Summary report

**Factors that impact driving behaviour**

**in young drivers and promising practices for young driver engagement**

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Summary report

Factors that impact driving behaviour in young drivers and promising practices for young driver engagement

Context

Youth and young adults are killed in crashes at a higher rate than any other age group under 75 years old (Statistics Canada, 2020). Reaching the young driver population for the purpose of awareness and education presents unique challenges and opportunities compared to other demographic groups. Young drivers are highly influenced by their peer group while still looking to their parents as role models (Morrish, 2011), their cognitive, physical, and social skills are still developing (Delgado, Wanner, & McDonald, 2016), and cannabis legalization and the widespread influence of social media have contributed to risky driving behaviour among young drivers (Windle et al., 2019).

The *For Young Drivers, By Young Drivers* project recognizes the need for new, innovative strategies to reach and engage youth, especially in light of the COVID-19 pandemic. *For Young Drivers, By Young Drivers* aims to effectively address the issue of road fatalities among youth by partnering with Canadian youth aged 15 to 24 to:

* understand the facilitators, barriers and attitudes/perceptions that affect safe driving behaviours in young drivers
* identify new opportunities and channels for increasing youth awareness of road safety issues, with a specific focus on technology and communications solutions
* build a framework and tools that will guide engagement of young drivers and their passengers in Parachute’s road safety initiatives

Parachute’s history with youth engagement

As motor vehicle crashes continue to be a leading cause of injury and death among young Canadians and there is an inability to implement community engagement because of the COVID-19 pandemic, meaningful and appropriate youth engagement in road safety is important now more than ever. Parachute has engaged with youth for various campaigns including #KnowWhatImpairedMeans, #SpeedIsNoGame and Parachute’s flagship program in youth road safety, National Teen Driver Safety Week (NTDSW). NTDSW is an annual campaign to build awareness of teen driver safety issues and encourage community and youth involvement as part of the solution. This campaign has run annually over the last nine years and focuses on important road safety topics including speeding, drug-impaired, drunk, distracted and aggressive driving, and rail safety. Some specific strategies Parachute has used to engage youth in road safety programming include:

* establishing a youth advisory team of approximately 12 youth who acted as a sounding board, but the engagement became tokenistic as youth engagement was not sustainable due to a lack of resources to implement programming for them and empower them
* participating in the Registered Graphic Designers Designathon, where student designers, mentored by a senior designer, volunteered their time to selected charities. The team working with Parachute created the first iteration of the #KnowWhatImpairedMeans for 2018’s National Teen Driver Safety Week
* running several youth focus groups via Zoom meetings to test NTDSW themes and creative collateral, including drawing on the RCMP Youth Advisory Council in 2018 and a youth advisory group working with Brock University in Southern Ontario in 2020.
* participating in a second Registered Graphic Designers Designathon, where student designers, mentored by a senior designer, volunteered their time to selected charities. The 2020 team working with Parachute tested and developed #SpeedIsNoGame as a theme to raise awareness of the dangers of speeding motivated by thrill rather than impatience and created the first iterations of the illustrations for National Teen Driver Safety Week. As with the 2018-19 NTDSW and 2020-21 NTDSW, student designers were then hired each year to further develop artwork, illustrations and social media GIFs.

Objective and scope

This report summarizes findings from a literature review and environmental scan on the following:

* factors that impact driving behaviour in young people
* youth engagement and partnership strategies in health promotion and injury prevention programming
* tools and platforms used to engage young people in health promotion and injury prevention programming

This current knowledge from published research and the environmental scan will increase understanding of best practices in youth engagement within road safety and inform key questions for young drivers and passengers on how they think and feel about safe driving behaviours, how they behave, what influences their behaviours, who influences their behaviours and where they go for trusted information will be developed. The learnings from youth engagement will inform the development of a national youth road safety framework.

Methods

The process used to synthesize the literature and relevant documents was based on rapid review methodology as outlined in Dobbins (2017). Data for this report were extracted from grey literature and peer-reviewed academic literature. The review used the following steps:

* Generate the research questions in collaboration with project team members. The final set of research questions are:
	+ What factors impact driving behaviour in young people?
	+ What are effective youth engagement practices within health promotion and injury prevention?
	+ What are effective youth engagement tools and platforms within health promotion and injury prevention?
* Use research questions to generate concepts, their synonyms and alternative spellings to be used in academic database searches, as well as the keywords to be used in the search strategy for web searches
* Define the inclusion criteria as:
	+ Study population are youth aged 15 to 24
	+ Study is set in developed countries e.g., Canada, the United States, Australia
	+ Studies from 2016 to 2021
	+ English language only
* Define the exclusion criteria as:
	+ Articles that were older than 2016
	+ Study population were solely adults or older adults
	+ Non-English language
	+ Programming and engagement activities were not in health promotion or injury prevention
* Search grey literature – pertinent keywords were entered into Google and in Parachute’s Dropbox folders to obtain relevant sources
* Search academic literature
	+ Four interdisciplinary databases were searched: Google Scholar, PubMed, ScienceDirect and Directory of Open Access Journals
	+ Search strategies were created according of each database’s specifications (see [Appendix A](#Appendix_A) for each database’s search strategies)
* The citations were assessed for relevance according to the inclusion and exclusion criteria through a title and abstract screening and a subsequent full-text screening (see [Appendix B](#Appendix_B))
* Relevant data from each source that passed the full-text review were extracted and organized into an Excel spreadsheet
* The data were sorted and grouped into common themes to generate conclusions

Risky driving behaviour

There are several risky driving behaviours that can result in fines, loss of driver licences, injury and death. The most common risky behaviours among young drivers are distracted driving, impaired driving, speeding and lack of or improper seatbelt use.

## Distracted driving

Also called secondary task engagement, distracted driving involves driving where the driver does not have their eyes on the forward roadway and/or their mind is off the road (Delgado, Wanner, & McDonald, 2016; O’Brien, Klauer, Ehsani, & Simons-Morton, 2016). Divided attention between the primary task of driving and secondary tasks results in limited cognitive resources for both tasks. Distractions also result in compensatory behaviour that can be dangerous e.g., more rapid and frequent braking during phone calls (Stabrinos, Pop, Shen, & Schwebel, 2018). Examples of distractions can include eating, interacting with passengers, using electronic devices and adjusting the radio. Maturity and driving experience make young drivers at higher risk than middle-aged drivers for distracted driving (Guo et al., 2017). Teen drivers are more likely than older drivers to adopt new technologies and use them while driving, overestimating their ability to multitask while driving (Gershon, Zhu, Klauer, Dingus, & Simons-Morton, 2017). Young drivers are particularly likely to engage in cellphone use while driving for the purposes of texting, going on social media, taking a call or looking for directions. Texting combines three types of distractions: cognitive, manual and visual, and can be just as dangerous as speeding and driving drunk (Cismaru & Nimegeers, 2017). Adolescents know that cellphone use when driving is dangerous but they still engage in the behaviour: continuing to raise awareness about the dangerous of distracted driving may not be effective to reducing behaviour (Delgado, Wanner, & McDonald, 2016). Youth have different attitudes and idea of perceived risk toward the different aspects of texting while driving e.g., initiating texts, monitoring texts and intention to respond (Gauld, Lewis, White, Fleiter & Watson, 2017). Factors that impact cellphone use while driving include the importance of incoming or outgoing call, social acceptance of cellphone use while driving, possession attachment and positive attitude toward cellphone use while driving (Delgado, Wanner, & McDonald, 2016).

## Impaired driving

Driving under the influence of cannabis (DUIC) was most prevalent among 18- to 19-year-old Canadians, followed by 15- to 17-year-old Canadians. Many young people believe that cannabis has a limited effect on driving, with 10 per cent reporting DUIC in their lifetime and 20 per cent reporting driving with a driver who is DUIC (Carpino, Langille, Ilie, & Asbridge, 2020). Findings on the impact of cannabis on collision risk has been mixed, with some studies finding that it increases risk while other say that it doesn’t increase risk (Cook, Shank, Bruno, Turner, & Mann, 2017).

Alcohol plays a factor in half of the motor vehicle crashes that result in fatalities among 16- to 25-year-old drivers (Brown, Vanlaar, & Robertson, 2017). Young drivers are the least likely to drive impaired but those who do are at high risk of crashes due to inexperience in both driving and drinking alcohol (MADD Canada, n.d.). Those who engage in driving under the influence of alcohol are more likely to be older teens, males, driving in the summertime, driving on weekends, driving at night time and most likely to be involved in single-vehicle crashes. In almost two-thirds of multiple vehicle crashes in which alcohol was a factor, it was the fatally injured young driver who had been drinking alcohol, rather than the other drivers (MADD Canada, n.d.).

## Speeding

Speeding entails driving over the speed limit, driving too fast for conditions or racing (Vanlaar, Robertson, & Marcoux, 2008; Governors Highway Safety Association, 2012). According to the Criminal Code of Canada, street racing is defined as “operating a motor vehicle in a race with at least one other motor vehicle on a street, road, highway, or other public place” (Department of Justice Canada, 2012). Speeding increases crash risk due to decreased reaction time, longer time to stop and decreased ability to steer safety around obstacles on the road (Vanlaar, Robertson, & Marcoux, 2008). Speeding plays a factor in one-third of teen driver deaths in Canada (Traffic Injury Research Foundation, 2015).

## Seatbelt use

Ninety-five per cent of Canadians use seatbelts when driving but having 100 per cent of Canadians would save many lives (Transport Canada, 2007). Those who are least likely to wear seatbelts include: young male drivers and passengers, drivers aged 18 to 24, those who live in rural areas and those who drive pick-up trucks (Strine et al., 2010; Transport Canada, 2010a). A significant proportion of individuals involved in fatal and serious injury crashes were not wearing seatbelts (Transport Canada, 2019). Factors that impact whether young drivers and passengers are likely to put on their seatbelts include: driving late at night, blood alcohol content, whether the driver is alone and if there are passengers under the age of 29 (Williams & Shabanova, 2002).

Factors that impact driving behaviour

## Beliefs and perceptions

Beliefs and perceptions have a significant impact on whether young people engage in risky driving behaviour. Risk perception is one’s judgment about the severity and characteristics of a risk. In young drivers, risk perception is dependent on the context and influenced by optimism bias, where young drivers are more likely to underestimate their risk of negative driving outcomes and to overestimate their driving abilities (Cordellieri et al., 2016). Young drivers report engaging in risky driving for gaining autonomy, self-enhancement, optimism bias, to please friends and gain more adult-like status (Cordellieri et al., 2016). The components of risk perception include:

* perceiving and recognizing a risk
* estimating the level of risk or the probability of negative consequence, and
* willingness to accept the risk level for the behaviour

Some common beliefs and perceptions around risk that young drivers have and their influence on driving behaviour are explained by the following health behaviour models and their constructs.

### Theory of Planned Behaviour

The Theory of Planned Behaviour (TPB) posits that behavioural intent is the most important determinant of an individual’s behaviour and is influenced by three factors (Ajzen, 1985). Individual levels of these three factors influence whether a young driver will engage in safe or risky driving behaviour (Potard, Kubiszewski, Camus, Courtois, & Gaymard, 2018):

* **Attitude**: An individual’s evaluation of a particular behaviour and its predicted outcomes. Attitude had a negative association with texting while driving among young drivers – they are aware that it is dangerous but still believe that it is acceptable behaviour (McBride, Carter, & Phillips, 2020).
* **Subjective norms**: An individuals’ beliefs about whether others would approve or disapprove of a given behaviour. Young drivers maintain the belief that texting while driving is expected among their peer group and responses to texts should be within five minutes. As a result, young drivers adhere to these norms to maintain relationships within their peer group (5, McBride, Carter, & Phillips, 2020)
* **Perceived behavioural control**: An individual’s perception of their ability to adopt a given behaviour. Perceived behavioural control was shown to be the strongest predictor of young drivers’ intention to drive after drinking (Potard, Kubiszewski, Camus, Courtois, & Gaymard, 2018). High levels of perceived behavioural control also increased the likelihood of young drivers texting and driving (McBride, Carter, & Phillips, 2020).

