Changing Driver Behaviour

Volume 1

THE PROBLEM OF URBAN CONGESTION IN CANADA

The recent CAA study *Grinding to a Halt: Evaluating Canada's Worst Bottlenecks* took a new perspective on a problem that Canadians know all too well: urban congestion is a growing strain on our economy and well-being. Canada's worst traffic bottlenecks are almost as bad as bottlenecks in Chicago, Los Angeles and New York. Bottlenecks affect Canadians in every major urban area, increasing commute times by as much as 50%.

This CAA briefing on investments in active transportation is one in a series that explore potential solutions to the problem of urban congestion in Canada. These briefings delve into solutions not only to highway congestion, but also to congestion on urban streets. Taken together the solutions explored in these briefings represent a toolkit to address this problem. The objective is to inform policy makers and the public about options to reduce congestion and key considerations for when and where a particular solution might be the right fit.

Broadly, behaviour patterns such as the decision to walk, cycle, carpool or take transit, rather than driving alone, have a significant influence on congestion. So do behaviours such as rubbernecking (slowing down to look at a collision). Other briefings examine these topics in detail.

This briefing focuses on some additional underexplored behavioural solutions to urban congestion. The potential benefits can be significant. For instance, in heavy traffic, congestion can be caused by drivers following too closely and then hitting their brakes too hard. Poor driving behaviour can also have costly safety implications. For example the RCMP reports that "drivers who use hand-held devices are four times more likely to get into crashes serious enough to cause injury."[1] In Ontario Road Safety's Annual Report 2014, "following too close" is the second most frequently observed driver action related to crashes. [2]

Unfortunately, there is no easy fix for congestion caused by poor driving behaviour. Ultimately, vehicle automation seems to have the most potential. For example, researchers were able to reduce congestion on a test track when less than 5% of vehicles were equipped with adaptive cruise control, that is, cruise control that maintains a safe following distance.[3] However, this briefing focuses on solutions that may include an element of technology, but that rely more on changes to driver behaviour.

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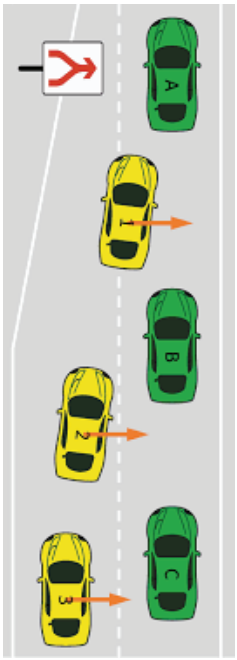
[1] *Royal Canadian Mounted Police (n.d.)*
[2] *Ontario Ministry of Transportation (2015)*
[3] *Stern et al. (2017)*

PROBLEM: CONGESTION ON URBAN STREETS

POTENTIAL SOLUTION: THE ZIPPER MERGE



How does is work & what are the benefits? Encourages drivers to stay in their own lane until the lane ends, and merge alternating vehicles, like a zipper.

Examples: Germany; Austria; US States includig Minnesota, Washington, Missouri, Kansas, multiple Canadian jurisdictions.

According to the Minnesota Department of Transportation, the technique reduces congestion and queues by up to 40%.

CONSIDERATIONS:

- **Late merging should not be promoted where traffic is light. It is most beneficial in more congested areas with less distance between intersections and where there are a greater number of lanes closed at once.**
- **Overcoming the existing driving culture to label drivers who merge late as cheaters is the biggest challenge. Additional promotion of the strategy is required.**
- **The Missouri Department of Transportation encourages zipper merging by not indicating which lane is closed until very close to the closure. Vague warning signs are provided further out, such as "construction ahead".**
- **In some jurisdictions, not allowing a vehicle to merge late is illegal. (i.e. Germany)**

PROBLEM: POOR DRIVING BEHAVIOUR CONTRIBUTES TO CONGESTION

POTENTIAL SOLUTION: BEHAVIOURAL INTERVENTIONS

How does is work & what are the benefits? Multiple strategies include roadway design changes, guidelines for smartphones to have an automatic "driving mode" and increased use of user-based insurance.

All of the strategies are designed to encourage less risky driving behaviour, which has the potential to reduce crashes and in some cases, congestion.

Example: US National Highway Transportation Safety Administration guidelines for smartphones.

