

# Cognitive Behavioural Interventions and Track Worker Safety

*Helen Warnock & Laura Stronge, 2014*

## Aim

The aim of this paper is to raise awareness and understanding of human behaviour and working memory function to improve track worker safety.

## Objective

To proactively introduce cognitive behavioural interventions to reduce lapses of attention which cause accidents and incidents.

## Introduction

Between January 2004 and June 2014 thirty incidents led to fatalities among rail workers. In 30% of these, trackside workers were struck by trains. In every case an underlying cause was a loss of attention or a lack of situational awareness (SA). Excluding machine failure and deliberate acts, loss of attention was an underlying cause in every case<sup>1</sup>.

Despite elaborate rules, procedures and standards, human behaviour is still the major factor in accidents and near misses for trackside workers. There is evidence to suggest that the Santiago de Compostela derailment that occurred in Spain on 24<sup>th</sup> July 2013 was due to the driver having a momentary lapse of attention, or situational awareness<sup>2</sup>. Yet techniques to improve attention and situational awareness are not encouraged or taught to the most vulnerable group of workers on the railway. This is especially surprising as many other large industries have introduced awareness of cognitive behavioural interventions and have included them as an integral part of their safety strategies<sup>3 4</sup>.

**The proliferation of document driven procedures, can lead to a mistaken belief that safety regulations are robust, but they have an inherent hidden weakness if human factors are not taken into consideration.**

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<sup>1</sup> [Data from NWR SMSS team from January 2004 shows fatalities as: 5 RTA, 3 Fall from height, 3 machine failure, 6 involving RRV, 3 suicide/natural causes, 9 struck by train, 1 other]

<sup>2</sup> R. Kemp. "The Spanish Train Crash – a deficit in Situational Awareness?" *Roger Kemp*. 1<sup>st</sup> August 2013 [blog entry]. Available from: <http://www.lancaster.ac.uk/news/blogs/roger-kemp/the-spanish-train-crash--a-deficit-in-situational-awareness/> [accessed 24 June 2014].

<sup>3</sup> Gillespie, B.M et al Building shared situational awareness in surgery through distributed dialog. *Journal of Multidisciplinary Healthcare*, 2013, (6) p109-118.

<sup>4</sup> Situation awareness and safety in offshore drill crews(2006) *Cognitive Technical Work*, 2006, (8) p255-267

The current Safe System of Work procedures including SSOWPS, OTP and ALO are heavily paper-based and can be difficult to follow, particularly when working on the track. The proliferation of document driven procedures, whether on paper or on electronic devices, can lead to a mistaken belief that safety regulations are robust. However, they have an inherent hidden weakness if human factors are not taken into consideration. The HSE define human factors as:

*...the environmental, organisational and job factors, and human and individual characteristics which influence behaviour at work in a way which can affect Health and Safety.<sup>5</sup>*

Initiatives such as the Life Saving rules, non-technical skills and the proposed Safe Working Leader initiative reflect a subtle shift away from reliance on elaborate and difficult to follow standards. However, it is time for the railway industry to embrace the role of human factors on the safety of our workforce. We believe the ideas expressed in this paper are in line the CEO's vision for CP5; focusing on tasks that add value and embracing new ideas and doing things differently. This paper highlights some specific examples, based on good practice from other industries that could help redress the balance.

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<sup>5</sup> Rail Safety and Standards Board. *Good Practice on Cognitive and Individual Risk factors* (2008) RS/232 Issue 1

## Background

Following the death of John Wright at Newark on 22<sup>nd</sup> January 2014 maintenance depots held debriefing sessions with front-line track staff. During discussions, track workers told how they had experienced near misses, come into contact with trains, or witnessed others being struck by trains. In nearly all their accounts they described how they had been acting: on autopilot, forgetting where they were, being complacent or not registering consciously what was going on. They were unable to explain why they had acted as they had done.

These experiences mirror descriptions given by train drivers and track workers in accident investigations and formal enquiries. Drivers state that track workers acknowledge warnings, often with their back to traffic but then inexplicably stay where they are, or move away but not far enough, or actually walk back into the path of the train. This paper aims to explain why this happens and that this behaviour is an element of normal brain function. It goes on to suggest some interventions that could make a real difference.