### Extended Parallel Process Model

The Extended Parallel Process Model (EPPM) is a framework that outlines how an individual’s emotional reaction or fear of a threat to their health, as well as beliefs about their self-efficacy, can predict whether they will engage in protective or harmful health behaviour (Witte, 1992). Threat of engaging in safe or risky driving behaviour is determined by two factors:

* **Perceived severity**: the degree of seriousness of the negative consequences from engaging in the risky behaviour
* **Perceived vulnerability**: the likelihood of experiencing negative consequences from engaging in risky driving behaviour

Efficacy is determined by two factors:

* **Perceived self-efficacy**: perception of one’s ability to not engage in risky driving behaviour
* **Perceived response efficacy**: perception of whether adopting safe driving behaviour will lead to desired health outcomes

Individual levels of these four variables combine to predict whether young drivers will engage in safe or risky driving behaviour. The EPPM is often used as a guide for road safety campaign design, implementation, and evaluation (Cismaru & Nimegeers, 2017). The EPPM explains why using fear in road safety messaging can either succeed or fail in behaviour change. Drivers who may find it difficult to adopt recommendations or feel like adopting recommendations won’t prevent them from causing negative road safety outcomes are less likely to change risky driving behaviour (Cismaru & Nimegeers, 2017).

### Health Belief Model

The Health Belief Model (HBM) posits that an individual’s likelihood in engaging in a risky or safe driving behaviour that promotes health is influenced by these factors (Jones et al., 2015):

* **Perceived susceptibility**: the likelihood of experiencing negative consequences from engaging in risky driving behaviour
* **Perceived severity**: the degree of seriousness of the negative consequences from engaging in the risky behaviour
* **Perceived benefits**: beliefs about whether engaging in risky or safe driving behaviour increases benefits or decreases negative consequences
* **Perceived barriers**: obstacles that an individual encounters when engaging in safe driving behaviour
* **Level of self-efficacy**: an individual’s confidence in their ability to engage in safe driving behaviour
* **Cues to action**: people, things or events in an individual’s life that encourage them to engage in safe or risky driving behaviour

### Strategies to target the influence of beliefs and perceptions on driving behaviour

Road safety messages should increase young drivers’ self-efficacy and confidence in refraining from risky behaviour (Cismaru & Nimegeers, 2017). To increase self-efficacy, messages should emphasize effectiveness of recommended behaviour in terms of benefits, include coping appraisal information, easy-to-follow recommendations, planning for safe driving behaviour and ways to overcome barriers to safe driving behaviour. This can look like encouraging young drivers to go public with their intent to engage in safe driving behaviour and straightforward encouragement (Cismaru & Nimegeers, 2017).

Messaging should also address differences in youth’s risk perception toward different risky driving behaviours. For example, many young drivers believe that driving under the influence of cannabis is less risky than driving under the influence of alcohol. Heightening the risk perception of young drivers who perceive that regular cannabis use poses no risk at all to driving is important. Similarly, some young drivers believe that monitoring and reading texts while driving is not as risky as initiating and responding to texts while driving (Gauld, Lewis, White, Fleiter, & Watson, 2017). Interventions and messaging that focus only on generating awareness and knowledge on perceived risk have either not been successful or have only been marginally successful (Harbeck, Glendon, & Hine, 2017). Reward-based programs such as insurance or licence fee monetary deductions may be effective for high-risk young drivers who often have high sensitivity to rewards (Harbeck, Glendon, & Hine, 2017).

Creating social norms to modify attitudes and behaviours, increase risk perception and correct acceptable perceived risk would be necessary for interventions (Choudhary & Velaga, 2019). Interventions should also identify motivating factors that can contribute to improved road safety and provide information that counter factors that may facilitate young drivers' risk perception and risky driving behaviour (Harbeck, Glendon, & Hine, 2017).

## Driver experience and knowledge

A frequently cited cause for high rates of crashes in young drivers is driver inexperience. Driver inexperience can look like decreased knowledge and understanding of road rules, inability to safely navigate through dangerous driving environments and scenarios and decreased skill in safe and routine vehicle control (Banz, Fell, & Vaca, 2019). Teens were twice as likely to be involved in a critical event, although young adult and experienced adults were more likely to be involved in sideswipe and pedestrian/cyclist-related near crashes than teens, which might be due to differences in the types of roadways traveled by teens in comparison to adults. In comparison to teens, young adults exhibited lower crash, near crash and critical event rates but these rates were still higher than those exhibited by experienced adult drivers (Seacrist et al., 2018).

Greater driving experience can also lead to increased risky behaviour as increased experience can lead to increased confidence and decreased risk perception (Gicquel et al., 2017). While graduated driver licencing (GDL) systems have been effective in reducing young driver crashes, drivers are less compliant as they progress through the GDL system. More experienced drivers were also found to be more non-compliant with new road rules. The safest period for young drivers is the newly licensed learner stage, where risk exposure is attenuated by in-vehicle supervision (Allen, Murphy, & Bates, 2017; Bates, Darvell, & Watson, 2017). In Ontario, graduated licensing had the strongest association with texting while driving as students with G2 or a full licence were 10 times more likely than those with a G1 licence to report texting while driving (Cook at al., 2018).

### Strategies to target the influence of driver experience on driving behaviour

Tailoring novice driver training and educational programs to target the most common errors exhibited by young drivers may be effective (Seacrist et al., 2018). Some common problem areas for young drivers include: eye glance behaviour, hazard perception, rear-end and road departure, pedestrian zones and intersection near-crashes (O’Brien, Klauer, Ehsani, & Simons-Morton, 2016; Seacrist et al., 2018). Developing training programs that focus on these areas can decrease young drivers’ chances of being in a crash/near crash (O’Brien, Klauer, Ehsani, & Simons-Morton, 2016).

Driving school can be a strong protective factor to prevent risky driving behaviour as a result of driver inexperience and other factors (Gicquel et al., 2017). Extending the learning and supervised driving period in the graduated driver licensing system can also be effective as many errors and lapses occur after young drivers complete the learning period (Gicquel et al., 2017, Weiss, Kaplan, & Prato, 2016)

There isn’t enough evidence to support the efficacy of simulator-based training programs for young or novice drivers to gain more experience (Martin-delosReyes et al., 2019).

## Social norms

Social norms are “rules and standards that are understood by members of a group and that guide and/or constrain human behaviour without the force of laws” (Cialdini & Trost, 1998, p. 152). Individuals tend to overestimate the extent to which other members of their social group engage in or approve of unhealthy behaviours (Merrikhpour & Donmez, 2017). Individuals use social and subjective norms as a reference point for their own behaviour and what they don’t want to deviate from. Social norms and peer influence are both risk factors and protective factors for young drivers (Trivedi & Beck, 2018). As young people get older, there is a shift in the perceived level of importance of influence and norms from teens’ parent/family to that of their peers (Banz, Fell, & Vaca, 2019).

## Peer influence

Young drivers’ peer groups have an influence on risk perception and risk-taking tendencies (Trivedi & Beck, 2018). Peer influence is affected by whether the driver is provided immediate social rewards when engaging in risky driving behaviour (Scott-Parker, 2017). Peer influence can act as a protective factor if young drivers are less likely to drive under the influence if they believe their peers disapproved of this behaviour (Trivedi & Beck, 2018).

Driving with a teenage passenger is a unique risk factor for young drivers as peers can exert social influence, and pressure the driver to engage in behaviour that favours more risky driving (Starkey & Isler, 2016). For example, when teen drivers transport only teen passengers, the drivers' seatbelt use may be strongly influenced by passenger seatbelt use and vice versa. All passengers were more than five times as likely to be wearing a seatbelt in a crash if the teen driver was also wearing a seatbelt (Shults et al., 2019).

Furthermore, young drivers’ perception of their peers’ distracted driving is associated with their own levels of distracted driving (Starkey & Isler, 2016). Peers are more accepting of cellphone use when driving, indicating that social norms opposing cellphone use while driving are weak (Delgado, Wanner, & McDonald, 2016). Young drivers believe that engaging in texting while driving is expected among their peer group and they must adhere to these norms to maintain their status within their peer groups (McBride, Carter, & Phillips, 2020). Adolescents and young adults use text as a main form of communication with their peers. This form of communication supports interactions between them and their peers and increases feelings of belonging. Young drivers felt disadvantaged by not texting while driving to maintain social relationships and engage in life in real time (McBride, Carter, & Phillips, 2020).

### Strategies to target peer influence on driving behaviour

Some components that campaigns and key messages can include to target peer influence include, social relationships, young drivers’ personal attitudes, their internal control and perception of social norms, how to reduce peer pressure effects on driving behaviour and how to self-monitor for safe driving behaviour (Vassallo, Lahausse, & Edwards, 2016; Li et al., 2020; Trivedi & Beck, 2018).

## Parental influence

Parents were among the most important influences on young drivers’ driving behaviours. Parent involvement can be most influential during the first stage of licensing, after which parental enforcement is superseded by other influences beyond the family environment, including peers (Shults, Haegerick, Bhat, & Zhang, 2016). Compared to formal deterrence, such as fines and police prosecution, younger drivers may be more influenced to drive safely as a result of parental enforcement in the form of withholding driving privileges, restricting vehicle access and an internal sense of shame evoked by family disapproval if they violate road rules and engage in risky driving behaviour (Scott-Parker, Goode, Salmon, & Senserrick, 2016; Shults, Haegerick, Bhat, & Zhang, 2016). Young drivers who believed they would be caught and punished by their parents for violating road rules were more likely to be compliant with road rules (Scott-Parker, Goode, Salmon, & Senserrick, 2016).

Teens who believed that their parents are guarantors of their safety and who provided encouraging feedback for safe driving reported driving more carefully, including reducing secondary task engagement (Vanlaar, Robertson, & Marcoux, 2008; Yellman, Bryan, Sauber-Schatz, & Brener, 2020). Youth who were most likely to engage in risky driving behaviour had low level of parental monitoring, increased parental permissiveness and weaker social bond (Cook, Shank, Bruno, Turner, & Mann, 2017).

### Strategies to target parental influence on driving behaviour

Interventions can enhance parents’ driving behaviours to positively influence the way their children perceive road safety and their own driving behaviour (Strine et al, 2010; Harbeck, Glendon, & Hine, 2017). Interventions that improve parents’ ability to supervise their children during the learning driving stage can also be effective (Shults, Haegerick, Bhat, & Zhang, 2016). Having parents talk to their children early and often about safe driving behaviour as well as modelling these behaviours can be effective in increasing safe driving behaviours in their children. However, parents must be actively interested in their children’s driving practices and commit to withholding driving privileges (Scott-Parker, Goode, Salmon, & Senserrick, 2016; Shults, Haegerick, Bhat, & Zhang, 2016).

This can be made easier by installing a camera in vehicles to enable parental modelling, involving nonparental supervisors such as siblings and extended family members, and having agreements or contracts between parents and their children that formalizes rules, outlining consequences for breaking rules and establishing commitment between parents and young drivers to adhere to safe driving behaviour (Li et al., 2020; Scott-Parker, Goode, Salmon, & Senserrick, 2016; Shults, Haegerick, Bhat, & Zhang, 2016; Youth.gov, n.d.).

## Brain development

Developmental changes during adolescence have an influence on risky driving behaviour. The brain is not fully developed until age 25, particularly in males (Banz, Fell, & Vaca, 2019). Maturation of prefrontal cortex continues into adulthood (Starkey & Isler, 2016). An immature prefrontal cortex can result in poor judgment, organization, planning and decision-making, behavioural disinhibition, increased impulsivity, increased sensation seeking, perseveration, poor attention and working memory (Starkey & Isler, 2016; Walshe, Ward McIntosh, Romer, & Winston, 2017). The socio-emotional system (limbic and paralimbic areas) also undergoes rapid development during adolescence, leading to increased reward and sensation-seeking (Starkey & Isler, 2016). It is during this maturation period that young people learn how to drive, a highly complex behaviour that relies on many cognitive faculties that have not matured yet, including working memory, inhibition and attention (Banz, Fell, & Vaca, 2019). Poor working memory capacity indicates poorer ability to update information in the moment and manage the many subtasks of driving and other secondary tasks. Poor inhibition of impulses for risky driving behaviour, such as speeding and difficulty ignoring distractions, can lead to poor speed control and lane maintenance (Walshe, Ward McIntosh, Romer, & Winston, 2017).

