

Category: Human Behavior in a Complex System
Safety Issues Associated with use of Personal Electronic Devices.

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Summary

This paper reviews three serious US accidents within the last 7 years involving freight trains, passenger trains and a metropolitan subway. In all three cases investigators found that the use of cell phones or text messaging contributed to the accidents. Next the paper examines some current policies and practices as well as the challenges of ensuring compliance.

Introduction

Within the last ten to fifteen years “personal electronic devices” such as cell phones, pager-transmitters and small digital video and music players have become a common part of everyday life. People in their teens and early 20’s probably cannot imagine life without instant communication and portable entertainment. Unfortunately this familiarity with such devices makes it likely that a person might be tempted to use them, even when deriving a vehicle or operating a train. Safety professionals in the US are beginning to recognize that “distracted driving” is potentially a major cause of accidents on the highway. As of this writing seventeen states and the District of Columbia have banned text messaging while driving and some legislators are considering bans cell phone use while driving. A number of locations already require hands-free devices only be used by drivers. On September 30 the US Secretary of Transportation has called for a meeting to devise, “concrete steps . . . to make drivers think twice about taking their eyes off the road for any reason.”

In recent years the railroad industry has developed rules to address the use of personal electronic devices.¹ Several recent serious accidents have caused the industry to take another look at this issue. What follows are discussions of three accidents involving a freight train a passenger train and a subway/streetcar operation where operator attention was diverted at a critical moment leading up to a collision. This will be followed by a brief review of current countermeasures and the challenges of ensuring employees are complying with these requirements.

¹In the mid-1990’s such rules were general in nature. For example, the 6th Edition (1997) of the Northeast Operating Rules Advisory Committee’s General Rule D was, “Employees must devote themselves exclusively to the Company’s service while on duty.”

General Rule E of the current document (9th Edition - 2008) expressly prohibits the use of personal electronic devices as follows unless reporting / responding to an emergency condition:

- Using a cellular telephone while operating the controls of a moving train or engine.
- Using a cellular telephone when occupying the controlling cab of a moving train or engine and not operating the controls, unless the communication directly relates to duties.

BNSF Clarendon, Texas, May 28, 2002²**NTSB**

At 08:57 a.m., an east bound loaded coal train which had improperly traveled almost 12 km past a meeting point collided head on with a west bound intermodal train in northern Texas near the small town of Clarendon. Both trains had two crewmembers that jumped from their trains before the impact. The conductor and engineer of the coal train were critically injured. The engineer of the intermodal train was fatally injured and his conductor received minor injuries. Both crews applied emergency brakes when the two trains were approximately 650 meters apart. At the time of braking the coal train was operating at 78 Km/h and the intermodal train 67 Km/h. The collision and fire damaged or destroyed several of the locomotives and other railroad equipment with damages exceeding \$8 million. The 1995-meter coal train consisted of 116 cars weighing 14,046 metric tons. The 2144-meter intermodal train carried 34 cars and weighed 5030 metric tons.

Maximum speed on this segment of track was 78 Km/h and movements were governed by *Track Warrant Control* with no wayside signaling except at sidings equipped with power switches that are operated by radio commands from the trains.

² For a detailed investigation of the accident, see the National Transportation Safety Board report at: <http://www.nts.gov/publictn/2003/RAR0301.pdf>

Movement instructions are issued by voice radio from the train dispatcher (rail traffic controller) to train crews who write the information on pre-printed track warrant forms.

To the right is an example of a track warrant form used by the train crew to record movement instructions from the train dispatcher. For example, after dictating information such as the track warrant number and date, the train dispatcher might instruct the crew to, “Check Box 2, proceed from A to B.” Before the transaction is complete the crew must read back the instructions to the train dispatcher who confirms the information is correct. Because an employee cannot receive and read back a track warrant while operating a moving train, the conductor often handles the duties and is required to ensure the engineer understands their contents.

As the train dispatcher is issuing instructions to trains they are also entering the information into a computerized track warrant system which records the data and ensures no conflicting instructions are issued.

