Peer-reviewed Papers

Original Road Safety Research

Extent of mobile phone use by pedestrians on controlled crossings in central Hobart, Tasmania

Emma Pharo

School of Technology, Environments and Design, College of Science and Engineering, University of Tasmania, Hobart, Tasmania, Australia

Corresponding Author: Emma Pharo, Private Bag 78, University of Tasmania, Sandy Bay, Tasmania 7005 Emma.Pharo@utas.edu.au (+61)3 62262049

Key Findings

- Pedestrian phone use was recorded for 16,032 people over 70 hours on 10 signalised crossings in central Hobart, Tasmania.
- On average, 12.4% were using their phones while crossing: 4.6% were looking down at their phone to read or type, 2.3% were talking and another 5.5% were listening to headphones.
- At busy crossings, as many as 158 people per hour were looking down at their phones to read or type as they crossed the road, including on steady red with conflicting motor vehicle movements.
- These results suggest various levels of cognitive and visual impairment while on the roadway, although further work is required to determine how this behaviour might link to the crash risk.

Abstract

Distracted walking is one way that pedestrians increase their risk of injury, but little is known about the extent of the problem. I quantified the extent of phone use by pedestrians over seven hours at each of the 10 signalised crossings in central Hobart. Of the 16,032 people counted, 12.4% of pedestrians were using phones: 4.6% were reading or typing on their phone, 2.3% were talking and another 5.5% were listening to headphones. The latter figure will be an underestimate because of the difficulty of seeing headphones obscured by hats and long hair. At the busiest sites at two ends of a pedestrian mall, there were as many as 155 and 158 people in a one hour period looking down at their phones to read or type. Fortunately these two roads had slow moving vehicle traffic, meaning consequences of crashes would likely be minor. However, four of the sites crossed wide, 50kph, arterial roads, so a combination of responses will be needed to lower crash risk, including education, enforcement and consideration of safe road speeds.

Keywords

Pedestrian, mobile phone, vulnerable road user, inattention, distraction, Tasmania

Introduction

Distracted walking is one way that pedestrians increase their risk of injury (Cassell et al., 2011). Although traffic-related pedestrian deaths have been decreasing over the past several decades (Cassell et al., 2011; BITRE 2015), pedestrians remain at increased risk of fatality and serious injury in a crash compared with motor vehicle occupants because of their lack of physical protection (Bungum et al., 2005). Pedestrians represented 14% of overall fatalities in Australia in 2017; a statistics that has not improved over the medium term (BITRE 2018; cf 14% average over 2003-2012; Williamson and Lennon, 2015). This is despite efforts to address pedestrian safety during this Decade of Action for Road Safety (2011-2020). In this paper, I present some preliminary results of pedestrian use of mobile phones on signalised crossings in central Hobart, Tasmania; only the third such study in Australia and the first in Tasmania.

Previous research on pedestrian mobile phone use

Distraction is inherent while using a mobile phone (Saltos et al., 2015). Using phones while walking is known to increase the frequency of motor vehicle-pedestrian crashes (e.g. Hatfield & Murphy, 2007; Alejalil & Davoodi, 2016). There has been a rapid increase in phone ownership (Pew Research Centre 2018) and in the number of people using a mobile phone while crossing a road (Neider et al., 2010; Schwebel et al., 2012; Thompson et al., 2013). Mobile phone ownership has risen from 77% of Americans in 2011 to 95% in 2018 (Pew Research Centre 2018) and mobile phone related injuries have increased relative to total pedestrian injuries in the US between 2004 and 2010 (Nasar & Troyer, 2013). Around 88% of Australians owned a mobile phone in 2017, including 95% of 18-34 year olds (Deloitte 2017).

Pedestrians using phones have been shown to experience cognitive distraction, reduction in their awareness of their surroundings and situation, reduced perceptual visual field, and reduced attention (e.g. Hatfield & Murphy, 2007; Hyman et al., 2010; Stavrinos et al., 2011; Nasar & Troyer, 2013; Alejalil & Davoodi, 2016; Banducci et al., 2016). These behaviors puts pedestrians at higher risk of collision with a motor vehicle (Schwebel et al., 2012; Nasar & Troyer, 2013). Inattentiveness has been found to be a crash factor in as much as 15% of pedestrian fatalities (Bungum et al., 2005). Studies in virtual road environments have found that mobile-phone users were less likely to 'successfully' cross the road and phone users were more likely than non-phone users to crash with a motor vehicles (Neider et al., 2010; Alejalil & Davoodi, 2016).