The mediating factors that influence risky driving behaviour include inadequate risk assessment experience, increased risk-taking, increased impulsivity, increased present-bias (the tendency to place more weight on current benefits) and less weight on future consequences (Delgado, Wanner, & McDonald, 2016; Gicquel et al., 2017). This leads to more errors, engaging in more dangerous driving behaviours and higher risk of crashing (Walshe, Ward McIntosh, Romer, & Winston, 2017).

Furthermore, individual developmental differences can result in some young drivers being more vulnerable to risky driving behaviour and its consequences. Adolescent drivers with executive function impairments, such as ADHD and ASD, have higher crash and risk of injury due to increased difficulty in paying attention, co-ordination, organized planning and making decisions while driving, resulting in more driving errors (Walshe, Ward McIntosh, Romer, & Winston, 2017). Poor working memory and inhibition exacerbated in young drivers with developmental disorders can play a role in increased distracted driving behaviours, resulting in negative consequences (Walshe, Ward McIntosh, Romer, & Winston, 2017). Young drivers with ADHD often overestimate their driving competence and had a higher risk of speeding violations, not wearing seatbelts, alcohol and/or drug use, and cellphone use while driving (Curry, Yerys, Metzger, Carey, & Power, 2019).

### Strategies to target the influence of brain development on driving behaviour

Studying the neural mechanisms that lead to unique vulnerability in young drivers can be important in creating interventions that address this (Banz, Fell, & Vaca, 2019). Screening measures to assess individual differences in executive function capacity and how this impacts potential risk on the road can provide insight into whether a young driver needs additional driver training and can inform personalized skill training to complete during driver education (Walshe, Ward McIntosh, Romer, & Winston, 2017).

## Emotional state

Driving for adolescents goes beyond efficient transport: it includes emotional purposes such as a sense of freedom and obtaining social status (Scott-Parker, 2017). Moods and emotions influence behaviour and can play a role in driving behaviour among young drivers. Stable personality characteristics, state factors or context-specific triggers all play a role in impact a driver’s moods and motions and, subsequently, their driving behaviour (Scott-Parker, 2017). Among young drivers, positive affect and strong negative affect is associated with lower risk perception and greater risk driving behaviour. Emotionally charged young drivers make poor choices as emotions effect both risk perception and risk attitudes, which contribute to risky driving behaviour. Adolescent drivers appear most risk-averse in circumstances where emotional responses are not evoked (Scott-Parker, 2017). Emotion regulation is normative in adolescence but greater difficulty in emotion regulation is associated with risky driving behaviour. Two factors that lead to emotional regulation difficulties in adolescents are sleep deprivation and ego depletion (being emotionally drained) (Scott-Parker, 2017).

Boredom is another factor that can play a significant role in risky driving behaviour. Driving can give rise to boredom due to low traffic, slow or constant speed, and routine routes. Coping mechanisms for boredom while driving can include approach strategies such as speeding and avoidance strategies such as cellphone use (Steinberger, Schroeter, & Watling, 2017). Fear can reduce driving speed in some contexts, such as after a critical incident like a near crash, but it does not have an impact on driving behaviour (Scott-Parker, 2017).

Worry, which is an emotional response to threat, can reduce hazardous behaviour. Interventions can focus on worries to increase careful driving behaviour (Cordellieri et al., 2016). Gamified boredom intervention significantly reduced overall driving speed and speeding. It also improved anticipatory driving but also slower reactions during sudden hazard events (Steinberger, Schroeter, & Watling, 2017).

## Cognitive factors

Cognitive capture is when an individual is focused on a secondary task and is not cognitively present in their current environment. For example, adolescents who reported mind wandering also reported more risky driving (Scott-Parker, 2017). Similarly, multitasking increases a driver’s overall workload, leading to variability in steering wheel movement and lane-keeping and can potentially contribute to increased risk for a crash (Choudhary & Velaga, 2019).

Developmental changes during adolescence and early adulthood can lead to sleep deprivation and increased risk of sleepiness-related crashes (Alvaro et al., 2018). This is compounded by academic and work demands as well as social pressures. Sleep-deprived young drivers are likely to be poorly prepared to drive or make poor decisions about when to drive or stop driving (Bates, Darvell, & Watson, 2017). Intensive education programs can mitigate sleepiness-based crashes (Alvaro et al., 2018).

Youth perception of driving risk is also impacted by comparative optimism bias, which can lead young drivers to estimate their own risk as being lower than others (Carpino, Langille, Ilie, & Asbridge, 2020).

## Personality traits

Specific personality traits are associated with increased risky driving behaviour. This includes increased aggression and hostility, lack of tolerance, easy irritability, poor ability to cope with stress, poor emotional regulation and increased thrill-seeking (Gicquel et al., 2017; Steinberger, Moeller, & Schroeter, 2016). Anger, altruism, normlessness, empathy, neuroticism and quality of parent-offspring attachment are also linked to increased risky driving behaviour (Banz, Fell, & Vaca, 2019).

Reward, punishment and threat response are connected to personality and produces individual differences in sensitivity to reward and punishment. Individuals with high reward sensitivity and prefer immediate rewards have difficulty with learning inhibition and controlling impulsive behaviour. These individuals are more likely to have lower risk perception and engage in risky driving behaviour (Harbeck, Glendon, & Hine, 2017).

Prosocial driving behaviour negatively correlates with driving errors and violations. A high level of life satisfaction mediates positive, proactive and prosocial behaviours and reduces harmful, risky behaviours. Individuals who are goal oriented, have high self-esteem and are agreeable engage in courteous, prosocial, patient and careful driving behaviour (Isler & Newland, 2017). A low level of life satisfaction is correlated with anxiety, depression, neuroticism and loneliness, and is related to negative driving outcomes (Isler & Newland, 2017; Banz, Fell, & Vaca, 2019). Pleasure, meaning and engagement are the three factors that contribute to life satisfaction. Lower-risk drivers, which include female drivers, drivers older than 25 years old and drivers without incidences, score higher on measures of engagement and meaning and lower on measures of pleasure. The hedonistic orientation of pleasure was most strongly endorsed by younger drivers (Isler & Newland, 2017). Similarly, civic mindedness, which entail behaviours and attitudes that benefit society, was associated with stable speeding pattern. Stable speeding drivers are less likely to be civic-minded than stable low-risk drivers (Seacrist et al., 2018).

Cellphone use while driving is also influenced by certain personality traits. Young drivers who are prone to problematic or compulsive cellphone use are more likely to report texting while driving (Delgado, Wanner, & McDonald, 2016; Cook at al., 2018). Problematic cellphone use is characterized by using phones in unsuitable places, how frequently it is being used (often obsessively throughout day) and with whom (often with peers to maintain social ties). Three personality traits relate to problematic cellphone use: low conscientiousness, high extraversion and high neuroticism. Increased cellphone use relates to some young people’s self-identities, desire to improve their social status and their self-confidence, as well as develop social and interpersonal connections (Luria, 2018). Young people with problematic cellphone use are often highly anxious about their interpersonal relationships and stay close to their phones to maintain social ties (Luria, 2018). These drivers find it hard to overcome the temptation to use their device and will engage in distracted driving (Luria, 2018).

Personality also impacts whether an individual is more prone to boredom than others. Boredom is made up of arousal, stimulation, engagement and attention (Steinberger, Schroeter, & Watling, 2017). Factors that contribute to driver boredom include repetition, routine, lack of challenge, a sense of obligation and trait boredom (Steinberger, Schroeter, & Watling, 2017). Trait boredom is an increased propensity to boredom due to certain individual characteristics. Individuals who are more prone to boredom are more likely to make errors on cognitive tasks, have increased impulsivity and are less attentive (Steinberger, Moeller, & Schroeter, 2016). Drivers who are more prone to boredom and pose a higher threat to road safety are male, younger, less conscientious and less enthusiastic about driving. These factors can make driving go from relaxed to uncomfortable. To combat boredom, drivers may seek sensation through risk-taking such as speeding, weaving through traffic or creating driving-related games (approach strategy) or distraction such as cellphone use and daydreaming (avoidance strategy) (Steinberger, Moeller, & Schroeter, 2016).

### Strategies to target the influence of personality traits on driving behaviour

In healthcare contexts, positive psychology intervention could be prescribed to help young drivers move their mental state toward increased life satisfaction and healthcare professionals can encourage anger and frustration management to decrease crash risk (Isler & Newland, 2017; Gicquel et al., 2017). Road safety interventions can emphasize character strengths, provide assertiveness training and how they can be used for safe driving (Linden et al., 2019). They should also aim to reduce young people’s engagement in other problematic behaviours, promote positive peer connections and increase sense of connection to their broader communities (Vassallo, Lahausse, & Edwards, 2016; Isler & Newland, 2017).

## Demographic factors

### Gender differences

Young male drivers often show optimism bias and overconfidence, often due to skewed self-perception that they are more skilled and safe drivers (Steinberger, Moeller, & Schroeter, 2016). As such, young male drivers have consistently been found to perceive lower risk, report less concern over road incidences, misjudge and overestimate their driving abilities and engage in more frequent and a greater range of risky driving behaviours such as driving over the speed limit, and driving under the influence (Harbeck, Glendon, & Hine, 2017; Klaitman, Solomonov, Yaloz, & Biswas, 2018). Young males are less likely to be compliant with road laws, more prone to accept speeding and traffic violations and more likely to be involved in collisions as a result of violating traffic laws in comparison to young female drivers (Allen, Murphy, & Bates, 2017, Cordellieri et al., 2016). Male drivers are more likely to be involved in fatal crash than female drivers, even taking their increased exposure levels into consideration (Mannocci, Saulle, Villari, & La Torre, 2019).

Despite having a greater safety orientation than young male drivers, young female drivers are more like to be involved in crashes as a result of judgment errors, problems in vehicle handling and mastering traffic situations (Cordellieri et al., 2016). Female drivers were more aware of correct driving behaviour and gauging high risk and dangerous driving situations. Both young female and male drivers have the same perception regarding dangerous or risky situations but only female drivers showed concerns about perceived risk and more likely to experience shame-related emotions (Allen, Murphy, & Bates, 2017).

### Age differences

Risky driving behaviour is common among drivers in their late teens and early twenties, but it decreases when drivers reach their mid-twenties due to increased driving experience, which is associated with increased ability to anticipate, accurately assess, and decrease exposure to hazards, developmental changes and cognitive maturation. This leads to decreased risk-taking as a result of the protective factors of multiple life transitions, such as stable relationships and careers and decreased susceptibility and vulnerability to negative peer influence (Vassallo, Lahausse, & Edwards, 2016). Risky driving behaviour can also increase with age as adult supervision is not present and young drivers gain driving experience. However, the prevalence of wearing a seat belt increased with age, indicating that while adolescents are more likely to engage in risky driving behaviour, they still maintain a sense of risk perception and self-preservation (Yellman, Bryan, Sauber-Schatz, & Brener, 2020).

### Ethnic differences

Texting and driving are more common among white students than students of other races (Li et al., 2020). Racial/ethnic minorities were likely to be driver in a street race. Hispanic students in the U.S. had a higher prevalence of riding with a driver under the influence and driving after drinking alcohol than white or Black students. U.S.-born Hispanic youth were more likely to engage in this risky behaviour than first-generation immigrant Hispanic youths (Yellman, Bryan, Sauber-Schatz, & Brener, 2020).

### Education level differences

Completing school was associated with decreasing levels of risky driving behaviour (Vassallo, Lahausse, & Edwards, 2016). Students with lower academic grades are more likely to engage in risky driving behaviour, which might be indicative of tendency to engage in general risky behaviour or make risky decisions that contribute to lower grades. Texting while driving did not differ by academic achievement, which may indicate that youth perceive the benefits and risks of texting while driving to be different from other risky driving behaviours (Yellman, Bryan, Sauber-Schatz, & Brener, 2020).

