

A REVIEW OF THE LITERATURE ON AGGRESSIVE DRIVING RESEARCH

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Thus it happens all too often, as an outlet whether of a permanent or temporary state of mind, that sitting behind the wheel a person's whole attitude changes as if the period of driving were not part of real life, but some stage between episodes of real life. Many think only in terms of 'other cars' not of 'other drivers', and thus forgetting all consideration assume a dangerously competitive or even aggressive attitude towards those other cars. The motor car offers man a tremendous increase of power, and by identification it becomes the driver's own power and will which are thus multiplied. The greater this uncritical self-exaltation, the greater the irritation when it is obstructed.

J.J. Leeming
Road Accidents: Prevent or Punish? (1969)

Executive Summary

Research on aggressive driving behaviour has been relatively scant despite sustained interest by the media and wider public. The available research can be divided into two main categories: 1) surveys of the driving public and 2) small-scale field experiments involving small samples of drivers. The surveys provide estimates of self-reported, not actual on-road behaviour. The field experiments have generally been designed to provoke aggressive behaviours in a contrived setting. Systematic observational studies of actual, aggressive driving behaviour on highways are not available. These studies are necessary to improve our understanding of the incidence and causes of aggressive driving behaviour.

Available definitions of aggressive driving are reviewed. These definitions are quite general and tend to exclude violent exchanges arising from traffic disputes where the intent is to harm another road user i.e. "road rage." They suggest that road rage can be viewed as criminal behaviour that can be more adequately addressed through existing criminal statutes rather than through traffic laws and road safety programs.

This review suggests that a more precise definition of aggressive driving would focus on deliberate and willful driving behaviours that while not intended to physically harm another road user show disregard for their safety and well-being. These behaviours are motivated by impatience, annoyance, hostility and/or an attempt to save time. The following formal definition is offered:

A driving behaviour is aggressive if it is deliberate, likely to increase the risk of collision and is motivated by impatience, annoyance, hostility and/or an attempt to save time.

The specific behaviours which constitute aggressive driving would include:

- Tailgating
- Weaving in and out of traffic
- Improper passing (eg. cutting in too close in front of vehicle being overtaken)
- Passing on the road shoulder
- Improper lane changes (failure to signal)
- Failure to yield the right of way to other road users
- Preventing other drivers from passing
- Unwillingness to extend cooperation to motorists unable to merge or change lanes due to traffic conditions
- Driving at speeds far in excess of the norm which results in frequent tailgating, frequent and abrupt lane changes
- Running stop signs
- Running red lights

Displays of annoyance or hostility which are not intended to physically harm other road users but likely to intimidate, irritate, anger or provoke them may accompany these behaviours and serve as indicators of the underlying motivation. These behaviours would include:

- flashing headlights
- sustained horn-honking
- glaring at another driver to show disapproval
- yelling
- gesturing

This list of specific behaviours is preliminary. There is a need to describe some of these behaviours and the circumstances under which they would occur in greater detail. For example, while tailgating is always included on lists of aggressive driving behaviours, we are never offered a more detailed description of what constitutes an unacceptable gap length between two vehicles. These descriptions can best be obtained through observational studies.

The small amount of survey research on aggressive driving indicates that most drivers admit to these behaviours, at least on occasion. However, it appears that survey respondents tend to provide socially desirable responses. It is unclear if the lower incidence of certain behaviours associated with higher collision risks such as running stop signs is due to this tendency rather than to an actual low incidence of such behaviour.

The traffic safety and psychological literature specifically on aggressive driving is limited to twenty-one studies. While insufficient from the standpoint of traffic safety research, these studies have

suggested several factors which increase the likelihood of aggressive driving behaviour. Drivers are more likely to engage in these behaviours if they are:

- relatively young
- male
- in traffic situations which confer anonymity and/or where escape is highly likely
- generally disposed to sensation-seeking or aggressiveness in other social situations
- angry (possibly due to events unrelated to traffic situation)
- believe they possess superior driving skills
- obstructed by unexpected traffic congestion

It is important to emphasize that these findings are only suggestive. They are based on either survey research (not the direct observation of behaviour in traffic) or on exploratory field experiments with small samples of drivers.

Introduction

Leeming's words about British drivers were written thirty years ago in one of the first books to offer a systematic study of motor vehicle collisions. He did not offer any empirical evidence to support his assertion that many drivers think in terms of other cars and not of other drivers. His statement, however, makes it clear that aggressive driving behaviour did not escape his notice.

Formal interest in aggressive driving behaviour as a research topic can be traced back to a short monograph by Meyer Parry entitled Aggression On The Road. Parry's work pre-dated that of Leeming by one year. Also writing in England, he suggested that "the increasing stress involved in motoring nowadays makes the psychological efficiency of the driver a more important factor than the mechanical efficiency of the vehicle he drives" (Parry, 1968). He found that drivers with high scores on tests for anxiety and aggression had a higher crash risk.

Parry's work makes it clear that aggressive driving is not a new phenomenon. What has changed, however, is the amount of attention devoted to the subject. Nevertheless, despite assertions from the media and even some "experts" that aggression on the roads is increasing there is an absence of hard statistical evidence. Surveys on the topic are too recent to provide useful time series data and there has not been a systematic effort to collect the relevant data at crash sites or through spot studies of actual driving behaviour. The truth of the matter is that we simply don't know whether aggressive driving is increasing or decreasing. There is even considerable variation in estimates of how much aggressive driving is actually taking place due largely to differences in how aggressive driving has been defined. The first step towards accumulating the statistical evidence needed to verify both the size of the problem and prevailing trends will be to review definitions of aggressive driving currently available.

Definitions

In a study of aggressive driving, Hauber (1980) defined aggression on the road as actual or intended behaviour which the offender supposes will do physical or psychological harm to the victim and which the victim experiences as such. This definition states that the aggressors must have the expectation that their behaviour will cause victims to experience physical or psychological harm. Hauber, however, does not provide a list of driving behaviours he would include or exclude from this definition.

Mizell (1997) offers a more dramatic and specific definition. For the purposes of his study, aggressive driving is defined as an incident in which an angry or impatient motorist or passenger intentionally injures or kills another motorist, passenger or pedestrian or attempts to injure or kill another motorist, passenger or pedestrian, in response to a traffic dispute, altercation or grievance. This definition focusses exclusively on behaviour intended to physically harm, or indeed, fatally injure another road user.

The Mizell definition is extremely narrow and differs substantially from that offered by the U.S. National Highway and Traffic Safety Administration (NHTSA). In testimony before a Congressional subcommittee, then NHTSA administrator Ricardo Martinez defined aggressive driving as the operation of a motor vehicle in a manner which endangers or is likely to endanger people or property (U.S. House of Representatives, 1997). For NHTSA, aggressive drivers are more likely to: speed, tailgate, fail to yield, weave in and out of traffic, pass on the right, make improper and unsafe lane changes, run stop signs and red lights, make hand and facial gestures, scream, honk and flash their lights. NHTSA is currently preparing a more thorough description of the specific driving behaviours that constitute aggressive driving. It has also undertaken research to develop the observational methods necessary to measure the incidence of aggressive driving (Goehring, 2000).

