tracking.

The client's application of the clock-face method

Since the client completed training he continues to use the clock-face method of scanning and tracking. The client is able to independently orientate himself in the local shopping centre without assistance. Both the client and his wife commented that he was able to assist in navigating out of Melbourne (a major Australian city) in unfamiliar areas. The client has not experienced any falls or collisions with objects or pedestrians since training. The client stated that as a result of the training, he was surprised his visual field had not improved (according to his perimetry visual field test). Instead, he thought it might have improved because he experienced an increased awareness of his deficit and was not experiencing any

mobility issues. The client confirmed that his confidence in his O&M had improved since completing training.

The client's wife reported that since the training, her husband automatically scans to the left-side when walking; he is never lost in unfamiliar environments such as shopping centres, and can even recall and negotiate routes in unfamiliar locations. She also confirmed that he had not had a fall since training or walked into obstacles, and said that training has been "hugely helpful" to both her and her husband.

Conclusion

The clock-face method appears to have many advantages. In particular one advantage is that scanning from the feet, the client is made aware of hazards such as gutters and drop-offs that are frequently not detected when scanning left to right at eye level. The clock-face method also assesses the visual field at varying distances as opposed to a set distance as in a clinical setting. This distance scanning appears to assist with landmark identification and approaching cars particularly at road crossings.

The clock-face method could be used in conjunction with current standardised methods for a more comprehensive assessment and training for people with neurological visual field loss. Further research using controlled and uncontrolled client groups with visual neglect is required to validate the clock-face method.

Acknowledgements

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