### Socioeconomic differences

While there are mixed results on the correlation between socioeconomic status and traffic incidents, some studies do show that material deprivation is associated with risky driving behaviours among young drivers (Adanu, Penmetsa, Jones, & Smith, 2018). Young drivers from lower socioeconomic opportunities are more vulnerable to hazards, often must travel longer distances due to living outside of urban centres, drive cars that require maintenance or repairs, and face social and economic disparities that impact behaviours, including driving behaviour. This puts these young drivers at more risk for serious road crashes and resulting fatal and non-fatal traffic-related injuries (Klaitman, Solomonov, Yaloz, & Biswas, 2018).

### Rural populations

Many young drivers involved in fatal traffic crashes were from rural areas. These crashes were attributable to specific risky behaviours exhibited by young, rural drivers (Vassallo, Lahausse, & Edwards, 2016). For example, youth in rural areas in Montana were likely to drink and drive after social activities that are conducive to drinking alcohol such as tailgating, brandings, festivals, outdoor activities, holidays and going to restaurants and bars (Rossheim, Greene, & Stephenson, 2018). Underage drinking is often viewed as acceptable within some rural communities and police don’t intervene unless young people are driving (Rossheim, Greene, & Stephenson, 2018). Outdoor activities were also often in remote locations without access to public transport so young people often drove due to lack of options. Activities specific to rural areas that involve driving under the influence include, booze cruising, where a group drink while driving around back roads, often to avoid getting caught by police, and spotlighting, which is similar to booze cruising but involves carrying guns and hunting animals (Rossheim, Greene, & Stephenson, 2018). Lack of sufficient activities to occupy young, rural drivers can lead to risky driving behaviour (Rossheim, Greene, & Stephenson, 2018).

### Strategies to target demographic factors

It is important to target interventions toward populations of young drivers who are more prone to risky driving behaviour to influence their understanding and knowledge of risk awareness and risky behaviour (Brockamp et al., 2018). For young, rural drivers, some recommendations for intervention include targeting brandings and festivals with safe driving messages, implementing fun, alcohol-free activities in the community, and an awareness campaign to challenge the idea that drinking while driving is safe and why it is important for designated drivers to abstain from alcohol consumption despite social pressure and desire to socialize (Rossheim, Greene, & Stephenson, 2018).

## Engaging in other risk-taking behaviour

The sub-population of young drivers who engage in other risky behaviours are often called a “problem young driver”. This contrasts with the “young driver problem”, which is the increased crash risk experienced by young drivers in general due to level of driving experience, brain development and other factors (Gicquel et al., 2017). Risky driving tends to occur with other risky, problem behaviour, reflecting a broader propensity to engage in risky behaviour in some young people (Seacrist et al., 2018; Lastrucci et al., 2021). Problematic drug and alcohol use increased chances of young drivers driving under the influence of alcohol and cannabis (Steinberger, Moeller, & Schroeter, 2016). Drug use also induced an increase in other risky driving behaviour including nighttime driving, driving in the snow, texting while driving, not wearing a seatbelt and driving above the speed limit (Cook, Shank, Bruno, Turner, & Mann, 2017; Vassallo, Lahausse, & Edwards, 2016; Möller et al., 2021). This is consistent with the Problem Behaviour Theory, which implies that developmental, social and cognitive processes cause problem behaviours to cluster within individuals (Möller et al., 2021).

Young drivers who continually commit traffic offences differ from nonoffending young drivers in their alcohol consumption, law-breaking tendencies, driving styles, sociodemographic factors and personality traits (Breen, Næss, Hansen, Gaarder, & Stray-Pedersen, 2020). Out of the four adolescent driver categories of safe driver, average driver, careless driver and reckless and impaired drivers, reckless drivers had the highest degree in risky driving behaviour and were most likely to have weaker social bonds, experienced more frequent psychological distress and engaged in unhealthy behaviours (Steinberger, Schroeter, & Watling, 2017; Alvaro et al., 2018).

### Strategies to target the influence of other risk-taking behaviour on driving behaviour

Prevention strategies that target risky driving more generally rather than focusing on one behaviour in particular may be more effective as many young drivers who engage in risky driving behaviour engage in more than one type of risky behaviour (Cook et al., 2018). Interventions tailored to drivers who engage in a multitude of risky behaviours and are across multiple settings can address several risk behaviours and unhealthy habits (Steinberger, Schroeter, & Watling, 2017). Current programs and resources in schools and communities that address health behaviours can be leveraged to educate young people about risky behaviour (Yellman, Bryan, Sauber-Schatz, & Brener, 2020).

Holistic early intervention programs, such as the Safe Streets Treatment Options Program (SSTOP), which works to keep offenders in the community and uses supervision, education, and treatment to reduce risky behaviours, can also be successful in reducing consequences of risky driving behaviour (Möller et al., 2021). Interventions that provide social skills training and are targeted to pre-teens can also reduce risk-taking behaviour later on in adolescence and young adulthood (Möller et al., 2021).

## Driving context

Distractions and peer passengers can lead to risky driving behaviour (Banz, Fell, & Vaca, 2019). Driving with teenage passengers is considered a risk factor uniquely associated with teens. Teen passengers can use social influence and pressure to engage in social norms that favour risky driving behaviour (Gershon, Zhu, Lauer, Dingus, & Simons-Morton, 2017). Interacting with passengers also increases risk of crashes for teenage drivers and young adult drivers but not for other age groups (Guo et al., 2017). Most frequent in-vehicle distractions include interacting with passengers, eating, drinking, smoking, daydreaming, using in-vehicle entertainment system or phones for music (Lansdown, Kovanda, & Spence, 2021).

The type of relationship between the young driver and any individual communicating with them while driving influences whether young drivers use their cellphones while driving. Young people are more likely to speak to parents while driving than a significant other or a friend but they are more likely to text their significant other or friend than parent (Delgado, Wanner, & McDonald, 2016).

Time pressure, which is influenced by time constraints, time uncertainty and goal importance, impacts driving behaviour in adolescent drivers (Scott-Parker, 2017). Young drivers who engage in greater urgency exhibit the greatest risky driving behaviour. Teens driving in their own vehicle are more likely to engage in risky behaviours than driving in a family member’s vehicle (Gershon, Zhu, Lauer, Dingus, & Simons-Morton, 2017). Young drivers with their own vehicle are also 50 per cent more likely to engage in secondary tasks. Driving alone doubled this likelihood in comparison to driving with a passenger (Gershon, Zhu, Lauer, Dingus, & Simons-Morton, 2017).

## Systemic factors

Current deterrence measures are largely ineffective in influencing young drivers’ compliance with traffic rules (Bates, Darvell, & Watson, 2017). Texting and driving bans have had mixed impact. Some studies have shown that handheld calling bans led to a 55-per-cent reduction of self-reported calling while driving but there are inconclusive findings regarding texting bans and young driver bans and whether they lack effectiveness in reducing short-term and long-term cellphone use while driving (Li et al., 2020). Some studies have found that bans have also been associated with increased frequency of crash claims, likely due to lowering phones from view to avoid punishment. Even with legislation, young drivers continue to text and drive (McBride, Carter, & Phillips, 2020). Poor enforcement of bans has contributed to the decreased effectiveness of legal bans (Delgado, Wanner, & McDonald, 2016). Police officers have expressed that they experience a sense of discomfort ticketing for cellphone use while driving (Li et al., 2020).

Young drivers are more inclined to participate in driving under the influence of cannabis because of the lack of policies and procedures for testing for cannabis use in drivers and the difficulty in policing this behaviour (Cook, Shank, Bruno, Turner, & Mann, 2017).

### Strategies to target the influence of systemic factors on driving behaviour

There is consensus that a systemic approach is required to achieve decreased traffic injuries and fatalities (Scott-Parker, Goode, Salmon, & Senserrick, 2016). Interventions that solely focus on the driver will be ineffective as there are several systemic factors that influence driver behaviour.

An approach that is focused on “fixing the driver” will ultimately prove ineffective as there are other factors across the system that influence driver behaviour (Scott-Parker, Goode, Salmon, & Senserrick, 2016). Pairing policy interventions with youth development programs affecting a broad array of health risk behaviours among high-risk youth can be an effective way to improve safety behaviour (Shults, Haegerick, Bhat, & Zhang, 2016).

Formal deterrence, or the increasing probability of being caught engaging in risky driving behaviour and severity of sanctions, is unlikely to reduce risk of crashes among youth. Alternative approaches to legal bans can target the internal motivators of youth through education campaigns or through third-party policing – that is, working closely with parents, schools and health agencies to monitor youth driving behaviour and take responsibility in this shared problem (Allen, Murphy, & Bates, 2017, Bates, Darvell, & Watson, 2017).

Interventions should target improving infrastructure to increase road safety and to deter youth from engaging in risky driving behaviour (Cook at al., 2018). In rural areas in particular, the lack of alternate transportation availability and a lack of infrastructure for activities influences young drivers’ behaviours, including driving under the influence (Windle et al., 2019). Other effective systemic interventions include primary enforcement of seat belt laws that allow police to ticket drivers or passengers for not wearing seat belt, zero tolerance laws and publicized sobriety checkpoints (Li et al., 2020).

Youth engagement practices and strategies

There is wide consensus that youth engagement will lead to more effective programming and healthier youth (Dunne, Bishop, Avery, & Darcy, 2017). Child and youth engagement in public health interventions can lead to increased effectiveness of disease prevention and lifestyle changes and it also instills accountability, ownership and empowerment within children and youth (Agdal, Midtgård, & Meidell, 2019). Youth are more likely to adopt health promotion and injury prevention strategies when they are involved in knowledge generation than when adults solely develop these strategies (Ramey et al., 2019). It is imperative for youth to become true stakeholders and decision-making partners rather than having adults make decisions that impact young people (Vision Zero for Youth, n.d.).

Authentic youth engagement entails providing meaningful opportunities to youth to practise their skills, including leadership skills in real-world settings, making decisions that impact their daily life, and recognizing the value of youth voices in making an impact in their communities (Ramey et al., 2019). Youth engagement activities that facilitate empowerment and instill a sense of agency within youth have three critical components: skill development, opportunitie, and critical awareness (Cardarelli et al., 2021). Examples of youth engagement in injury prevention across ecological levels include working as leaders to improve safety, advocating for changes in the built environment, spread information and resources on safe behaviours to their peers and networks, and developing programs that address specific needs (Vision Zero for Youth, n.d.).

There are many benefits to youth engagement for both young people and the organizations that engage young people:

* Youth develop an interest and capacity for community leadership and engagement (Gallerani, Besenyi, Stanis, & Kaczynski, 2017; Jenkins, Bungay, Patterson, Saewyc, & Johnson, 2018)
* Youth develop important life skills that they can apply in their personal and professional lives (Gallerani, Besenyi, Stanis, & Kaczynski, 2017; Marie Creamer, Hughes, & Snow, 2020)
* Youth gain a sense of empowerment when they make decisions, advocate for issues that matter to them and feel a sense of ownership over projects (Jenkins et al., 2020)
* The value of youth engagement becomes more visible, leading to an increase in organizational champions for integrating youth engagement within the organization (Jenkins, Bungay, Patterson, Saewyc, & Johnson, 2018)
* Organizations develop and implement solutions that are relevant to youth, increasing effectiveness and positive health outcomes (Jenkins et al., 2020)

## Youth engagement models

Efforts to engage youth in health promotion should be grounded in theoretical frameworks and models related to youth empowerment and action. There are several different frameworks and models but there is no single, most effective way to engage youth. Successful youth engagement may require a tailored approach based on unique needs and resources available (Dunne, Bishop, Avery, & Darcy, 2017). The following youth engagement frameworks and models have commonly been used in creating and implementing youth-focused health promotion and injury prevention programs and projects.

### Roger Hart Ladder of Participation

Hart’s Ladder of Participation outlines the eight levels of children and youth participation, from disengagement to meaningful engagement (Hart, 1992). The ladder starts with constructs of nonparticipation:

* manipulation
* decoration
* tokenism

The ladder progresses to increasing levels of meaningful youth participation and decision-making power:

* youth are assigned and informed
* youth are consulted and informed
* the initiative is adult-initiated but youth share decision-making power
* the initiative is youth-initiated and directed
* and the top rung of the ladder, the initiative is youth initiated and they share decision-making power with adults.

