Y TXT N DRIVE? Predictors of texting while driving among a sample of Ontario youth and young adults

Erin Berenbaum*, Daniel Harrington, Sue Keller-Olaman, Heather Manson

Health Promotion, Chronic Disease and Injury Prevention Department, Public Health Ontario, 480 University Avenue, Suite 300, Toronto, Ontario, M5G 1V2, Canada

ABSTRACT

Background: Distracted driving is of particular concern among young drivers. According to the 2012 National Highway Traffic Safety Administration (NHTSA) survey, the greatest proportion of distraction prone drivers is within the 16–19 and 20–24 age groups. One relatively new distraction is texting while driving behaviour (TWD). TWD increases the amount of time drivers spend looking away from the road, slows reaction times and increases the risk of collisions by two-fold. To deter this behaviour many distracted driving campaigns focus on highlighting the risks and dangers of distracted driving; however, evidence suggests that youth and young adults continue to engage in TWD despite awareness of the related risks. Previous studies have examined constructs from the theory of planned behaviour as predictors of TWD (e.g., attitudes, intentions). Understanding the full range of factors that may influence this behaviour can inform the development of evidence-based public awareness campaigns and related interventions.

Purpose: The purpose of this paper was to examine predictors of TWD behaviour among youth and young adults. We examined constructs from the theory of planned behaviour in addition to the role played by perceived TWD driving skills, experience with collisions due to TWD, descriptive norms (i.e., an individual's beliefs about a behaviour that are gained as a result of observing the actions of others) and risk perceptions.

Methods: An online survey was administered to 2001 Ontario youth and young adults examining potential predictors of TWD behaviour. Regression models were used to examine which key variables were associated with TWD (both reading and sending behaviour) among participants.

Results: Overall, regression models had good predictability for reading and sending behaviours. Perceived TWD driving skills and 'almost getting in a collision due to TWD' were positively associated with TWD behaviour in the past week (both reading and sending behaviours). Descriptive norms were positively associated with sending text messages while driving in the past week, but were not significant for reading. In contrast, risk perceptions were positively associated with reading text messages in the past week but not sending.

Discussion and conclusion: The results from this study highlight constructs that can be used to design interventions to deter young drivers from engaging in TWD. Interventions targeting perceived TWD driving skills and descriptive norms have the potential to be more effective than interventions emphasizing risk perceptions. Future studies are needed to better understand the relationships between these predictors and TWD behaviour among this population.

1. Introduction

Distracted driving occurs when a driver's attention is temporarily diverted from the task of driving to an object, person, or task not related to driving (Vanlaar et al., 2007). This might include visual (e.g., taking your eyes of the road), manual (e.g., taking your hands of the wheel) or cognitive (e.g., taking your mind off the road) distractions (National Highway Traffic Safety Administration, 2012; National Highway Traffic Safety Association, 2010; Strayer et al., 2013).

Distracted driving is of particular concern among young drivers. According to the 2012 National Highway Traffic Safety Administration (NHTSA) survey, the greatest proportion of distraction prone drivers is within the 16–19 and 20–24 age groups (Schroeder et al., 2013).

One relatively new distraction is texting while driving (TWD). TWD involves using a handheld electronic telecommunications device, such as a cell phone, to manually communicate with another device using an

electronic message (Farris, 2011). TWD can be classified into two behaviours: 1) reading (i.e., viewing a message that has been received), and 2) sending (i.e., actively typing out a message – whether it is initiated by an individual or in response to a previous message).

Younger drivers (< 25 years of age) are more likely to engage in TWD, compared to older drivers (Tison et al., 2011). TWD has been shown to increase collision or near-collision event risk by two-fold (Fitch et al., 2013), and studies among younger drivers have found that TWD is associated with 35% slower reaction times (Reed and Robbins, 2008) and a four-fold increase in time spent looking away from the road compared to those driving undistracted (Hosking et al., 2006).

Many distracted driving prevention campaigns (which include TWD) focus on raising awareness of the risks and dangers of distracted driving (Morrish and Hasheminejad, 2012); however, evidence suggests that youth and young adults continue to engage in TWD despite awareness of the related risks (Atchley et al., 2011). For example, Atchley et al., (2011) found that despite reporting that TWD was dangerous, 70–90% of young adults in their sample reported ever engaging in TWD (Atchley et al., 2011). Furthermore, they found that risk perceptions were a weak predictor of TWD behaviour (Atchley et al., 2011).

In an effort to unpack TWD behaviours in this population, previous studies have examined constructs from the theory of planned behaviour (e.g., subjective norms, attitudes, perceived behavioural control) as predictors of TWD among young drivers (Gauld et al., 2013; Gauld et al., 2014; Nemme and White, 2010). These constructs have been shown to have reasonably good predictability explaining 39%–69% of the variance in intentions to engage in TWD behaviours among young drivers ages 17 to 25 (Gauld et al., 2013; Gauld et al., 2014; Nemme and White, 2010). However, based on our review of the literature, we identified additional factors that may influence TWD among young drivers, including their: 1) perceptions of their TWD skills and capabilities, 2) past experiences with the consequences of TWD (e.g., collisions) and 3) descriptive norms (i.e., an individual's beliefs about a behaviour that are gained as a result of observing the actions of other) (Carter et al., 2014).

