

## Reviewing how distraction involvement is coded in the New Zealand crash analysis system

Dr Craig Gordon  
Transport Research and Evaluation, Ministry of Transport, New Zealand<sup>1</sup>  
c.gordon@transport.govt.nz,

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### Abstract

In recent years driver distraction has been gaining increasing attention as a road safety issue. The Ministry of Transport has been leading a project examining police crash reports for evidence of driver distraction. The New Zealand crash analysis system codes distraction under a series called 'attention diverted by'. To better understand the detail and content of this series, all crashes involving this series from 2000-2006 were reviewed and re-coded into an expanded classification system. An overview of the project is provided and some issues involved in matching theoretical discussions on distraction to the existing coding system are discussed. An estimate of distraction involvement in crashes and trends over time is presented, and some data issues facing the way distraction information is currently coded are discussed. Some suggestions based on our experience are presented.

### Introduction

Driver distraction is emerging as an important road safety issue. There is growing evidence using different methodologies that distraction is prevalent as a contributing factor in crashes. Analysis of the North American CDS database suggests driver distraction is involved in at least 10-12% of tow-away crashes (Stutts et al, 2005). An Australian survey of hospitalised drivers found that 32% of the drivers indicated being distracted just prior to the crash, and 14% attributed distraction as a contributing factor in the crashes (McEvoy et al, 2007). The naturalistic 100-car observational study using vehicles equipped with video capture technology estimated that 22-23% of crashes and near-crashes involved secondary task distraction (Klauer et al, 2006).

However, distraction is a complex term, as it covers a wide variety of potential sources of distraction which can interfere with the driving task in different ways and may have different levels of crash risk associated with them (Klauer et al, 2006; Regan et al, 2008; Shinar, 2007). These include non-driving-related activities drivers undertake inside the vehicle such as using cell phones, conversing with passengers, adjusting entertainment system controls/CDs, responding to children, drinking and eating, grooming and a wide range of other secondary tasks that drivers engage in. They also include drivers paying attention to activities that occur outside the vehicle, such as scenery, people-related activity (i.e. sports games), rubber-necking, and weather watching (Horberrry & Edquist, 2008; Wallace, 2003).

<sup>1</sup> Corresponding author address: Dr Craig Gordon, Transport Research and Evaluation, Ministry of Transport, PO Box 3175, Wellington 6140, New Zealand. Tel: +64 4 439 9000. Acknowledgements to my colleague Stephen Evans who assisted with reviewing the traffic crash reports.

The Ministry of Transport (Ministry) in New Zealand is leading a project examining the information contained in the police crash reports from the New Zealand crash analysis system (CAS) related to driver distraction. The project's aims are gain a better understanding of the different sources of distraction recorded and how distraction is currently coded within the CAS system, and to improve our estimate of distraction involvement in police-reported crashes.

## Context and background

In 2003 the Ministry was asked to provide more detail on inside-the-vehicle distractions. However, the standard CAS series used to capture distraction was insufficient to provide detail on the specific objects and activities involved. Therefore a content review of all traffic crash reports from 2002-2003 that included a code from this series was undertaken (2,029 crashes). This phase of work examined inside-the-vehicle distractions (Gordon, 2005a) and was later expanded to include outside-the-vehicle distractions (Gordon, 2005b, 2008).

In 2006, the Ministry expanded the coverage of the content review to include crashes from 2000-2006 (7,261 crashes). This was in response to media and public inquiries on driver distraction, and requests for more up-to-date information to support policy development. Preliminary results of this analysis are provided in Gordon & Evans (2008). As part of on-going monitoring for driver distraction additional years of crash data are being assessed.

### *The New Zealand CAS system*

In New Zealand, when the police attend an injury crash they fill out a traffic crash report (TCR). The TCRs contain information on crash location, road environment, the vehicles and drivers involved, injuries and the circumstances of the crash (Ministry of Transport, 2008a). While the TCRs include forced-choice options they primarily rely on narrative, such as driver or witness interviews, the attending officer's observations and diagrams of the crash movements involved. While prompted for, distraction in the TCR primarily requires the police officer to indicate it in their narrative. The TCRs are sent to coders in the New Zealand Transport Agency (NZTA) who use standardised coding schemes to classify the information and identify the contributing factors involved. This coded information, the TCR and any additional information provided are electronically stored in CAS. This was the information reviewed in the TCR content review.