The Ladder of Participation challenges organizations to think about the level of youth engagement that is needed and barriers that need to be overcome to have meaningful engagement.

### Critical Social Theory of Youth Empowerment

This model was created after examining four previously existing youth development and empowerment models (Jennings, Parra-Medina, Hilfinger-Messias, & McLoughlin, 2006). According to this model, there are six key dimensions to critical youth empowerment:

* a welcoming and safe environment: youth are valued, supported and respected; they are encouraged and feel comfortable sharing their feelings; they can experiment with ideas and different skills, and have fun and social interaction
* meaningful participation and engagement: the opportunities are relevant to young people and they are able to practice leadership skills and other important skills such as planning, communication and advocacy
* equitable power-sharing between youth and adults: adults provide youth with support, resources and expertise to lead but without dominating
* engagement in critical reflection on interpersonal and sociopolitical processes: enable youth to increase their understanding of community, institutional and bureaucratic processes and structures and provide space for critical reflection and subsequent action
* participation in sociopolitical processes to effect change: enable youth to have the capacity to understand and address issues within their communities and effect change
* integrated individual- and community-level empowerment: provide opportunities that result in development and empowerment at both the individual and community levels

This model stresses that not all youth will experience empowerment the same way when applying this model as there are many power inequalities in race, class, gender, culture, sexuality and more that can have an influence.

### Positive Youth Development

This framework posits that there are four domains that organizations must meet to have strong, productive and healthy youth engagement programs (Hinson et al., 2016):

* **assets**: youth have the resources, skills, and support to achieve the desired objectives
* **agency**: youth employ their assets to make decisions, set and achieve goals, and influence action in their communities
* **contribution**: youth are provided with opportunities that allow them to participate in ways that are relevant and comfortable to them
* **enabling environment**: youth can work in an environment that develops their assets and agency as well as feel safe, secure and protected

### McCain Model of Youth Engagement

The model outlines effective strategies to engage youth in programming and decision-making (Heffernan et al., 2017). Implementing this model creates an environment for youth to engage in shared decision-making and reciprocal learning. There are five main tenets of the McCain Model of Youth Engagement:

* **flexibility**: providing youth with opportunities that can be adapted according to differing skills and skill levels that youth may have
* **mentorship**: providing youth with guidance and support in developing their skills, building relationships and achieving goals
* **mutual respect**: ensuring shared powwer between youth and adults and creating an environment that is welcoming and safe
* **authentic decision-making**: ensuring that youth are partners in decision-making instead of being merely consulted
* **reciprocal learning**: recognizing that youth are experts, and they can teach adults while also learning from them

## Promising practices in youth engagement

There were several recurring themes across the studies with respect to what works when meaningfully engaging youth in developing health promotion and injury prevention programming and initiatives.

### Invest in relationships with youth

It’s important to put time, effort and resources into building relationships with youth. Young people know when adults use youth in a tokenistic manner. Spending time to learn about their interests, listen to their stories and mutual sharing between youth and adults are important to develop a sense of trust and enable youth to feel comfortable asking questions and being vulnerable (Cordellieri et al., 2016). Policies, procedures and guidelines have to be co-developed with youth and made to ensure youth are involved in a way that is inclusive. These guidelines can be iterated frequently to establish a culture where youth of differing experiences and ages feel safe and comfortable doing the work that they are doing (Ramey et al., 2019; Nolan, Coker, Ward, Williamson, & Harley, 2021).

### Provide youth with incentives and opportunities that benefit their growth

Many organizations provide compensation in different forms to acknowledge the value that youth provide and as a strategy to recruit and retain youth. This can include a stipend, gift cards, free meals, access to community resources, workshops and access to mentors. Providing youth with support completing post-secondary school and job applications is another common incentive that programs offer youth (Nolan, Coker, Ward, Williamson, & Harley, 2021).

### Establish a feedback loop

Providing youth with a consistent, ongoing platform for engagement and transparency with respect to how youth input is being used is key. Many organizations employ the feedback loop process to inform youth of how and why their input was used or not used in their organizations’ projects and initiatives. The feedback loop can provide youth with a look of the impact of their input and how they have co-created change within their community. This can motivate youth to be engaged and contribute their ideas (Ramey et al., 2019; Henderson, Hawke, & Relihan, 2018).

### Be flexible and open to change

Youth have multiple priorities, differing abilities, differing experiences and differing levels of comfort in participating. Recognizing this, it is important to encourage engagement with all youth at the table and to make the work that youth do an easier, accessible and smoother process. Organizations should be flexible and comfortable with ambiguity. This means providing generous time frames for deadlines, being receptive to different ways of communicating and different types of knowledge and experience (Ramey et al., 2019). Young people like structure but would also like to make their own choices. There needs to be transparency around engagement that is non-negotiable and where there is flexibility. Providing a variety of experience to suit different skill level and interests can also be effective in retaining youth engagement (Johnson, 2020; Henderson, Hawke, & Relihan, 2018).

Young people also adopt new technology and trends quickly and have a keen ability to predict the next big thing before the public. Approaches to health promotion and injury prevention should be open to change and growth and done in collaboration with young people to ensure materials are reflective of the changing trends (Johnson, 2020).

### Let youth take the lead

Having youth in leadership roles gives youth ownership over initiatives and enhances relatability to other youth. This can foster a sense of comfort and confidence in youth expressing themselves. A shared partnership that facilitates youth empowerment and enables a degree of autonomy is important. This can look like having youth run their own social media platforms, manage their own decision-making, providing training opportunities for skill development and focusing on issues that are relevant to them (Johnson, 2020).

## Examples of youth engagement in health promotion and injury prevention

There are many strategies to meaningfully engage youth in health promotion and injury prevention. The strategies below have been implemented across many health promotion and injury prevention areas, including road safety, mental health, substance abuse, and sexual and reproductive health. Many programs and interventions outlined integrate multiple strategies and modify strategies used by others according to their needs.

### Youth-led program development

One of the most direct forms of youth engagement is youth participation in program development. This can range from light-touch participation, such as soliciting feedback using comment boxes and surveys, to primary decision-making ability at every program stage (Dunne, Bishop, Avery, & Darcy, 2017). Youth engagement can also be top-down, with youth sitting on boards and committees formalized within organizations, or bottom-up, where youth participate as peer-support workers or researchers (Dunne, Bishop, Avery, & Darcy, 2017). Traditionally, youth were seen as beneficiaries or the target population. However, the shift needs to be made to see youth as partners and agents. Youth’s various identities as community members, siblings, artists, entrepreneurs and more can make health promotion and injury prevention more relevant and responsive to youths’ needs (Johnson, 2020).

Jenkins, Bungay, Patterson, Saewyc, and Johnson (2018) outlines an example of a program that implemented youth-led program development. The researchers hired youth co-researchers to design an evidence-based mental health promotion intervention using different knowledge sources including the youths’ lived experiences. The research team engaged these youth in activities that enabled them to build their skills, such as public speaking skills, advocacy and website management, as well as foster self-efficacy, bonding and prosocial behaviour. Youth also engaged in brainstorming exercises that encouraged them to think big to address the issue of poor community connectedness as a cause of poor mental health. When youth had difficulty with these exercises, the research team sought to inspire them by providing them with examples of youth action that had led to community transformation.

A research methodology often used in youth-led program development is youth participatory action research (YPAR). YPAR is a type of community-based participatory research that emphasizes strengths-based youth engagement, youth inclusion and leadership in all aspects of research, co-learning between youth and adult team members, capacity building with youth and addressing priorities that are relevant to youth (Nolan, Coker, Ward, Williamson, & Harley, 2021). It has a focus on the structural determinants of health and health inequalities and aims to enact social change using efficacy, empowerment and collective capacity (Anang, Gottlieb, Putulik, Iguptak, & Gordon, 2021; Langdon et al., 2016). Through YPAR, youth are provided with skill development and educational opportunities, mentorship, paid work and support with post-secondary preparation and application (Nolan, Coker, Ward, Williamson, & Harley, 2021).

YPAR was used by Anang, Gottlieb, Putulik, Iguptak, & Gordon (2021) to create a youth suicide prevention strategy in an Inuit community. The goal of the program was to build youth and community capacity, including instilling a deeper appreciation of Inuit ways of knowing and the Inuit concept of wellbeing as well as coping skills, efficacy and collective agency for community partners. Youth led weekly meetings to build on the theme of each week to co-produce interventions and organize activities, including tournaments, fundraisers, sewing circles, presentation series and trips out on the land.

Another YPAR intervention was the Lumbee Rite Passage mental health intervention for Indigenous youth (Langdon et al., 2016). Youth leaders developed cultural activities to enhance enculturation, provide social support and improve self-esteem as a means of suicide prevention. This program led to decreased suicidal ideation among community youth and became sustained by youth who wanted to continue their involvement in cultural activities with support from tribal youth services.

Within road safety, YPAR was used in creating a road safety walking tour for newcomer youth in Surrey, B.C. The goal of this intervention was to engage newcomer youth in creating a walking tour that would promote conversation around road safety, resource sharing among youth and their family networks, and improve their wellbeing through meaningful community relationships. Surrey newcomer youth participated in creating painting activities and led conversations about the walking tour and road safety (Art On the Go, n.d.).

A Samoan road safety initiative integrated YPAR to enable local youth to design and implement their own independent road safety projects. Youth were supported and incentivized to collect representative data about road users’ knowledge, skills and attitudes toward road safety legislation and policies, conduct a peer-to-peer capacity building program to increase youth understanding of the safe system approach, and design and implement road safety awareness and education activities (Youth For Asia, n.d.).

### Peer education and messaging

Peer education can be effective in increasing knowledge and changing attitudes among young people as they have a greater propensity to be influenced by their peers (Crocker, Pit, Hansen, John-Leader, & Wright, 2019). Health promotion messages disseminated by teenagers, for teenagers leads to increased buy-in and message believability due to credibility of teenagers within their peer groups. Teenagers’ ability to relate to a message delivered by another teenager is influenced by many factors, including whether the message deliverer’s reputation aligns with the message. For teenaged males, a difficult-to-reach population with health promotion messaging, social marketing campaigns by their role models can be effective. Teenagers often look to their peers on how to act in order to fit in. Young people often weigh the pros and cons of engaging with online health promotion messaging. Engagement depends on whether doing so will result in being rewarded or punished by their peer groups, pre-existing attitudes and behaviours, past experiences with health behaviour and level of involvement with the organization running the campaign (Dunn, Pearlman, Beatty, & Florin, 2018). They may hesitate to share because it might lead to them being perceived as “uncool” and not conforming to norms within their peer groups. They feared this could lead to offending peers, jeopardizing their relationships and being cyberbullied. This is also why youth are likely to participate in simple engagement such as “liking” instead of creating or sharing due to the effort required and the need to be discreet. Raising a campaign’s awareness in schools and creating buzz within schools and other youth-friendly spaces can help facilitate online engagement (Dunn, Pearlman, Beatty, & Florin, 2018).

There are many examples demonstrating the effectiveness of peer education in health promotion. Crocker, Pit, Hansen, John-Leader, and Wright (2019) used youth peer educators as part of the Positive Adolescent Sexual Health Consortium conference to build confidence, skills, resilience and knowledge of sexual health and health services among both the peer educators and the youth attendees. Peer educators participated a two-day training program. Peer educators led several activities, including facilitating open discussions in a comfortable and relatable environment, theatre performances to cover a range of sexual health issues in collaboration with local youth theatre, and a “What’s Legal, What’s Not” session where youth discussed legalities surround consent and differences between legal obligations and community practice. Using peer educators led to increased sexual health literacy, improved critical thinking and knowledge transfer and improved ability to discuss emotions and sex-related matters with parents and peers among the youth participants.