Specifically, previous evidence has shown that those who perceived themselves to be more skillful drivers were more likely to use a cell phone while driving (Poysti et al., 2005). Drivers often inaccurately estimate their ability to engage in distracting tasks while driving (Horrey et al., 2009), and young drivers tend to perceive their own ability to use a phone while driving to be better than their peers' ability to do the same (Hill et al., 2015). For example, Allsop (2012) found that among their sample of 17–26 year old drivers, about 80% of respondents indicated that their driving skills were 'much better/somewhat better' or 'much safer/somewhat safer' compared to other drivers on the road (Allsop, 2012). This over-confidence may be a contributing factor to TWD behaviours among this population.

Another potential predictor of TWD is descriptive norms. Descriptive norms are defined as an individual's beliefs about a behaviour that are gained as a result of observing the actions of other (Carter et al., 2014). Chen and Donmez (2016) found that drivers reported higher levels of engagement in technology-based distractions if they perceived that other drivers on the road were doing the same (Chen and Donmez, 2016). Additionally, Hill et al., (2015) proposed that when young drivers witness other individuals engaged in distracted driving they are more likely to engage in the behaviour themselves (Hill et al., 2015).

Lastly, previous collisions due to TWD may influence future TWD behaviour. Experiencing a collision and its associated consequences e.g., injuries, insurance fees etc.) due to TWD may deter future engagement in the behaviour. However, Allsop (2012) found that 88% of young drivers had never been in a collision due to their own distracted driving (Allsop, 2012). It is possible that the rarity of personal collisions related to TWD may instead serve to support young drivers' perceptions that they are good/safe drivers and immune to impact of distractions.

This may encourage engagement in TWD behaviours.

Given the prevalence to TWD among youth and young adults and its associated risks, it is important to understand how TWD related-collisions, perceived driving skill, and other factors, in addition to theory of planned behaviourconstructs, contribute to the likelihood of engaging in TWD behaviours.

This study builds on previous work by utilizing the theory of planned behaviour to examine predictors of TWD behaviour among youth and young adults. Specifically we explore the additional role played by perceived TWD driving skills, experience with collisions due to TWD, descriptive norms and risk perceptions.

2. Methods

2.1. Data collection

A cross-sectional survey based on self-reports was conducted between January 2015 and February 2015 using an online research panel. Recruitment and data collection were conducted by a commercial market research company based on our study specifications. Participants registered in an online research panel were recruited via email. Procedures were approved by Public Health Ontario's Research Ethics Board (REB). Screening was used to determine eligibility. Participants were eligible to participate if they were a resident of Ontario, Canada, between the ages of 16 to 24 who had driven an on-road motor vehicle in the past 12 months, and had also used a mobile device in the past 12 months. Quota sampling was use to ensure that our sample was representative of the Ontario population in terms of age and gender based on population estimates from the 2011 Canadian Census (Statistics Canada, 2012). The final sample included 2001 Ontario youth and young adults. Eligible participants were provided with a link to the online survey and were required to complete all questions; participants had the option to select 'prefer not to answer' for each question. Incomplete surveys (i.e., terminated survey early or left blank responses) were excluded from this analysis.

2.2. Measures

Demographic variables including age, gender, and education level were measured in addition to the items described below.

2.2.1. Frequency of texting behaviour

was measured by one survey item: "Approximately how many text messages do you send or receive in a typical day" (Response options included '0 texts', '1–10 texts', '11–30 texts', '31–50 texts', '51–100 texts', 'More than 100 texts', or 'Don't know') (Allsop, 2010).

2.2.2. Frequency of driving behaviour

was measured by one survey item adapted from NHTSA (2011) asking 'How often do you drive a motor vehicle, regardless of whether it's for work or personal use? (Response options included: 'Almost every day (or more)', 'A few days a week', 'A few days a month', 'A few days a year', 'Less than a few days a year', or 'Don't know') (Tison et al., 2011).

For each of the following constructs separate items were measured for reading and sending behaviours respectively. Most items were adapted from previous distracted driving surveys on youth and young adults (Allsop, 2012; Atchley et al., 2011; Bayer and Campbell, 2012; Nemme and White, 2010).

2.2.3. Texting while driving (TWD) behaviour

Past behaviour was measured by a single item asking "In the past week, how often did you (read/send) text messages while driving?' (Response options were rated on a 7-point scale ranging from 1-'I did not read/send any text messages while driving' to 7- 'I regularly read/ sent text messages while driving' (Nemme and White, 2010). Past behaviour was used as the outcome variable as it has been shown to be a

good predictor of future TWD behaviour among youth and young adults (Nemme and White, 2010)· Results were dichotomized into those who 'Did not read/send any text messages while driving' and those who did (i.e., all other responses).

2.2.4. Attitudes

Mean composite scores were created using four items (Bayer and Campbell, 2012; Nemme and White, 2010). Attitudes were measured using the items "For me, (reading/sending) text messages while driving in the next week would be:…" followed by four adjective pairs rated on a 7-point scale with the following anchors: bad–good, worthless–valuable, unwise–wise, negative–positive (Read: Cronbach's $\alpha = 0.93$; Send: $\alpha = 0.93$).