From NHTSA's standpoint, Mizell has provided a definition of "road rage" - an extreme form of aggressive driving behaviour. For NHTSA, the behaviours associated with road rage are criminal offences while the unsafe driving practices associated with aggressive driving consist of traffic offences.

The American Automobile Association defines aggressive driving as the operation of a motor vehicle without regard to others' safety. The AAA definition also excludes behaviours associated with road rage, which is defined as "assault with the intent to do harm arising from the use of a motor vehicle (Goehring, 2000).

The exclusion of road rage from definitions of aggressive driving is reasonable. Using Mizell's own statistics, it is clear that road rage is a relatively rare phenomenon on U.S. roads. He reports that violent traffic disputes resulting in homicide and assault are increasing at the rate of 7 per cent per year. Mizell's study is based on 10,037 media and police reports of violent traffic disputes over a six year period. These incidents resulted in 218 deaths.

Mizell's estimates are open to criticism (Fumento, 1998). His estimates are based on stories from thirty major newspapers, reports from sixteen police departments and an unspecified number of

insurance company claim reports. Mizell does not appear to have selected these newspapers, police departments and insurance companies at random. While not an unreasonable approach for an exploratory study, it would not be appropriate to treat his estimate of a seven per cent annual increase as accurate. Moreover, one problem with using media accounts as a data source is that the number of incidents reported often reflects increased interest in an issue by journalists and not necessarily an actual increase in its occurrence.

Bearing these methodological limitations in mind, it should nevertheless be noted that the incidence of this extreme roadway violence appears to be quite low relative the number of fatalities and injuries resulting from motor vehicle collisions. During the same six year period covered in Mizell's study, there were 22,761,000 motor vehicle collision injuries and 290,105 motor vehicle collision fatalities recorded in the U.S. (NHTSA, 1999).

A British study reported six fatalities in Britain in 1996 resulting from road rage (Connell and Joint, 1996). The authors postulated that a British driver's chances of being fatally injured in a road rage incident were closer to one in 9.5 million while the likelihood of being fatally injured in a motor vehicle collision was estimated to be one in 15,686. While the precision of these estimates is open to question, the fundamental point is beyond dispute: an individual is much more likely to die in a fatal car crash than as a result of a road rage incident.

Mizell reported that the majority of drivers who use weapons and/or their motor vehicle to intentionally kill or injure another driver are relatively young, poorly educated males with criminal histories and/or histories of drug/alcohol abuse. Many of these individuals had recently suffered an emotional set back due to a divorce, the loss of a girlfriend, an injury or the loss of a job.

Less frequently, road rage incidents can involve drivers from more affluent backgrounds with spotless records. In these cases, an inconsiderate driving maneuver by another driver appears to be the trigger for violent behaviour. In general, the person succumbing to road rage will have been under tremendous stress for some time prior to the incident.

Elliott (1999) contends that road rage is not a road safety concern. He argues that any damage, apprehension or injury resulting from behaviours associated with road rage would fall under the purview of the criminal law. For Elliott, assault on the road should not be dealt with any differently than assault in the home or the workplace. He suggests that causal factors for road rage are probably similar to those identified in studies of criminal violence and are likely quite different from those applicable to the behaviours listed in the broader definitions of aggressive driving used by NHTSA and the AAA.

Both NHTSA and the AAA are justified in distinguishing road rage from aggressive driving. Their definitions of aggressive driving, however, remain somewhat vague. It may be possible to improve upon them by reviewing some recent work in traffic psychology.

Shinar (1998) has sought to develop a comprehensive definition of aggressive driving that is grounded in the psychological theory of aggression. According to the frustration-aggression model (the dominant theory of aggression in psychology), aggression is behaviour directed at a person with

the intention of inflicting psychological or physical harm to that person. All aggressive behaviours are triggered by frustrating behaviours, situations or events. The level of aggression will vary depending upon three important factors.

The first factor is the level of frustration experienced by the driver. Drivers have differing thresholds for how much frustration they will tolerate in a particular situation. Drivers who have extroverted, Type A personalities may have a low threshold and be more inclined to respond with an aggressive driving maneuver.

The second factor affecting whether aggressive behaviour will be displayed is the negative consequences for the aggression. Consequences can be broadly defined to include personal consequences, social consequences or legal consequences. As we shall see, one environmental condition which seems to increase the perception that negative consequences are unlikely is the extent to which drivers feel anonymous (eg. because they are driving at night or on a freeway).

The third factor is the extent to which the frustration is seen as unfair or inappropriate. Surveys indicate that drivers are particularly annoyed by slow moving vehicles in the left lane of divided highways. Driving slowly in the left lane contravenes accepted driving practice which stipulates that slow moving traffic should keep to the right. Conversely, a slow moving vehicle in the right lane is less likely to irritate other motorists.

Shinar identifies two broad categories of aggressive behaviour: hostile and instrumental. Hostile aggression is characterized by strong emotion and involves behaviour intended to make the aggressor feel good. An individual engaging in hostile aggression is venting anger at someone without giving much thought to the possible consequences. An example of hostile aggression might be a driver who decides to follow a vehicle that cut him off abruptly on the highway. The pursuing driver would be highly emotional and preoccupied with "getting even." It is unlikely that a pursuing driver has given much thought to how the chase will affect arrival time at his/her original destination, what would happen if the other driver uses a cell phone to contact the police or how involvement in a fight with another motorist would affect one's personal life or livelihood.

Instrumental aggression refers to aggressive behaviour which is used as a means to an end rather than an end in itself. This latter form of aggression seeks solely to overcome the frustrating situation or event. The aggressive behaviour stops as soon as the source of frustration has been removed. An example of instrumental aggression might be a driver who decides to weave in and out of traffic because s/he is late for a meeting. Other drivers are simply obstacles and the aggression is not characterized by anger directed at a particular individual. The driver has presumably behaved in this way only because s/he is late.

Most aggressive driving behaviours are unlikely to be exclusively hostile or exclusively instrumental. We would expect them to have elements of both hostility and instrumentality. Nevertheless the distinction is helpful to researchers because there are clearly aggressive driving behaviours that are more hostile than instrumental and vice versa.

Using these concepts, Shinar defines aggressive driving as instrumental behaviours which are

manifested in either 1) inconsiderateness towards or annoyance with other drivers or 2) deliberate dangerous driving to save time at the expense of other road users. These behaviours would include tailgating, disobeying traffic controls, weaving in and out of traffic, preventing a vehicle from passing, flashing headlights and horn-honking.