### *Standard coding of distraction within CAS*

Distraction in the CAS system is coded under a series called 'attention diverted by' (diverted attention). This series has existed from at least the 1960s, and has undergone minor changes where additional sub-codes were added. The series was set up to cover a wide range of issues where the driver's attention may be diverted. This included, but was not limited to, distraction. The series currently consists of the main code, which is often used as a general unknown or suspected category, and 10 sub-codes:

- Passenger/s
- Scenery or persons outside the vehicle
- Other traffic
- Animal or insect inside the vehicle
- Trying to find an intersection, house number, destination
- Advertising signs
- Emotionally upset
- Cigarette, radio, glove box, object under driver's feet/pedals, etc
- Cell phone, navigation device or any communications device
- Driver dazzled (or sunstrike)

The standard CAS codes vary in the range of inattention/distraction they cover. For example, the 'animal or insect inside the vehicle' and 'advertising signs' sub-codes are relatively specific, whereas 'cigarette, radio, glove box, object under driver's feet/pedals, etc' is very open-ended. The standard CAS codes do not provide sufficient precision in terms of the objects or activity involved to meet the policy, media and public requests for information on distraction.

## Methodology and issues in conducting the content review

From 2000-2006 there were 7,261 police-reported crashes where a code from the CAS diverted attention series was cited as a contributing factor in the crash. The TCR for each crash was reviewed, and categorised using a more detailed coding scheme developed for the content review. The original standard CAS coding decisions were retained, and the results of the content review were kept in a separate database to the CAS system.

### *Development of the content review coding scheme*

The approach used in the content review was to indicate, with as much detail as was possible from the TCR content, what the distraction object involved was (e.g. cell phone, can of drink, book, cake tin, scarf, MP3 player, animal), and the activity the driver was engaged in (e.g. searching, using, reading, trying to prevent from falling/moving, looking at). Regan et al (2008) provides a summary of the large range of objects and activities different studies have used. This level of detail, while useful for answering specific information requests, such as how often the use of cigarettes are cited as a distraction in crashes, is impractical from the point of view of summarising the information. A new classification scheme was developed and applied as a filter to each crash.

The content review classification scheme has undergone revision. In the 2002-2003 analysis, a scheme using 25 categories was developed (Gordon, 2005). This scheme attempted to cover the range of objects and activities covered under the diverted attention series. Categories included, for example, passenger/s, telecommunications, entertainment systems, food-drink, smoking, emotionally upset, personal effects, driver dazzled (sunstrike), other road users, checking for traffic and scenery. Not all of this series relates to distraction. The development of the scheme relating to distraction was guided by the United States NHTSA distraction scheme (Stutts et al, 2001) and observational research on the frequency and types of driver distraction (Stutts et al, 2003).

In the 2000-2006 analysis, the classification scheme was revised in response to developments in the distraction literature (Kircher, 2007; Klauer et al, 2006; Ranney, 2008; Regan et al, 2008) and lessons learned from the earlier analysis. There were some minor revisions to some of the specific categories such as adding a daydreaming/thinking category. Additional high-level summary filters were also added. These were secondary task distraction, driving-related inattention/distraction, daydreaming/thinking, suspected distraction, suspected inattention and driver state. The remainder of this section outlines issues, some specific to the CAS system and others that are more generic, that needed to be resolved. Information presented is from the 2000-2006 analysis.

### *Distraction is wider than drivers*

While most of the focus is on driver distraction, other road users (pedestrians and cyclists) can also be distracted. In 1.6% of the crashes reviewed, the road user involving the diverted attention code was a pedestrian or cyclist.

