

MODELLING AGGRESSIVE OR RISKY DRIVING:  
THE EFFECT OF CINEMATIC PORTRAYALS OF RISKY DRIVING

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## Abstract

The purpose of the current research was to investigate the influence of motion pictures, depicting aggressive or risky driving, on subsequent driving behaviour. Both experimental and descriptive research approaches were used in an attempt to demonstrate the robustness of this relationship. Study 1 employed an experimental design, in which participants drove through a test course on a driving simulator following exposure to either neutral, arousing, or aggressive and risky driving movie content. Various person, situation, and internal factors were assessed, along with various measures of aggressive or risky driving (e.g., speed, acceleration, passing frequency). Study 2 was an event study, which linked automated enforcement speeding data, from the City of Edmonton, to the release of two aggressive or risky driving movies (i.e., *Fast and Furious 6* and *Furious 7*) to investigate changes in the number of speeding infractions and speed differential (i.e., amount the driver exceeded the posted speed limit). Multiple years of speeding infraction data provided a built in replication, allowing for comparisons across different years. The results from Study 1 provided evidence for the contribution of trait aggression, sensation seeking, driving vengeance, a history of violation (i.e., particularly speeding), and a provoking racing scenario to the modelling of aggressive or risky driving. Study 2 revealed an increase in the number of speeding infractions and mean speed differential for the opening weekend and first week post-movie release for *Furious 7*. The findings from these studies demonstrate the interactivity of person, internal, and situation factors in the modelling of aggressive or risky driving and suggest that movies, which depict this content, can influence real-world speeding behaviour. Public policy implications are addressed, with a strong suggestion for increased enforcement following the release of such movies, particularly during the first week. An emphasis is placed on production companies to provide warnings and address unsafe driving

as a public health and safety concern. Also, viewers of such material are reminded of their responsibility, as drivers, to engage in thoughtful, non-risky action when presented with an aggressive driving opportunity.

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## Modelling Aggressive or Risky Driving: The Effect of Cinematic Portrayals of Risky Driving

### **Introduction**

#### **Aggressive or Risky Driving**

Each driver, at some point in their driving experience, has likely witnessed, or even engaged in, an act of aggressive or risky driving on the road. Behaviours such as tailgating, weaving in and out of traffic, running red lights, and driving at excessive speeds are examples of aggressive driving (Tasca, 2000). Driving behaviour is considered 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” (Tasca, 2000, p. 2). Such behaviours have been proposed to be frustration-driven and more likely in an enabling environment (Shinar, 1998). Some aggressive driving involves hostile aggression, where the behaviour is directed at an object of frustration (e.g., cursing at another driver), whereas other acts involve instrumental aggression, where the frustrated driver attempts to move ahead at the expense of other drivers’ rights (e.g., weaving in and out of traffic) (Roseborough, 2014; Shinar, 1998). Though the latter acts would certainly be considered risky, they may not be as aggressive as those involving hostility. The United States National Highway Traffic Safety Administration suggested that excessive speeding should be included in a definition of aggressive driving, following consensus among focus group participants, who considered it aggressive, as well as aggressive drivers’ confessions of speeding more frequently (Tasca, 2000). Though the intent of speeding behaviour may not always be known, the act of speeding has been used in research as a measure of risky driving (Simons-Morton et al., 2005; Iversen & Rundmo, 2002; Jonah, Thiessen, & Au-Yeung, 2001).

Media depictions of dangerous or aggressive driving and glorifications of such risk-taking have become increasingly popular (Fischer et al., 2012). A pivotal influence was the 1968

release of the motion picture *Bullitt*. This featured an exciting car chase, starring Steve McQueen, which involved risky and aggressive driving through the streets of San Francisco (Wiesenthal, Lustman, & Roseborough, 2016). A more current driving movie franchise is the *Fast and Furious*, in which entire movies depict acts of illegal street racing and heists. The franchise has grown in popularity since its first movie release, *The Fast and the Furious*, in June of 2001. This movie grossed approximately 2 million dollars at the worldwide box office, compared to the most recent franchise installment, *Furious 7*, which grossed over 1.5 billion dollars worldwide, with an additional 70 million dollars in DVD sales (Nash Information Services, 2017a).