Shinar also makes an important distinction between aggressive drivers and aggressive driving. Aggressive drivers constitute a small sub-set of the driving population who display aggressive driving behaviours most of the time. Aggressive driving refers to the behaviours themselves which tend to be displayed by most drivers less frequently.

Shinar lists a series of driving behaviours which could be described as "inconsiderate" or "deliberate dangerous driving." He lists many of the behaviours included in NHTSA's preliminary definition. The most notable exception is speeding which he omits from the list. He argues that while speeding is dangerous and purposeful behaviour it is not caused by obstacles or frustration, i.e. it is not triggered by traffic conditions and/or the behaviour of other motorists.

In contrast to Shinar, the NHTSA definition refers to aggressive drivers as more likely to engage in a series of behaviours that include speeding. The inclusion of speeding may reflect the fact that it is conceptually difficult to think about aggressive driving behaviour without recognizing that we are dealing with a set of interrelated behaviours. For example, weaving in traffic and tailgating tend to involve speeding.

A focus group study conducted in the Washington D.C. area indicates that drivers who think of themselves as aggressive certainly drove at speeds faster than the general driving population (NHTSA, 1998a). The general consensus among all participants was that "excessive speed" is an action which should be included in a definition of aggressive driving. Driving at excessive speeds, at least occasionally, was reported by about two-thirds of respondents to a nationwide NHTSA survey on aggressive driving behaviour. These drivers reported exceeding what they consider to be the maximum safe speed on roads they regularly travel (NHTSA, 1998b). It is important to note that these drivers are not reporting exceeding the posted limit, but rather exceeding the limit which they perceive to be safe on a given road.

The NHTSA survey also provides some additional insight into speeding behaviour and its place in any definition of aggressive driving behaviour by the U.S. driving public (NHTSA, 1998b). NHTSA survey respondents viewed certain types of speeding as more dangerous than others. Only 14 per cent rated driving 10 miles per hour over the posted limit on an interstate as "extremely dangerous" while 44 per cent rated this behaviour as "somewhat dangerous." When asked about someone driving 20 miles per hour faster than traffic, however, 57 per cent and 35 per cent rated this behaviour as, respectively, extremely dangerous and somewhat dangerous.

Drivers' views on speeding within the context of aggressive driving can also be gauged by considering the recently released results of a nationwide survey of 1,008 Canadian residents aged 18 and over (Steel Alliance - Canada Safety Council, 2000). The survey results indicate that two-thirds of respondents viewed driving at twenty kilometres per hour above the speed limit as aggressive. Behaviours deemed to be even more aggressive seem to be those that are more likely to

involve another driver. Drivers who tailgate or pass on the road shoulder are more likely to be perceived as an immediate threat by a driver. Someone who speeds by in the left lane and quickly disappears on the horizon may be viewed as foolhardy, but not as an immediate threat.

The following behaviours were identified by respondents as aggressive:

Behaviour	Per cent Answering Yes
Tailgating or driving too closely behind another car	93
Passing on the shoulder of the road	87
Making rude gestures	87
Pulling into a parking space someone else is waiting for	82
Changing lanes without signalling	73
Flashing high beams at the car in front of you	72
Driving through yellow lights that are turning red	69
Waiting until the last second to merge with traffic on highway	66
Driving 20 kms per hour or more over the speed limit	65

It is likely that an even higher percentage of respondents would have chosen the speeding item if it had read driving 30 kilometres per hour over the speed limit. This is probably because such a speed would be much faster than that of most other vehicles on the road and more likely to result in traffic conflicts.

The NHTSA survey sought to measure this type of speeding behaviour by asking drivers about their tendency to pass other vehicles on the road. About 30 per cent of all respondents indicated they tend to pass other cars more than other cars tend to pass them. This behaviour decreased with age: 60 per cent of those aged 16-20 reported a tendency to pass other vehicles compared to 9 per cent of those aged 65 and over. Positive feelings about speeding as measured by three statements ("I enjoy the feeling of speed", "I often get impatient with slower drivers" and "I try to get where I am going as fast as I can") also decreased with age. Males were more likely to report positive feelings about speed than females.

Unfortunately, the NHTSA survey did not construct a profile of drivers who tend to both pass other vehicles and report positive feelings about speeding. These drivers, however, are engaging in speeding behaviour that is qualitatively different from that of most drivers. One would expect them to engage in tailgating, weaving in and out of traffic and improper lane changes more frequently. Their impatience with slower drivers would also imply that they are more likely to experience frustration and anger on the road.

Speeding which involves elements of sensation seeking and a disregard for other motorists should be included in a definition of aggressive driving. This category of speeding would be characterized by frequent traffic conflicts and may force other drivers to speed up, slow down or take evasive action. While driving over the posted limit must never be condoned given what we know about injury outcomes in high speed crashes, the speeding associated with aggressive driving would involve

exceeding the posted limit at speeds which 1) are perceived as intimidating or threatening by other motorists and 2) substantially increase collision risk. While more research needs to be done, the available evidence suggests there is a linear and positive association between the probability of crash involvement and vehicle speed at the time of the crash (TRB, 1998).

Towards A Definition

The discussion thus far has reviewed the relatively few definitions of aggressive driving offered in the literature. While more conceptual work needs to be done, we can, at least, derive some guiding principles and offer a definition which should be helpful to researchers and policymakers interested in developing a more rigorous approach to the study of this behaviour.

Three guiding principles suggest themselves. First, as suggested by Shinar, we must avoid a definition that is too general. A useful definition will enumerate the specific driving behaviours that constitute aggressive driving. Road safety programs are more likely to be successful if they address specific behaviours. Second, following Elliott's suggestion, the definition should not include behaviours associated with road rage. Extreme violence on the road is criminal behaviour which cannot be adequately addressed through traffic safety programs. Attempting to incorporate such rare behaviour into a definition of aggressive driving will only shift our focus away from behaviours that are both far more frequent and more amenable to modification through traffic safety interventions. This does not mean that all hostile behaviour should be excluded from a definition of aggressive driving, only hostile behaviour that is intended to cause physical harm. Third, the driving behaviours included in the definition would very likely be deliberate and willful and not the unintended result of a medical condition, mental lapse or error. It is highly likely the offending driver possesses the knowledge, skills and ability to do better. The driving behaviour generally has one or more of the following characteristics:

- likely motivated by impatience, annoyance or anger with another road user(s) or with a prevailing traffic condition
- calculated to save time at the expense of other road users
- shows obvious disregard for other road users

The behaviour is also likely to:

- intimidate or be perceived as dangerous by other road users
- irritate or anger other road users
- force other road users to take evasive action

With these principles in mind we can suggest the following definition:

A driving behaviour is aggressive if it is deliberate, likely to increase the risk of collision and is motivated by impatience, annoyance, hostility and/or an attempt to save time.