Most naturalistic research of pedestrian mobile phone use in real road crossing settings has been done in the United States. A Seattle study of 1102 people across 20 crossings found that 24.7% of pedestrians were using their phones as they crossed the street. Of the total of 1102, 7.3% were reading or typing, 6.2% were talking on the phone and 11.2% were listening (Thompson et al., 2013). A 2005 Las Vegas study of 886 people on a crossing near a university found that 20.8% of people were distracted by phones, eating, drinking, smoking or talking. Of the 886, 5.7% were distracted by phones (Bungum et al., 2005). A study of two American college campuses found 8% reading or typing, 5% talking on the phone and 19% listening via headphones (Wells et al., 2018). A study of self-reported pedestrian crash history among US teenagers (13 to 18 years) found that 30% reported having been hit, or almost hit, by a car, cyclist, or motorcyclist while walking and 71% reported using of a device when walking 'all of the time', 'often' or 'sometimes' (Rosenthal et al. 2016). Rosenthal (et al. 2016) found that frequent use of mobile devices while walking or crossing the street resultsed in increased odds of self-reported crash history among these teens.

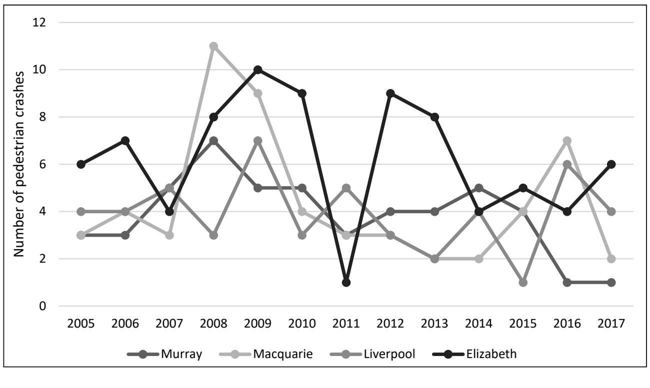

Figure 1. Number of pedestrian crashes on four major roads in central Hobart, Tasmania (Department of State Growth)

In Australia, Williamson and Lennon (2015) asked 211 pedestrians in Brisbane to self-report their smart phone use while crossing the road. More than half the group were aged 18-30 years (56%) and this cohort reported particularly high levels of mobile phone use; 32% texted at high frequency levels and 27% used internet at high frequency levels while on the roadway. These data were self-reported, so actual use may have been quite different, but the study clearly showed that many people were aware of their regular use of distractions while crossing roads. A 2007 study in three Sydney suburbs found that 33% of 546 people crossing the road were on the phone; 27% were talking and 6% were texting (Hatfield & Murphy, 2007). To my knowledge, these are the only two existing studies of phone use on crossings in Australia.

Hobart context

This study adds to our understanding of mobile phone use on roadways and provide some data for Tasmania. Annual pedestrian road fatalities are low in Tasmania compared with larger jurisdictions, but pedestrians are still over-representation in the crash record in Tasmania (Department of State Growth 2018). Data from arterial roads in central Hobart over 2005 - 2017 showed a consistent level of pedestrian involvement of around 10-30 crashes per year, with little sign of a downward trend (Department of State Growth unpublished data). The crash statistics for four roads in central Hobart showed large variability from year to year and site to site over 2005 to 2017 (Figure 1).

For this paper, the number of people using their mobile phones were observed while crossing at ten signalised crossings in central Hobart, Tasmania. I targetted intersections because most pedestrian crashes occur at intersections, particularly when the crossing has a high number of 'red walkers' who cross illegally (Gårder 1989). People were counted over 7 hours each at 10 locations in order to quantify the extent to which pedestrians were (a) looking at their phone to read or type (cognitive and visual distraction), (b) talking (active cognitive distraction), or (c) listening to headphones (passive cognitive distraction). The research question was 'what proportion of people crossing the study crossings were using their mobile phones?'