2.2.5. Intentions

Mean composite scores were created using three items (Nemme and White, 2010). These items included: "I plan to (read/send) text messages while driving in the next week.", "I intend to (read/send) text messages while driving in the next week." and "It is likely that I will (read/send) text messages while driving in the next week." All items were rated on a 7-point scale from 1-strongly disagree to 7-strongly agree (Read: Cronbach's $\alpha = 0.91$; Send: $\alpha = 0.93$).

2.2.6. Perceived behavioural control

Perceived behavioural control was measured by two separate items (Bayer and Campbell, 2012; Nemme and White, 2010). These items included: "I have complete control over whether I will (read/send) text messages while driving in the next week," and "It is mostly up to me whether I will (read/send) text messages while driving in the next week." All items were rated on a 7-point scale from 1-strongly disagree to 7-strongly agree. Due to low correlation between items, only the former item was used in the analysis.

2.2.7. Subjective norms

Mean composite scores were created using three items (Nemme and White, 2010). These included "Those people who are important to me *would approve of* me (reading/sending) text messages while driving in the next week.", "Those people who are important to me *would want me to* (read/send) text messages while driving in the next week.", and "Those people who are important to me *think I should* (read/send) text messages while driving in the next week." All items were rated on a 7-point scale from 1-strongly disagree to 7-strongly agree. Lower scores reflected subjective norms that were less in favour of TWD (Read: Cronbach's $\alpha = 0.94$; Send: $\alpha = 0.94$).

2.2.8. Moral norms

Mean composite scores were created using three items (Bayer and Campbell, 2012; Nemme and White, 2010). These items included: "I would feel guilty if I (read/sent) text messages while driving.", "I personally think that (reading/sending) text messages while driving is wrong.", and "(reading/sending) text messages while driving goes against my principles." All items were rated on a 7-point scale from 1-strongly disagree to 7-strongly agree. Higher scores reflected moral norms that were less in favour of texting while driving (Read: Cronbach's $\alpha = 0.89$; Send: $\alpha = 0.92$).

2.2.9. Risk perceptions

Risk perceptions were measured by one item asking participants "In general, how dangerous is it to (read/send) a text messages while driving?" This question was rated on a 7-point rating scale from 1- not at all dangerous to 7-extremely dangerous (Atchley et al., 2011).

2.2.10. Descriptive norms

Open-ended questions (for reading and sending TWD behaviours respectively) asked "What percentage of young Ontario drivers (16 to 24 years of age) do you believe at least occasionally (read/send) text

messages while driving?" Responses from 0% to 100% were accepted. Responses options were recalculated to a scale from 1 to 10, where an increase in one unit corresponds to a 10% increase.

2.2.11. Perceived TWD skills

One item was used to measure participants' perceptions of their ability to engage in TWD. It asked "How skilled/competent do you think you are at (reading/sending) text messages while driving? (Response options ranged from 1-Not skilled at all to 7-extremely skilled).

2.2.12. Collisions due to TWD

One item was used to determine if participants had personally been in a collision or near collision due to their TWD (Allsop, 2012). This item asked "Have you ever been in, or almost been in a collision because you were texting while driving?". Response options included: 'Yes - I have been in a collision because I was texting while driving', 'Yes - I have almost been in a collision because I was texting while driving', 'No I have not been in, or almost been in a collision because I was texting while driving', or 'Unsure'.

2.3. Analysis

In order to understand the relative contributions of demographic factors, theory of planned behaviour constructs, and the additional independent variables of interest, we built two multivariable logistic regression models. The outcome variables were binary variables representing TWD behaviours (reading and sending) in the previous week. Coefficients from the logistic regression are presented as adjusted odds ratios (aORs) with 95% confidence intervals (CIs). Multicollinearity in the model was assessed using generalized variance inflation factor analysis. All analyses were conducted using R v. 3.3.1.

3. Results

3.1. Descriptive analysis

Participant characteristics are provided in Table 1. Forty-five percent of participants were youth (ages 16–19), and 55% were young adults (ages 20–24). Fifty-one percent of participants were male and 49% were female. The majority of participants had more than a high school level education (63%).

3.2. Participant characteristics

Overall, 21.4% of participants reported reading text messages with driving in the last week, while 35.1% reported sending them. Few had been in or almost been in a collision due to TWD; 1.1% reported being in a collision due to their TWD while 8.0% report *almost* being in a collision due to their TWD.

Mean scores and standard deviations for key constructs (where

Table 1
Participant Characteristics.

Variable n = 2001 (%)	
Age	
Youth (ages 16–19)	899 (45%)
Young adults (ages 20–24)	1102 (55%)
Gender	
Males	1021 (51%)
Female	980 (49%)
Education level	
High school or less	730 (36%)
More than high school	1260 (63%)
Missing	11 (1%)

Table 2
Mean Responses.

