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Characteristics of the close to home crash

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A B S T R A C T

Crashes are over-represented on roads close to home, but it is not clear why. We sought to address this gap by exploring the characteristics of close to home crashes. We used twelve months of crash data that included driver home address, and travel survey data captured over the same period to group crashes based on equivalent amounts of travel at different distances from home, controlling for exposure. We compared crashes on high-speed (rural) and low-speed (urban) roads; crashes caused by different types of error (lapse and violation); and crashes at major intersections (roundabouts and traffic signals), minor intersections (priority intersections and driveways), and midblocks; to find out which road type, error type, and locations were most common in crashes on roads close to home. Findings revealed that crashes over-represented close to home were on low-speed (urban) roads; were more likely to involve lapses of attention than violations; and that crashes related to lapses of attention on low-speed roads were more common at minor intersections and mid-blocks than at major intersections. Although drivers may be most likely to consider busy intersections risky and worthy of effortful focus, these results show that seemingly safe, slow streets and minor intersections account for a surprisingly high proportion of crashes overall, particularly on familiar urban roads close to home. The interplay of drivers' attentional regulation with momentary driving demands, and risk is complex and worthy of continued investigation.

1. Introduction

A high proportion of road crashes happen close to home. Motor vehicle insurance reports have stated that one third of crashes happen within one mile (1.6 km) of home, for example (Telegraph, 2015); and 77% of crashes are within 15 miles (24 km) of home (Driving Today, 2015). More rigorous research has also reported that crashes are common close to home. Steinbach et al. (2013) found that 53% of injured car occupants were within a 5 km (3.1 mile) radius of their home when they crashed, and a study of child injuries found that 95% of trips in which children were injured happened within one hour's drive of home (Chen et al., 2005). None of these studies accounted for exposure, so with this evidence alone, the high proportion of crashes close to home might just be because most driving happens near where we live.

To address this gap, we recently conducted a study to investigate the close to home effect in road crashes whilst accounting for exposure. We calculated distance from home for each kilometre (0.6 mile) travelled across 32,102 trips from New Zealand's household travel survey, and compared the resulting distribution to that of crash distance from home for all reported injury crashes in the same period. Our results showed that in New Zealand, crashes are over-represented compared to travel on roads within 11 km (6.9 miles) of where drivers live (Fig. 1; Burdett et al., 2017). The mean crash distance from home was 25 km (15.6 miles) whereas the average (mean) distance travelled was 38 km (23.8 miles) away. The means were affected by positive skew in the travel and crash data (a lot more travel and crashes happened on roads closer to home than further away), so medians were much lower: half of all travel was on roads within 11 km (6.9 miles) of home, whereas the median crash distance from home was 7 km (4.4 miles). Therefore, the high proportion of crashes close to home is not solely related to exposure.

At this point it is unclear why crashes are over-represented compared with travel on roads close to home. One possibility is that it is due to the types of roads we encounter close to where we live. In highly motorised countries, crash risk is highest per kilometre travelled on *urban* roads (excluding urban motorways), based on analysis of high income countries in Europe and North America (Elvik et al., 2009). This is seemingly implausible as urban roads are relatively low-speed, and we tend to think that higher speed roads generally result in higher crash risk (Aarts and van Schagen, 2006). However, urban roads also have higher traffic volumes, and more pedestrians, cyclists, and intersections than most high speed (rural) roads, so these factors might explain why they are the scene of more crashes overall (Elvik et al., 2009).

If high traffic volumes and an abundance of potential hazards are

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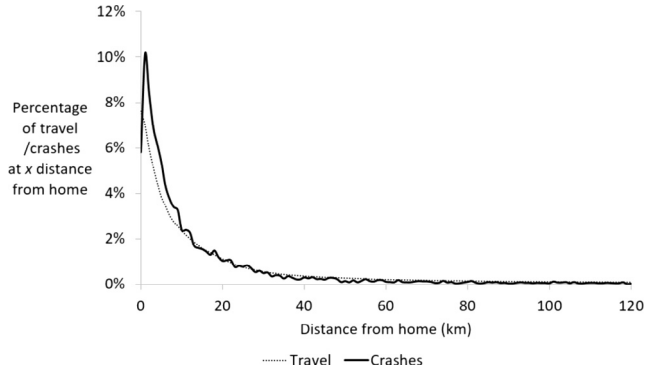

Fig. 1. The percentage of crashes and travel by distance from home. Reprinted from Burdett et al. (2017).

the cause of crashes close to home, we might expect most crashes to occur at busy urban intersections. Traffic volume is one of the main determinants of crash risk (Fridstrøm et al., 1995; Greibe, 2003), so high-volume urban intersections are likely to show relatively high crash rates. The close to home effect may therefore be a consequence of driving through busy intersections, where the demands of driving can exceed a driver's momentary capacity.