## Memory, attention and situational awareness

### Memory

There are two basic types of memory: short term memory (working memory) and long term memory.

Working memory allows several pieces of information to be held in the mind at the same time. Research has shown that there is a finite amount of information that can be held in working memory. Some studies have shown that the maximum number of unrelated items that can be retained in working memory is about seven, and these can typically be held for 10 to 20 seconds<sup>6</sup>. Other studies have shown that there is a sharp decline in memory performance as individuals attempt to store three or more items from an array of sources<sup>7</sup>. Once these limits are exceeded, one or more items are likely to be lost.

Long-term memory is intended for storage of information beyond the present. Recollection of rules and procedures, for example, are stored in long-term memory. Long-term memory is influenced by expectation. In practice, the capacity of short-term memory is limited and that long-term memory can be influenced by

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<sup>6</sup> [Good Practice Guide on Cognitive and Individual Risk Factors RSSB 2008]

<sup>7</sup> [There is still a debate about whether WM holds limited pieces of information, or has limited slots for holding more complex information. Other research has suggested that WM storage is limited by resource, so you can store an unlimited amount of information but the more you store the less resource each item has. Discrete Resource Limits in Attention and Working memory. E.Ester, E.Vogel and E.Awh in Cognitive Neuroscience of attention ed M.Posner 2012]

expectation. This is critically important when understanding how we can improve trackside safety.

When a lookout warns that a train is approaching this is just one of many pieces of information that a track worker has to process and hold in working memory. Just consider all the environmental, work and personal stimuli that a track worker is processing in 10 to 20 seconds. Given a person must be in a position of safety within 10 seconds, it could only take a matter of seconds for the lookout warning to drop from working memory if not consciously kept there. Raising the hand and actively watching the approaching train can do that, but many workers raise their hand with their back to traffic, or finish off a task so miss visual reminders of the on coming train. Processing just a few items of information therefore, is sufficient for the warning to be lost from working memory. This may be one reason why track staff said they “knew” the train was coming. They had raised their arm in acknowledgement, but had forgotten about it, or been distracted, as they stepped back onto the track before the train had passed.

**Processing a few items of information, is sufficient for the warning to be lost from working memory**

One way to mitigate against dropping key thoughts from working memory is to remind oneself of the upcoming risk by saying out loud that the train is approaching. This is the basis of Risk Based Commentary (RBC) which is used by many other industries. Verbalising the risk will keep the approach of the train at the forefront of attention. This process applies not just to acknowledging the warning but also to moving and staying in a place of safety. Verbalising each stage of the process would help not just the acknowledging and moving to a place of safety but also staying in the place of safety until the train has passed. It is particularly powerful if all team members do it as this also increases social group safety awareness.

## Attention

There are frequently changing stimuli that affect trackside workers every day. The tasks may be similar but the conditions vary enormously in a way that is not experienced by office staff. Examples of changes to a track worker's environment include seasonal variation affecting visibility and temperature, vegetation, changes in the track itself because of work that has taken place. The team may change in size and makeup, altering the dynamic of the gang, and their jobs may change from day to day. Crucially, personal circumstances can influence which information is selected as important to process. The primacy of attention to safety will be only one of many competing areas to select as important at any one time when at work on the track.

The detection and interpretation of sensory inputs by track workers will be greatly influenced by their own expectations. So, if a patroller does the same walk every week there is an expectation about what they will see. This may alter how they perceive upcoming risks in their situation. Expectation can inhibit focused attention

and lead to track workers missing risks. Practising risk-triggered commentary, literally calling out what they see, can help mitigate against this. Again this will be more powerful if the team does it, as different risks will be picked up by different team members<sup>8</sup>.