Table 1. Total people crossing and the average and standard deviation of the percentage of pedestrians using phones for each of the study intersections. These data are based on seven hours of observations for each crossing.

	Total people crossing over 70 hours	Average % looking at phone (reading or typing)	Average % talking on phone	Average % listening to phone (headphones)	Total % using phone
1	841	5.2 ± 0.9	1.3 ± 0.3	2.9 ± 0.5	9.4± 0.5
2	361	3.9 ± 0.4	2.5 ± 0.3	3.6 ± 0.3	10.0 ± 0.3
3	3566	3.8 ± 0.7	1.7 ± 0.4	7.2 ± 1.0	12.7 ± 0.7
4	1573	3.8 ± 0.5	2.6 ± 0.5	3.8 ± 0.5	10.2 ± 0.5
5	2202	2.7 ± 0.5	2.2 ± 0.5	3.0 ± 0.6	7.9 ± 0.5
6	1423	6.5 ± 0.5	2.8 ± 0.3	7.0 ± 0.5	16.3 ± 0.5
7	1280	6.1 ± 0.5	3.5 ± 0.4	5.5 ± 0.5	15.1 ± 0.4
8	4029	3.9 ± 0.6	1.7 ± 0.4	5.8 ± 0.7	11.5 ± 0.5
9	267	5.6 ± 0.3	0.7 ± 0.1	6.0 ± 0.3	12.4 ± 0.3
10	490	5.1 ± 0.3	3.5 ± 0.4	10.2 ± 0.5	18.8 ± 0.4
Total	16032	4.6 ± 0.5	2.3 ± 0.4	5.5 ± 0.6	12.4 ± 0.5

Methods

Ten study sites were chosen in the central business district of Hobart. Hobart is the capital city of Tasmania, and the largest urban centre with a population of 222,356 at the last census (ABS 2017). All ten crossings were in speed zones of 50km/hr or less; had high pedestrian activity; were signalised; and had no filtering traffic, i.e. no left or right-turning vehicles entering the pedestrian crossing. The lack of filtering motor vehicles is important to note, given that the most common crash scenario involving pedestrians is right-turning motor vehicles and the second most common is left-turning motor vehicles (Mantilla & Burtt, 2016). There were some differences in the characteristics of each site, such as distance across the road and time allowed for crossing. In this paper, I sought to quantify the extent of the problem rather than look for covariates that might explain variation between sites.

The data were collected over two weeks in May, 2017. Autumn weather in Hobart tends to be fairly stable, with large high pressure system moving slowly over the state bringing mild, calm and generally sunny conditions over the two weeks of data collection. Maximum daily temperatures ranged from a low of 9˚C to a high of 18˚C, and averaged 13˚C. Wet weather was avoided because of lower pedestrian numbers and greater difficulty of observing pedestrians from a sheltered location.

Data were manually recorded over seven 1-hour periods at each of the 10 crossings, totaling 70 hours of data collection. Data collectors positioned themselves in a location where they had a good sightline of the crossing, but remained unobtrusive. Data were collected during busy periods on Mondays, Wednesdays and Fridays, from 8 to 9am and again 4 to 5pm. A seventh hour was added to capture some weekend traffic on Saturday from 10 to 11am. Time of day was a means of stratifying the data collection, rather than being a variable of interest in the study. The light sequence was variable with some crossings cycling every minute and some every two minutes.

A total of 11 data collectors were used. One person did 16 of the 70 hours of data collection and acted in the role of data coordinator/quality control. She was responsible for training the other observers and attended the first data collection session with new people to ensure that their technique was correct. The data collection was simple and there was not much scope for error. The main difficulty was in counting the number of people wearing in-ear headphones (or earbuds) because they could be difficult to see under hats or long hair. Therefore, the figures presented in this study were likely to be an underestimate. Herein, both earbuds and over-ear headphones are referred to as 'headphones'.

Descriptive statistics were used to describe the proportion of pedestrians engaged in each type of phone use at each crossing. Average and standard deviation were calculated, with each green light phase acting as one data point. Therefore, a crossing with a light sequence of one minute for the three phases (green, flashing red and steady red) yielded 60 separate records over an hour of data collection for the three variables: people texting, talking and listening to their phones.