This definition focusses on driving behaviours which are not specifically intended to result in collisions, death or injury i.e. it excludes deliberate attempts to collide with, kill or injure a road user(s). Such hostile behaviour would be more appropriately treated as a criminal act. Some aggressive driving behaviours may occur frequently and be generally accepted by the driving population. For example, most drivers do not come to a complete stop at stop signs. Many drivers would claim the behaviour is acceptable because everyone seems to do it. The fact that a behaviour is widespread and habitual, however, does not make the behaviour less deliberate. To be sure, the majority of drivers engaging in this behaviour are in all likelihood well aware that coming to a complete stop is inconvenient (i.e. it increases their trip time).

Most definitions of aggressive driving offered to date have included a list of specific behaviours. The lists of specific behaviours can vary substantially in length and precision. The behaviours which should be considered would include:

- Tailgating
- Weaving in and out of traffic
- Improper passing
- Cutting in too close in front of vehicle being overtaken
- Passing on the road shoulder
- Improper lane changes (failure to signal)
- Failure to yield the right of way to other road users
- Preventing other drivers from passing
- Unwillingness to extend cooperation to motorists unable to merge or change lanes due to traffic conditions
- Driving at speeds far in excess of the norm which result in frequent tailgating, frequent and abrupt lane changes
- Running stop signs
- Running red lights

Displays of annoyance or hostility that are not intended to physically harm other road users but are likely to intimidate, irritate, anger or provoke them may accompany these behaviours and serve as indicators of the underlying motivation. These behaviours would include:

- flashing headlights
- sustained horn-honking
- glaring at another driver to show disapproval
- yelling
- gesturing

The list of specific behaviours is also meant to spur broader discussion. There is definitely a need to describe some of these behaviours and the circumstances under which they would occur in greater detail. The preceding discussion on speeding serves as a good example of why this can be both helpful and necessary.

Another example would be tailgating or following too closely. This behaviour is always included in lists of specific aggressive driving behaviours. Tailgating, however, remains a very general term which refers to someone driving too closely behind another vehicle. We should perhaps develop a more precise definition based on the size of the gap between two vehicles. Postans and Wilson (1983) found 23 per cent of drivers in the centre lane of the M1 motorway following a vehicle with gaps of less than one-half second of stopping time. They also distinguished between provoked, unprovoked and unnecessary tailgating. In provoked tailgating, a slower moving vehicle chooses to remain in the centre lane instead of moving into a clear inside lane. In unprovoked tailgating a slower moving vehicle remains in the centre lane, but access to the inside lane is blocked by another vehicle. Unnecessary tailgating involves a vehicle following closely despite the availability of a clear outside lane. About 43 per cent of the tailgating incidents observed occurred with a clear outside lane. The vehicles involved in tailgating incidents may also be of particular interest. For example, tailgating incidents involving large vehicles have a greater potential for serious injury or death in the event of a collision.

As the work of Postans and Wilson makes clear, developing more precise descriptions of aggressive driving behaviour will require careful observational studies. These studies will help us develop a clearer understanding of the circumstances under which these behaviours occur and which subcategories of these behaviours should be considered in any review of the rules of the road.

Incidence

There is evidence from public opinion surveys that many people believe aggressive driving is on the rise. The Steel Alliance-Canada Safety Council survey indicates that 73 per cent of Ontario respondents believe aggressive driving is increasing, while only 22 per cent believe the amount of aggressive driving is unchanged (Steel Alliance - Canada Safety Council, 2000). The survey was conducted on a nationally proportionate random sample of 1,008 Canadian residents. Surveys on the subject, however, are relatively recent. It will interesting to see how these estimates vary in the future.

The survey also provides estimates of the incidence of self-reported aggressive driving behaviour. The table below lists the reported distribution of aggressive driving acts within the past year reported by the Ontario sub-sample.

Behaviour	Per Cent Answering Yes
Driven through yellow lights that are turning red	69
Driven 20 kms per hour or more over the speed limit	60
Changed lanes without signalling	30
Tailgated or driven too closely behind another car	21
Flashed high beams at car in front of you	16
Made rude gestures	15
Waited until last second to merge with traffic on highway	14
Pulled into parking space someone else is waiting for	9
Passed on the shoulder of the road	7

Unfortunately, the survey does not provide results on frequency of occurrence, but only asks whether they behaved in this way at least once during the past year. About two-thirds of the Ontario drivers surveyed report running amber lights and driving 20 kilometres per hour above the limit within the past year. Other behaviours associated with aggressive driving are reported less frequently. About one in five drivers reports tailgating, while about one in six reports making a rude gesture.

Thirty-three per cent of the respondents in the NHTSA survey reported they felt driving was more dangerous than it was in the year preceding the survey (NHTSA, 1998b). Only six per cent felt it was safer, while 54 per cent reported there was little change. Most drivers (65 per cent) reported no differences in the aggressiveness of drivers in their area. Thirty per cent reported aggressive driving was increasing. This stands in marked contrast to the Canadian survey in which 73 per cent of respondents (the same percentage as that reported for the Ontario subsample) reported an increase in aggressive driving (the same percentage as that reported for the Ontario subsample). Similarly, in a 1995 British survey, 62 per cent of the respondent drivers agreed that the behaviour of motorists changed for the worse in recent years (Joint, 1995).

Over half the NHTSA respondents reported they see vehicles travelling at unsafe speeds all or most of the time. Sixty-two per cent of the respondents reported the behaviour of another driver had been a threat to them or their passengers in the past year. The most frequently cited threatening behaviours were:

Behaviour Reported By Respondent	Per Cent
Another driver had cut very closely in front me	36
Another driver drove very closely behind me	19
Another driver passed me in a dangerous manner	15
Another driver cut me off at an intersection or exit	13
Another driver made an obscene or threatening gesture	5
Another driver wove in and out of traffic	4

Interestingly, one in five report a tailgating incident within the past year. Only one in twenty reported being the target of an obscene or threatening gesture. The incidence of obscene or threatening gestures again seems lower than one might expect based on anecdotes and media accounts. Of course, if the question had asked whether a respondent had ever been the target of an obscene or threatening gesture, the reported incidence would have likely been higher. Hemenway and Skolnick reported that 46 per cent of male drivers and 31 per cent of female drivers admitted to ever having made an indecent gesture at another driver (Hemenway and Skolnick, 1993).