Attention can also be compromised by the frequency of performing certain tasks. For example, when a train sounds its horn, trackside workers are taught to raise an arm in acknowledgment and move to a position of safety. However, acknowledging a train is only the first part of the process. After they have acknowledged the warning, they must move to a position of safety which is x distance from the running rail depending on line speed, then they must remain in a position of safety until the COSS announces it is safe to go back on track. Acknowledging the warning can become an automatic response. This pattern of behaviour is thus characterised by fast automatic responses which are largely unconscious. When this happens it is easy to understand how the whole chain of conscious thought and action is interrupted, thus compromising safety.

In addition to the changing environment and habituation of responses to warnings, competing simultaneous goals may also be a major factor in dangerous lapses of attention<sup>9</sup>. Track workers often refer to this state as being distracted by the work they are doing. The problem occurs when workers are undertaking tasks which require a lot of conscious attention.

Track workers nearly always have two simultaneous goals when they go track side. The first is the task they are doing e.g. ultrasonic testing, patrolling, faulting etc which will be under conscious control and occupying their attention. The second goal is keeping safe and moving to a place of safety when warned. However, moving to a place of safety means that they cannot achieve their first goal which requires them to be on the track<sup>10</sup>. Therefore the first goal literally competes with the second goal. If the response to the warning has become automatic, the first goal will still have conscious priority. Even if they do move to a position of safety, they may proceed to a new goal, aligned to the first, which may involve crossing the track because the safety goal has failed to monopolize their conscious attention.

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<sup>8</sup> [Life on the Line. N.Turner, et al Journal of Occupational Health Psychology (2010)]

<sup>9</sup> Rail Safety and Standards Board. *Good Practice on Cognitive and Individual Risk factors* (2008) RS/232 Issue 1

<sup>10</sup> Implementation Intentions and Effective Goal Pursuit. P.Gollwitzer V.Brandstatter. (1997) pub Journal of personality and social psychology

## Situational awareness

Situational awareness at its most basic is “being aware of what is happening around you in terms of where you are, where you are supposed to be, and whether anyone or anything around you is a threat to your health and safety”<sup>11</sup>. Evidence indicates that those who have a high level of awareness of what is going on around them can better anticipate what will happen and what risks will emerge. Being able to anticipate what is about to happen improves risk perception and accident prevention (RSSB, 2008).

Rehearsing upcoming tasks in a team as part of the COSS brief is one way of focusing on potential risks. During the task, use of RBC will help to keep open monitoring and situational awareness at all times. This is important as “Situational awareness is dynamic, hard to maintain and easy to lose. Knowing what is going on around you all of the time is difficult especially during complex, high-stress operations”.<sup>4</sup> Verbalising helps to keep track workers in the present and receptive to emerging risk.

**Situational awareness is dynamic, hard to maintain and easy to lose**

Factors affecting situational awareness are very similar to those that affect attention. They can be external in nature, for example, environmental and physical conditions such as temperature, noise levels and light. Physical and psychological states of individuals can dramatically affect an individual’s ability to be situationally aware, which will interfere with their primary perception of risk. For this reason it is critical that discussions about how people are feeling (e.g. tired, depressed, or stressed) should be included as part of the discussion before going on the track. The COSS or safety leader should be aware of how personal circumstances of team members could affect how they perceive risk. Someone who has just become a parent may be tired. Someone who has recently split from a partner may be distracted. These should be included in evaluations in setting up safe systems. This could be done by raising issues like tiredness as part of the brief. If teams are used to working together listening to conversations and noticing changes to behaviour may help to identify those who are more likely to be distracted. If the COSS or SWL is not familiar with the team, discussing how people feel before they go track side and asking others to watch out for individuals who seem “off” could be a way of getting around this.

Workload can have an impact upon situational awareness. If it is too low, boredom, inattentiveness, decreased vigilance and reduced motivation can occur. Conversely if it is too high or if tasks are extremely complicated, individuals may be distracted by complexity and not apportion adequate time to monitor their situation. It is critical that the length of time required to perform high attention tasks does not exceed

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<sup>11</sup> Health and Safety Executive. *Knowing what is going on around you (situational awareness)* London: HSE 2012 [online] Available from: <http://www.hse.gov.uk/construction/lwit/assets/downloads/situational-awareness.pdf> [accessed 14 June 2014]

certain limits. This may mean taking time out from demanding tasks and rotating staff so that they spend only a limited time focussing on tasks such as lookout duties. Crucially it is important that trackside staff feel comfortable flagging up when they feel their attention is waning because they are too hot, cold or preoccupied etc. It is also crucial that the team take measures to mitigate against this, even if it includes stopping work for a while. The quality of communication in the team is directly related to the level of team situational awareness.