Often in media, acts, such as speeding, racing, dangerous passing, and being aggressive towards other vehicles and drivers, have commonly been shown in the absence of negative consequences (Beullens, Roe, & Van den Bulck, 2011b; Greenberg & Atkin, 1983). According to media effects theory, viewers' perceptions of what is normal can be influenced by the frequent portrayal of certain behaviours (Beullens et al., 2011b). The risky driving behaviours often depicted in media are novel, such that viewers do not commonly see them on the roads (Atkin, 1989). The more normative the events appear, the greater the possibility of viewer disinhibition (Atkin, 1989). Combined with the lack of depiction of negative consequences, learning of aggressive or risky driving can be enhanced (Beullens et al., 2011b). Adding to the possibility of imitation is the portrayal of a hero as the risky driver, which can be attractive to viewers (Beullens et al., 2011b) and create a scenario where the behaviour seems justified, further fostering disinhibition (Atkin, 1989). Vitaglione (2012) suggests that media which is "arousing, nonfictional, justified, positively reinforced, and performed by individuals with whom viewers identify and feel similar" is the most likely to influence behaviour (Vitaglione, 2012, p.489).

When a driver chooses to imitate acts of aggressive or risky driving, depicted in the media, in the real world, on the roads, it puts more than just the driver at risk. It becomes a public health concern.

### **Imitation and Modelling**

In social learning theory, transmission of behaviour can occur through observational learning, where an individual acquires new patterns of behaviour following the observation of another (Bandura, 1971). The novelty, relevance, and consequences of the behaviour displayed are factors that play a role in the imitative effects of observation (Bandura, 1971). The term *modelling* encompasses the broader psychological effects that can occur with observational learning, beyond mere imitation or mimicry (Bandura, 1971). These could include cognitive changes (e.g., attitudes) that accompany the learning of a behaviour, even if the behaviour was not performed following observation (Modeling, n.d.).

Marketing relies upon individuals wanting to mimic the use of products shown in advertising, and uses media to communicate this information. How much alcohol individuals choose to drink, or what they perceive as an ideal body image is influenced by what they see and hear on television, in the movies, on the Internet, or in newspapers and magazines (Koordeman, Anschutz, & Engels, 2011; López-Guimerà, Levine, Sánchez-Carracedo, & Fauquet, 2010). Media recognizes this influence and, in some cases, limits what viewers can see, in an attempt to prevent imitation of a behaviour. For example, the Toronto Transit Commission (TTC) has an agreement with local media to not treat subway suicides as newsworthy, in an attempt to prevent imitation. Soon after the adoption of this standard in 1971, the TTC reported a marked decrease in the number of suicides at that time (Toronto Transit Commission, 2010).

There is also evidence that motion picture production companies are aware of the possibility of modelling risky and unsafe driving portrayed in the movies. Prior to the release of *The Fast and the Furious* in 2001, Universal Studios posted a disclaimer on the film's promotional website stating, "All of the racing stunts in '*The Fast and the Furious*' were performed in a staged environment by professionals with years of training and experience. Please do not try any of these yourself. Be smart. Drive safe. Stay legal" (Orwall, 2001; Goldberg, 2001). In the days leading to the film's release, they also ran two public service announcements, recorded by the two lead actors in the film, Vin Diesel and Paul Walker, emphasizing safe driving. Given the awareness of possible imitation, it has been said that media is a major part of the problem when imitative behaviour is undesirable or antisocial (Coleman, 2004). Though observational learning can be useful and efficient (i.e., when errors in learning are costly or dangerous or when teaching structured rules and skills is time-consuming and difficult) (Bandura, 1971), modelling behaviour that is risky or aggressive can have serious negative consequences.