Nyandoro, Kelly, Macey, & Mak (2016) used peer champions to serve as “faces” of an influenza vaccination campaign. The peer champions were considered influential figures within their student organizations and who commanded respect among their peers. Peer champions were provided training on the efficacy, risks and policy behind influenza vaccines. They disseminated information pamphlet to their peers, delivered weekly reminders in lectures and through social media and their faces were featured on posters appealing to students in school-specific campaigns. This peer champion strategy led to a 20-per-cent increase in influenza vaccinations among students.

Wilson et al. (2016) recruited, hired, trained and supported Indigenous youth leaders to organize and lead art workshops that explored the link between HIV and structural inequality with their peers. The art-making activities were culturally relevant – including carving, painting, throat singing and drumming – and contemporary, including photography, theatre, and hip hop. Youth leaders also led interactive games to support HIV education, including Sexual Health Bingo and Connect it!, where youth participants graphically link words related to HIV and colonization. This intervention increased conversations about HIV among youth and community members, encouraged networking, and the use of cultural activities was important for youth empowerment and healing.

The Healthcare Traveling Roadshow used near-peers to educate rural high school students in different communities about rural health careers (Maurice et al., 2019). Near-peers were healthcare students in their early to mid-20s. Near-peers worked with community partners to identify specific community needs and tailored the roadshow accordingly. The intervention led to an increase in rural youth indicating that they would practice healthcare in a rural community and an increased understanding of what this would entail.

### Capacity building

Youth capacity-building initiatives entail supporting skill and competency development in youth to improve youth empowerment and wellbeing. Jenkins et al. (2020) outline an example of a capacity-building program for youth mental health policy based in the Positive Youth Development model. Using multimedia, applied activities and facilitated activities, youth learned about mental health promotion, social determinants of health, resilience, youth rights, understanding policy youth roles in policy change, health inequities, accessing and interpreting evidence, campaign development, evaluation and more. Equipped with increased knowledge and skills, the youth were then provided with supports to identify factors that impact youth mental health that can be targeted for policy change. They developed strategies and action plans to engage with stakeholders to enact necessary policy development. Youth also developed a sustainability plan for youth policy engagement.

Grounded in Youth Empowerment Theory, the Youth Tobacco Advocacy Training Program trains youth to be advocates to promote tobacco control policies (Cardarelli et al., 2021). High school students participate in skill-building activities throughout their training and monthly booster sessions. Training includes community assessment and developing elevator speeches to talk to policymakers and government officials about policy change.

The youth leadership program in the injury prevention initiative outlined in Myers, Orr, Vered-Chen, and Baron-Epel (2021) provided youth with a toolkit and training where they learned about injury data, causes, mechanisms and means of prevention to allow them to effectively lead injury prevention training in their communities.

### Integrating art

Using creative arts-based youth engagement methods in injury prevention can lead to improved memory, development of critical thinking skills and increased candid conversations on road safety. Arts-based intervention can make injury prevention more accessible and engaging for young people. Examples of activities that support arts-based youth engagement include making crafts, journey maps, creating traditional and digital games, painting a mural, and having young artists help create social media content and marketing material as well as documenting events (Johnson, 2020; Kemoli, 2020).

Photovoice is a popular method often used with youth where youth use photographs that they take to communicate, from their point of view, the strengths and weaknesses of their community and how it impacts themselves, their families and their health. Employing photovoice can encourage dialogue on relevant issues as well as promote social change by using the photographs to communicate to policymakers and the public. Cook, Shank, Bruno, Turner, & Mann (2017) looked at the Mountain Air Youth Photovoice Project, which engaged youth in the Appalachia region to share their perspectives via photographs on the environmental determinants of respiratory illness and engage them as advocates for environmental health change (Cardarelli et al., 2021).

Theatre and drama-based sexual health education has been shown to be an effective strategy accessible to many different communities and age groups. Roberts, Lobo, and Sorenson (2017) studied the Sharing Stories youth theatre program, which empowered diverse community members to break through cultural barriers by becoming peer educators using theatre, filmmaking and drama. The program uses the Theatre of the Oppressed methodology, allowing youth to become aware of their potential and do role play that reflects their own reality. Participation in the program led to improvements in knowledge on sexual health, positive attitude toward sexual health and confidence levels.

### School-based initiatives

There are eight characteristics of effective school-based injury prevention interventions (Reed et al., 2017):

* theoretically informed
* uses various teaching methods
* encourages positive relationships
* there is sufficient exposure for behavioural change
* appropriate timing
* has socio-cultural relevance
* implemented by well-trained staff
* evaluation

An injury prevention program for youth in detention outlined the strategies that were effective in engaging this population of youth in a school setting. Youth were receptive to engaging problem-solving activities; having teachers incorporate personal experiences to increase relevance and building positive relationships with students before education takes place; flexible and interactive use of role plays; using pictures and visual materials; providing positive reinforcement for completing tasks correctly; and using minimal and easy-to read text. Among this population, reputation can be important, so unwillingness to perform a risky behaviour may be socially undesirable. Interventions should challenge these beliefs and reframe positive aspects of injury prevention and peer protection. Involving more mature/responsible youth to support younger students can also be effective in addressing beliefs that engaging in risky behaviour is desirable (Reed et al., 2017).

CMDA Business Model is a New York City Public Schools and District of Columbia Public Schools program provider that teaches students to make real-world connections outside the classroom. Some of the strategies they have used to promote Vision Zero among students include having students create targeted campaign messages, organizing youth-led traffic safety events with a focus on streets where young people are travelling and organizing youth safety town halls (Johnson, 2020).

### Vicarious engagement (engaging youth via third party)

Vicarious engagement involves using non-youth to deliver health promotion messages to youth. The program examined in Lauwerier, Van Poel, Van der Veken, Van Roy, and Willems (2020) is an example of vicarious engagement that trained coaches to disseminate health-promoting messages and facilitate positive changes in health behaviour and attitude among at-risk youth. The training provided to coaches aimed to increase their awareness and knowledge of health behaviour effects, strategies to promote health and wellbeing to youth, and tools and skills to encourage youth to adopt a healthier lifestyle. The training increased the coaches’ awareness, improved their knowledge on health behaviours and instilled increased motivation to engage in health promotion practices. Regular, meaningful contact with youth allow coaches to build trusted relationships with them. At-risk youth are likely to be receptive to health promotion messages from coaches due to their status, perceived power and trustworthiness. Coaches can directly provide information and instruction on health behaviour changes, can model positive health behaviour or can act as a social prompt to children to perform positive health behaviour.

The Talking with Teens about Traffic Safety Program (Guo et al., 2020) engages parents to promote safe driving behaviour and traffic safety information to their children. The intervention consists of a clinic-based, health coaching session with parents of teenagers at their annual well-child visit. Parents receive a parent handbook, an interactive practice driving toolkit and a primary care provider endorsement. The health coaches go over the materials with the parent, go over the risk and protective factors associated with driver safety, and provide them with strategies on how they can stay engaged in the first six months of their child’s independent driving journey. Parents who underwent this intervention reported more frequent discussions on traffic safety than parents who did not.

## Youth engagement in social marketing

Social marketing to youth is ineffective when done in isolation and must be incorporated as part of an integrated intervention strategy. Social marketing can also have different effects on different age groups due to factors such as "meta-messaging" and its effect on behaviour norms (Dunne, Bishop, Avery, & Darcy, 2017).

### Digital and social media

The interactive characteristics of digital and social media make these tools useful for promoting health behaviour change among youth. Digital and social media can promote positive health outcomes in youth and provide opportunities to express their opinions, have their voices heard on issues that are relevant to them, enable them to create messages in different forms including videos, photos, written material or art, and be recipients to accurate health information (Park, Kulbok, Keim-Malpass, Drake, & Kennedy, 2017). Please see [Youth-targeted tools and platforms](#Youth) for more on digital and social media as tools of engagement.

### Innovation contests

Innovation contests are a form of crowdsourcing where non-experts are called on to provide solutions to relevant and emerging problems. It has been used to promote public health in many context, including shaping policy, HIV testing and encouraging condom use. These contests stimulate discussions on public health topics and encourage target populations to come up with solutions that impact them. Zhang et al. (2017) looked at an innovation contest that sought out youth to help develop sexual health messaging and campaign materials that would resonate with their peers. Youth involved in promoting the contest and generating ideas for it indicated increased knowledge and health attitudes toward sexual health and fostered conversations among youth and their peers, community-based organizations and public health authorities.

### Peer crowd targeting and influencers

Peer crowd targeting in public health uses tailored messaging targeted to subcultures of young people who share interests, behaviours, norms and values (Guo et al., 2020). Peer crowd targeting often uses influencers who are part of the subculture that youth belong to disseminate information. Fresh Empire is an example of a tobacco cessation intervention that targets hip hop youth who centre their interests around hip hop culture and are mostly multiracial, Black or Hispanic. Fresh Empire established itself as a health brand and aimed to change knowledge, attitudes and beliefs related to tobacco and spark positive messaging around tobacco cessation and prevention within young people and their social environment. This intervention used broadcast and digital ads, organic and paid social media, a website and events to do this. Fresh Empire purchased ad space on Facebook, Instagram and hip-hop media platforms such as complex.com. They took incorporated messages associated with important hip hop events and trend such as the Black Entertainment Television (BET) awards. They also used an influencer strategy where they used micro influencers, who have built their following around a niche topic, and local influencers who are popular teenagers and who can have a local impact. Local influencers apply to join the campaign, often motivated by personal experiences. They receive training on tobacco messaging and how to engage with youth at events. They promote the campaign messages within their social networks, at local events and on their social media accounts using their own organic content.

Youth-targeted tools and platforms

## Social networking sites

Social media can increase engagement in health promotion and injury prevention as it can reach large audiences, enable wide dissemination of health information, allow for highly personalized and tailored messages to target audiences, increase the credibility of information shared between contacts and augment the effectiveness of in-person programming (Andrade, Evans, Barrett, Edberg, & Cleary, 2018). There are several ways that social networking sites (SNSs) can be used in health promotion and injury prevention (Giustini, Ali, Fraser, & Boulos, 2018; Hargittai, Füchslin, & Schäfer, 2018):

* Use as a tool for health education to provide information on many topics
* Facilitate dialogue among health professionals, scientists and the public
* Collect data and feedback on the public’s experiences and opinions regarding health topics
* Use as a platform for online consultations

Several systematic reviews showed increased interactions with health content on social media triggered positive changes in managing health problems. It can also provide benefits in terms of improved care, self-efficacy and adoption of healthy lifestyles (Giustini, Ali, Fraser, & 2018). In health promotion interventions, social media was used to disseminate information and provide social support but while these were acceptable uses, users preferred face-to-face components more than social media interaction (Klassen, Douglass, Brennan, Truby, & Lim, 2018). Interventions with the highest levels of acceptability and engagement used private Facebook group where users and experts shared health information and tips, posted events, conducted polls and posted other interactive content.

It is important to understand social media preferences and concerns of the target audience and tailor messages to both target audiences and the platform that messages are being disseminated through (Arigo, Pagoto, Carter-Harris, Lillie, & Nebeker, 2018). There are three types of social media users that need to be accounted for when planning health promotion messaging and interventions (Fergie, Hunt, & Hilton, 2016; Ridout & Campbell, 2018):

* Non-engagers or lurkers, those who have reliable offline support and so have limited engagement in health-related content
* Tacit consumers, those who consume user-generated health content but don’t contribute any themselves
* Prosumers, those who have low levels of offline support but high levels of production and consumption of health-related content

Day-to-day identity management plays a significant role in determining social media user choice and can be a barrier to engaging with health content (Fergie, Hunt, & Hilton, 2016).

Youth embrace SNSs that offer them the most autonomy, which is why YouTube, Instagram, Snapchat and TikTok are the most popular for those under 30 years old (Auxier & Monica, 2021; Sezgin & Lin, 2019). SNSs that were not specifically developed as digital health resources for young people, such as YouTube, Instagram and Tumblr, often suit young peoples’ needs when finding resources. Young people appreciate being able to connect with peers, find emotional support and often see social media as one of their major sources of news, science and knowledge (Andrade, Evans, Barrett, Edberg, & Cleary, 2018; Hargittai, Füchslin, & Schäfer, 2018). Young adults click and comment on science and research content on social media more frequently than other topics such as finance and the economy, election news and political campaigns. They are more likely to click or comment than to share (Hargittai, Füchslin, & Schäfer, 2018). Social media can also be used to reach and engage with young people who may not otherwise seek out health information in traditional settings.