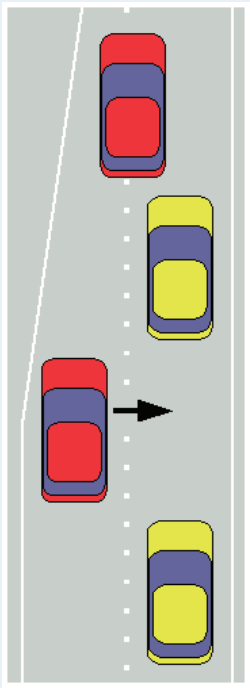
CONSIDERATIONS:

- **Some of the solutions (e.g. design interventions) are very localized, but appear to be more effective than other strategies to improve behaviour such as speed limit changes.**
- **Other behavioural solutions, including smartphone "driving modes" and user-based insurance, require additional research through some initial findings are promised.**
- **Ultimately, greater vehicle automation will reduce the need for some of these interventions.**

THE ZIPPER MERGE

It is antithetical to Canadians' usual politeness: zooming up a clear lane before a construction zone and attempting to merge late at the lane closure pylons, rather than merging early into the through lane at the first sign of construction. Yet, while politeness and consideration are typically preferred when driving, an increasing number of jurisdictions are encouraging drivers to fill up the soon-to-be closed lane and merge at the end of the lane, alternating with drivers in the through lane. This approach, called the "zipper merge" because the alternating vehicles look like zipper teeth, has been shown to reduce congestion.

Figure 1: Zipper Merge



Source: Koenb, Wikipedia

EXAMPLES

There are numerous examples of jurisdictions promoting zipper merging, including in Canada, the United States (e.g. Minnesota, Washington and Missouri) and overseas (e.g. Germany). Although an increasing number of jurisdictions are promoting the zipper merge, it has yet to take hold. Even as this briefing is written, some CAA clubs promote zipper merging (Alberta),[4] whereas others (Northern and Eastern Ontario) have relatively recent articles that suggest the behaviour is "annoying."[5]

Implementation Considerations

A key challenge implementing the zipper merge is overcoming the tendency to move over into the through lane at the first sign of a lane closure. As one of the early adopting US states promoting the zipper merge noted:

> Since zipper merging is "somewhat unique to Minnesota," [Ken] Johnson [Minnesota Department of Transportation's] state work zone engineer surmises that might be one reason drivers are not overly familiar with it. ***But mostly, it's a challenge to change the mind-set of drivers who think others are "cheating," he said***. [Emphasis added][6]

In addition, awareness of the practice can also be an issue. Even though zipper merging had existed in Minnesota for over 10 years, a 2013 survey of drivers indicated that 60% were unaware of the practice.[7] Jurisdictions have to complement roadside signage with media awareness campaigns. The practice is also often listed in drivers' handbooks. Figure 2 shows some of the educational material provided by the Missouri Department of Transportation illustrating the zipper merge and contrasting it with the early merge, which is still often promoted in light traffic conditions.

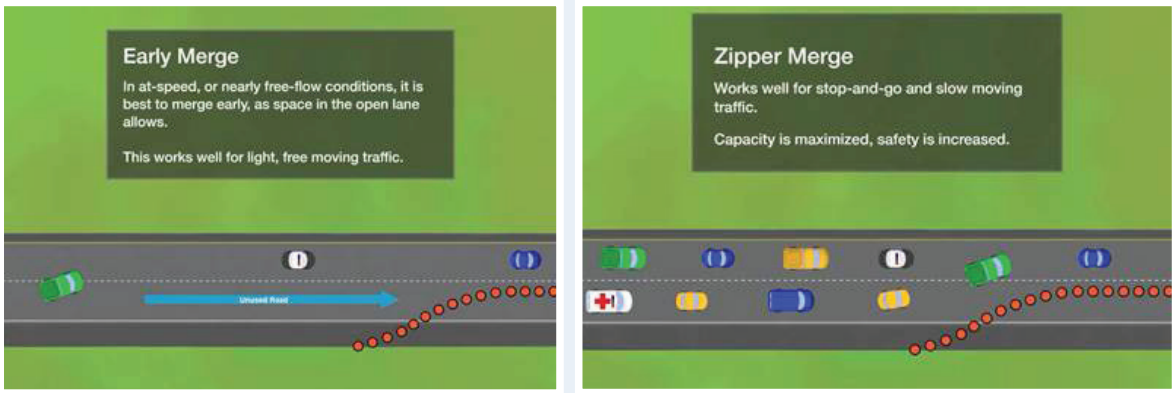
[4] *Harris*

[5] *A 2016 article cites "the Lane-ending Denier" – a motorist that is effectively zipper merging, as an "annoying" driver (***Wimmer 2016***)*