Results

A total of 16,032 people were recorded over the seven hours of data recording at each of the 10 sites. No crashes were recorded during the two weeks of the study, although some near misses were observed during periods when pedestrians were on the roadway during the steady red pedestrian lantern phase. The crash history for the 10 study sites showed that there were nine incidents over a 10-year period (2007 – 2016). Of these nine, two were serious (requiring hospital stay), four were minor (brief visit to hospital), and three required first aid. The locations with the most crashes were the two ends of the main pedestrian mall (Elizabeth Street

Mall), with the northern end having one crash (serious injury) and the southern end having four crashes (2 minor, 2 first aid). This result was to be expected statistically because these two crossings were the busiest of the 10 study crossings with 22% (3566 people; northern end) and 25% (4029 people; southern end) of the total number of people counted. It is not known how many of these crashes involved pedestrian inattention.

Overall, 12.4% of pedestrians were using phones: 4.6% were reading or typing on their phone, 2.3% were talking and another 5.5% were listening to headphones (Table 1). The number of people looking down at their phone to read or type while they cross the road was as high as 155 per hour (Site 3) and 158 per hour (Site 8), which represented a large number of occasions where a pedestrian's attention was potentially compromised.

Discussion

This study found that of 16,032 people counted at the ten signalised crossings, an average of 12.4% of pedestrians used phones to talk, text, or listen to headphones. This high proportion of distracted pedestrians is of concern, given the established connection between mobile phones and reduced attention (e.g. Nasar & Troyer, 2013; Alejalil & Davoodi, 2016). It is known that these behaviors put pedestrians at higher risk of crash (Schwebel et al., 2012; Nasar & Troyer, 2013) and mean they are less likely to successfully cross the road (Neider et al., 2010; Alejalil & Davoodi, 2016).

These results for Hobart were lower than those reported for Sydney in 2007, where 27% of people were talking on their phones and 6% were texting (Hatfield & Murphy, 2007). The Hobart figure of 12.4% is also lower than studies of phone use on road crossings in the United States:

- A Seattle study of 1102 people across 20 crossings found that a total of 24.7% of pedestrians were using their phones as they crossed the street: 7.3% reading or typing, 6.2% talking on the phone and 11.2% listening (Thompson et al., 2013).
- A Las Vegas study of 886 people on a crossing near a university found that 20.8% of people were distracted by phones, eating, drinking, smoking or talking and 5.7% of the total were distracted by phones (Bungum et al., 2005).
- A Norfolk (VA) and Birmingham (AB) study of 10,543 people on US college campuses found that 32% were using their phones as they crossed the road: 8% texting or reading, 5% talking and 19% listening (Wells et al. 2018).

In the Hobart study, only 4.6% of pedestrians were using headphones while crossing at crossings compared with 11.2% in Seattle, 16% in Birmingham, and 21% in Norfolk. The difference between the results might partly be accounted for by the cool, hat-wearing autumnal weather during the Hobart study and the resulting underestimate of headphone use, compared with the American studies that were all done over summer or early autumn (fall). The only study that reported lower distraction by phones compared with Hobart was the Las Vegas study that is now more than 13 years old and is likely to be out of date, given the rapid rise in phone ownership since 2005 (Pew Research 2018).

The link between headphone use and crash risk has not been well established. A US study of pedestrian injuries or fatalities from crashes involving trains or motor vehicles during 2004 - 2011 found that in 74% of the 116 reports of death or injury the pedestrian was using headphones (Lichenstein et al., 2012). However, further research is needed to establish a causal link.

Implications for road safety campaigns

The type of phone use that has been of most concern has been texting, where the pedestrian is looking down, rather than at their surroundings (e.g. Saltos et al., 2015; Banducci et al., 2016). In our study, 5.6% of pedestrians were looking down at their phones, which was similar to the older study of 5.7% in Las Vegas but lower than for the college campuses (8%) and Seattle (7.3%). The first pieces of legislation related to distracted walking specifically target texting while walking. Some US jurisdictions, including parts of Hawaii and New Jersey, have passed legislation to target people looking down at their phones while on a road crossing (e.g. City and County of Honolulu 2017). In Australia, there is no fine for pedestrians who use their phones on the roadway, but people can be fined AU$110 fine for 'not considering other road users'.

