Human Factors
- Distraction and Inattention

Asia Pacific Cabin Safety Working Group
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Overview

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- What is distraction?
- What is inattention
- Characterising distraction
- Sources of distraction
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- Driver distraction and inattention
- Human interaction with intelligent transport systems
- Field operational tests – conventional and electric vehicles
- Naturalistic driving and riding studies
- Driver training
- Human-in-the-loop simulation research
Shameless Promotion

• 34 chapters
• 40+ authors
• theory, effects and mitigation
• and more....
Driver Distraction and Inattention: Advances in Research and Countermeasures

Edited by:

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Asgate

Shameless Promotion:

• 24 chapters
• 50+ co-authors
• theory, effects and mitigation
• and more….
• (In Press)
INTRODUCTION
Introduction (1)

• Driving is a complex, multi-task, activity.
• Involves: following the road; avoiding accidents; obeying traffic rules; monitoring speed; navigating; controlling the vehicle. (Brown, 1986)
• Despite this complexity, drivers engage in other activities that take their minds and eyes off the road.
• Converging evidence that distraction is a significant contributing factor in crashes and critical incidents.
What is Driver Distraction?

• people talk about it as if they know what it means
• but..“driver distraction” is poorly and variously defined
• confusion about the relationship between distraction and inattention
• lack of an agreed definition is problematic:
  – can make inter-study comparisons difficult
  – can lead to vastly different estimates of role of distraction in crashes and near-crashes
Driver Distraction Definitions

• “diversion of attention from the driving task that is compelled by an activity or event inside the vehicle” (Treat, 1980, p. 21).

• “a shift in attention away from stimuli critical to safe driving toward stimuli that are not related to safe driving” (Steff & Spradlin, 2000).

• “driver distraction occurs when a driver is delayed in the recognition of information needed to safely accomplish the driving task because some event, activity, object or person within or outside the vehicle compelled or tended to induce the driver’s shifting attention away from the driving task.” (Stutts et al., 2001).

• “distraction can be defined as misallocated attention” (Smiley, 2005).
Driver Inattention

• driver inattention and driver distraction are related concepts
• driver distraction is … I think … a sub-set of driver inattention
• few definitions of driver inattention exist
• those that do, vary widely
Driver Inattention Definitions

• “….whenever a driver is delayed in the recognition of information needed to safely accomplish the driving task, because of having chosen to direct his attention elsewhere for some non-compelling reason”. Treat (1980)

• “improper selection of information, either a lack of selection or the selection of irrelevant information”. (Victor, Engstrom and Harbluck, 2008)

• “…diminished attention to activities critical for safe driving in the absence of a competing activity” (Lee, Young and Regan, 2008)

• “low vigilance due to loss of focus” (Talbot & Fingerland, 2009)

• “when the drivers’ mind has wandered from the driving task for some non-compelling reason” (Craft & Preslopsky, 2009)
A Taxonomy of Driver Inattention

An attempt to resolve the confusion....

Driver Inattention

• Driver inattention – “diminished attention to activities critical for safe driving” (Regan, Hallett & Gordon, 2010):

• Driver inattention can be brought about by:
  – Driver restricted attention
  – Driver misprioritised attention
  – Driver neglected attention
  – Driver cursory attention
  – Driver diverted attention (ie driver distraction)
Model of Driver Inattention

Figure 1: Taxonomy of Driver Inattention

Source: Regan, Hallet & Gordon, 2011
Examples of Inattention and Distraction (1)

• Driver dozes off momentarily, with closed eyes, and almost hits a pedestrian crossing the street ahead (driver restricted attention)
• Driver looks over their shoulder for too long while merging and fails to see a lead vehicle rapidly braking (driver misprioritised attention)
• Driver neglects to scan to the left for approaching trains at a railway level crossing, because he does not expect trains to be there (because they are rarely or never seen) (driver neglected attention)
• Driver in a hurry does not complete a full head check when merging onto a highway and collides with a merging car (driver cursory attention)
• Driver looks at cell phone while dialing a friend (driver diverted attention – non-driving related)
Examples of Inattention and Distraction (2)

- Driver looks at unexpected flashing fuel warning light (driver diverted attention – driving-related)
- Driver thinks about what needs to be done when she gets to work (driver diverted attention – non driving related)
- Driver thinks constantly about where to find nearest service station, because the fuel tank is almost empty (driver diverted attention – driving related)
- Driver *daydreams* about a romantic holiday in Paris (driver diverted attention – non driving related)
Munich, Germany
Toward common definitions

• “Driver distraction (or driver diverted attention): is a diversion of attention away from activities critical for safe driving toward a competing activity, resulting in inattention” (Regan, Lee and Young, 2008; Regan, Hallett & Gordon, 2010)

• “Driver inattention: is diminished attention to activities critical for safe driving.” (Regan, Hallett & Gordon, 2010)
Distraction Definition - Assumptions

- It includes both driving and non-driving-related activities.
- It can be driver-initiated or can occur involuntarily.
- It can derive from inside or outside the vehicle.
- It includes “internal” sources of distraction, such as daydreaming and “task unrelated thought” (Smallwood et al, 2003).
- It can give rise to interference that is “manifest” and observable (e.g. lane excursion) or “intrinsic and unobservable” (e.g. loss of situational awareness).
CHARACTERISING DRIVER DISTRACTION
Types of Distraction (1)

There are different types of distraction (Regan, 2010):

- things we can see (visual distraction)
- things that we can hear (auditory distraction)
- things we can smell (olfactory distraction)
- things we can taste (e.g., a rotten apple; gustatory distraction)
- things we can feel (e.g., a spider on our leg; tactile distraction)
- things we think about (internal distraction) (often referred to as “cognitive distraction”)
SOURCES OF DRIVER DISTRACTION
Sources of Distraction

- objects (e.g., mobile phone; advertising billboard)
- events (e.g., crash scene; earthquake)
- other road users
- internal thoughts

Objects, events and people will be distracting only if drivers choose to interact with them, or if they capture attention involuntarily.
Sources and Types of Distraction

• The same source of distraction can induce different types of distraction.