To summarize the accident sequence, approximately 1’10” prior to the

collision the coal train received a track warrant allowing it to proceed as far as the east switch of Ashtola. About 40 minutes later the opposing intermodal train left Hedley with authority to proceed to Ashtola and enter the siding. About ten minutes later the coal train received a track warrant allowing it to leave Ashtola and proceed to Hedley after the arrival of the intermodal train. Four minutes later the coal train improperly proceeded past Ashtola and the collision occurred ten minutes later.

After listening to recordings of the radio conversations and examining the train dispatcher’s computerized records, investigators concluded all procedures were complete and properly followed. In addition the train crews and train dispatcher were experienced railroaders who were familiar with the territory. As the train was approaching Ashtola (the location where it should have stopped to meet the opposing train) the conductor properly received the track warrant directing his train to proceed after the arrival of the opposing train. It is unlikely the engineer would forget to act on this critical instruction so soon after it was received by the conductor, especially considering he would have to begin braking the heavy train within a minute of the track warrant being received.

Investigators looked at cell phone use. Because the operation of the intermodal train did not cause the accident we will focus on the coal train. Cell phone records

(Suggested Form)
Track Warrant

NO. _____, 19 ____

To: _____ At: _____

1. Track Warrant NO. _____ Is Void.
2. Proceed From _____ To _____ On _____ Track.
3. Proceed From _____ To _____ On _____ Track.
4. Work Between _____ And _____ On _____ Track.
5. Not In Effect Until _____
6. This Authority Expires At _____
7. Not In Effect Until After Arrival Of _____
_____ At _____
8. Hold Main Track At Last Named Point.
9. Do Not Foul Limits Ahead Of _____
10. Clear Main Track At Last Named Point.
11. Between _____ And _____ Make All Movements At Restricted Speed. Limits Occupied By Train.
12. Between _____ And _____ Make All Movements At Restricted Speed. Limits Occupied By Men Or Equipment.
13. Do Not Exceed _____ MPH Between _____
And _____
14. Do Not Exceed _____ MPH Between _____
And _____
15. Flag Protection Not Required Against Following Trains On The Same Track.
16. Track Bulletins In Effect _____

17. Other Specific Instructions: _____

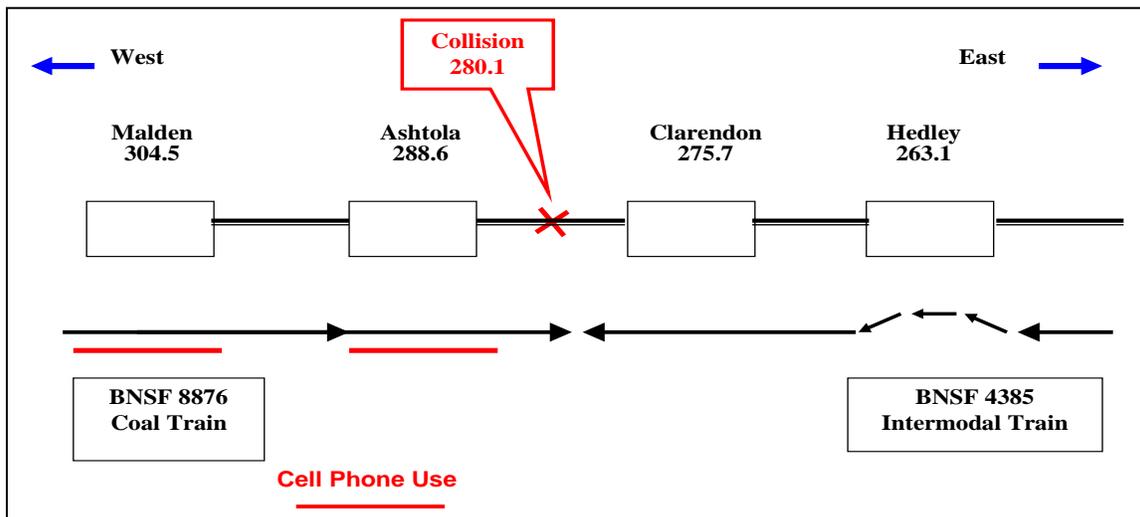
OK _____ Dispatcher _____

Relayed To _____ Copied By _____

Limits Reported Clear At _____ By _____

(Mark "X" in box for each item instructed.)