As with other road safety issues, multiple tools are likely to be needed as part of a safe system approach to tackle distracted walking. Enforcement, education and engineering responses all have a role to play in ensuring that any mistakes that result from distracted walking do not result in serious injury or fatalities. A safe systems approach requires appropriately low speed limits in areas of high pedestrian activity. We observed near misses at the two crossings with the highest pedestrian volume in Hobart, but motor vehicles were travelling slowly and both parties had time to compensate. However, four of the ten sites were on the main arterial couplet for through traffic (Davey and Macquarie Streets), and any move to reduce speed limits to 30 or 40 kph would present considerable socio-political challenges.

Education campaigns may help raise public awareness of how mobile phones contribute to safety risk (Hatfield & Murphy, 2007). However, the difficulty of communicating the safe walking message should not be underestimated, given that campaigns about the risks of mobile phone use while driving do not appear to be succeeding (Rowden & Watson, 2014). Road safety education campaigns have been found to change road crossing behaviour, but the effect is highly variable between different studies and it is not known whether the campaigns reduces the risk of pedestrian injury (Duperrex et al., 2002).

In terms of engagement between authories and road users, the US National Safety Council (2018) has recommended that pedestrians not wear headphones or use a cell phone while walking, and the World Health Organisation (2013) highlights talking and walking as an emerging problem for children, but offers no advice on tackling the issue in adults beyond boosting law enforcement. In Australia, the Austroads Research Report: Guide Information for Pedestrian Facilities only mentions phones once in the context of pedestrians being 'GPS enabled' through their phones (Austroads, 2013). The design of interventions and education campaigns needs to be carefully targetted to suit the particular context and more work is needed on the role and effectiveness of education in reducing pedestrian risk from distracted walking.

Limitations and further research

This study was done opportunistically as a side project in an evaluation of pedestrian countdown timers in central Hobart. Given the large number of pedestrians in this study, the paucity of data on pedestrian phone use in Australia and the different issues involved in phone use versus timer compliance, it was decided to separate out these data from the project on countdown timers. It would have been desirable to collect more detailed information on the gender and age category of the pedestrians and also the road environment, but this was not possible.

Phone use by university or 'college' age pedestrians is of particular interest in Hobart because their numbers are set to increase with the University of Tasmania's plans to shift campuses from an inner suburb into the central business district. University students have been shown to be particularly susceptible to pedestrian injuries through intensive use of mobile phones and risk taking behaviour (Stavrinos et al., 2011; Byington & Schwebel, 2013; Williamson & Lennon, 2015; Stavrinos et al., 2017). A study of 405 university students found that there was a perception that they could compensate for the negative effect of mobile phone distractions while crossing (Jiang et al., 2016). These studies are suppported by evidence from studies of teenagers (13 to 18 years) that found teens were at high risk because of frequent use of mobile phones while walking, and group norms encourage mobile phone use while crossing the road (Lennon et al., 2017).

A number of informal observations were made during data collection that could inform further work and education campaigns but for which no data were collected. It was noted that some people who were not using phones when they approached the study crossings proceeded to take their phones out of their pocket and use them while waiting for the green light. They then continued to use them while crossing the road. We observed that phone checking behaviour appeared to influence other people waiting at lights to also check their phones. Phone checking while waiting appeared to mostly be restricted to crossings with long wait times for pedestrians, such as the legs across the major arterial road of Macquarie Street.

Conclusions

Technology-related distractions are a growing concern for road safety. The use of mobile phones while crossing the street divides attention, potentially increasing the risk of crash with a motor vehicle (Basch et al. 2014). This study helps fill a knowledge gap by quantifying the extent of the problem of distracted walking in central Hobart. While the percentages of the total number of people was not as high as in some other recent studies, almost 5% of people crossing at our sites were reading or typing on their phone, which translated into as many as 158 people per hour at a single crossing who were on the road while looking down at their phone. These figures are not encouraging in the context of work that has shown distracted walking decreases the number of successful road crossings by pedestrians (Hatfield & Murphy, 2007). More work needs to be done to establish a causal link between pedestrian crashes and mobile phone use. However, the trends and correlative work to date present a worrying picture.