[6] *As cited in Harlow (2013)*

[7] *As cited in Harlow (2013)*

Figure 2: Early Merging Versus the Zipper Merge



Source: Missouri Department of Transportation, http://www.modot.org/workzones/ZipperMerge.htm

In most jurisdictions, the zipper merge is implemented through road signage and promoted with awareness campaigns. However, in Germany, prohibiting a vehicle from merging late is illegal under road safety laws. In Missouri, the Department of Transportation observed that an important success factor was not indicating which lane is closed until much closer to the actually lane reduction. Warning signs are still provided further out, but they are vague, such as "lane closed ahead" or "construction ahead."[8] Jurisdictions that have implemented the zipper merge also remind drivers to merge when it is safe to do so.

Evidence from practice and research indicate that there are several benefits to the zipper merge, including:

- Reduc[ing] differences in speeds between two lanes
- Reduc[ing] the overall length of traffic backup by as much as 40 percent
- Reduc[ing] congestion on freeway interchanges
- Creat[ing] a sense of fairness and equity that all lanes are moving at the same rate.[9]

The benefits of being able to handle a large volume of traffic are particularly important when there is a larger number of lanes reduced, e.g. moving from three lanes down to one. The benefits are larger on roads with higher volumes of heavy vehicles.[10]

Trends Affecting Costs and Benefits

In addition to increasing vehicle automation, the most notable challenge with the zipper merge has been dealing with the notion that it is annoying or impolite to use all available road space.

TREND	WHAT IS IT	POTENTIAL IMPACT ON IMPLEMENTING THE ZIPPER MERGE
Inertia of existing driving culture	The challenge of changing the common opinion that it is annoying or impolite to use all available road space	Increases cost of implementation by requiring additional promotion

[8] *Schmitz (2016)*
[9] *Minnesota Department of Transportation.*
[10] *Breacher et al. (2004)*

BEHAVIOURAL INTERVENTIONS
TO IMPROVE DRIVING BEHAVIOUR

Most research into driving behaviour focuses on improving safety, other researchers focus on reducing environmental impacts, while the smallest portion study congestion solutions specifically.[11] However, as noted in the CAA briefing on "Traffic Incident Management," it is possible that improving driver behaviour can reduce congestion by (1) limiting the amount of time that roadways are disrupted following a crash, (2) reducing the amount of rubbernecking that occurs following a crash and (3) fostering better driving behaviour that also helps to reduce congestion (e.g. driving slower and following less closely so that less hard braking is required). To this end, we highlight three strategies with the potential to reduce congestion: roadway design interventions, promoting guidelines for smartphone design, and studying user-based insurance.

Figure 3: Example of Distracted Driving

Source: Canadian Automobile Association

EXAMPLES

Implementing Roadway Design Interventions – Lake Shore Drive – Chicago (US)

Traffic engineers conduct research into human factors affecting roadway design.[12] In addition, in recent years, behavioural economists have popularized the concept of a nudge. With a nudge, the environment is tweaked to encourage decisions that lead to better outcomes, without removing the available choices. In essence, nudges exploit the natural biases in human decision making.

Taken together, one popularized example of a road design nudge occurred in Chicago, where drivers would often drive too quickly and skid off the road.[13] At a low speed 40 km/h corner on Lake Shore Drive, lines were painted perpendicular to the road while approaching the curve, with each successive line getting closer and closer. The rationale for painting the lines was that drivers would perceive the illusion that they were going faster and faster as they approach the curve, and hence want to slow down. "There were 36 percent fewer crashes in the six months after the lines were painted compared to the same six-month period the year before (September 2006 – March 2007 and September 2005 – March 2006)."[14]

[11] *There is research on the impacts on safety of behavioural interventions such road safety campaigns and driver training. This research shows that such interventions can have a safety impact under the right circumstances. However, there is insufficient research on the connection between these interventions and congestion to conclude that they would be an effective tool to reduce congestion.*

[12] *Batelle and Midwest Research Institute (2012)*

[13] *Thaler and Sunstein (2008)*

[14] *Thaler, R.H. and Sunstein, C.R. (2010)*

This intervention is unique to a specific location in Chicago. One of the challenges with implementing design changes to address driving behaviour is that "the empirical record is far from conclusive with respect to the ability to predict drivers' speed choices associated with relevant geometric, environmental, and traffic factors."[15] However, the same report noted that simply changing the speed limit generally just changes the number of people in compliance with the speed limit, rather than changing driver behaviour. As a result, although the design intervention in Chicago may not be directly applicable elsewhere, design interventions generally show promise to improve safety and potentially reduce congestion.