Variable	Number of Items	Scale	Reading Mean (SD)	Sending Mean (SD)
Attitudes	4	1 to 7	1.70 (1.14)	1.50 (1.02)
Intentions	3	1 to 7	1.72 (1.29)	1.53 (1.16)
Perceived Behavioural Control	2	1 to 7	6.35 (1.44)	6.46 (1.39)
Subjective norms	3	1 to 7	1.57 (1.11)	1.45 (1.01)
Moral norms	3	1 to 7	5.09 (1.89)	5.34 (1.95)
Risk perceptions	1	1 to 7	5.37 (1.50)	6.27 (1.11)
Descriptive norms	1	0 to 10[a]	7.55 (1.79)	7.50 (1.78)
Perceived TWD skills	1	1 to 7	3.28 (2.06)	2.56 (1.86)

[a] units equal to 10% increases.

applicable) are provided in Table 2. Generally, participants had low intentions to engage in, negative attitudes towards and high perceived behavioural control over their TWD behaviour. Subjective norms were low (e.g., participants believed those who were important to them would disapprove of their TWD behaviour). Additionally moral norms were high (e.g., participants believed TWD was wrong and they would feel guilty about doing it). They also perceived that a large percentage of other young drivers engage in TWD behaviour (e.g., mean estimates around 75%). Risk perceptions were high (e.g., participants perceived TWD to be dangerous) with sending text messages while driving perceived to be more dangerous that reading them. Lastly, participants' perceptions of their ability to engage in TWD were neither high or low (i.e., means 2.56/7 and 3.28/7).

3.3. Regression analysis

3.3.1. Reading

Overall the model for TWD reading behaviour had good predictive ability (McFadden's pseudo R^2: 51.5; Area under ROC Curve: 91.1%) (See Tables 3, 4 and Fig. 1). For categorical variables all comparisons are to the reference group unless otherwise stated. Age and gender were not significant predictors of reading text messages while driving in the past week ($ps > 0.05$). However, individuals with more than a high school education were less likely to report reading text messages while driving in the past week compared with those who had a high school education or less (aOR:0.65, 95% CI 0.42–1.00, $p = 0.05$). Individuals who reported sending/receiving more than 50 text messages a day were nearly 3 times more likely to report reading text messages while driving in the past week compared to those who reported sending/receiving less than 10 text messages a day (aOR: 2.84, 95% CI 1.65–5.04, $p < 0.001$). Individuals who reported driving everyday (or more), were 6.5 times more likely to report reading text messages while driving in the past week compared to those who drove less than once a week (aOR: 6.48, 95% CI 4.16–10.32, $p < 0.001$).

Intentions to engage in TWD were positively associated with reading text messages while driving in the past week (aOR: 2.16, 95% CI 1.85–2.56, $p < 0.001$) while perceived behavioural control (aOR:0.82, 95% CI 0.74 – 0.91, $p < 0.001$) and moral norms were negatively associated with the behaviour (aOR: 0.87, 95% CI 0.79–0.96, $p < 0.01$). Subjective norms and attitudes towards TWD were not found to be significant predictors of reading behaviour ($ps > 0.05$).

Individuals' perceived TWD driving skills, risk perceptions and their experience with TWD-related collisions were positively associated with reading behaviour. Individuals who perceived their driving skills to be better were more likely to report reading text messages while driving in the past week (aOR: 1.35, 95% CI 1.22–1.49, $p < 0.001$). Counter-intuitively, individuals who perceived TWD to be more dangerous were more likely to report engaging in the behaviour in the past week (aOR: 1.17, 95% CI 1.02–1.33, $p < 0.05$). Lastly, individuals who had '*almost been* in a collision' due to their own TWD behaviour were nearly 3 times

Table 3
Multivariable Logistic Regression Model for Reading and Sending Behaviours.

	Reading	Sending
Variable	([a]OR, 95% CI)	([a]OR, 95% CI)
Age	1.09 (1.00, 1.20)	1.08 (1.00, 1.18)[*]
Gender		
Female (reference)	—	—
Male	0.72 (0.52, 1.00)	0.92 (0.70, 1.22)
Education		
< High school (reference)	—	—
> High school	0.65 (0.42, 1.00)[*]	0.79 (0.55, 1.15)
Frequency of texting		
< 10 texts/day (reference)	—	—
11-50 texts/day	2.02 (1.19, 3.54)[*]	2.01 (1.35, 3.03)[***]
> 50 texts/day	2.84 (1.65, 5.04)[***]	2.04 (1.33, 3.16)[**]
Frequency of driving		
< 1 day/week (reference)	—	—
Few days/week	3.14 (1.94, 5.17)[***]	3.62 (2.50, 5.27)[***]
Almost every day or more	6.48 (4.16, 10.32)[***]	7.99 (5.62, 11.51)[***]
Attitudes	0.87 (0.73, 1.04)	1.20 (0.98,1.46)
Intentions	2.16 (1.85, 2.56)[***]	2.42 (1.93, 3.09)[***]
Perceived Behavioural Control	0.82 (0.74, 0.91)[***]	0.96 (0.86,1.07)
Subjective norms	1.16 (0.99, 1.36)	1.00 (0.85, 1.18)
Moral norms	0.87 (0.79, 0.96)[**]	0.87 (0.81, 0.94)[***]
Risk perceptions	1.17 (1.02, 1.33)[*]	0.98 (0.83, 1.15)
Descriptive norms	1.07 (0.96, 1.20)	1.22 (1.11,1.35)[***]
Perceived TWD skills	1.35 (1.22, 1.49)[***]	1.14 (1.04, 1.25)[**]
TWD collisions		
No collision (reference)	—	—
Yes collision	N.R.[a]	N.R.[a]
Yes – almost collision	2.98 (1.87, 4.76)[***]	3.01 (1.85, 4.96)[***]

* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.
[a] High variance due to small event rate McFadden's pseudo R^2: Reading 51.5; Sending 48.7 Area under ROC Curve: Reading 91.1%, Sending 88.0%.