### *What to include as distraction?*

While most definitions treat distraction as a subset of inattention they vary over what should be included (Lee et al, 2008). These differences can have marked effects on the classification of distraction and estimates of involvement in crashes (Gordon, 2008; Gordon & Evans, 2008). One difference is in how cognitive activity such as daydreaming/thinking is treated. Some researchers argue for its inclusion (Regan et al, 2008) and others for its exclusion (Kircher, 2007).

A key point of difference involves whether to include driving-related activity as distraction (Kircher, 2007; Regan et al, 2008). This includes activity related to the driving task such as using mirrors to check for traffic when lane changing, scanning left or right and looking at other vehicles or pedestrians in the immediate road environment, or looking at vehicle feedback such as the speedometer. Some approaches include these activities as distraction where they draw attention away from tasks critical to driving or the overall driving task (Lee et al, 2008; Regan et al, 2008). Others argue distraction should be restricted to secondary task activity (activity not related to the driving task) (Hedlund et al, 2006; Ranney, 2008).

The CAS diverted attention series includes secondary task distraction and driving-related activity (Gordon, 2008; Gordon & Evans, 2008). For the content review, fields were added to indicate whether an activity was a secondary task, driving related or daydreaming/ thinking. This provides flexibility in matching the information to different distraction definitions.

### *Identifying non-distraction related content*

The content review found there was insufficient detail to indicate what form of inattention was present for 6.2% of the crashes. These were coded as suspected inattention. An additional 5.2% of the crashes were related to driver state. The majority of these crashes involved psychological state such as anger or aggression (Gordon & Evans, 2008). Recent distraction definitions explicitly exclude driver state and other pre-existing conditions, such as fatigue, impairment by alcohol or drugs, and psychological state (Hedlund et al, 2006; Regan et al, 2006). The level of driver state involvement in CAS is a direct result of the standard CAS 'emotionally upset' sub-code. This sub-code includes a range of activity, from daydreaming/thinking to emotional state such as domestic arguments where one of the participants then drives while upset (Gordon, 2005a).

In the 2002-2003 analysis, daydreaming/thinking was included as distraction, along with some of the incidents involving emotional state (Gordon, 2005a). The inclusion of emotional state as distraction has been questioned by others (Parliament of Victoria, 2006; Ranney, 2008). In response to this, and the exclusion of driver state in distraction definitions, these crashes have been separated into a category called driver state in the 2000-2006 analysis (Gordon & Evans, 2008). However, as the standard CAS sub-code includes both daydreaming and emotional state, all crashes involving this sub-code still need to be reviewed.

### *Within-category coding issues*

There is some evidence, when comparing the results of the content review with the standard CAS coding for the diverted attention series, that some misallocation is occurring within the CAS series. Under the standard CAS coding system, 12% of the diverted attention series was effectively coded as 'unknown' or 'suspected' rather than under one of the 10 sub-codes. The content review suggests approximately half of the 'unknown or suspected' could be re-coded to a more precise standard CAS sub-code. In addition, 8% of the crashes identified by the review involving a telecommunications-related device were not coded under the appropriate standard CAS sub-code. Similarly, 7% of the crashes identified as having a passenger distraction were not coded under the appropriate original CAS sub-code. The project has only recently begun to have a closer look at potential miscoding, and the information will be passed on to the NZTA coders for consideration.

Filters have also been added in the content review to deal with crashes involving multiple sources of distraction for the same driver or multiple drivers in the same crash. Three main categories have been used: multiple sources involving the same driver (80% of the multiple source crashes identified); the same source involving multiple drivers in the crash (19%); and different sources involving different drivers (1%). Some of the potential miscoding identified in the content review may be because the NZTA coders are instructed not to use more than one code within the same series (NZTA, 2009).

### *Issues in identifying driver-related activity*

Gordon & Evans (2008) have estimated that 38% of the driver distraction/inattention crashes in the diverted attention series are driving related. This typically arose in relation to external distractions, where the driver was looking at something outside the vehicle. Clear examples of secondary task external distraction included driver's looking at people playing sport, weather watching, or looking at architecture/scenery or farm animals in paddocks. However there are a number of situations captured in the CAS diverted attention series that are not as simple to determine.