Other examples of roadway design interventions with the potential to impact congestion, including indirectly by improving safety, include simple measures such as augmenting stop signs with flashing red lights, rumble strips to signal to drivers that they have crossed a lane marking, and "prepare to stop" signage to alert drivers to a stop ahead that is not yet visible. Street design features such as flexible plastic bollards placed at the edge of lanes, which create the illusion that a lane is narrower than it really is, causing drivers to slow down, could also be effective in specific circumstances.

Promoting Guidelines for Smartphone Design and In-Vehicle Technology – U.S.

With the popularization of smartphones, distracted driving is an increasing concern. For example, in the United States in 2014, 1.1 percent of all crashes, resulting in 33,000 injuries, involved the use of cell phones.[16] In Ontario, inattentive driving causes one-fifth of road deaths.[17] This small but important fraction of crashes is certainly an indication of poor driving behaviour. Canadian Transport Minister Marc Garneau has called for tougher national standards and penalties for distracted driving.[18]

In the United States, the National Highway Traffic Safety Administration has issued guidelines for smartphone makers to reduce driver distraction by limiting the time a driver's eyes are off the road, while making sure that devices not being used while driving remain fully functional, e.g. devices being used by a passenger.[19] A key concept here is "driver/driving mode." Like the well-known airplane mode, driver mode automatically locks out certain functions of a smartphone, in this case those that create higher risks of distraction such video and scrolling text. There are several options to activate driver mode, including when the smartphone detects that it is travelling above a certain speed either through its own internal GPS or communications with the vehicle. The guidelines encourage smartphone makers and vehicle manufacturers to improve the reliability and timeliness of the activation of driver mode.

While this is an example of a (voluntary) regulatory mechanism, it relies on the underlying concept of the power of the default option. To illustrate the power of the default option, psychologists studying organ donation rates in Europe found that over 99% of the population of Austria has given consent to donate organs (where consent is presumed), whereas only 12% of the population of Germany has given consent (where consent has to be explicitly granted). Although the issue of explicit versus presumed consent related to organ donation is more controversial in nature, the study nonetheless highlights the power of the default option. In the case of smartphones and driving, even if individuals can turn off driver mode, the inertia of the default option could contribute to less distraction.

[15] *Batelle and Midwest Research Institute (2012)*
[16] *National Highway Traffic Safety Administration (2016)*
[17] *Ontario Ministry of Transportation (2017)*
[18] *Toronto Star (2017)*
[19] *Ibid.*

In its latest iOS 11 update, Apple has created a driving mode which automatically replies to messages with an automated message, although this option must be manually activated.[20] A variety of apps exist that provide helpful verbal input capabilities and audio output such as the reading aloud of text messages.

Studying User-Based Insurance – United States and United Kingdom

Would drivers behave better, potentially reducing congestion, if they knew that their behaviour was being monitored? User-based insurance (UBI) is a model of insurance in which vehicle insurers can vary their rates based on an individual's specific driving behaviour rather than general demographic information (e.g. age, etc.). With UBI, drivers opt-in to having a telematics device installed in their vehicle or on their smartphone, which then monitors vehicle usage (by time of day) and driver behaviour (e.g. hard acceleration, deceleration, etc.).[21] Insurers can then offer discounts to drivers who display "good" behaviour due to lower risks of crashing. One type of UBI is called "pay-as-you-drive" (PAYD) insurance, which is based only on vehicle usage.