It is possible, however, that attention regulation in response to driving demands might also contribute towards high crash rates close to home, but at places of low demand rather than high demand. Driving rapidly becomes habitual with practice, so in undemanding places drivers might not be paying much attention to the driving task (Charlton and Starkey, 2013; Gibson and Crooks, 1938; McKenna and Farrand, 1999). After travelling the same route many times, drivers often report driving without awareness; that is, they have no recollection of the preceding journey (Charlton and Starkey, 2011, 2013; Kerr, 1991). When any activity is repeated so often as to become proceduralised, task-unrelated thoughts (ie, mind wandering) are also much more likely to surface and be maintained (Mason et al., 2007; Smallwood and Schooler, 2015).

Some consequences of mind wandering during driving are that drivers' gaze patterns are narrowed (He et al., 2011) and reaction times increase (Yanko and Spalek, 2013). Mind wandering is also associated with inattentional blindness (Charlton and Starkey, 2011), and reduced subjective engagement in the driving task (Martens and Brouwer, 2013). Familiarity with the driving task generally is known to result in failure to notice changes in the road and roadside environment (Harms and Brookhuis, 2016; Martens, in press; Martens and Fox, 2007). Research has suggested that familiarity may be a risk factor in driving (Intini et al., 2018), although crash patterns close to home are yet to be analysed in depth. It is possible that the close to home effect is related to driving on familiar, undemanding urban midblocks and through minor intersections, where drivers occasionally fail to react in time to uncommon hazards because they allow their minds to wander and are not consciously engaged in the driving task.

One approach to investigating the interaction of attentional regulation and driving demands is by studying the types of errors involved in crashes in different driving environments (major intersection, minor intersection and midblock). Crashes caused by deliberate but illegal behaviours (i.e., violations) are different from those caused by unintentional errors (i.e., lapses of attention). Violations such as excessive speeding have socio-cultural influences (Reason et al., 1990) and have been correlated with risk-taking personality traits (Parker et al., 1995). Excessive speed may also be linked with familiarity, in that drivers may select faster speeds in familiar environments to minimise their travel time (Colonna et al., 2016; Intini et al., 2017). In contrast, a lapse of attention is an unintentional action or failure to act; it is the outcome when a driving situation exceeds the driver's momentary ability to perceive a hazardous situation, select a suitable course of action and respond in time to avoid a collision (Reason et al., 1990). The idea that violations and lapses are distinct has been confirmed multiple times in different jurisdictions, through analyses of driver behaviour surveys and crash data (e.g. Gregory et al., 2014; Măirean et al., 2017; Stephens and Fitzharris, 2016; Useche et al., 2017).

In New Zealand, police officers attending a crash assign codes to describe likely crash causes, which can then be used in research to distinguish between different errors (Reason et al., 1990). For example, 'showing off' and 'excessive speed' can be defined as a violation. In contrast, a code of 'failure to notice' or 'fail to give way' can be categorised as a lapse of attention (Reason et al., 1990). The distinction between violations and lapses is considered robust enough to compare crash patterns based on different psychological mechanisms involved in drivers' behaviour (Blockey and Hartley, 1995).

This study sought to explore factors underlying the close to home effect. We know that crashes are more common both close to home, and on urban roads, but where on these roads are crashes happening and why? Building on our previous study (Burdett et al., 2017) which demonstrated that the close to home effect exists in spite of higher exposure on roads close to home, we sought to explore differences between crashes that happen close to home compared with further away. If the majority of close to home crashes are happening at major intersections, where driving demands are high, the effect might be the result of high traffic volumes with frequent opportunities for conflict. If crashes are over-represented at relatively undemanding minor intersections and midblocks on roads close to home, the effect might be due to lapses of attention and drivers not applying conscious focus to the task, and therefore failing to react in time when confronted with an unexpected hazard on the road.

We addressed this question in three steps: first, studying whether crashes close to home are relatively more common on low speed urban roads as compared to high speed rural roads; second, exploring what types of errors are most common on urban roads close to home (lapses of attention, vs violations); and third, determining where the resulting crashes happen (major intersections, minor intersections or midblocks). The study involved analyses of crash data, accounting for overall exposure on roads at different distances from home.

2. Methods

2.1. Data sources

2.1.1. Crash data

Crash data were all reported injury crashes that happened between 1 July 2013 and 30 June 2014 inclusive, involving a driver with a full New Zealand licence and known home address in New Zealand (n = 9105). The dates were a convenience sample to match travel data collected to account for exposure on roads at increasing distance from home (Burdett et al., 2017). The shortest distances by road between the crash locations and drivers' home addresses were calculated to determine the distribution of crash distances from home. Other information extracted from police crash reports included the posted speed limit at the crash site (to determine if the crash occurred in an urban (low speed: lower than 75 km/h (47 mph) posted speed limit) or rural (high speed: greater than 75 km/h posted speed limit) location); causal factors related to driver error (lapse or violation); and the crash location (major intersection, minor intersection or mid-block). Both single and multiple-vehicle crashes were included, but for crashes with more than one driver involved, the driver assigned as 'role one' by attending police officers was used in this analysis so that each crash was used only once (n = 3901).

The posted speed limit at the crash site was recorded for every crash in the sample. The speed limit was used to define each crash as low-speed (posted speed limit < 75 km/h) or high-speed, as a proxy for urban and rural roads, according to a definition used by the New Zealand Transport Agency (2017). Although the proxy does not directly