Table 4
Confusion Table: Reading Text Messages While Driving.

		Actual/Reported TWD (Reading)	
		No	*Yes*
Predicted	*No*	1046	43
TWD (Reading)	*Yes*	250	318

Sensitivity: 0.8809.
Precision: 0.9605.
Accuracy: 0.8232.

more likely to report reading text messages while driving in the past week compared to those who had not been in or almost been in a collision due to their TWD behaviour (aOR: 2.98, 95% CI 1.87–4.76, $p < 0.001$). Due to low event rates no conclusions could be made regarding those who *had been* in collisions due to their TWD. Descriptive norms was not found to be a significant predictor of reading behaviour ($p < 0.05$).

3.3.2. Sending

Overall the model for sending behaviour had good predictive ability (McFadden's pseudo R^2: 48.7; Area under ROC Curve: 88.0%) (See Tables 3, 5 and Fig. 2). Age was a significant predictor of sending texting messages while driving in the past week (aOR: 1.08, 95% CI 1.00–1.18, $p = 0.05$), while gender and education were not ($ps > 0.05$). Individuals who reported sending/receiving more than 50 text messages a day were 2 times more likely to report sending text messages in the past week compared to those who reported sending/receiving less than 10 text messages a day (aOR: 2.04, 95% CI 1.33–3.16, $p < 0.01$). Individuals who reported driving everyday (or more) were 8 times more likely to report sending text messages while driving in the past week
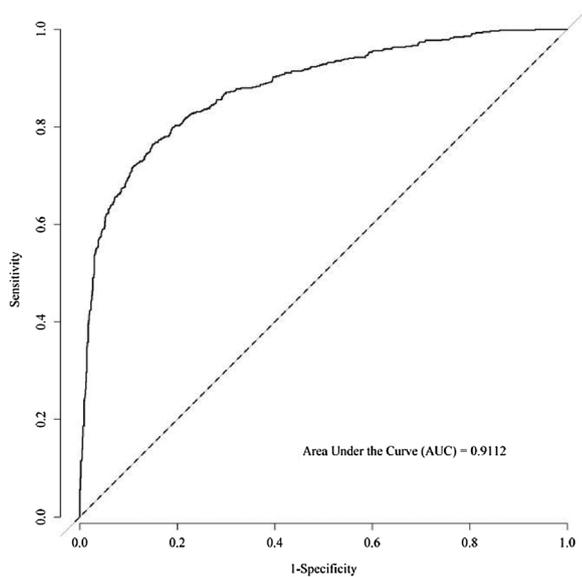
Fig. 1. Receiver Operating Characteristic (ROC) curve: Reading Text Messages While Driving.

Table 5
Confusion Table: Sending Text Messages While Driving.

		Actual/Reported TWD (Sending)	
		No	*Yes*
Predicted	*No*	894	135
TWD (Sending)	*Yes*	157	438

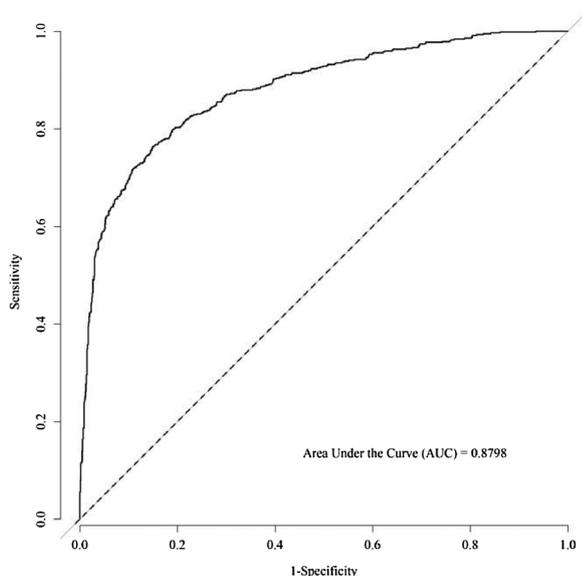Sensitivity: 0.7644.
Precision: 0.8688.
Accuracy: 0.8202.

Fig. 2. ROC Curve: Sending Text Messages While Driving.

compared to those who drove less than once a week (aOR: 7.99, 95% CI 5.62–11.51, $p < 0.001$).

Intentions to engage in TWD were positively associated with sending text messages while driving in the past week (aOR: 2.42, 95% CI 1.93–3.09, $p > 0.001$) while moral norms were negatively associated with the behaviour (aOR: 0.87, 95% CI 0.81 – 0.94, $p < 0.001$). Subjective norms, attitudes and perceived behavioural control were not

found to be significant predictors of sending behaviour ($ps > 0.05$).

Individuals' perceived TWD driving skills, risk perceptions, descriptive norms and their experience with TWD-related collisions were positively associated with sending behaviour. Individuals who perceived their driving skills to be better than other drivers were more likely to report sending text messages while driving in the past week (aOR: 1.14, 95% CI 1.04–1.25, $p < 0.01$). Descriptive norms was a significant predictor of sending text messages while driving in the past week. Additionally, individuals who perceived a greater proportion of their peers to send text messages while driving, were more likely to report doing so themselves (aOR: 1.22, 95% CI 1.11–1.35, $p < 0.001$). Lastly, individuals who had '*almost* been in a collision' due to their own TWD behaviour were nearly 3 times more likely to report having sending text messages while in the past week compared to those who had not been in or almost been in a collision due to their TWD behaviour (aOR: 3.01, 95% CI 1.85–4.96, $p < 0.001$). Due to low event rates no conclusions could be made regarding those who had been in collisions due to their TWD. Risk perceptions were not a significant predictor of sending text messages while driving in the past week ($p > 0.05$).