While some Canadian-based insurance companies offer UBI, the logistics of how it could be used to support public policy objectives is underexplored. As some have pointed out,

> [UBI] pricing . . . [could] support insurance regulatory [private-sector] objectives, including increased actuarial accuracy, increased insurance affordability, reduced uninsured driving, and reduced traffic accidents . . . [and could] ***also help achieve other social objectives, including reduced traffic congestion and pollution emissions***. [Emphasis added][22]

Early results seem promising: an empirical study found

> that consumers who enroll in the UBI program and allow the automobile insurance company to access their otherwise private driving behavior data become better drivers by the end of the monitoring period and receive discounts (on average of 12%) that apply to all future insurance premiums as long as they remain policy holders with this company.[23]

While there is self-selection bias in this experiment – drivers decided themselves whether to purchase UBI – some drivers improve their behaviour from some combination of the financial incentives and other feedback.

Governments in the United States and United Kingdom, have studied and promoted UBI. In the United Kingdom, the Department for Transport launched a study on the impact of telematics on driving behaviour.[24] In the United States, the Federal Highway Administration is:

> 1) supporting one or more before-after studies of driver behavioural changes resulting from PAYDAYS [pay-as-you-drive-and-you-save] insurance;
>
> 2) helping small and mid-sized insurance companies through an initiative designed to figure out the precise relationship between crash-caused insurance claims and the amount of driving (distance and time in motion), driving conditions (congestion, roadway type, weather and night versus day) and driver behaviours (operating "smoothness" and speed limit compliance). This bolsters companies' actuarial know-how and enables them to offer PAYDAYS insurance products; and;

[20] *Moloney (2017)*
[21] *Collison (2017)*
[22] *Litman, undated*
[23] *Soleymanian, Weinberg, and Zhu (2017)*
[24] *Tong et al. (2015)*

3) working with small businesses and insured drivers to collect, understand and repackage usage-based driving data to coach drivers to improve safety (and to save money) and provide them with multiple PAYDAYS insurance price quotes, thereby encouraging purchases of PAYDAYS UBI products that reward driving reductions and safer driving.[25]

Ultimately, these studies are intended to help explore how these policies could help achieve broader public policy outcomes, such as reduced congestion.

IMPLEMENTATION CONSIDERATIONS

Unfortunately, none of the examples cited above offer an off-the-shelf solution to reduce congestion for policy makers. In the case of the design interventions, these are very location-specific tools. In the case of greater promotion of a Driver Mode or UBI, more research is likely required to understand how to craft effective policies around these tools. For example, Ontario law only permits changes to an insurance discount once per year,[26] yet, further research might suggest that driver behaviour would improve more quickly if it could be altered throughout the year.

Privacy concerns are the key barrier to greater use of UBI. In particular, there are a number of privacy issues associated with UBI in regards to the data collected by insurers. However, many of these issues would exist regardless of UBI. For example, the increasing prevalence of in-vehicle technology and communication capabilities means that vehicle manufacturers already have the ability to monitor driver behaviour.[27] Therefore, privacy concerns with increasing vehicle technology need to be addressed regardless of whether UBI is implemented.

TRENDS AFFECTING COSTS AND BENEFITS

In all of the examples above, while it is clear that certain types of driver behaviour are the ***cause*** of increased congestion, it is admitted that the evidence regarding less-technological approaches to alter driver behaviour is limited. Ultimately, the trend towards greater automation will obviate the need for these interventions in the long-term.

TREND	WHAT IS IT	POTENTIAL IMPACT
Greater Vehicle Automation	Greater vehicle automation will diminish the impact of driver behaviour on congestion. For example, one study found that it was able to reduce behaviour-induced congestion by having less than 5% of vehicles with adaptive cruise control, that is, cruise control which automatically maintains a safe following distance.[28] Yet, intermediate forms of automation (not full automation), may also potentially lead to new types of poor driving behaviour that will need to be addressed, such as drivers falling asleep at the wheel due to the less engaging style of driving.	Diminished need for these policies.

[25] *Greenberg (2015)*
[26] *Financial Services Commission of Ontario (2016)*
[27] *US Government Accountability Office (2017)*
[28] *Stern et al. (2017)*

CONCLUSION

Ultimately, while it is clear that driver behaviour is the ***cause*** of additional congestion, it is less clear that less technological options are the ***solution*** to this congestion. What is clear is that research into approaches to reduce congestion through behavioural changes are underexplored, particularly as they relate to leveraging the greater understanding of the biases in human decision making. It is important to note the interconnection between safety and congestion as they relate to driver behaviour: many interventions aimed at improving safety will also alleviate congestion. Moreover, as noted in other briefings, traffic incidents, many of which result from bad driver behaviour, are the cause of significant urban congestion, and reducing incidents reduces congestion.

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