Cognitive Distraction & Attentional Error

Bringing Science to the Rail Industry

APTA Rail Conference

Boston, Mass.

June 15, 2010

George Elsmore
Vice President of Safety
Veolia Transportation

Randy Jamieson
Interim Director of Safety
Veolia Transportation

Dr. Daniel Smilek
Professor
University of Waterloo
Agenda

• Background: Root Cause Analysis
• Major Rule Violations: A Scientific Perspective
• A Step Change in Safety Performance
  – A New Perspective on Employee Responsibility
  – A Paradigm Shift for Management
• Opportunities
• A Path Forward
Background: Root Cause Analysis

• Major Rule Violations (Q4 2009)
  – Uncertainty as to cause(s)
  – Lack of consensus on corrective action
• Root Cause Analysis (2009 – 2010)
Major Rule Violations 2005 – 2009

Number of Major Rule Violations

Year

2005 2006 2007 2008 2009
Major Rule Violations Prior & Post Accident

Number of Violations (in 17 Months)

Type of Violation

Prior to Accident
Post Accident

- Red Signal
- Form B
- Speeding
- 6.32.2
- Switch
- Near Miss
- Other

7/5/2011
Causes of Major Rule Violations

- Attention: 67%
- Experience: 20%
- Judgment: 6.5%
- Violation: 6.5%
Cognitive Distraction & Attentional Error

So what exactly are we talking about?
Cognitive Distraction & Attentional Error

“Instances where we are distracted or lose focus on the task at hand when...
Cognitive Distraction & Attentional Error

... our attention wanders to a concurrent task(s) ...
Cognitive Distraction & Attentional Error

… or to unrelated internal thought(s)…
Cognitive Distraction & Attentional Error

… or when we act automatically based on past experience regardless of the present circumstances”
Cognitive Distraction & Attentional Error

Workplace Distractions:
The Anatomy of a Red Signal Violation
Cognitive Distraction & Attentional Error

Bringing Science to the Rail Industry
Human Limitations

- Attention
- Perception

Safety Performance
Attention: A Limited Resource

Behavior is governed by two distinct brain systems

- Controlled
  - Intentional
  - Effortful
  - Conscious

- Automatic
  - Habitual
  - Routine
  - Unconscious
Attention: A Limited Resource

Behavior is governed by two distinct brain systems:

- **Controlled**
  - Intentional
  - Effortful
  - Conscious

- **Automatic**
  - Habitual
  - Routine
  - Unconscious

Task-at-hand
Attention: Overload

Other tasks take attentional resources away.
Attention: Overload

Other tasks take attentional resources away
Attention: Overload

Other tasks take attentional resources away
Attention: Overload

Other tasks take attentional resources away
Attention: Overload

Other tasks take attentional resources away
Attention: Overload

Other tasks take attentional resources away
Attention: Overload

Other tasks take attentional resources away
Attention: Overload

Solution: Reduce the number of other tasks
Internal thoughts also take attentional resources away.
Internal thoughts also take attentional resources away.
Internal thoughts also take attentional resources away.
Internal thoughts also take attentional resources away.
Internal thoughts also take attentional resources away.
Internal thoughts also take attentional resources away.
Internal thoughts also take attentional resources away.
Rumination

My manager never acknowledges me...

Maybe he thinks I am not a good employee...

Maybe I am going to get fired...

How will I provide for my family?
Errors Lead to More Errors

- Did I just make an error?
- Will I be disciplined?
- Will I be fired?
- Did anyone see that?

Reason (1988)
Three States of Mind Wandering

- Momentary Absence
- Disengage Detail
- Disengage Global Task

Cheyne, Smilek et al., 2009
Consequences of Mind Wandering

Blink Rate (blinks / 5 sec)

Participant

Not Wandering
Wandering

Smilek, Carriere & Cheyne (2010)
Attention: Underutilization

Some tasks require very few attentional resources
Attention: Underutilization

... because they can be accomplished by the automatic system
Attention: Underutilization

Internal Thoughts

Task-at-hand

Controlled

Automatic

Internal thoughts will fill the void
Attention: Underutilization

Internal Thoughts

Task-at-hand

Controlled

Automatic

Internal thoughts will fill the void
Attention: Underutilization

Internal thoughts will fill the void
Attention: Underutilization

When more attention is needed for a task, it is not available.
Workplace Attention and Awareness Survey

Operating Employees

The following questions are to be considered in the context of you being **actively engaged in your duties as an engineer or conductor** while your train is in motion under normal running conditions.

**... I catch myself losing attention to the task-at-hand.**

<table>
<thead>
<tr>
<th>almost never</th>
<th>rarely</th>
<th>sometimes</th>
<th>often</th>
<th>very often</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

**... I do my duties automatically without thinking about them.**

<table>
<thead>
<tr>
<th>almost never</th>
<th>rarely</th>
<th>sometimes</th>
<th>often</th>
<th>very often</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

**... I find I have to exert effort to keep my attention focused on the immediate task-at-hand.**

<table>
<thead>
<tr>
<th>almost never</th>
<th>rarely</th>
<th>sometimes</th>
<th>often</th>
<th>very often</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

**... I find that I make errors when I am thinking about something other than the immediate task-at-hand.**

<table>
<thead>
<tr>
<th>almost never</th>
<th>rarely</th>
<th>sometimes</th>
<th>often</th>
<th>very often</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

**... I momentarily forget operating authority related items such as what signal I just had, Form B’s etc.**

<table>
<thead>
<tr>
<th>almost never</th>
<th>rarely</th>
<th>sometimes</th>
<th>often</th>
<th>very often</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

**... I have to go back and check whether I did a task correctly.**

<table>
<thead>
<tr>
<th>almost never</th>
<th>rarely</th>
<th>sometimes</th>
<th>often</th>
<th>very often</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

**... I lose track of where I am, what I’ve just done or what I am supposed to be doing at any given moment.**

<table>
<thead>
<tr>
<th>almost never</th>
<th>rarely</th>
<th>sometimes</th>
<th>often</th>
<th>very often</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
WAAS Causal Model

71% of employees think about being disciplined ‘often’ or ‘very often’

58% of employees do their duties automatically without thinking about them ‘often’ or ‘very often’

46% of employees reported having near misses ‘sometimes’
A Step Change in Safety Performance

A New Perspective on Employee Responsibility

• The science of attention may explain why some accidents happen...
A Step Change in Safety Performance

A New Perspective on Employee Responsibility

• The science of attention may explain why some accidents happen... *but it’s not an excuse!*

Employees:

• are responsible for their behavior
• are personally accountable to be attentive
• must have highly developed attention skills
• must maintain attentional competency
A Step Change in Safety Performance

A Paradigm Shift for Leaders and Managers

• Workplace Distractions:
  – operational changes, stress, organizational culture, labor/management relations, external influences

• Personal Distractions:
  – Family, financial, health, etc.

• Overload:
  – multitasking beyond capacity, job requirements, work schedules
A Step Change in Safety Performance

A Paradigm Shift for Management (con’t)

• Underutilization:
  – mind wandering/attention lapses

• Routine & Repetitious:
  – “auto pilot” response regardless of current circumstances
Opportunities

- Cognitive sciences are evolving
- Attention skills can be learned
- New considerations for how we lead & manage
- Evolve investigation and root cause analysis
- A new strategic approach to better manage risk and exposure to loss
A Path Forward

• On-going Awareness / Education

• Competency Based Attention Training

• Future Research & Development
  – locomotive simulator analysis
  – cognitive analysis of accident & injury data
  – workplace attention & awareness surveys
  – cognitive interface with new technology (PTC)