Acknowledgements

Thanks to Huanfang Wang and the data collectors for their patience in manually counting pedestrian behaviour. Thanks to the Department of State Growth for financial support for the data collectors and in choosing the sites and providing the crash data. Thanks in particular to Simon Buddle and Janice Miller of the Department of State Growth for data and feedback. Thanks to Professor Ian Johnston for his encouragement in reformatting my Department of State Growth report for publication.

Funding: This work was supported by DEPARTMENT OF STATE GROWTH [NR-433, 2017].

References

Alejalil, N., & Davoodi, S.R. (2016). Mobile phone usage and its effects on pedestrian distraction. *High Risk Behaviours & Addiction*. *5*(4), 1-5.

Australian Bureau of Statistics. (2018). 2016 Census Quick Stats: Greater Hobart. Retrieved from http://www.censusdata.abs.gov.au/

Austroads. (2013). Guide Information for Pedestrian Facilities. Retrieved from https://www.onlinepublications.austroads.com.au/items/AP-R423-13

Basch, C. H., Ethan, D., Rajan, S., & Basch, C. E. (2014). Technology related distracted walking behaviours in Manhattan's most dangerous intersections. *Injury Prevention, March 25*. Retrieved from 10.1136/injuryprev-2013-041063

Banducci, S. E., Ward, N., Gaspar, J. G., Schab, K. R., Crowell, J. A., Kaczmarski, H., & Kramer, A. F. (2016). The effects of cell phone and text message conversations on simulated street crossing. *Human Factors, 58*(1), 150-162.

Bureau of Infrastructure, Transport and Regional Economics. (BITRE; 2015). Pedestrians and road safety. Retrieved from https://bitre.gov.au/publications/2015/is_070.aspx

Bureau of Infrastructure, Transport and Regional Economics. (BITRE; 2018). Road safety statistics. Retrieved from https://bitre.gov.au/statistics/safety/

Bungum, T.J., Day, C., & Henry, L.J. (2005). The association of distraction and caution displayed by pedestrians at a lighted crosswalk. *Journal of Community Health, 30(4),* 269–79.

Byington, K.W. & Schwebel, D.C. (2013). Effects of mobile Internet use on college student pedestrian injury risk. *Accident Analysis & Prevention. 51*, 78–83.

Cassell, E., Kerr, E., Reid, N., Clapperton, A., & Alavi, H. (2011). Traffic-related pedestrian injury in Victoria (2): Fatal injury. *Hazard: Victorian Injury Surveillance Unit*, *72*, 1-12.

City and County of Honolulu. (2017). A bill for an ordinance relating to mobile electronic devices. Retrieved from: http://www4.honolulu.gov/docushare/dsweb/Get/Document-196183/DOC007%20(14).PDF

Deloitte. (2017). Mobile consumer survey 2017: The Australian cut. Retrieved from https://www2.deloitte.com/au/mobile-consumer-survey

Duperrex, O., Bunn, F., & Roberts, I. (2002). Safety education of pedestrians for injury prevention: a systematic review of randomised controlled trials. *British Medical Journal, 324 (7346),* 1129.

Department of State Growth. (2018). Tasmanian Crash Statistics. Retrieved from https://www.transport.tas.gov.au/roadsafety/crash_statistics

Gårder, P. (1989). Pedestrian safety at traffic signals: a study carried out with the help of a traffic conflicts technique. *Accident Analysis & Prevention*, *21(5),* 435-444.

Hatfield, J., & Murphy, S. (2007). The effects of mobile phone use on pedestrian crossing behaviour at signalised and unsignalised intersections. *Accident Analysis & Prevention*, *39(1),* 197-205.

Hyman, I. E., Boss, S.M., Wise, B.M., McKenzie, K.E., & Caggiano, J.M. (2010). Did you see the unicycling clown? Inattentional blindness while walking and talking on a cell phone. *Applied Cognitive Psychology*, *24*(5), 597-607.