4. Discussion

Consistent with the theory of planned behaviour, intentions were positively associated with reading and sending behaviours. Moral norms were negatively associated both reading and sending behaviours. This means that the more participants agreed that reading or sending text messages while driving was morally wrong, the less likely they were to report engaging in the behaviour. Neither attitudes nor subjective norms were significant predictors for reading or sending behaviours. These results (i.e., intentions, moral norms, attitudes and subjective norms) echo those reported by Nemme and White (2010). Lastly, perceived behavioural control was negatively associated with both reading and sending behaviours, meaning that the greater control participants felt they had over their TWD, the less likely they were to report doing it. Nemme and White (2010) also found a negative correlation between perceived behavioural control and TWD; however this correlation was not significant and may have been due to their sample size (Nemme and White, 2010).

Individuals' perception of their own TWD driving skills was shown to be a significant predictor of TWD behaviour (both reading and sending). Participants who perceived themselves to be more skilled at TWD were more likely to report reading or sending text messages while driving in the past week. Similarly, Horrey et al., (2008) found that drivers' confidence in their ability to deal with distractions was positively associated with their willingness to engage in distracting activities (Horrey and Lesch, 2008). Additionally, Hill et al., (2015) found that young drivers' self-efficacy or confidence in their ability to drive while distracted was a significant predictor of engaging in distracted driving; those who were more confident in their ability to talk or text while driving reported more distracted driving than those with lower confidence (Hill et al., 2015). Lastly, a qualitative analysis by McDonald and Sommers (2015) supports this idea noting that youth feel that they are good enough drivers and can 'get away with it' (McDonald and Sommers, 2015).

Descriptive norms (i.e., an individual's beliefs about a behaviour that are gained as a result of observing the actions of others) were positively associated with reading and sending text messages while driving; however this association was only significant for sending. Hill et al., (2015) found that those who witnessed other drivers engaging in distracted driving behaviour were more likely to report engaging in the behaviour themselves (Hill et al., 2015). Similarly, Chen and Donmez (2016) found a marginally significant effect of descriptive norms on engagement with technology-based distractions while driving (Chen and Donmez, 2016). This positive association was stronger for younger drivers (< 30 years) compared to older drivers (> 30 years) suggesting

that younger drivers are more susceptible to social influences (Chen and Donmez, 2016).

No significant association was found between risk perceptions and sending text messages while driving. Atchley et al., (2011) found that risk perceptions had weak to no association with sending and reading behaviour respectively (Atchley et al., 2011). Additionally, Rupp et al., (2016) found that risk perceptions was not a significant predictor of engagement in distracted driving behaviour (Rupp et al., 2016).

Interestingly, risk perceptions were positively associated with reading text messages while driving in the past week; meaning that the more dangerous participants perceived the behaviour to be, the more likely they were to report doing it. Risky sensation seeking behaviour is commonly associated with adolescence and young adults (ages 15 and 25 years)(Gicquel et al., 2017). Rupp et al., (2016) found that risk seeking traits (such as sensation seeking and risk taking) influence engagement in distracted driving behaviours (Rupp et al., 2016) where individuals with higher sensation seeking score are more likely to engage in distracted driving (Chen and Donmez, 2016; Rupp et al., 2016). High sensation seekers may proactively seek out riskier driving situations than lower sensation seekers (Rupp et al., 2016). Given their ages, participants in our sample may have been high sensation seekers and therefore the more dangerous they perceived TWD to be the more appealing it may be to them, resulting in a greater the likelihood of them engaging in the behaviour. However, we did not measure participants' levels of sensation seeking to confirm this. Future research should examine the association between risk seeking traits among this population in relation to TWD.

Another possible explanation for the dissociation between risk perceptions and TWD is optimistic bias. Optimistic bias is the tendency to view the likelihood of negative events as higher for others than for oneself) (Arnett, 2002). It has been suggested that young drivers may believe that TWD behaviour is risky – but risky is for others, not themselves (Rupp et al., 2016; U.S Department of Transportation, 2013,). Alternatively, they may believe that the risk is high, but not high enough to avoid engaging in the behaviour (Rupp et al., 2016). Drivers inaccurately estimate the impacts of distractions on their driving performance while distracted (Horrey et al., 2008), and many youth and young adults believe that they are better and safer drivers than everyone else (a finding that our data supported)(Allsop, 2012). Additionally, young drivers tend to perceive their own ability to use a phone while driving to be better than their peers ability to do the same (Hill et al., 2015). For example, Hill et al., (2015) found that when asked about their capabilities to drive distracted, 46% of college aged students sampled reported that they were capable or very capable of talking on a cell phone and driving; however they felt that only 8.5% of other drivers were capable of doing the same (Hill et al., 2015). Optimistic bias may help to explain why the participants in our sample report that TWD was dangerous, but these risk perceptions were not associated with lower engagement in the behaviour.