There appear to be marked cross-national differences in the reported incidence of aggressive driving behaviours. Only 5 per cent of the U.S. respondents reported being the target of an obscene or threatening gesture in the past year. In a British study, 48 per cent of drivers reported receiving an aggressive or rude gesture in the past twelve months (Joint, 1995). An estimate is not available for Canada, but only 14 per cent of the respondents to a national survey reported making a rude gesture at another driver (Steel Alliance - Canada Safety Council, 2000). Twenty-two per cent of British drivers reported making an aggressive or rude gesture. Similarly, tailgating is reported more frequently by

British drivers. Sixty-two of the respondents in the British survey compared to 19 per cent of the respondents to the NHTSA survey. Twenty-three per cent of Canadian drivers reported they had tailgated or driven too closely behind a car in the past year. However, while 62 per cent of British drivers reported having been tailgated, only 6 per cent reported doing it themselves.

These comparative data suggest aggressive driving appears to be fairly widespread in Britain. Parker (1998) found only 11 per cent of respondents indicating they had never chased another driver, shown hostility towards another driver or sounded their horn in annoyance at another driver. In addition to the behaviours reported above, Joint also found 59 per cent of drivers reported having headlights flashed at them, 21 per cent reported being deliberately obstructed or prevented from maneuvering their vehicle, 16 per cent reported being verbally abused and one per cent reported being physically assaulted (Joint, 1997).

This section has only offered estimates of aggressive driving behaviour obtained through survey research. Survey responses may be affected by social desirability considerations. Respondents may be more willing to admit to running amber lights or excessive speeding because they may believe that such behaviour is less likely to be viewed negatively. The lower self-reported incidence of certain behaviours such as tailgating may reflect an unwillingness to admit to such behaviour because it may be viewed more negatively. Moreover, as we can see in the British survey results, respondents seem to be much more inclined to report negative behaviour by others than about themselves. If only six per cent of respondents admit to aggressive tailgating, one would not expect 62 per cent of them to report being tailgated aggressively by other drivers.

The only way to measure the actual incidence of aggressive driving behaviours is through direct, systematic observation. Most of the specific behaviours that are listed in definitions of aggressive driving have never been observed and counted in a systematic manner.

The discrepancy between self-reported and actual driving behaviour can be best illustrated by comparing one result from the NHTSA survey and a result obtained from an observational study. According to the NHTSA survey, 26 per cent of the respondents reported slowing but not completely stopping at a stop sign in the past week (NHTSA, 1998b). This self-reported estimate, however, may be extremely inaccurate.

Luoma (1995) observed driver behaviour at intersections in two mid-sized cities: Lahti, Finland and Ann Arbor, Michigan. The Ann Arbor, Michigan results pertaining to behaviour at stop signs is of particular interest here because of its implications for the reliability of the results in the NHTSA survey. Eighty-four per cent of Ann Arbor drivers did not come to a complete stop at an urban intersection, while 87 per cent and 96 per cent, respectively, did not come to a complete stop at two suburban intersections.

While these results are limited to a few intersections in one U.S. city, they suggest most drivers do not come to a complete stop at stop signs. This contrasts sharply with the self-reported behaviour in the NHTSA survey and suggests that respondents may be giving a socially desirable response rather than an accurate description of their behaviour.

Causal Factors

Several causal factors have been identified in studies of aggressive driving behaviour. This section lists factors identified in the relatively few research studies conducted to date. This section will also discuss factors which could be theoretically relevant. These will be factors identified in studies of "risky driving", a related concept which generally refers to a broader set of unsafe driving behaviours. Risky driving will typically include drinking and driving and driving without wearing a seat belt and exclude behaviours such as horn honking or making abusive gestures.

Age and Gender

Parry (1968) conducted a small exploratory study which consisted of a survey of the attitudes and behaviours of 279 British motorists. The analysis of scaled items designed to measure "aggressiveness" indicated that the highest scores for aggression on the road were associated with male drivers aged 17 to 35. Their average aggression scores were twice those recorded for middle-aged males. Females aged 17 to 35 had average aggression scores comparable to those of middle-aged male drivers. The lowest scores were observed for the oldest age groups. High aggression scores were associated with increased collision risk. The collision analysis, however, is based on self-report data which were not verified by checking respondents' driving records.

Males aged 17 to 35 were more likely to report overtly aggressive behaviours such as "making rude signs at another motorist", "sometimes taking unnecessary risks when driving for the sake of it" and "chasing other cars." This overt behaviour stood in marked contrast to middle-aged male respondents who were in general quite satisfied to make only verbal protests when they encountered drivers who thwarted their progress.

A Dutch study (Hauber, 1980) reported negligible gender effects, but substantial age-related differences. He observed 966 drivers approaching pedestrian crossings and conducted a follow-up survey to measure drivers' perceptions of aggression on the road. Driver behaviour was coded as aggressive if the driver failed to stop, the driver forced pedestrians to increase their walking speed, the driver gesticulated or shouted at the pedestrians and/or the driver sounded the vehicle's horn.

Twenty-five per cent of the drivers observed at the pedestrian crossings behaved in an aggressive manner. Gender differences were negligible (24.4 per cent of the female drivers and 27.5 per cent of male drivers behaved aggressively). There was, however, a substantial age-related difference with 31 per cent of younger drivers behaving aggressively compared to 20.7 per cent of older drivers. Younger male drivers were the most aggressive (33.4 per cent). It was also determined that commercial vehicle drivers were more likely to drive aggressively (37.6 per cent) than drivers of other vehicles (24 per cent).

Pedestrian gender also affected the incidence of driver aggression. When males crossed the street, drivers showed aggression nearly twice as often. The importance of pedestrian gender for driver behaviour was borne out in Dutch collision statistics which showed male pedestrians were twice as likely to be killed female pedestrians.

Parker (1998) reports driver age was a significant predictor of aggressive driving violations with older drivers less likely to self-report aggressive driving violations (or violations of any kind). Gender, however, was found to be a poor predictor once researchers controlled for the effects of psychological variables.

Gender and age-related differences in the propensity to commit traffic violations were recently explored in an Israeli study (Yagil, 1998). A survey administered to 181 university students indicated females have a stronger sense of obligation to obey traffic laws. They are also more likely to evaluate traffic laws positively. The observed gender differences are even more pronounced among young drivers.

Women were more likely to view the content of traffic laws as important, clear and reasonable. This resulted in a stronger sense of obligation to obey traffic laws. Women would comply with traffic laws even in situations where non-compliance was not perceived as risky. For example, women were less likely to speed even in situations where they believed that it was safe to speed. Men, on the other hand, tend to overestimate their driving ability and feel more confident in complying selectively with traffic laws. Young males in particular are more likely to evaluate traffic laws negatively i.e. see them as annoying and exaggerated. They are also more likely to underestimate the risks associated with traffic violations.

Anonymity

Research on aggressive behaviour in other settings has consistently demonstrated that it is more likely in situations that confer anonymity on the perpetrators. This appears to be true of aggressive behaviour on the road as well. In fact, the importance of the anonymity factor for studies of roadway aggression has been underscored by Raymond Novaco. He suggests that:

Generally, people lose self-restraint when are not mindful of who they are and of their place in a rule-governed society. A highway, especially at night, provides anonymity and the opportunity to escape. Expectations of punishment are diminished, and aggressive impulses are more readily expressed. The chance to "get away with it" can release aggression that would otherwise have been held in check. This is evident in traffic jams, which produce few incidents of flagrant aggression, in spite of stressful circumstances (Novaco, 1998).