indicted that the conductor used his phone for brief calls before the train left its initial terminal. The engineer's cell phone was used twice while the train was moving. (See red lines on diagram showing the approximate location of the train when the calls occurred) A 23-minute call occurred after the train received authority to proceed to Ashtola. After that call was completed there was a 16-minute delay at which time a second call was made. Investigators determined that this was the same time that the critical track warrant was being received by the conductor directing the train to proceed past Ashtola after the opposing train arrived. Investigators believe this call would have diverted the engineer's attention during the time he would have read the track warrant. At the same time the conductor may have been reluctant to interrupt the engineer's telephone conversation and subsequently neglected to inform him of the need to stop. During the call and until just before the collision the coal train proceeded at normal speed.



The National Transportation Board concluded that the probable cause was:

- (1) The coal train engineer's use of a cell phone during the time he should have been attending to the requirements of the track warrant his train was operating under and
- (2) the unexplained failure of the conductor to ensure that the engineer complied with the track warrant restrictions

Metrolink Chatsworth, California, September 12, 2008³

At 1643 pm a northbound 3-car commuter train which had improperly passed a stop signal at the end of a siding and travelled about 530 meters through a sharp curve before colliding head on with a southbound freight train that had just exited a tunnel. The engineer on the commuter train and 24 passengers were fatally injured and 135 others were injured. Total damages exceeded \$7 million. The force of the collision, with a closing speed of more than 128 Km/h pushed the lead locomotives of both trains onto their sides and drove the passenger locomotive back into 70% of the lead coach. The commuter train, designed for push/pull operation, consisted of one locomotive in the lead with three bi-level coaches. The freight train consisted of two locomotives and 17 cars totaling 1359 long tons.

Maximum speed at the location of the accident is 40 mph and train movements along this single track route are governed by Centralized Traffic Control whereby the train dispatcher directs trains using wayside signals and powered switches. The adjacent

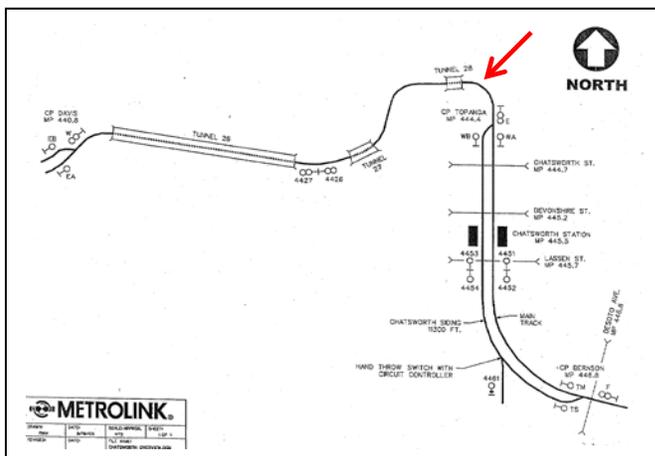


diagram shows the arrangement of tracks in the accident location. The passenger train had just stopped at Chatsworth Station (black rectangles) and proceeded northward passed the stop signal, through the switch lined for the southward freight train and collided in the middle of the curve indicated by the arrow.

³ As of this writing the National Transportation Safety Board has not completed its investigation. However, many investigative items are available at:

<http://www.nts.gov/Dockets/Railroad/DCA08MR009/default.htm>

The engineer was the only crewmember in the locomotive cab and while stopped at the station on tangent track the stop signal located about 1.6 Km ahead should have been continuously visible.