### **The Copycat Effect**

The *copycat effect* refers to imitation or adoption of behaviours or practices of another, and its effects, usually negative and unfavourable, are believed to be triggered by media (Coleman, 2004). In 1974, Phillips first coined the term *Werther effect*, which describes the copycat effect associated with suicide. In the novel "The Sorrows of Young Werther", written by Johann Wolfgang von Goethe in 1774, the young Werther, shoots himself after realizing that he could never be with the woman he loved. In following years, many young men killed themselves in the exact same manner, sitting at a desk, dressed like Werther, with Goethe's novel in front of them (Coleman, 2004). To investigate this effect, Phillips reviewed the number of

monthly suicides in the United States, following the publication of front-page suicide stories in the *New York Times*, during the period of 1947-1967. Using the previous and subsequent year as a comparison, he found a significant tendency for suicides to increase, and a dose-response relationship between the number of suicides and the amount of front-page story coverage (Phillips, 1974). The influence of the newspaper coverage was also shown to be location specific, such that stories published in the *New York Times*, but not in Great Britain's most popular newspaper, *The London Daily Mirror*, resulted in a greater increase in suicides in the United States, compared to Great Britain. However, when the suicide story was covered in both newspapers, British suicides also revealed a significant increase (Phillips, 1974).

The *Werther effect* has also been demonstrated for suicide stories covered on network television news programs. For example, In California, between 1968 and 1985, the number of suicides were shown to significantly increase between 0 – 7 days after a publicized television story (Phillips & Carstensen, 1988). The effect of this coverage can also be influenced by the involvement of a celebrity. In Korea, between 2005 and 2008, Jeong et al. (2012) found that television news coverage of a celebrity suicide increased the number of emergency department visits, associated with suicide attempts or self-injury, in the three weeks following the reported suicide. Hegerl et al. (2013) found that the method of suicide used by celebrities can also imitated. This was investigated following the 2009 railway suicide of Robert Enke, a celebrated national football goalkeeper. German railway suicides increased both short-term (2 weeks following the event) and long-term effect (2 years after the event). In a follow-up study, Koburger et al. (2015) used trends in Google searches for “Enke” as a proxy of media exposure to the reported suicide. They found a significant association between frequency of these searches and frequency of railway suicides in Germany, suggesting media's role in the influence



of this copycat behaviour (Koburger et al., 2015). However, it was not possible to determine if those who committed suicide had experienced the media exposure.

With respect to movie content, there is anecdotal evidence supporting the copycat effect. In 1993, Disney made a controversial decision to remove a scene from their movie *The Program* (Pristin & Fox, 1993). The scene depicted an inebriated college football quarterback lying in the middle of the highway, with cars passing by, barely missing him. As the scene continued, other football players joined him and no one was ever hurt. Disney's decision to remove the scene came after the reported death of a teenager in New Jersey, who had attempted imitation. Two others were seriously injured in the incident (Pristin & Fox, 1993). Attempts to imitate the daredevil scene resulted in further death when, months later (April 19, 1994) in Ottawa, Ontario, a 21 year old died in the same manner (The Free Radical, 2003).

In California, following the release of *The Fast and the Furious*, the Los Angeles Police Department increased patrols for street racing (Goldberg, 2001). Supporting their action was the knowledge that copycat behaviour had occurred in their area following the release of *Gone in 60 Seconds*, which glamorized auto theft (Goldberg, 2001). On the day of this film's release, and the day after, the number of stolen vehicles in the area more than doubled, compared to the previous two years (Goldberg, 2001). Increased enforcement was also reported for the release of the fourth installment of the *Fast and Furious* franchise in 2006, *The Fast and The Furious: Tokyo Drift* (Rowland, 2006). California Highway Patrol reported being extra vigilant during this time in stopping any unsafe or illegal driving, such as street racing or speed contests (Rowland, 2006). Increased enforcement was also reported in Toronto for the release of this film, with cruisers positioned outside theatres near highways (Grewal & Brennan, 2006). The Ontario Provincial Police (OPP) reported witnessing copycat behaviour and resulting crashes

following the release of the previous *Fast and Furious* film, *Turbo-Charged Prelude*. They expressed the opinion that young people get caught up in the excitement and adrenalin of these films and attempt to imitate their heroes (Grewal & Brennan, 2006).