The first situation includes where the driver was using a vehicle mirror (side or rear). In most cases (90%) the use of the mirror was in relation to a driving-related task, such as a lane change. When the information in the TCR was unclear it was assumed to be driving related. However in some cases (10%), there was sufficient evidence in the TCR to indicate that the driver was watching a vehicle for non-driving related reasons (i.e. the vehicle looked interesting or they were 'rubbernecking'). These cases are probably secondary task distraction. Thus, if someone is using a mirror, it cannot be assumed it is always for a driving-related task.

Similar issues also arose for other activity involving people or vehicles when they were near the roadside (Gordon, 2005b). This was specifically related to the standard CAS sub-codes 'scenery or persons outside the vehicle' and 'other traffic'. For example, if the driver is watching other vehicles on or near the road because they are a possible hazard, then this is clearly driving related. However, if they are watching them because the vehicle 'looks cool' then this is secondary task external distraction. Situations under these sub-codes include looking for gaps in traffic, watching specific vehicles or people or focusing only in one direction at intersections, to the detriment of the awareness of the wider driving situation (Gordon, 2005b). A conservative approach was adopted where the information was coded as driving related unless the contents of the TCR clearly indicated that it was not.

Two other standard CAS sub-codes 'trying to find intersection, house number or destination' and 'driver dazzled' also raise issues. Driver dazzled refers to a situation where the driver is affected by sunstrike or headlights on full (at night). It is clear that the sunstrike or headlights themselves are not distraction, but the activity in response to the sunstrike-headlights, such as shading the eyes or lowering the sunvisor, could be considered driving-related inattention/distraction (Gordon, 2008; Regan et al, 2008). Similarly, while searching for destinations is part of the driving task, and not a source of distraction itself, the associated actions such as thinking/preoccupation or looking for signs could be sources of distraction (Regan et al, 2008).

In earlier analyses (Gordon, 2005a, 2005b) 'driver dazzled' was included as distraction, with some caveats around that decision. In the 2000-2006 analysis (Gordon & Evans, 2008) it is now treated as driving-related inattention/distraction. The 'trying to find intersection, house number or destination' sub-code is currently treated as secondary task distraction, though this is open to review. Unfortunately, there is often insufficient information contained in the TCRs to provide an indication of any specific behavioural responses. For example, in the 'driver dazzled' crashes where there is evidence of action in response to the sunstrike-headlights, filters have been added to identify them. However, there was sufficient information in the TCR to identify a behavioural response in only 6% of these crashes. We are assuming that drivers are reacting to the event (i.e. sunstrike) but this is not necessarily being recorded in the TCRs.

## Estimate of distraction involvement in the diverted attention CAS series (2000-2006)

Overall, the CAS diverted attention series is cited as a contributing factor in 10.4% of all police-reported crashes during 2000-2006. However not all of this series can be attributed to distraction. Table 1 provides a summary of the estimate of distraction involvement in police-reported crashes in New Zealand based on the content review. Secondary task driver distraction (excluding daydreaming/ thinking) is involved in 5.1% of all New Zealand police-reported crashes. If daydreaming/ thinking and the general unknown/suspected categories are included, the estimate rises to 5.7%. Driving-related inattention/distraction is estimated to be involved in 3.4% of all crashes.

Overall, our current estimate of distraction involvement in crashes, including secondary task and driving-related activity, based on the CAS diverted attention series, is 9.2%. Gordon & Evans (2008) provide a more detailed breakdown of involvement by the different sources of distraction. For practical purposes, the current content of the CAS diverted attention series fits best with definitions of distraction that include driver-related inattention/distraction, such as Lee et al (2008).

**Table 1 : Estimate of distraction involvement from the diverted attention series in police-reported crashes in New Zealand (2000-2006)**

Category	Percentage involvement in all New Zealand police-reported crashes
CAS diverted attention series	10.4%
Content review	
Driver distraction and inattention	
Secondary task driver distraction (excl daydreaming and suspected)	5.1%
+ daydreaming/thinking	5.2%
+ suspected distraction	5.7%
Driving-related distraction/inattention only	3.4%
All secondary task driver distraction + driving-related distraction/inattention	9.0%
All road-user distraction	
All secondary task distraction + driving-related distraction/inattention	9.2%
+ other distracted roadusers	

Adapted from Gordon & Evans (2008).