The engineer’s cell phone records indicate that on the day of the accident there were 21 text messages sent, 22 received and 4 telephone calls placed during times when the engineer was responsible for the operation of the train. The last message was an outgoing “sent” message, which was logged by the telephone company at 4:22:01, about 22 seconds before the collision. The following shows some of the last messages sent and received by the engineer before the collision at 1643.⁴

Received Date	Received Time	Sent Date	Sent Time	From Number	To Number	Message Length	Message
PDT	PDT	PDT	PDT				
9/12/2008	16:07:08	9/12/08	16:07:08	(Engineer)	(Person A)	N/A	[text missing from SMS content report]
9/12/2008	16:08:47	9/12/2008	16:08:47	(Engineer)	(Person A)	46	(I'd prefer 2 meet them @ strathern or nowhere.)
9/12/2008	16:21:03	9/12/2008	16:20:54	(Person A)	(Engineer)	71	(I would like that too. We already need to meet 796. That would be best)
9/12/2008	16:22:01	9/12/2008	16:22:01	(Engineer)	(Person A)	32	(yea...usually @ north camarillo.)

To the right is a news photograph reportedly of a cell phone owned by a train enthusiast who was communicating with the engineer.

While the investigation of this accident is not complete, preliminary information indicates that tests of the signal system and train brakes showed no defects and it seems very likely the that the cause of the accident was the engineer being distracted by text messaging at a critical point in the trip.



⁴At this time, the *General Code of Operating Rules*, fifth edition, April 2005 included the following:

1.10 Games, Reading, or Electronic Devices

Unless permitted by the railroad, employees on duty must not:

- Play games
- Read magazines, newspapers, or other literature not related to their duties; Or
- Use electronic devices not related to their duties.

Massachusetts Bay Transportation Authority, Boston, MA, May 8, 2009⁵

Operating in a tunnel in downtown Boston during the evening rush hour a two-car street car vehicle passed a yellow and red signal and struck the rear of another two-car vehicle 24 meters ahead. There were 62 injuries and three of the four cars were destroyed with damages estimated at \$9 million.

Press articles indicate that the driver admitted he was texting at the time of the accident and that investigators have found no problems with the mechanical condition of the cars or track. The streetcar was reportedly operating at 40 Km/h at the time of the collision and the car ahead should have been visible for at least 13 seconds. The impact propelled the stationary car 9 meters forward.

The MBTA general manager said that the system had banned cell phone use by operators while driving but would now prohibit them from even carrying cell phones onto trains or buses. The operator of the train faces charges of gross negligence and could be imprisoned for up to three years.

Strategies for Addressing Use of Personal Electronic Devices

As discussed in the footnotes railroads and transit operations have long had rules such as one requiring employees to “devote themselves exclusively to the Company’s service while on duty.” Perhaps at the time this was intended to forestall reading a newspaper or listening to a personal radio. As products such as portable music players, cell phones and text devices became common; rules became more specific and sometimes listed such devices.

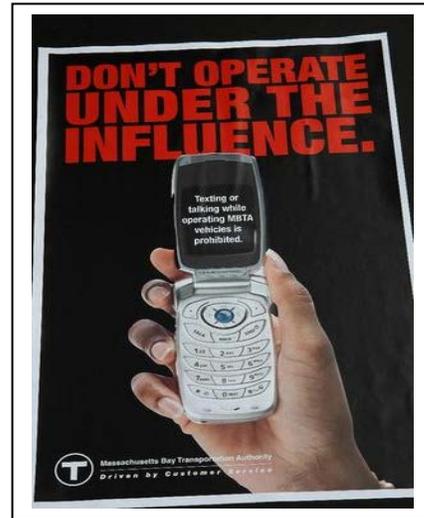
At the same time, the risks associated with the use of these devices by vehicle drivers were gaining the attention of safety agencies. The National Transportation Safety Board issued a press release in November 2006 after a motor coach struck a low

⁵As of this writing the National Transportation Safety Board has not completed its investigation. However, the following report of another MBTA accident provides information about the equipment and types of operation on this system. <http://www.nts.gov/publicctn/2009/RAR0902.pdf>

overhead bridge while the driver was using a hands-free cell phone. The bridge was plainly marked and the accident tore off the roof of the bus causing 11 injuries.⁶

At the time of the Boston accident the MBTA already had a policy banning the use of cell phones by bus drivers. The term “under the influence” is inspired by a commonly-used term in motor vehicle laws prohibiting a driver from operating a vehicle if “under the influence” of alcohol or drugs. After the accident the agency changed their policy to ban operators from having a cell phone in their possession while on a bus or train.