## **Practical examples to help aid attention and situational awareness**

If we want to move forward as an industry in tackling attention deficit as a causal factor in accidents and incidents we need to provide practical training and examples for trackside workers. RBC should not be made mandatory its usefulness is likely to decrease if it becomes a process.

It is important that this way of working is discussed and agreed as part of the safety brief at the beginning of the shift/task and is thought of as an integral part of setting up and maintaining a safe system of work.

Some teams will already be doing some RBC. However, the continuous, dynamic nature of the commentary will be new.

The groups who are most likely to find this difficult to implement will be the groups who are most prone to lapses of attention due to distractions. These are small groups of track workers undertaking tasks that require conscious attention to perform e.g. section managers measuring up switches and crossings for weekend works, technical staff surveying, ultrasonic testing, lookouts etc.

The influence of team dynamics and peer pressure in trackside worker safety behaviour is yet to be properly researched. It cannot be stated strongly enough however that without the engagement of section managers, supervisors and team leaders RBC and SA will not be properly implemented. Going forward RBC should be included as part of trackside training for new starters and when refreshing skills.



## Situational awareness

### **Example 1 – Use when performing high attention focused tasks e.g Look Out duties.**

Performing lookout duties requires a high level of focus and alertness over a sustained period of time. Lookouts are often separated from their team and are not allowed to take part in activities or conversation. Many lookouts find the duty boring as it has a low physical workload and is unvaried. Lookouts are more likely to be distracted or preoccupied by personal thoughts or internal dialogue as a result.

Lookouts should talk themselves through what they see ahead and identify risks which could limit their visibility e.g. “right hand curve, vegetation in cess”.

A lookout should comment on his position of safety “ballast on troughing, cable in cess”.

On sighting a train they should comment on the approach continuously and after blowing the warning whistle should continue to remind themselves of the approaching train until it has passed. E.g. “ train approaching, train approaching, giving warning, train passing me, train approaching group, train passed group, no other traffic, wave flag all clear”.

Internalising the commentary will significantly help with raising situational awareness. Verbalising the commentary also fits in with RBC outlined overleaf.

## **Example 2 – On site safety briefings**

The quality and effectiveness of a safety brief is directly related to high levels of situational awareness within the team. An example of this is the trackside COSS briefing. These briefs can become routine and meaningless as they rely on ticking boxes and signing paper. Situational awareness techniques are a way of making safety briefs effective.

Groups should discuss or rehearse what is coming ahead. The COSS could initiate discussion on upcoming risks like changes in weather, known obstacles and limited clearances etc. Asking the question “What will we see when we start our patrol” will help team members begin to focus on the task and potential risks. By asking the team to visualise this they are more likely to be aware and pay attention to risks that have been highlighted.

Research has shown that “perceived co-worker support for safety was most important for keeping employees safe in the face of high job demands”<sup>8</sup>

To improve levels of team SA, gangs should watch out for team members who are obviously lacking concentration, or those who are more withdrawn than usual and needing instructions repeated.

## **Example 3 Rehearsing SA through training**

Rehearsing situational awareness should become a central part of safety training. Use of interactive visual aids in training sessions would allow staff to practice identifying risks. Using systems like the 360 Mission Rooms with footage of different trackside situations would be a valuable way to practice RBC among teams. This has been used to increase awareness around slips, trips and falls and could be used as part of lookout training in a similar way to the hazard perception test used during driving theory examinations.

Training for safety critical skills could include role play and practical application of RBC and SA techniques. Training teams as teams to rehearse the techniques is key to improving team SA which is so critical for the safety of railway workers.