The overall estimate for distraction involvement is similar to that of other police-report crash databases such as the United States CDS (Stutts et al, 2001, 2006). But it is less than estimates using different methodologies, such as the post-crash interview approach of McEvoy et al (2007) and the naturalistic 100-car observational study (Klauer et al, 2006). As with other police report crash estimates of distraction, the New Zealand estimate is expected to underestimate actual crash involvement. This is because of the limitations involved in gathering information on distraction at a crash scene using a police report-based system (Gordon, 2008; Ranney, 2009).

### Preliminary analysis on changes over time

The project has also begun examining trends over time in the CAS diverted attention series and the content review. Figure 1 provides a time series from 1990-2007 for the standard CAS diverted attention series (Ministry of Transport, 2008). Since 1990 the percentage involvement of this series for both fatal and injury crashes has been increasing over time. In 1990 diverted attention was cited as a contributing factor in 3.1% of fatal and 7.3% of injury crashes. In 2007 diverted attention was cited as a contributing factor in 9% of fatal and 11.5% of injury crashes.

Figure 1 : Time series of percentage crash involvement out of all police-reported crashes for the CAS diverted attention series from 1990-2007.

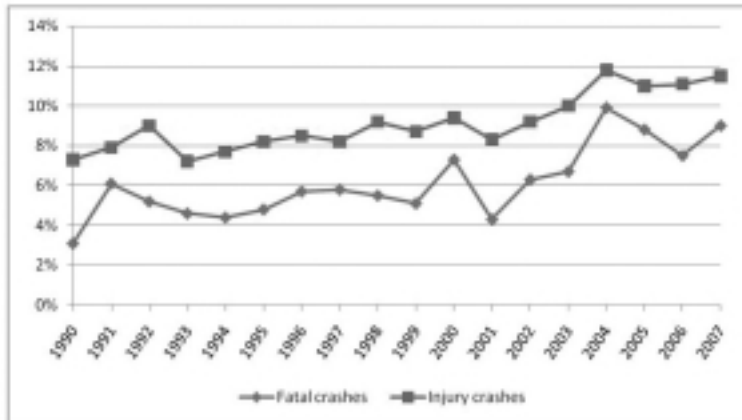
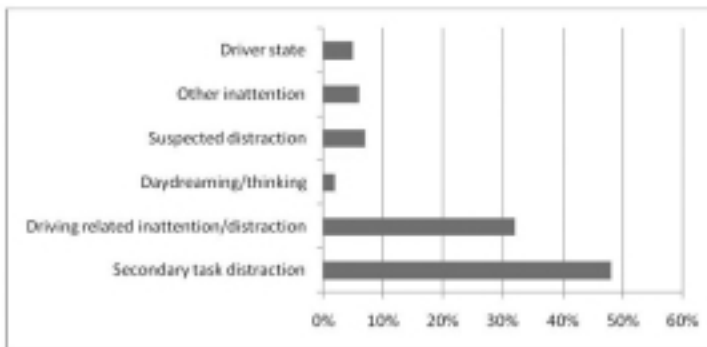


Figure 2 : Proportion of crashes involving six summary content review categories (2000-2006).



The CAS diverted attention series comprises more than just distraction however. Figure 2 provides a percentage breakdown of the content review into six summary categories: secondary task distraction; driving-related inattention/distraction; daydreaming/thinking; suspected distraction; other inattention; and driver state. Figure 3 shows the percentage change over time for the six summary categories of the content review between 2000-2001 and 2005-2006. Increases over time have occurred for all six main categories, and particularly for the 'other inattention' category. The overall growth in the 'attention diverted by' series in this period was 67%. The two largest categories (Figure 2, secondary task distraction and driving related inattention) show growth below or comparable to the overall series growth.

Figure 3 : Percentage change over time (comparing 2000-2001 and 2005-2006) for the six summary content review categories.