Devising uniform rule text restricting the use of personal electronic devices is complicated by the need to take into account the ability to enforce the rule and the fact that there are legitimate business or safety uses for



some technology. For example a train might have difficulty contacting the train dispatcher using the radio or a switching crew may need to call a customer in order to open a security

Within a few days of the September 2008 collision in Chatsworth, CA the Federal Railroad Administration issued an *Emergency Order* significantly restricting the use of personal electronic devices. The order discusses the issue in detail and includes a list of mishaps that occurred inside locomotive cabs as well as alongside the tracks.⁷ Key features of the order are:

- (c) *Personal electronic and electrical devices.* (1) Each personal electronic or electrical device must be turned off with any earpieces removed from the ear while on a moving train, except that, when radio failure occurs, a wireless communication device may be used in accordance with railroad rules and instructions.
- (2) Each personal electronic or electrical device must be turned off with any earpieces removed from the ear when a duty requires any railroad operating employee to be on the ground or to ride rolling equipment during a switching operation and during any period when another employee of the railroad is assisting in preparation of the train (e.g., during an air brake test).
- (3) Use of a personal electronic or electrical device to perform any function other than voice communication while on duty is prohibited. In no instance may a personal electronic or electrical device interfere with the railroad operating employee’s performance of safety-related duties.
- (d) *Railroad-supplied electronic and electrical devices.* (1) The use of a railroad-supplied electronic or electrical device by a locomotive engineer (including a remote-control locomotive operator) is prohibited while on a

⁶ See the following for a video clip of a rear-end collision associated with cell phone use <http://www.youtube.com/watch?v=1M74j8LvX6k>

⁷ FRA Emergency Order – 10 October 2008 <http://www.fra.dot.gov/downloads/PubAffairs/EmergencyOrder26.pdf>

moving train, or when a duty requires any member of the crew to be on the ground or to ride rolling equipment during a switching operation, or during any period when another employee of the railroad is assisting in preparation of the train (e.g., during an air brake test).

(2) A railroad operating employee other than a locomotive engineer operating the controls of a moving train may use a railroad-supplied mobile telephone or remote computing device in the cab of a moving locomotive for an authorized business purpose, after a safety briefing, provided that all assigned personnel on the crew agree that it is safe to do so. Any other use is prohibited in the cab.

(3) A railroad operating employee may use a railroad-supplied electronic or electrical device for an approved business purpose while on duty within the body of a passenger train or railroad business car. Use of the device shall not excuse the individual using the device from the responsibility to call or acknowledge any signal, inspect any passing train, or perform any other safety-sensitive duty assigned under the railroad's operating rules and special instructions.

(4) For freight train crewmembers, a railroad operating employee may not use a railroad-supplied electronic or electrical device for an approved business purpose while on duty outside the cab unless the following conditions are met:

(1) The employee is not fouling a track;

(2) no switching operation is underway;

(3) no other safety duties are presently required; and (4) all members of the crew have been briefed that operations are suspended.

(e) *Operational testing.* (1) The railroad's program of operational tests and inspections under 49 CFR Part 217 shall be revised as necessary to include the requirements of this order and shall specifically include a minimum number of operational tests and inspections, subject to adjustment as appropriate.

(2) When conducting tests and inspections under 49 CFR Part 217, a railroad officer, manager or supervisor is prohibited from calling the personal electronic or electrical device or the railroad-supplied electronic or electrical device used by a locomotive engineer while the train to which the locomotive engineer is assigned is moving.

(3) When an operational test involves stopping a train, interrupting a switching operation, or interrupting an activity involving other employees of the railroad (e.g., through use of a banner, signal, or radio communication), the limitations set forth in this order regarding use of electronic and electrical devices shall continue to be in effect even though the train movement, switching operation, or other activity is temporarily suspended.