## 1. Risk Based Commentary.

Trackside workers need to take conscious steps to manage their attention levels, particularly when performing safety critical skills e.g. Lookout duties, COSS or machine controllers. RBC is used in many industries as a method of maintaining attention and awareness of ones surroundings. It can be done when performing tasks away from a group, or when working as part of a group.

RBC is simply the verbalisation of upcoming risks which combines external and internal memory aids. Speaking out loud retrieves internal memory and feeds it back externally through hearing the commentary. It is effective at helping to retain relevant information in the shorter working memory, as well as helping to process information from long-term memory. RBC can help prevent mistakes and errors due to automatic actions or distractions. There is also evidence that the technique can help overcome fatigue simply because it increases awareness.

## Examples of using Risk Based Commentary

### Example 1. Use as a team walking to site of work from the access gate

This is an example where a group are performing an activity together and face similar risks. Within a team individuals will have differing levels of attention. Some will be focused on the work ahead and be preoccupied and some will be distracted in conversation. RBC keeps the group focused together and alert as a team to risks from slips trip and falls.

The person in front should lead the commentary

e.g. "Loose ballast on trough lid up , missing troughing lid up, branch overgrown up, cables in cess up". These shouts are repeated back through the line until the person at the back repeats "loose ballast passed, missing troughing lid down" etc. The "up" and "down" simply indicate a risk that is coming up and when the risk is past. The actual phrases can be decided and agreed on as part of the briefing.

## **Example 2. Use when moving to a place of safety and staying in a place of safety**

Many teams already do some RBC naturally and shout out to each other “one on” as a warning call when a train approaches. This is normally done in larger groups. Interestingly, the majority of fatalities involving being struck by a train have occurred in smaller gangs where team members do not normally call or verbalise a lookout's warning. Consequently, it is as important, if not more important, to use this method in small teams, or when working alone. People usually call out in larger groups to warn other team members. RBC involves the individual alerting themselves.

Once the lookout warning has sounded the team leader calls “train up” and should be echoed through the line until all are clear of the line, then “train approaching” repeated until the train has passed. “Train back” should then be called throughout the team as the train passes.

Again, the commentary needs to be continuous to ensure everyone is in the attention loop.

## Challenge

It is important that RBC or SA does not become habituated but is a dynamic part of safety systems on the front line. One way to do this is to ensure that challenge is encouraged as part of the commentary. An example of this is when a call is not heard or understood. Following team members should challenge out loud, in real time to get clarity that the risk is understood. It should be agreed at the brief that when a challenge is given team members stop until they understand the risk.

Another example of challenge would be to prompt those who have not repeated a call. This could be a sign that a particular team member has become distracted, or is losing focus, and therefore more at risk of making an error. This is more difficult when working with a small team, or not feasible when alone. In these instances situation awareness and commentary become more vital and should be encouraged even more.

Challenge inside the team structure is key and more influential on positive safety outcomes than challenge from supervisors. This is because co workers are on site so can make challenges whilst the work is underway, they have a vested interest in challenging unsafe working because it affects their own safety, and are more likely to develop closer bonds with team mates than with supervisors<sup>12</sup>. For these reasons training and practising the methods outlined above are most productive when done as a team.

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<sup>12</sup> Line on the Line: Job demands, Perceived Co-Worker Support for safety and hazardous work events. N.Turner, N.Chmeil, M.Hershcovis and M.Walls 2010.

## Conclusion and next steps

Understanding the role that human behaviours plays in track worker safety is key to reducing the number of near misses and fatalities amongst the industry's most vulnerable group. There is evidence from the experience of other safety critical industries that the application of RBC and situational awareness techniques have benefited employee safety. Both can and should be implemented on our railway to achieve considerable and ultimately measurable, improvements to our track safety record.

A trial is underway within Orpington delivery unit to promote some of these techniques to improve attention and situational awareness. The use of RBC will not be mandatory and teams will decide what to say. Supported by the WHSEA and managers, teams will be encouraged to feedback what they have found using these techniques. After three months this trial will be reviewed in order to understand how comfortable teams are doing this, what the blockers are, where it was successful and why.