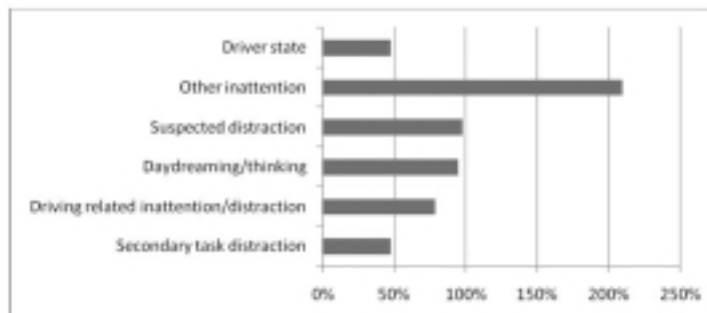


Figure 4 : Percentage change over time (2000-2001 and 2005-2006) in involvement of secondary task distraction in crashes

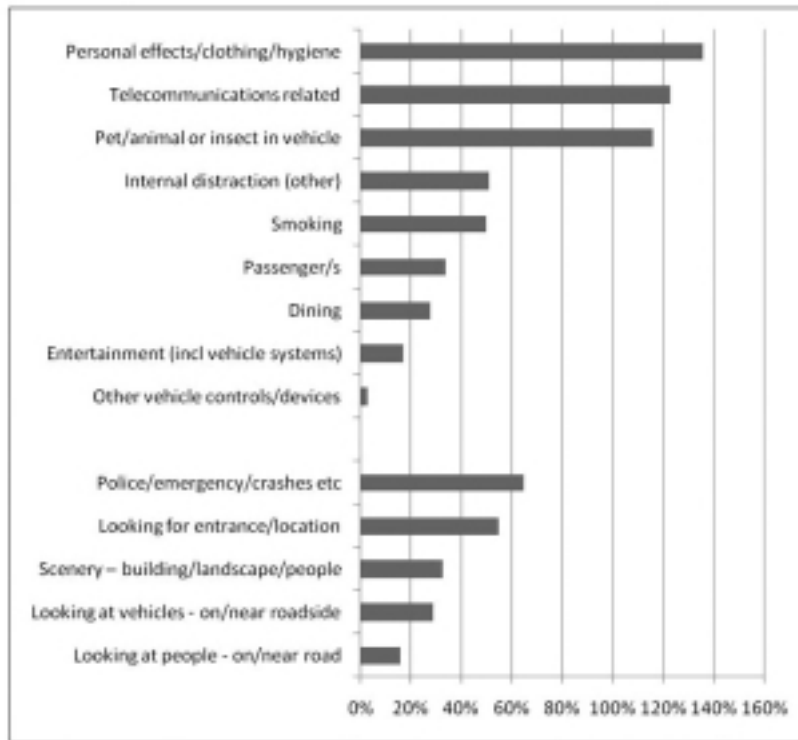
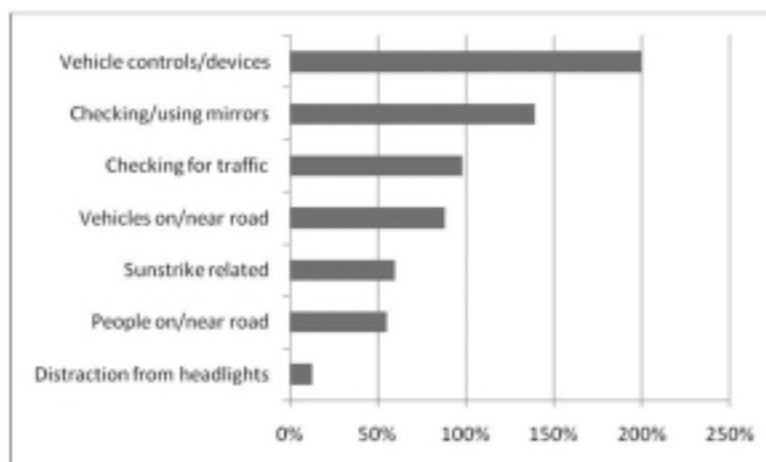