In response to recommendations from the National Transportation Safety Board the Federal Railroad Administration was already at work on this issue via a labor/management working group of the Rail Safety Advisory Committee. The working group was close to agreement on guidelines which the agency used when devising the emergency order.

As noted in the emergency order, having rules in place does not automatically create 100% compliance. The FRA includes a requirement to provide training to employees and adds this issue to the list of items monitored on mandatory operations tests by supervisors.

= **Examples of Other Rules / Policies** =

Canadian Railroad Operating Rules

General rule A

- (i) While on duty, not engage in non-railway activities which may in any way distract their attention from the full performance of their duties. Except as provided for in company policies, sleeping or assuming the position of sleeping is prohibited. The use of personal entertainment devices is prohibited. Printed material not connected with the operation of movements or required in the performance of duty, must not be openly displayed or left in the operating cab of a locomotive or track unit or at any work place location utilized in train, transfer or engine control.

- (ii) The use of communication devices must be restricted to matters pertaining to railway operations. Cellular telephones must not be used when normal railway radio communications are available. When cellular telephones are used in lieu of radio all applicable radio rules must be complied with.

A Canadian Railway's General Rule

Personal electronic or electrical devices

Except as provided for below, employees are prohibited from using all such devices; they must be turned off and any ear pieces removed. (Not applicable to medical devices such as hearing aids, etc.) Railway provided electronic or electrical devices

Note: The terms electronic or electrical devices do not apply to devices used for, and directly relating to, safe railway operations; e.g.: railway radios, remote switches etc.

(a) The employee controlling the engine or track unit is prohibited from using such devices:

- (i) when in motion or
- (ii) when any employee is on the equipment or track unit, outside the cab, or on the ground for related work activities.

(b) Other employees may use such devices when:

- (i) inside the cab while in motion, only after all crew members or operator of the track unit, agrees it is safe to do so;
- (ii) outside the cab only if:
 - the employee is not foul of a track;
 - the employee is not engaged in physical work related activities; and
 - all crew members or operator of the track unit, confirm that operation will remain suspended until advised otherwise.

In all cases stated above, cellular telephones (personal or railway provided) may be used during emergencies or in lieu of radio during radio failure.

Australia

Personal Digital Audio & Visual Devices

iPods and similar devices can be distracting and decrease worker productivity for certain types of jobs. iPod usage can be a safety issue for some jobs if failure to pay attention leads to accidents and injuries.

- The use of these devices is only permitted with the approval of your supervisor.
- The use of these devices in an operational Safeworking environment is prohibited

Australia

Procedure

Traincrew mobile phones are not to be contacted by Roster Officers or Controllers whilst undertaking operational duties. Additionally, Traincrew are not to use their mobile phones, iPods or MP3 players whilst working any train service or when trackside.

All Safety Critical and Train Operations communication, including the issuing of SW10 Forms, shall only be via the Traincrew Radio unless intermediate officer is in place for the issuing of these forms.

The only exception for the use of mobile phones is in the event of a failure of the Traincrew Radio.

Ireland

General Mobile Telephone Safety

- When calling a mobile phone, always ask if it is safe for the person to talk and offer to call back if it is not.
- Always switch off your mobile phone if there is a known risk of an explosive atmosphere such as when refueling equipment or vehicles with petrol.

Mobile Telephones in Driving Cabs

- Personal mobile phones must be turned off when in the driving cab of any train. This instruction applies to all persons authorized to travel in driving cabs.
- Company issued mobile phones must only be switched on and used if essential to the safe delivery of the work in hand and as part of a safe system of work.
- A mobile phone must not be used in a driving cab to make or receive calls or to make or receive text messages while the train is moving.

Mobile Telephones in Signal Cabins

- Personal mobile telephones must be turned off when in a Signal Cabin (or ECP). These instructions apply to all personnel authorized to be in Signal Cabins.
- Company issued mobile telephones must only be switched on and used if essential to the safe delivery of the work in hand and as part of the safe system of work.

UK

Using a mobile phone on duty

There are 2 prime rules when using a mobile phone when on duty, regardless if it's a private or (Company) phone.