Ellison et al. (1995) conducted a field study to test the effects of anonymity on driver aggression. The study compared the aggressiveness of drivers in an anonymous condition (i.e. drivers of convertibles and 4X4s with the tops up) with that of drivers in an identifiable condition (i.e. drivers of convertibles and 4X4s with the tops down). It was predicted that drivers in the anonymous condition would honk sooner, honk for longer durations and honk more frequently if delayed at an intersection by a driver who failed to proceed when the light turned green than drivers in the identifiable condition. Subjects were unaware they were under observation. The offending driver was a confederate who recorded variables such as horn honking behaviour, vehicle type, number of passengers, driver gender and age.

Statistically significant differences between the anonymous and identifiable conditions were observed. Drivers in the anonymous condition did honk sooner, honk for longer durations and honk more frequently. The differences observed between the drivers in the anonymous and identifiable conditions were statistically significant. Interestingly, vehicle class, the use of sunglasses (i.e. increased anonymity), gender, age, number of passengers or location of testing were not predictive of horn-honking behaviour. These results indicate that anonymity serves to facilitate aggressive behaviour more than factors identified in previous research such as age and gender.

Social Factors

From a social learning perspective, aggression is a response learned through observation or imitation of socially relevant others. Aggression, therefore, is the result of the norms, rewards, punishments and models to which individuals have been exposed (Grey et al., 1989). Social psychologist Leon James contends that aggressive driving is, in part, culturally transmitted. He argues that children are reared in a car culture that condones irate expressions as part of the normal wear and tear of driving (U.S. House of Representatives, 1997). There is strong support for this view, but unfortunately little research to establish precisely to what extent aggressive driving behaviour is condoned and precisely which cultural mechanisms are most likely to promote this behaviour.

While those who routinely drive in an aggressive manner may have, in part, learned their behaviour from parents, peers, the media and on-road experiences, the available evidence suggests most people do not publicly condone aggressive driving behaviour. Parker et al. (1998) found that aggressive driving violations characterized by hostility are more likely to be viewed negatively by British drivers. Respondents to their survey generally had negative attitudes towards such aggressive driving violations both in cases where a driver initiated the violation and in cases where the violation was committed in retaliation. Respondents tended to believe that people important to them would disapprove of such behaviour. They also reported that it would be easy for them to refrain from such behaviour. Interestingly, however, while survey respondents were negative about retaliation for aggressive driving violations, the level of disapproval was significantly lower than reserved for instigators of aggressive driving.

Parker et al. also found that drivers who reported high levels of aggressive driving violations were more likely to believe that people important to them would approve of these violations. Drivers who believed socially relevant others approved of such behaviour were also less likely to report they could restrain themselves from such behaviour and more likely to report positive affective attitudes towards involvement in aggressive driving incidents.

Exposure to aggression in other spheres of daily life may also increase the likelihood that it is displayed on the road. A Dutch study, however, has found only modest support for this hypothesis. Hauber (1980) conducted follow-up semi-structured home interviews with 124 drivers who were observed to be driving aggressively in a pedestrian crossing situation. Based on behaviour during the interview, only 11.3 per cent of these drivers were rated as aggressive. The interview also included items on the respondent's life style and environment. A factor analysis of interview items indicated a factor labelled as "acquired aggression" explained 16 per cent of the variation in aggression scores. The following items were particularly important: subjected to corporal punishment in the parental

home, a low level of education, being authoritarian at home and using corporal punishment in the present home.

One study, however, suggests that in some cases a motorist's inability to deal effectively with anger can seriously degrade driving performance. Selzer et al. (1968) reported that exposure to very recent aggression in one's personal life substantially increases the risk of involvement in a fatal collision. They examined fatal accidents and reported that 20 per cent of the cases studied involved drivers who had been in aggressive altercations within a six hour period before their deaths.

The social learning approach would certainly suggest that the role of the media in transmitting such behaviour should be examined. Automobile commercials emphasize some aggressive driving behaviours and have routinely offered models with powerful engines and names that have unmistakably aggressive overtones. Television programs and films often feature spectacular car chase scenes with dangerous driving, often through busy urban roads or freeways. Nevertheless, the research on how the media influences driving behaviour, particularly in the young, remains to be done.

What some drivers believe about prevailing norms is probably also influenced not only by the views of family and friends, but by what they see on the road. Novaco (1998) suggests that the extent to which drivers are exposed to unpunished aggressive driving behaviour may also weaken inhibitions. If drivers routinely see others vent anger, gesture obscenely or violate traffic laws by following too closely, greatly exceeding the speed limit, passing on the right at high speed or weaving in traffic, then this may help to create the sense that these behaviours are normal or acceptable.

Social factors may also be relevant when considering who is likely to be the target of aggression. Doob and Gross conducted a study of how driver aggressiveness at intersections (as measured by horn-honking responses) is affected by the social status of the driver in the offending vehicle (Doob and Gross, 1968). In this experiment, one of two vehicles, a new luxury model and an older car were driven up to a signalized intersection and stopped for 15 seconds after the light had turned green. The experiment was conducted at six California intersections and included 82 drivers (26 females and 56 males) who were unaware they were under observation.

Only 50 per cent of the drivers honked at the high status vehicle whereas 84 per cent honked at the low status vehicle. The sex of the driver was the only other good predictor of honking behaviour, with men tending to honk faster than women in both conditions.

Personality

Individuals have traits which dispose them to behave regularly and persistently in a variety of situations. These traits are said to constitute their personality. Efforts have been made to explain social behaviour with personality test results. Personality, however, has been found to be a poor predictor of social behaviour. Personality traits rarely explain more than 25 per cent of the variance in individual social behaviour (Argyle, 1983).

The general lack of success in explaining individual behaviour through personality traits has not

deterred efforts to use this approach in traffic safety research. The relationship between personality traits and driving behaviour has been studied at considerable length over the years. Jonah (1997) offers a systematic review of thirty-eight studies which focussed on "sensation seeking," a trait of particular interest in traffic safety research. Sensation seeking may be defined as the "need for varied, novel and complex sensations and experiences and the willingness to take physical and social risks for the sake of such experiences." He reports that only four of the thirty-eight studies did not find a positive relationship between sensation seeking and risky driving. Much of the research has focussed on drinking and driving, but thirteen of the studies reviewed also assessed the effects of sensation seeking on other risky driving behaviours. Drivers classified as sensation seekers based on their sensation seeking scale scores are more likely to pass other cars, change lanes frequently and less likely to wear their seat belts.