Jiang, K., Ling, F., Feng, Z., Wang, K., & Guo, L. (2017). Psychological predictors of mobile phone use while crossing the street among college students: An application of the theory of planned behavior. *Traffic Injury Prevention*, *18*(2), 118-123.

Lennon, A., Oviedo-Trespalacios, O., & Matthews, S. (2017). Pedestrian self-reported use of smart phones: positive attitudes and high exposure influence intentions to cross the road while distracted. *Accident Analysis & Prevention*, *98*, 338-347.

Lichenstein, R., Smith, D. C., Ambrose, J. L., & Moody, L. A. (2012). Headphone use and pedestrian injury and death in the United States: 2004–2011. *Injury Prevention*, *18(5),* 287-290.

Mantilla, J., and Burtt, D. (2016). Safer road design for older pedestrians. Victoria Walks report, Melbourne. Version 1.1. Retrieved from http://www.victoriawalks.org.au/Assets/Files/Final_SRDOP_V1.1.pdf

Nasar, J.L. & Troyer, D. (2013). Pedestrian injuries due to mobile phone use in public places, *Accident Analysis Prevention*, *57,* 91-95.

National Safety Council. (2018). Take steps to avoid injury while walking. Retrieved from http://www.nsc.org/learn/safety-knowledge/Pages/news-and-resources-pedestrian-safety.aspx

Neider, M.B., McCarley, J.S., Crowell, J.A., Kaczmarski, H., & Kramer, A.F. (2010). Pedestrians, vehicles, and cell phones. *Accident Analysis & Prevention*, *42*(2), 589-594.

Pew Research Centre. (2018). Mobile fact sheet. Retrieved from: http://www.pewinternet.org/fact-sheet/mobile/

Rosenthal, K., Gautam, P., & Ferguson, R.W. (2016). Mobile device use increases odds of self-reported pedestrian crash history among teenagers in US. *Injury Prevention, 22(2),* A67.

Rowden, P., & Watson, B. (2014). Mobile phone use and driving: the message is just not getting through. *Journal of the Australasian College of Road Safety*, *25(1),* 41.

Saltos, A., Smith, D., Schreiber, K., Lichenstein, S., & Lichenstein, R. (2015). Cell-phone related injuries in the United States from 2000–2012. *Journal of Safety Studies*, *1(1),* 1-14.

Schwebel, D.C., Stavrinos, D., Byington, K.W., Davis, T., O'Neal, E.E., & De Jong, D. (2012). Distraction and pedestrian safety: how talking on the phone, texting, and listening to music impact crossing the street. *Accident Analysis & Prevention*, *45*, 266-271.

Stavrinos, D., Byington, K.W., & Schwebel, D.C. (2011). Distracted walking: cell phones increase injury risk for college pedestrians. *Journal of Safety Research*, *42(2),* 101-107.

Stavrinos, D., Pope, C.N., Shen, J., & Schwebel, D.C. (2017). Distracted walking, bicycling, and driving: Systematic review and met-analysis of mobile technology and youth crash risk. *Child Development*, *89(1),* 118-128.

Thompson, L.L., Rivara, F.P., Ayyagari, R.C., & Ebel, B.E. (2013). Impact of social and technological distraction on pedestrian crossing behaviour: an observational study. *Injury Prevention*, *19(4),* 232-237.

U.S. National Safety Council. (2018). Take steps to avoid injury or death while walking. Retrieved from: https://www.nsc.org/home-safety/safety-topics/distracted-walking

Wells, H.L., McClure, L.A., Porter, B.E., & Schwebel, D.C. (2018). Distracted pedestrian behaviour on two urban college campuses. *Journal of Community Health*, *42(1),* 96-102.

Williamson, A., & Lennon, A. (2015, October). *Pedestrian self-reported exposure to distraction by smart phones while walking and crossing the road.* Paper presented at the Australasian Road Safety Conference, Gold Coast. Retrieved from https://eprints.qut.edu.au/90176/3/90176.pdf

World Health Organisation. (2013). *Pedestrian safety: A road safety manual for decision-makers and practitioners*, Retrieved from http://www.who.int/roadsafety/projects/manuals/pedestrian/en/