- **Do not** use a mobile phone if you are carrying out safety critical duties
- **Do not** put yourself or anyone else in a position of danger when using a mobile phone

This means:

- Only make or answer a call including electronic messaging when it is safe to do so
- Remain in a position of safety
- Do not make calls when in any public area unless your duties permit this
- Switching off any personal mobile phone or device when on duty

UK***Mobile Phones, don't do it***

Mobile phones, iPods, PDA's and other mobile electronic devices, play a major part in our lives. The pace of life and the ease of accessing information makes millions of people all over the world use them each and every day.

There is absolutely no problem using this equipment when off duty, but we must mitigate the risk they have when we are carrying out safety critical tasks.

Already this year several SPADs have occurred as a result of mobile phones. And who could miss the catastrophic part they played in Los Angeles last September.

Electronic devices affect your safety critical performance. If you're thinking it doesn't apply to you Think Again.

- Using a mobile phone when driving car increases your risk of being involved in an accident by up to five times. The same applies to those of us who carry out safety critical work.
- 17 SPADs were caused (nationally) when mobile phones were used on the approach to red signals.
- Several derailments have occurred when a shunter was talking on a mobile phone.

The effects

All of the below increase the risk of distraction:

- Becoming aware of a text message
- Reading a text message
- Composing a text message
- Conversations (both hand held and hands free)
- Dialing a number

When using a mobile phone your:

- Verbal memory is reduced by 25%
- Numerical memory is reduced by 21%
- Interpretation is reduced by 21%

Your reaction times suffer dramatically too:

Condition	Reaction Time (in seconds)
Controlled driving (no distraction or impairment)	0.89
Impaired by alcohol	1.05
Hands free cell	1.30
Hand held cell	1.39

Don't do it

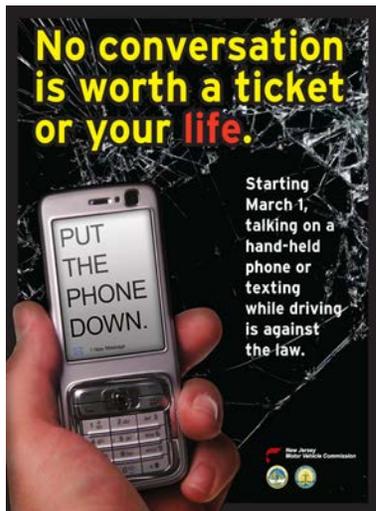
Using mobile phones or any other electronic devices whilst carrying out safety critical tasks such as train driving, train dispatch, or shunting, is strictly prohibited. It increases the risk of you and our passengers being involved in an accident / incident.

Only use your mobile phones and other equipment when you are not carrying out safety critical work.

What it means to you.

Role	Requirement	Why
Train Drivers	Electronic devices should always be switched off in the cab and kept out of sight and reach. Train drivers are only permitted to use a mobile phone as the last resort of communication in the following circumstances: cab radio failure, detained at signals with limited clearance telephones, or in the event of an emergency.	The device will distract you when driving a train. Your phone needs to be out of reach because it is always tempting to check messages and texts.
Shunters	The same rules apply as for drivers	
Train dispatch staff and conductors	Electronic devices must never be used whilst undertaking safety critical work such as train dispatch, door closure, or ascertaining ready to start status	The device will distract you from properly observing that it is safe to dispatch a train and could cause a passenger or train movement accident.
Managers and other staff	Electronic devices should be used with extreme care so as not to distract yourself and any other member of staff carrying out safety critical work. When traveling in driving cabs electronic devices must be switched off and out of reach.	You need to set an example to all about the risks arising from this equipment. When using electronic devices you're a source of distraction.
Any staff who are required to go on or near the line	Electronic devices should be switched off when you are on or about the line. Electronic devices may be used from a position of safety	Electronic devices will distract you from regularly looking up to ascertain the status of your personal safety on or about the lineside environment.

Examples of some safety posters:



National Safety Council Website

http://www.nsc.org/resources/issues/distracted_driving.aspx