Lastly, there was a positive association between 'almost being in a collision due to their own TWD' and reported TWD behaviour in the past week. Individuals who reported *almost* being in a collision due to TWD were more likely to report engaging in the behaviour in the past week compared to those who did not report any collisions due to their TWD.

This finding may also be indicative of a greater optimistic bias or perceived invincibility. *Almost* getting into in a collision due to their TWD may confirm young drivers' perception that 'crashes happen to other people not me' leading them to believe that they are more invincible/unaffected by the dangers of TWD, thus further encouraging engagement in the behaviour. For example, Rupp et al., (2016) found that self-reported 'near misses' (of collisions) in the previous year was significantly correlated with risk seeking traits (which have been shown to be are positively associated with TWD behaviour) (Rupp et al., 2016). Future prospective studies are needed to further examine this hypothesis.

The results of this cross-sectional study should be considered in the context of its limitations. First TWD behaviour was a self-reported measure. Due to the illegal nature of the behaviour, participants may be influenced by social desirability bias and thus under report their TWD behaviour. Additionally, because our sample was recruited from an online panel, those who chose to participate in an online panel may be more inclined to use technology, such as cell phones, while driving and thus the results may not be representative of the general population of the same age. For instance, Beck et al., (2009) found that among participants completing either a telephone or online survey about traffic safety issues, telephone respondents were less likely to report risky driving behaviour compared to the online respondents (Beck et al., 2009). Lastly, due to resources and time constraints, TWD behaviour and predicting constructs were measured concurrently, and the TWD outcome was reported "within the last week". As a result, we cannot determine the causal directions of these associations reported. Future prospective studies should be conducted to examine the impact of these constructs on future behaviour. Despite these limitations, our study does contribute to the literature on predictors of TWD among youth and young adults by including additional of novel variables into the regression model and analyzing reading and sending behaviours separately.

The results from this study provide useful insight into the predictors of TWD among youth and young adults. This information can be used to design interventions to deter this population from engaging in the behaviour. Since risk perceptions were shown to be a weak predictor of TWD behaviour, TWD campaigns that highlight the risks and dangers of the behaviour may not prove to be effective because youth and young adults are already aware of the risks and dangers yet choose to engage in the behaviour anyways. Instead, interventions focusing on stronger predictors of the behaviour such as perceived TWD driving skills, moral norms and descriptive norms have the potential to be more effective. For example, Gauld et al., (2017) examined effectiveness of public education messages aimed at reducing smartphone use among young drivers (Gauld et al., 2017). They found that providing participants with educational messages targeting perceived TWD skills reduced their intentions to engage in behaviours such as TWD (Gauld et al., 2017). Additionally, Merrikhpour and Donmez (2017) found that providing normative feedback to young drivers reduced their engagement in distracted driving behaviours (Merrikhpour and Donmez, 2017). Future research testing the effectiveness of interventions targeting perceived TWD driving skills, moral norms and descriptive norms is still needed.

5. Conclusion

The results from this study highlight predictors that can be used to design interventions to deter young drivers from engaging in TWD. Interventions targeting perceived TWD driving skills, and descriptive norms have the potential to be more effective than interventions emphasising risk perceptions. Future studies are needed to better understand the relationships between these predictors and TWD behaviour among this population.

Funding

Conflicts of interest

None.

References

Allsop, D., 2010. AAAFTS Messaging Res (presentation).
Allsop, D., 2012. Changing traffic safety culture with values-based campaigns: effective

messaging around distracted driving. Driven to Distraction Conference: Priorities.

Arnett, J.J., 2002. Developmental sources of crash risk in young drivers. Inj. Prev. 8 (Suppl 2) ii17-21; discussion ii21-31.

Atchley, P., Atwood, S., Boulton, A., 2011. The choice to text and drive in younger drivers: behavior may shape attitude. Accid. Anal. Prev. 43 (1), 134–142.

Bayer, J.B., Campbell, S.W., 2012. Texting while driving on automatic: considering the frequency-independent side of habit. Comput. Hum. Behav. 28 (6), 2083–2090. https://doi.org/10.1016/j.chb.2012.06.012.

Beck, K.H., Yan, A.F., Wang, M.Q., 2009. A comparison of web-based and telephone surveys for assessing traffic safety concerns, beliefs, and behaviors. J. Saf. Res. 40 (5), 377–381. https://doi.org/10.1016/j.jsr.2009.07.007.

Carter, P.M., Bingham, C.R., Zakrajsek, J.S., Shope, J.T., Sayer, T.B., 2014. Social norms and risk perception: predictors of distracted driving behavior among novice adolescent drivers. J. Adolesc. Health 54 (5), S32–41. https://doi.org/10.1016/j.jadohealth.2014.01.008.

Chen, H.Y., Donmez, B., 2016. What drives technology-based distractions? A structural equation model on social-psychological factors of technology-based driver distraction engagement. Accid. Anal. Prev. 91, 166–174. https://doi.org/10.1016/j.aap.2015.08.015.

Farris, A., 2011. LOL? Texting while driving is no laughing matter: proposing a coordinated response to curb this dangerous activity. Wash UJL & Pol'y 36, 233–259.

Fitch, G.M., Soccolich, S.A., Guo, F., McClafferty, J., Fang, Y., Olson, R.L., Perez, M.A., Hanowski, R.J., Hankey, J.M., Dingus, T.A., 2013. The impact of hand-held and hands-free cell phone use on driving performance and safety-critical event risk. Natl. Highway Traffic Saf. Admin. (NHTSA) Report No. DOT HS 811, 757.