Arnett et al. (1997) used the Arnett Inventory of Sensation Seeking (AISS) and, the Aggressiveness sub-scale of the California Psychological Inventory (CPI) to measure, respectively, sensation-seeking and aggressiveness in a sample of 139 young drivers aged 17-18 and 38 adults aged 41-59. They found both personality traits were significantly related to reckless driving behaviours such as driving 20 mph or more over the speed limit, racing another car and passing in a no passing zone. Sensation-seeking and aggressiveness were significantly correlated, with adolescents scoring higher than adults and male adolescents scoring higher than female adolescents. This study found not only a relationship between trait aggressiveness (a general tendency to be aggressive) and reckless driving, but also found that state aggressiveness (i.e. being in an angry mood at a particular time) is related to episodes of high-speed driving.

Sensation seeking and aggressiveness are not the only traits that may predispose an individual to engage in aggressive driving behaviour. There are other personality traits that may also result in aggressive behaviour. Shinar (1998) suggests that drivers possessing traits associated with extroverted or Type A personalities may be more likely to drive aggressively. While Shinar's suggestion is certainly plausible, there does not appear to be any published research which reports a significant relationship between these two personality traits and aggressive driving behaviour.

Much of the road safety research on personality has focussed on crash risk, not driving behaviour. Grey et al. (1989) report that personal factors which have been identified as associated with motor vehicle crashes include generally high levels of aggression and hostility, competitiveness, less concern for others, poor driving attitudes, driving for emotional release, impulsiveness and risk taking. Norris et al. (2000) conducted a prospective study of 500 drivers aged 19-88 and found that the combination of high trait hostility and low self-esteem resulted in significantly higher crash risk. Personality traits certainly appear to have some predictive value. However, Grey et al.'s assertion that there appears to be no single personality test or test battery which significantly improves our ability to predict a given individual's crash risk remains true. We should expect the same to be true of specific driving behaviours as well. This should not be surprising because personality traits have been found to change with time, age and situation. If traits are not stable over time, they cannot predict behaviour adequately.

A more useful approach might be to see how situational factors combine with personality traits to affect driving behaviour. A recent Ontario study has taken precisely this approach. Hennessy and

Wiesenthal (1997) interviewed a small sample of 40 drivers who experienced rush hour congestion on a major divided highway in the Greater Toronto Area. They measured each driver's trait stress (i.e. the driver's predisposition to stress) and state stress (driver's exposure to traffic congestion) and interviewed the drivers to determine how these variables affected a driver's behaviour. Observed stress levels were highest in drivers with high trait stress who also experienced higher levels of roadway congestion.

Life-Style

The concept of lifestyle refers to clusters of behaviours typically displayed by individuals with certain personalities. Beirness (1996) reviewed the fairly substantial research on the relationship between lifestyle, driving performance and collision risk. These studies, which focussed primarily on young drivers, found a higher incidence of risky driving behaviour and collision involvement in individuals with lifestyles characterized by a favourable disposition towards taking chances, impulsiveness and displaying aggression. These characteristics seemed to permeate all aspects of their lives, not just driving. These young drivers were more likely to display other delinquent and health-compromising behaviours i.e. drinking, drug use, smoking, fatigue due to late night socializing, poor academic performance and encounters with the police.

Longitudinal research conducted by the Traffic Injury Research Foundation on a sample of 2,400 Ontario high school students further demonstrates the importance of lifestyle factors (Beirness, 1996). Subjects completed the Student Life-Style Questionnaire and a cluster analysis subsequently identified three distinct subgroups with similar psychosocial characteristics. Forty per cent of the sample were classified as "Thrill Seekers." They were tolerant of deviant behaviour and were more likely to be influenced by peers. Thirty-nine per cent of participants were "Conventional" and displayed a strong attachment to traditional values, high levels of self-confidence and less responsiveness to peer influence. The remainder were classified as "Inadequate" and displayed low levels of self-confidence, difficulty controlling anger and frustration, low attachment to traditional values and poor academic performance. By the second year of the study, the Thrill Seeking group scored significantly higher on a risky driving index than either the Inadequate or Conventional groups. By the third year of the study, 27 per cent of Thrill Seeking group, 14 per cent of the Inadequate group and 9 per cent of the Conventional were involved in motor vehicle collisions.

Research on lifestyle factors has not been applied specifically to aggressive driving behaviour. The combined focus on both personality and social factors typical of lifestyle research may improve our ability to understand the motivation of an individual who often displays aggressive driving behaviour (i.e. an aggressive driver).

Driver Attitudes

A Finnish study compared the Driver Anger Scale (DAS) scores of 270 volunteer drivers with their self-reported driving behaviour and skills level as measured by the Driver Skills Inventory (DSI) and the Driver Behaviour Questionnaire (DBQ) (Lajunen et al., 1998). The DSI was used to measure self-rated vehicle handling skills and safety-mindedness while a DBQ sub-scale was used to measure the self-reported incidence of traffic violations. The study sought to determine if drivers' views of

themselves as measured by the DSI affected their irritability behind the wheel and the likelihood of committing traffic offences.

Drivers were more likely to report aggressive traffic violations if they encountered traffic situations that impeded their progress or when other drivers showed direct hostility towards them. Drivers who rated themselves highly on vehicle handling skills were more likely to experience anger in traffic situations that resulted in impeded progress. In contrast, drivers who rated themselves highly on safety skills were less likely to be irritated by impeded progress or hostility from other drivers. These were drivers who reported driving more defensively (eg. keeping a safe following distance). The result was a statistically significant negative correlation between safety-skills scores and the number of aggressive violations. The authors suggest that anger-behaviour relationship could be manipulated by improving the safety-mindedness of drivers rather than by improving their vehicle handling skills. Safety-mindedness may improve a driver's ability to cope with frustration in traffic.

A recent Norwegian study suggests drivers who show little concern or regard for other drivers may be more likely to become involved in a collision (Assum, 1997). While the study was primarily conducted to assess the effects of driver attitudes on collision risk, it also reported on the relationship between collision risk and drivers' scores on both an index of consideration for other road users and a responsibility index. The study was based on a 56-item attitudinal survey of a large random sample of Norwegian drivers and a follow-up survey conducted two years later to gather information on subsequent collision involvement and distance driven. Drivers' classified as "inconsiderate" averaged 2.6 more crashes per million kilometres driven ($p < .01$) than drivers classified as "considerate." While only two per cent of drivers were classified as "irresponsible", they averaged 4.4 more crashes per million kilometres driven than drivers classified as "responsible."