Figure 4 and Figure 5 provide a more detailed breakdown of the growth observed (between 2000-2001 and 2005-2006) in the summary classification scheme used for the content review. Categories were excluded if there were fewer than 10 crashes per year. Figure 4 provides a summary for secondary task distraction and shows that substantial growth (near or over 100%) was observed for 'personal effects/clothing/ hygiene', telecommunications (mainly cell phones) and 'pets or insects inside the vehicle'. Figure 5 provides a summary for driving-related inattention/distraction. Substantial growth was observed in 'vehicle controls/devices' 'checking/using mirrors' and 'checking for traffic' without using the mirrors. An indication of the relative size of crash involvement for each of the summary classification categories is provided by Gordon & Evans (2008).

Figure 5 : Percentage change over time (2000-2001 and 2005-2006) in involvement of driving-related inattention/distraction in crashes.



## Discussion and concluding comments

The project examining distraction in the CAS system has provided the Ministry with a much better understanding of the content of the diverted attention series. While distraction is coded within this series, it also contains a number of other inattention and driver state elements that are not related to distraction. Because of the limitations of the standard CAS coding for this series, in order to separate out distraction the Ministry had to review the TCRs of all crashes involving this series. This approach has provided a wealth of valuable information which we are working our way through, but this is extremely time consuming. We are currently exploring options for how to streamline this process.

At present, based on our analysis to date, we estimate that distraction is involved in at least 9.2% of police-reported crashes in New Zealand. We expect this to be an underestimate due to the complications involved in establishing in a police-report system, whether a driver was distracted. There is also some preliminary evidence to suggest some under-reporting from other CAS series (Gordon & Evans, 2008). Considerable growth in the citing of this series in crashes has been observed over time. However, it is unclear what may be behind this growth. It may be related to improved police reporting, increasing salience of the role distraction has in crashes from the media and researchers, or changes in driver distraction over time. A definition of distraction that includes driver-related inattention/ distraction aligns best with the current CAS diverted attention series structure and content.

The project has been careful to keep the information obtained from the content review separate from the official CAS system. The base information in the content review does not change, as it is coded with as much detail as possible. Essentially a description of what was written in the TCR is entered as a narrative and then filters are applied for coding and classification. Over time we have altered the summary categories used, based on what we have learned in examining the CAS information and research on distraction. The current content review classification scheme is a compromise between the demands for information on specific distraction issues (such as cell phones) from the media, the public and for policy development, and the developments in the research literature. This approach has provided flexibility and allowed the project to modify or apply different classification schemes and different definitions of distraction.

It is important to separate factors related to impairment such as alcohol, fatigue and psychological states from distraction. This was a specific issue for this project as the standard CAS coding includes a sub-code called 'emotionally upset'. Given the current discussions in the distraction literature, it is also important to identify activity such as daydreaming/thinking and separate secondary task distraction from driving related distraction/inattention (Gordon, 2008). This is not a simple task due to issues associated with the quality of information contained within the TCRs.

It is also important to identify driving-related inattention/distraction, which is highly involved with outside-the-vehicle distraction. Based on our experience, however, it cannot be assumed that all activity involving looking at other road users or using mirrors is driver-related inattention/ distraction. Some of this activity appears to be more related to secondary task distraction. This has implications for methodologies using video capture technology where, for example, the use of a mirror can be identified, but it is not clear what the driver is looking at.

Other sub-codes specific to the standard CAS coding structure, 'driver dazzled (sunstrike)' and 'searching for a destination', also pose issues. While the events themselves are not distraction, some researchers have argued that the behaviour in response to them (i.e. pulling down the visor, shading eyes, reading a map) could be driving-related distraction (Regan et al, 2008). Where possible, specific behaviours related to these events has been recorded in the content review.

The current NZ CAS coding structure for diverted attention has been around for a long time and it may be time to consider whether some changes could be made. As part of this consideration we intend to begin engaging in discussions with the NZTA about how the current standard CAS coding for the diverted attention series might be improved.



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