• An advertising billboard, for example, will induce visual distraction if the driver looks at it, involuntarily or deliberately.

• If the driver thinks about the message that it conveys, this is internal distraction.

• Drivers may continue to be internally distracted long after they have passed a billboard.
MODERATING FACTORS
Whether distraction, when it occurs, impacts on performance and safety depends on four main factors (Young, Regan & Lee, 2008):

- driver characteristics
- driving task demand
- competing task demand
- driver ability to self-regulate
Moderating Factors (1)

Source: Regan, Lee & Young, 2008
MECHANISMS
Interference

- If a driver is distracted, performance of the competing task will *interfere* in some way with driving. This interference can be minimal or significant.
- The 4 moderating factors regulate the amount of interference between the competing task and activities critical for safe driving.
- The effects of the interference may be *manifest* (as in a lane excursion) or *intrinsic* (as in a loss of situation awareness).
IMPACT ON DRIVING PERFORMANCE
Impact on Driving Performance

- Eyes off the road
- Mind off the road
- Ears off the road
- Hand (s) off controls
Various driving performance deficits have been reported for different competing activities.

Reported deficits include (Bayley et al., 2008; Horberry, et al., 2008):

- degraded lane keeping
- degraded speed control
- increased reaction time
- missed traffic signals
- shorter or longer following distances
- unsafe gap acceptances
- reduced situation awareness
- poorer visual scanning
- reduced horizontal field of view
- missed checks
IMPACT ON SAFETY
Impact on Safety

- Findings from Police-reported crashes in the USA suggest that driver distraction is a contributing factor in around 20 percent of crashes (NHTSA, 2010).
- About 15 to 20 percent of these crashes involve driver interaction with technology.
- Police-reported data underestimates the true magnitude of the problem.
- Naturalistic driving studies suggest that up to 22% of car crashes and 71% of truck crashes involve driver distraction as a contributing factor (Klauer et al, 2006; Olsen et al, 2009).
Olsen et al (2009) from VTTI in the US investigated the prevalence of driver distraction in 4,452 safety-critical events (ie crashes, near-crashes) involving heavy trucks.

Safety-critical events were recorded in a data set that included 203 drivers and 3 million miles of data.

Truck drivers were engaged in “tertiary” (i.e., non-driving related) activities in:

- 71 percent of crashes
- 46 percent of near-crashes
- 60 percent of all safety-critical events.
Drivers were $X$ times more likely to be involved in a safety-critical event while performing the following activities:

Text messaging – 23 times
Using a dispatching device - 9.9 times
Writing – 9.0 times
using a calculator – 8.2 times
looking at a map – 7.0 times
reaching for an electronic device – 6.7 times
dialing a hand-held cell phone - 5.9 times
personal grooming – 4.5 times
Reading - 4.0 times
Tasks with the largest PAR percentages:

- reaching for an object (PAR = 7.6)
- interacting with a dispatching device (PAR = 3.1)
- dialing a hand-held cell phone (PAR = 2.5)

BUT....

- Text messaging, although it had a very high risk estimate, was a task performed infrequently by drivers and thus did not have a high PAR percentage (0.7).
- However, as texting while driving becomes a more prevalent activity, the frequency of safety-critical events is likely to increase, and the risk will increase.
100- Car Study (1)

- 100 cars
- 241 car drivers
- 2,000,000 vehicle miles
- 43,000 hours of data
- 12 to 13 months of data collection
Drivers were X times more likely to be involved in a crash or near-crash while performing the following activities:

- reaching for a moving object - 8.8 times
- looking at an external object - 3.7 times
- reading – 3.38 times
- applying makeup - 3.1 times
- dialing a hand-held device - 2.8 times
- Listening to a hand-held phone - 1.3 times; **but this was not significant different from 1.0.**

The highest PAR percentages, however, were obtained for dialing a hand-held device (3.6), talking on a hand-held device (3.6), and reading (2.9).
MANAGING DISTRACTION
Vision Zero Approach

• Design a *distraction-tolerant* road system in which no one involved in a distraction-related crash is killed or seriously injured (*Tingvall et al.*, 2009)
Managing Distraction

- Data collection
- Education
- Company car fleet management
- Legislation
- Enforcement
- Driver licensing
- Road and traffic design
- Driver training
- Vehicle design

(see Regan, Lee and Young, 2008)
The Flip Side

• Not all distraction is bad.
• Some potentially distracting activities may have safety benefits, such as combating the effects of drowsiness or fatigue.
• Distraction can be both enemy and friend.
• We need to understand the interactions that moderate its effects.
THANKS FOR YOUR ATTENTION

Pont de la Guillotiere -
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