There are five types of social media content that influences young people’s health knowledge, attitudes and behaviour:

* Automatically sourced content, health-related content that SNSs select and promote to young people e.g., Instagram’s search and explore page exposes users to content based on their likes, who they follow and their followers’ likes
* Suggested or recommended health-related content, specific health-related content that young people search for, which leads to SNSs promoting partially related content on their accounts; this type of content can limit or exclude young peoples’ access to a range of information
* Peer content, health content created by peers in young peoples’ network
* Likes, an interactive function on SNSs which can be considered a form of content due to its relatedness with social purposes such as affirmation of health-related information; likes can help young people determine whether they should engage with or use the health-related information or not; liking a post is often positioned as an endorsement for the health information or behaviour emulated in the post
* Reputable accounts, access and engagement of health-related content by young people is influenced by which social media accounts disseminated the content and how it is framed; those considered reputable among young people include official organizations, celebrities, athletes and commercial brands.

Official organizations were found to have the strongest influence on changing young people's health-related behaviours. Reputable accounts post common-sense assumptions about health, limit the range of information available to young people and influenced young people through affect (Goodyear, Armour, & Wood, 2018). Young people can have difficulty determining credibility of information due to the vast quantities of content they are regularly exposed to. Young people often look to trusted adults (parents or medical professionals) to help them make sense of the vast amount of information online. Older youth preferred looking for health information online while younger people sought help primarily from their parents, teachers and other adults.

Certain features of social media content are especially attractive to young people and facilitate their engagement. Visual media such as GIFs and memes are very popular in health-related content creation and sharing. However, visual media should be short and direct as youth are not likely to share if it is too long. Content should be novel and attention-grabbing. Young people like funny, shocking believable content that does not feel scripted. Messages containing humour and fact-based fear strategies can also be engaging, though there is ongoing debate about whether fear tactics are effective in injury prevention (Sezgin & Lin, 2019). Social media influencers, content creators and microcelebrities can also play an important role in conveying health information (Lupton, 2013). Combining social media with traditional media to deliver messaging can also be effective. In an intervention to reduce indoor tanning among female adolescents, combining social media and traditional media led to a reduction in indoor tanning use in this population by more than 30 per cent and also decreased the number of adolescents who started indoor tanning at age 15 (Falzone et al., 2017).

There are many social media tools that have been used to engage youth in health behaviour change and injury prevention. Below are some of the most popular platforms, outlining some best practices and examples of use.

### Instagram

YouTube and Instagram are the most popular social media platforms among young people (Auxier & Monica, 2022). Instagram can be used in a variety of ways to engage youth in health behaviour change. It can be used to demonstrate safe behaviour through image-based posts that demonstrate and explain safe behaviour. Images and messaging on Instagram should match and be developed based on health behaviour theory to attract young people’s attention and increase recall of safety information (Manganello et al., 2021). Youth dislike static content such as static text and images and are more receptive to short videos (Ibrahim et al., 2021).

Adolescents tend to like Instagram posts that have inspirational quotes, colourful images, opportunities to win prizes, memes, selfies and photos of their family and friends (Thomas, Chavez, Browne, & Minnis, 2020). A seatbelt campaign called BuckleUp4Life found six main appeals used in the photo, text, and caption of an Instagram post:

* rational appeal
* ego appeal
* social appeal
* fun appeal
* positive emotional appeal and
* fear appeal

The study found that high school students preferred rational appeal, or providing justification for seatbelt use, over the others as demonstrated by the number of likes. They also engaged more with positive emotional appeal that were found in text and caption and fun photos. They did not engage as much with selfies of individuals wearing seatbelts, likely because they were not individuals these students knew, and they did not like fear appeal (Zhang, Drake, & Ding, 2020).

Instagram can also be a useful tool for recruiting youth to health promotion interventions by reducing barriers to participation, increasing participant comfort in participating and meeting COVID-19 regulations. Kutok et al. (2021) used targeted Instagram ads to recruit adolescents from the United States to complete a screening survey for a randomized control trial. Ads were placed in stories, feeds and the explore page. The study showed that using Instagram is a feasible, cost-effective and efficient platform for recruitment. The disadvantage of solely using Instagram to recruit is that it reduces the recruitment of low socioeconomic status youth, racial and ethnic minorities and other at-risk youth (Kutok et al., 2021).

Youth can be engaged to create health content, including imagery, messaging and design, for Instagram. In a study by Thomas, Chavez, Browne, and Minnis (2020), researchers held design sessions to understand how adolescents used Instagram, the types of content they liked and shared and what kind of Instagram content they would create for the study. Youth ambassadors co-created content, including captions, designing graphics that included memes, GIFS and videos, and engaging followers through interactive components such as polling in Instagram stories. The researchers found it was difficult to have youth follow an account as youth wanted to appear “cool” to their peers by having a higher follower count than following. This is called the Cool Ratio. Youth-friendly accounts were more likely to have youth engagement and likelihood of sustained participation. The study also found that stories were the most engaging among youth as it netted more views than likes received on feed posts (Thomas, Chavez, Browne, & Minnis, 2020).

Other Instagram strategies that youth were receptive to include regularly posting behind-the-scenes footage and friendly reminders of upcoming events on Instagram stories, using relevant hashtags as a gateway for those following the hashtag, using current norms and trends within content, including the username of influencers within posts to get the information on youth’s radar, highlighting a clear call to action and not having too much text (Andrade, Evans, Barrett, Edberg, & Cleary, 2018; Manganello et al., 2021; Kutok et al., 2021).

### TikTok

TikTok is a popular social media platform among teenagers and is characterized by short videos under three minutes with simple-to-use editing and music functions. It has been used in healthcare for patient empowerment, health promotion, building patient-physician relationships, public health surveillance and quality improvement (Zhu, Xu, Zhang, Chen, & Evans, 2020). In a Chinese study looking at the types of TikTok videos posted by local health committees, the videos with the most engagement are those that involved cartoons, were done in a documentary style, promoted health professional images and disease knowledge, those that instilled feelings that caused the viewer to be moved, had a sense of humour or excitement, and were within 60 seconds. Engaging with regional influencers such as athletes and movie stars and having a pro-interaction environment where creators engage with their audience in content-creation and promotion can also increase public engagement (Zhu, Xu, Zhang, Chen, & Evans, 2020).

### Facebook

Facebook is more popular for middle age and older adults though young people may still use Facebook more passively and for specific purposes (Arigo, Pagoto, Carter-Harris, Lillie, & Nebeker, 2018). Facebook can be a platform for posting about personal experiences, asking questions and receiving feedback on health-related issues.

Youth tended to be passive consumers of content and are more likely to interact using clicks and likes but more hesitant to comment, share posts or independently post user-generated content. Facebook can be a place to construct one’s online persona and can be seen as too “public and cringey” by youth. Liking is seen as endorsement and personal association with the topic of the post or page (Fergie, Hunt, & Hilton, 2016). This is consistent with online identity management among youth, a process that ensures the social media content they create and engage with is inline with their personal brands. Interventions and campaigns should examine the intersection between youths’ personal brands and the intervention’s or campaign’s messaging as discrepancies can be a barrier when asking youth to share health messages within their networks.

In a primary prevention intervention study that used Facebook to target Latino immigrant youth, the authors found a few features that young people were receptive to posting photos that featured the youth, program update, and bilingual posts. Other recommendations for youth-targeted Facebook posts include working with youth to find compelling imagery to incorporate into posts, choose keywords reflective of likes and interests common among youth, and monitor campaigns using Facebook analytics to see which times and posts are performing the best among youth (Arigo, Pagoto, Carter-Harris, Lillie, & Nebeker, 2018).

### Twitter

Twitter is popular for expert debates about science and research but not generally used among young adults for science and health content (Hargittai, Füchslin, & Schäfer, 2018).

## Online course-based tools

Online, course-based tools can be effective in generating awareness and educating youth in health promotion and injury prevention. Four main factors impact engagement and recruitment in digital health interventions:

* personal agency and motivation
* personal life and values
* the engagement and recruitment approach
* the quality of the intervention (O’Connor et al., 2016).

McDonald, Brawner, Fargo, Swope, and Sommers (2018) examined "Let's Choose Ourselves", a theoretically grounded, web-based intervention to decrease adolescent distracted driving. The intervention’s target audience is newly licensed adolescent drivers and aims to address distractions from cellphone use and peer passengers. To develop the intervention, researchers conducted focus groups to ask youth about their perceptions on cellphone use and peer passengers. The intervention is delivered through a secure Learning Management System and has sections on general content on adolescent driving, ideas behind the intervention, cellphone use, peer passengers and wrap-up. The module had interactive activities including click and find out, multiple choice questions and driving simulator videos. The intervention also addressed incorrect attitudes such as hands-free communication being safer and the impact of peer passenger on driving. Young driver participants are given a menu of options with practical solutions about what they could do to avoid their phones and limit passenger distractions while driving. Providing options gave them the freedom to choose what worked for them as well as an option to indicate if they didn’t like any of the choices.

Ibrahim et al. (2021) looked at creating a science-based, accessible and non-cost-prohibitive Massive Open Online Course (MOOC) to teach healthcare workers and students about injury prevention for children and teens. Effective MOOCs ensure that learning experience is aligned with the user’s personal goals. To develop the MOOC, the study team created learner personas to develop the course using the lens of different learner groups. The MOOC had modules with multiple choice quizzes, a discussion board that was available and monitored for further learner engagement of questions, diverse media and frequent assessments. It led to improvement in healthcare workers’ performance and improved patient outcomes.

Moderated Online Social Therapy (MOST) is another web-based intervention that aims to address social anxiety in young males. It incorporates youth-friendly features such as expert clinical moderation, evidence-based therapeutic content delivered through bespoke comics, peer-to-peer social networking, accessible language and minimal jargon. It also provides therapy modules delivered in steps with behavioural tasks that users can implement in the real world. This intervention led to improved outcomes among many clinical and social indicators (Rice et al., 2020).

A mental health campaign that used online animations to enhance mental health literacy highlighted what works when using animations in health promotion: Keeping videos to no more than two minutes to maintain view attention and engagement, using minimal and simplistic animation style without overly polished characters, using first-person narrative voice-over, adding subtitles for accessibility and using social media as a means of low-cost promotion and high level of user engagement (Coughlan et al., 2021).

## Mobile applications

Young people prefer mobile apps over web-based interventions and appreciate receiving notifications on their phones (Ridout & Campbell, 2018). Perceived usability is an important principle in user-centred design and can impact uptake and engagement with the intervention (Shi et al., 2021). In a study looking at mental health app, ThoughtSpot, young people outlined a few features that made the app useable: easy-to-use, usefulness of the content visually appealing, functionality and intuitive.

There are many apps designed to prevent drivers from using their cellphone when driving. The purpose of these apps is to focus on driving and keep drivers’ eyes on the road by disabling phone functions such as texting once the phone senses the vehicle is in motion. A review on smartphone applications that prevent cellphone phone use while driving was reviewed (Oviedo-Trespalacios, King, Vaezipour, & Truelove, 2019). The most common distracted driving apps include Android Auto and Do Not Disturb While Driving on iPhone. Mobile phone functionality has changed significantly over the last decade to allow activities other than talking and texting, including GPS, listening to music, navigating social media and gaming. Apps that prevent mobile phone use while driving may not be able to prevent visual manual interactions such as GPS and streaming music.