Gauld, C., Lewis, I., White, K.M., 2013. Identifying the determinants of concealed and obvious texting while driving: are they distinct behaviours? 2013 Australasian College of Road Safety Conference – "A Safe System.

Gauld, C.S., Lewis, I., White, K.M., 2014. Concealing their communication: exploring psychosocial predictors of young drivers' intentions and engagement in concealed texting. Accid. Anal. Prev. 62, 285–293. https://doi.org/10.1016/j.aap.2013.10.016.

Gauld, C.S., Lewis, I., White, K.M., Fleiter, J.J., Watson, B., 2017. Evaluating public education messages aimed at monitoring and responding to social interactive technology on smartphones among young drivers. Accid. Anal. Prev. 104, 24–35 doi: S0001-4575(17)30138-0 [pii].

Gicquel, L., Ordonneau, P., Blot, E., Toillon, C., Ingrand, P., Romo, L., 2017. Description of various factors contributing to traffic accidents in youth and measures proposed to alleviate recurrence. Front. Psychiatry 8 (94). https://doi.org/10.3389/fpsyt.2017.00094.

Hill, L., Rybar, J., Styer, T., Fram, E., Merchant, G., Eastman, A., 2015. Prevalence of and attitudes about distracted driving in college students. Traffic Inj. Prev. 16 (4), 362–367. https://doi.org/10.1080/15389588.2014.949340.

Horrey, W.J., Lesch, M.F., 2008. Factors related to drivers' self-reported willingness to engage in distracting in-vehicle activities. Proceedings of the Human Factors and Ergonomics Society Annual Meeting. pp. 1546–1550.

Horrey, W.J., Lesch, M.F., Garabet, A., 2008. Assessing the awareness of performance

decrements in distracted drivers. Accid. Anal. Prev. 40 (2), 675–682. https://doi.org/10.1016/j.aap.2007.09.004.

Horrey, W.J., Lesch, M.F., Garabet, A., 2009. Dissociation between driving performance and drivers' subjective estimates of performance and workload in dual-task conditions. J. Safety Res. 40 (1), 7–12. https://doi.org/10.1016/j.jsr.2008.10.011.

Hosking, S., Young, K., Regan, M., 2006. The effects of text messaging on young novice driver performance. Monash University Accident Research Centre Report No. 246.

McDonald, C.C., Sommers, M.S., 2015. Teen drivers' perceptions of inattention and cell phone use while driving. Traffic Inj. Prev. 16 (Suppl 2). https://doi.org/10.1080/15389588.2015.1062886. S52-8.

Merrikhpour, M., Donmez, B., 2017. Designing feedback to mitigate teen distracted driving: a social norms approach. Accid. Anal. Prev. 104, 185–194 doi: S0001-4575(17)30145-8 [pii].

Morrish, J., Hasheminejad, E., 2012. In: Blair, K. (Ed.), Distracted Driving Among Youth: A Review of the Literature.

National Highway Traffic Safety Administration, 2012. Distraction, 2015 (January/15). .

National Highway Traffic Safety Association, 2010. Overview of the national highway traffic safety administration's driver distraction program, DOT HS 811 299.

Nemme, H.E., White, K.M., 2010. Texting while driving: psychosocial influences on young people's texting intentions and behaviour. Accid. Anal. Prev. 42 (4), 1257–1265. https://doi.org/10.1016/j.aap.2010.01.019.

Poysti, L., Rajalin, S., Summala, H., 2005. Factors influencing the use of cellular (mobile) phone during driving and hazards while using it. Accid. Anal. Prev. 37 (1), 47–51 doi: S0001457504000533.

Reed, N., Robbins, R., 2008. The effect of text messaging on driver behavior: a simulator study. Transport Research Laboratory Published Project Report (PPR) 367.

Rupp, M.A., Gentzler, M.D., Smither, J.A., 2016. Driving under the influence of distraction: examining dissociations between risk perception and engagement in distracted driving. Accid. Anal. Prev. 97, 220–230 doi: S0001-4575(16)30333-5.

Schroeder, P., Meyers, M., Kostyniuk, L., 2013. National survey on distracted driving attitudes and behaviors – 2012. National Highway Traffic Safety Administration DOT HS 811 729.

Statistics Canada, 2012. Age (131) and Sex (3) for the Population of Canada, Provinces, Territories, Census Divisions, Census Subdivisions and Dissemination Areas, 2011 Census, 2014 (11/14).

Strayer, D.L., Cooper, J.M., Turrill, J., Coleman, J., Medeiros-Ward, N., Biondi, F., 2013. Measuring cognitive distraction in the automobile. AAA Foundation for Traffic Safety.

Tison, J., Chaudhary, N., Cosgrove, L., 2011. National phone survey on distracted driving attitudes and behaviors. National Highway Traffic Safety Administration Report No. DOT HS 811 555.

U.S Department of Transportation, 2013. NHTSA Survey Finds 660,000 Drivers Using Cell Phones or Manipulating Electronic Devices While Driving At Any Given Daylight Moment.

Vanlaar, W.G.M., Simpson, H.M., Mayhew, D.R., Robertson, R.D., 2007. The road safety monitor 2006: distracted driving. Traffic Injury Res. Found.