The considerateness and responsibility indices, however, were only subscales of an overall attitudinal index. The study's main purpose was to assess the predictive power of the overall index. Drivers with the "right" attitudes towards driving had 2.5 fewer collisions per million kilometres driven than drivers with the "wrong" attitudes. Nevertheless, the overall index was a poor predictor of crash risk. When the effects of age on attitudes and collision risk are considered, the relationship between attitude and collision risk disappears for all but drivers aged 70 and over. In other words, drivers aged 70 and over with the right attitude had a significantly lower collision risk than those with the wrong attitude, but this difference was not observed in any other age group. This result suggests that while scores on the consideration and responsibility subindices are predictive of crash risk, the relationship between overall index scores and crash risk is spurious and due to a correlation between age and collision risk.

Environmental Factors

Shinar (1999) reports a strong association between environmental conditions and manifest driver aggression. He has reported a fairly strong relationship between the length of the red phase and length of the green phase at an intersection, on the one hand, and the tendency for drivers either run a red light or honk their horns when they are delayed by a vehicle that fails to proceed when the light turns green. Drivers were more likely to run red lights at intersections with long red phases and more likely to be impatient and honk at intersections with shorter green phases.

Hennessy and Wiesenthal (1997) found that the most commonly reported behaviours on a divided highway in high congestion conditions were direct coping behaviours (eg. seeking preplanned routes and listening to radio traffic reports), time facilitation behaviours (eg. listening to music or the radio) and aggressive behaviours (eg. tailgating, swearing and yelling at other drivers and horn honking). While the incidence of aggressive behaviours increased during congestion, these behaviours still ranked third behind both direct coping behaviours and time facilitation behaviours.

A recent British study investigated the effects of anger and the ensuing aggression have on driving performance and ability (Lajunen et al., 1998). The DAS, DBQ and the Social Motivation Scale (SMS) were administered to 104 volunteer drivers ranging in age from 17 to 42 years of age. The SMS was used to assess a subject's propensity to engage in mild social deviance. Subjects were also required to use a hand-held microcassette recorder for two weeks and record information about each trip (date, time, distance driven, congestion, near-misses, culpability, intensity of anger, how anger affected driving). One hundred drivers provided useable data.

A total of 1,778 trips were reported with 293 near misses recorded, 383 episodes of anger and 318 incidents of courteous driving. Eighty-five per cent of respondents reported experiencing at least one episode of anger while driving during the two week observation period. There was a significant positive correlation between the number of anger episodes and three variables: the number of near-misses, distance driven and number of trips taken. A large proportion of driving anger (48 per cent) was reported immediately after a near miss. Drivers who reported anger unrelated to near misses were more likely to score higher on mild social deviance and more likely to report traffic violations.

Although anger was more likely to be reported by drivers involved in near misses, it was, surprisingly, not more frequently reported by drivers who generally drove in the most congested conditions. In other words, drivers who routinely drove in heavy traffic were not more likely to report anger episodes. However, if anger was reported, it was more likely to be reported on trips that were more congested. This result would suggest that congestion is more likely to anger those who do not expect it.

Conclusions

There has to date been relatively little research on aggressive driving behaviour. Definitions of aggressive driving have been general and have tended to distinguish themselves from "road rage" (violent exchanges arising from traffic disputes where the intent is to harm another road user). A more precise definition of aggressive driving would focus on deliberate and willful driving behaviours that while not intended to physically harm another road user shows disregard for their safety and well-being. This review suggests the following definition of aggressive driving:

A driving behaviour is aggressive if it is deliberate, likely to increase the risk of collision and is motivated by impatience, annoyance, hostility and/or an attempt to save time.

More observational studies of actual driving behaviour are needed to develop a precise list of

aggressive driving behaviours. For example, more precise definitions of terms such as driving at excessive speed and tailgating.

Survey research indicates that most drivers report engaging in aggressive driving behaviours, but there is some evidence that survey responses reflect a tendency to provide socially desirable responses. It is unclear if the lower incidence of certain behaviours associated with higher collision risks such as tailgating is due to this tendency rather than to an actual low incidence of such behaviour.

Factors which seem to increase the likelihood of aggressive driving behaviour are:

- being relatively young
- being male
- being in a traffic situation which confers anonymity and/or where escape is highly likely
- being generally disposed to sensation-seeking or aggressiveness in other social situations
- being in an angry mood (likely due to events unrelated to traffic situation)
- belief that one possesses superior driving skills
- traffic congestion, but only if drivers do not expect it

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Aggressive driving is a growing problem that has been identified as a major risk factor for car accidents. Previous research has provided some insights about the characteristics of drivers prone to aggressiveness on the road, as well as external triggers of road aggressiveness. However, little is known of the personality traits of aggressive drivers. This study employs the theory of planned behavior (TPB) to consider the role of materialism in aggressive driving, and particularly its three source traits: envy, possessiveness, and non-generosity. A REVIEW OF THE LITERATURE ON AGGRESSIVE DRIVING RESEARCH Leo Tasca Ontario Advisory Group on Safe Driving Secretariat Road User Safety Branch Ontario Ministry of Transportation Canada. Thus it happens all too often, as an outlet whether of a permanent or temporary state of mind, that sitting behind the wheel a person's whole attitude changes as if the period of driving were not part of real life, but some stage between episodes of real life. Executive Summary Research on aggressive driving behaviour has been relatively scant despite sustained interest by the media and wider public. The available research can be divided into two main categories: 1) surveys of the driving public and 2) small-scale field experiments involving small samples of drivers. The definition was: "aggressive driving is any on-road behaviour adopted by a driver that is intended to cause physical or psychological harm to another road user and is associated with feelings of frustration, anger or threat". Two main theoretical perspectives informed the program of research. Qualitative analysis of the ten case study self-reports of on-road hostile aggression revealed a similar range of on-road situational factors to those identified in the literature review and Study One. Six of the case studies reported off-road generated stress that they believed contributed to the episodes of aggressive driving they recalled. Intense "anger" or "rage" were most frequently used to describe the emotions experienced in response to the perceived provocation. Less frequently. Research in autonomous navigation was done from as early as the 1900s with the first concept of the automated vehicle exhibited by General Motors in 1939. However, most techniques used by early researchers proved to be less effective or costly. In recent times, with cutting edge developments in artificial intelligence, sensor technologies, and cognitive science, researchers have got a step closer to realizing a practical implementation of a self-driving agent. A review and analysis of literature on autonomous driving. E-Journal Making-of Innovation. Note: This article was first published on LinkedIn here. However, according to the literature on aggressive driving, the role of gender is a very complex issue [33]. The research presented in Ref. [31] provided a detailed review on aggressive driving. Work in Ref. [33] also contained substantial research on gender differences in drivers' aggressive behavior. What about Chinese drivers? Thus, to understand driver behavior in a more holistic way, more systematic reviews and empirical research including affective aspects of driving behavior are required. First, the current driving models are briefly described and the research gap is identified. Then, the effects of affective states on driving performance are delineated from multiple perspectives. Finally, theoretical and practical future works are discussed.