Some apps use a reward and punishment model. This includes DriverAlertNow, which informs parents of mobile phone use while driving among young drivers; Text Ninja, which provides incentives for groups of drivers to monitor their driving performance and engaging in safe driving behaviour; and usage-based vehicle insurance schemes that provide either discounted or higher rates depending on driving behaviour and have been shown to be effective in improving driver behaviour (Oviedo-Trespalacios, King, Vaezipour, & Truelove, 2019). In order for these apps to be effective among young drivers and to prevent young drivers from overriding or disabling the app, they have to accept the app as a tool that can help them and must encounter minimal barriers. Whether or not an app is free influences drivers’ adoption and use of an app. Maladaptive attachment to mobile phones also prevents apps from fully stopping risky phone behaviour as these drivers are less likely to turn on the application (Oviedo-Trespalacios, King, Vaezipour, & Truelove, 2019). Overall, to motivate young drivers to use these apps, they must be free or low cost and there should be incentives, though the impact of the apps may be temporary (Sezgin & Lin, 2019).

## Gamification

Gamification is the addition of game elements such as scoring points, a reward system or participating in quests in non-game contexts. Quality computer games have shown to increase concentration, improve information retention, facilitate deep learning and instill behaviour change. Computerized game-based approaches have been used to educate, motivate and persuade users in health promotion through gamification. Factors that encourage engagement in gamified approaches include achievement, exploration, sociability, domination and immersion. Gamified mental health interventions have shown to have a significant effect on depressive symptoms and promising results. Factors that maximize the impact of gamified health intervention include having a user-centred approach by exploring the preferences and motivations of user groups, ensuring the intervention is engaging (e.g. interactive content), relatable situations or characters, visual appeal, development through intersectoral and international collaborations and rapid testing and implementation (Fleming et al., 2017; Garrido et al., 2019). Interventions that had unappealing interfaces, technical glitches and juvenile materials deterred users from engaging with the intervention. Many also don’t like a highly educational focus and if it appears to be designed for younger children.

Gamified driving apps are usually centred on economic concerns, such as fuel consumption or anticipatory driving. Young driver users indicated that they want a degree of challenge to make driving fun, be able to interact with others and personalize the app. Gamification has been shown to decrease unsafe driving by decreasing driving boredom though it can cause an increase in cognitive workload when driving and slower reaction times. It can also instill intrinsic motivation in young driver and thus promote safe driving behaviour (Sezgin & Lin, 2019). It is important to obtain feedback from young people when co-designing gamified interventions to ensure the content and aesthetics are appealing and not oversimplified (Lupton, 2021; Garrido et al., 2019). Youth like gamified health apps that are free, had rewards, are easy to use and had visual and auditory cues. However, they did not like to link the apps to social media (Lupton, 2021).

## Virtual reality and simulation

Virtual reality driving simulations allow participants to interact with a driving console and a virtual world in real-time. It can offer a safe environment to assess and provide targeted interventions for young people who are in the process of obtaining a driver’s licence. One study showed that a virtual reality driving simulation can led to improved tactical performance in driving in youth with Autism Spectrum Disorder, a population that has challenges with executive functions, shifting attention, sequential task performance and other skills needed for driving (Cox et al., 2017).

## Digital storytelling

Prevention and Preservation is a digital storytelling-based intervention where Indigenous youth and Elders created videos about the impact of colonization on eating habits, gathering, harvesting and eating traditional foods. This method is a visually appealing and accessible way to tell personal stories of community connection and cultural continuity as a means of decreasing negative health outcomes and increasing resiliency in Indigenous youth. Youth researchers and participants planned, designed and evaluated these workshops. Youth leaders were trained in creating digital stories, leadership and facilitation skills. This intervention led to increased critical thinking, allowed for deep reflection and created positive change and connection between youth and Elders (Fletcher & Mullet, 2016). Photovoice is another example of a digital storytelling method popular among youth and youth-based research.

## Edutainment

Edutainment uses melodramatic narratives to educate audiences on a variety of topics. It can be an effective health promotion tool though it faces stiff competition in environments already saturated with other forms of entertainment. Wang & Singhal (2016) examined a health promotion intervention that uses a TV series called East Los High to educate audiences about contraceptive methods, sexual health and modelled positive sexual attitudes and behaviours. Viewers indicated strongly identifying with the main characters of the show. This intervention also uses transmedia storytelling, where narrative elements are co-ordinated across different media platforms such as apps and websites, engage a broader spectrum of audience and provide enriching experience. East Los High was targeted toward Latino/Latina youth and led to tangible health-behaviour change, including increased information seeking on sexual health, increased discussions with friends, siblings, parents and relatives through social media, text messages and phone, and an increased awareness of health services available for pregnant youth. This study shows that transmedia edutainment can be a sustainable platform for large-scale, longer-term audience engagement (Wang & Singhal, 2016).

What works and what doesn’t work in youth-targeted campaigns

## What works

### Messaging should be relatable, educational and fun

The better the message aligns itself with a young person’s individual preferences and interests, the more intrinsically motivated they are to engage in behaviour highlighted in the messaging (Michel, Tachtler, Slovak, & Fitzpatrick, 2019). Young people want to hear messages expressed in their own language. Using youth lingo and pre-testing messages with youth before disseminating it to the public are effective ways to ensure messaging resonates with them (Lems, Hilverda, Broerse, & Dedding, 2019; Beck & Reilly, 2017). The messenger should also be someone who corresponds to young people’s daily lives. Youth still want to validate information for accuracy and will look for links to trusted websites, logos from official sources, production value and language used (O’Brien, Klauer, Ehsani, & Simons-Morton, 2016). Youth also liked health messages that were wrapped in entertaining, novel and fun activities such as making vlogs or cooking workshops (Park, Kulbok, Keim-Malpass, Drake, & Kennedy, 2017; Lems, Hilverda, Broerse, & Dedding, 2019).

### Messaging should promote self-efficacy

Messaging that demonstrates how to engage in safe behaviour or reducing risky behaviour, and the importance of doing so, is effective in enacting health behaviour changes. These messages should also include barriers to health behaviour change and ways to overcome these barriers (Robertson & Pashley, 2015). These types of messaging are likely to instill confidence in young people to engage in safe behaviour and invoke greater change than those that use fear or scare tactics. Youth who are more likely to engage in risky behaviour are most likely to ignore or reject road safety messages if it is not well constructed (Robertson & Pashley, 2015).

### Engagement with content should be low effort and interactive

Youth prefer more interactive and immediate communication, especially as they are moving away from passive media such as television and more toward interactive types of media such as social media and games (Michel, Tachtler, Slovak, & Fitzpatrick, 2019). Social interaction, meaningful activity, learning new skills and knowledge and prizes or free promotional materials are factors that promote youth engagement (Marie Creamer, Hughes, & Snow, 2020). Low-effort engagement, such as dropping an emoji in the comments to indicate endorsement of messaging, can also be effective in getting some engagement from youth and increasing reach of the message (Guo et al., 2020).

## What doesn’t work

### Passive messaging

This is messaging that is usually done through signs, pamphlets, brochures or buttons without a more holistic plan. These avenues of knowledge dissemination can be effective when integrated with other strategies such as weekly text alerts reminding students about the importance of safe driving. One-way messages in general through lectures and public service announcements are also not as effective. Reflection and dialogue are more effective in changing attitudes and behaviours. Young people need to experience something that results in an “aha moment” for them to reflect on what they experienced, what the experience means to them and what they want to do (National Youth Leadership Council, 2016).

### Extreme fear and scare tactics

Extreme fear or scare tactics can only be effective if young people believe that consequences of risky driving behaviour is likely to happen to them and they have the power to prevent these consequences. Extreme fear and scare tactics can result in negative outcomes if not done carefully. Younger and male audiences are more difficult to influence using fear-based campaigns and the effects are often short lived (Robertson & Pashley, 2015; National Youth Leadership Council, 2016).

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Appendix A: Search Strategy by Database

## Main search: Barriers and facilitators to safe driving behaviour in youth

|  |  |  |
| --- | --- | --- |
| **Database** | **Search Strategy** | **Filters** |
| PubMed | (“youth” OR “teen\*” OR “young adult” OR “adolescen\*” OR “student”)AND(“barrier” OR “disadvantage” OR “impact” OR “hinder” OR “obstruct\*” OR “prevent\*”)AND(“facilitat\*” OR “advantage” OR “enable” OR “assist” OR “promot\*”)AND(“safe driving” OR “road” OR “traffic” OR “vehicle” OR “young driver”)AND(“behaviour” OR “behavior” OR “action” OR “attitude” OR “perception” OR “habit”) | English onlyPapers 2016-2022Adolescent 13-18 yearsYoung adult 19-24 years |
| Google Scholar | youth, factor, road, OR traffic, OR "young driver" OR "safe driving" OR vehicle | Papers 2016-2022Sort by relevance |
| youth road safe driving factor | Papers 2016-2022Sort by relevance |
| Directory of Open Access Journals | Youth road safety behaviour | Papers 2016-2022English |
| Youth driver safety | Papers 2016-2022English |
| ScienceDirect(max 8 Boolean operators) | (“youth” OR “teen")AND(“barrier” OR “prevent”)AND(“facilitate” OR “promote”)AND(“road” OR “vehicle” )AND(“behaviour”) | Papers 2016-2022EnglishSort by relevance |

## Main search: Youth engagement in health promotion

|  |  |  |
| --- | --- | --- |
| **Database** | **Search Strategy** | **Filters** |
| PubMed | ("youth" OR "teen\*" OR "young adult" OR "adolescen\*" OR "student") AND ("engagement" OR "partnership" OR "outreach" OR "strateg\*" OR "particip\*") AND ("health promotion" OR "injury prevent\*" OR "solution" OR "public health") | English onlyPapers 2016-2022Adolescent 13-18 yearsYoung adult 19-24 years |
|  | ("youth" OR "teen\*" OR "young adult" OR "adolescen\*" OR "student") AND ("engagement" OR "partnership" OR "outreach" OR "strateg\*" OR "participat\*") AND ("road safety" OR "road\*" OR "passenger\*" OR "traffic") | English onlyPapers 2016-2022Adolescent 13-18 yearsYoung adult 19-24 years |
|  | (“youth” OR “teen\*” OR “young adult” OR “adolescen\*” OR “student”) AND (“engagement” OR “partnership” OR “outreach” OR “strateg\*” OR “particip\*) AND (“health promotion” OR “injury prevent\*” OR “solution\*” OR “public health”) AND ("tool" OR "platform") | English onlyPapers 2016-2022Adolescent 13-18 yearsYoung adult 19-24 years |
| Google Scholar | youth engagement partnership "injury prevention" "health promotion" | Papers 2016-2022Sort by relevance |
| youth engagement partnership "injury prevention" "health promotion" “road safety” | Papers 2016-2022Sort by relevance |
| Youth health engagement tool platform  | Papers 2016-2022Sort by relevance |
| youth health "injury prevention" tool platform engagement | Papers 2016-2022Sort by relevance |
| Directory of Open Access Journals | Youth engagement injury prevention | Papers 2016-2022English |
| Youth engagement health promotion | Papers 2016-2022English |
| Youth engagement driving | Papers 2016-2022English |
| Youth engagement road safety | Papers 2016-2022English |
| Youth engagement tool platform | Papers 2016-2022English |
| ScienceDirect(max 8 Boolean operators) | (“youth” OR “teen” OR “adolescen” OR “student”) AND (“engagement” OR “partnership” OR “outreach”) AND (“health promotion” OR “injury prevention”) | Papers 2016-2022EnglishSort by relevance |
| (“youth” OR “teen” OR “adolescen” OR “student”) AND (“engagement” OR “partnership” OR “outreach”) AND (“road” OR “traffic”) | Papers 2016-2022EnglishSort by relevance |
|  | (“youth” OR “teen” OR “adolescen”) AND health AND (“engagement” OR “partnership” OR “outreach”) AND (“tool” OR “platform”) | Papers 2016-2022EnglishSort by relevance |

Appendix B: Screening Flowchart

Youth driving behaviour: n = 52

Youth engagement: n = 34

Youth-targeted tools and platforms: n = 34

Articles included in synthesis

n = 120

Full-text screening

n = 136

Excluded (due to paywall)

n = 16

Excluded (based on exclusion criteria)

n = 102

Excluded (based on exclusion criteria)

n = 327

Title/abstract screening

n = 238

All articles retrieved from database (duplicates removed)

n = 565

All articles retrieved from database (duplicates removed)

n = 565