The copycat effect can also involve criminal behaviour. *Copycat crime* refers to imitative behaviour where an offence, originally portrayed in the media, is subsequently performed in reality. It can be motivated by real or fictional media depictions and the subsequent offender incorporates aspects of the original crime (Helfgott, 2015). Helfgott (2015) states that the 1994 film *Natural Born Killers* has been linked to over a dozen copycat crimes. The film depicts a young, attractive couple on a road-trip-serial-mass murder spree across the Southwestern United States, during which they kill over 50 people. Some couples, who committed similar murders, reported being obsessed with the movie and copied behaviours depicted in the film during their crimes (Helfgott, 2015). In one copycat case, the young woman lured her victim to his death by promising sex, just like a scene depicted in the movie (Helfgott, 2015). Helfgott describes fifty-two examples of copycat crime, each with its own unique media source, such as the news coverage of the Columbine school shooting. Following this review of research specifically focused on criminal aggression, Helfgott stated that the empirical evidence, linking viewing media violence to violent crime, has not been provided. The difficulty in demonstrating this link is the existence of other factors, such as individual, environmental, and situational elements, contributing to crime (Helfgott, 2015).

Acts of violence, where the goal is to create extreme harm (e.g., death), are acts of aggression, but not all acts of aggression are violent (Anderson & Bushman, 2002). In the context of driving, when a driver chooses to speed excessively and weave in and out of traffic, following the viewing of a movie which depicted such behaviour, they are not necessarily being

violent or wanting to create harm to other drivers. However, their risky and aggressive behaviour increases the likelihood of collision (Transport Canada, 2011) and, therefore, puts others at risk. Mass media is a source of social or situational influence on aggressive or risk taking behaviour (Bandura et al., 1963; Bushman, 1995; Eron et al., 1972; Paik & Comstock, 1994; Vitaglione, 2012). Depictions of patterns of aggressive behaviours can teach behaviour styles, alter restraints over the behaviour, desensitize an individual to aggression, and shape the viewer's image of reality, which is an important basis for individual choices of behaviour (Grey, Triggs, & Haworth, 1989). In order to better understand research investigating the imitation or modelling of aggression, or aggressive and risky driving specifically, it is important to consider the various factors proposed to contribute to the choice to engage in aggressive behaviour. These include social influences, sex differences, personality, memory, cognition, and arousal.

### **Explanations for the Modelling of Aggression**

Definitions of aggression can be described in either "response" or "intent" form. Response-form definitions use specific actions to operationally define aggression, such as measuring one's level of aggression by indicating their participation in certain behaviours (e.g., hitting or shoving) (Eron, Huesmann, Lefkowitz, & Walder, 1972). Intent-form definitions incorporate motivations associated with certain behaviours, such as the intent to cause harm (Anderson & Bushman, 2002). When the intent to harm is a result of a perceived provocation, it is referred to as hostile, whereas aggression that involves an act directed to obtain a goal is referred to as instrumental (Anderson & Bushman, 2002). Hostile aggression is considered to be more impulsive and driven by anger, whereas instrumental aggression is more premeditated and proactive, rather than reactive. These two types of aggression differ in terms of ultimate goals, which may or may not involve harm (Anderson & Bushman, 2002; Berkowitz (2012). For

example, armed robbery of a bank is an aggressive act that involves intent to harm in an immediate sense, but the ultimate goal is more related to profit, rather than harm.

There are various theories associated with the development and modelling of aggression, and the ultimate choice to commit an aggressive act. These theories consider the influences of social environment, evolutionary advantages, personality, certain cognitive factors (e.g., memory formation and higher order control processes), and arousal components. Though each theory offers a unique perspective, collectively, they demonstrate that the influences are multifaceted.

### **Social Learning Theory**

Social learning theory applies to the transmission of behaviours and aggression, like other complex social behaviours, through observational learning or direct exposure (Bandura, 1971). Bandura, Ross, and Ross' (1963) classic research experiment investigated the imitation of aggression in children, following the viewing of an adult model interacting with a 3-foot Bobo doll. Children, ages 3 to 6, viewed a video of the model being aggressive towards the doll (e.g., hitting the doll while sitting on it, kicking and throwing it, pummeling it with a mallet). Children displayed more aggressive acts when allowed to interact with the Bobo doll in a situation of frustration, compared to the control group, who did not view the aggressive model (Bandura et al., 1963). Though this study has been criticized for considering the acts displayed by the children to be aggressive, given that a Bobo doll is essentially designed to be pummeled (Freedman, 2007; Milgram & Shotland, 1973), it did demonstrate that children imitated specific observed behaviours, both physical (e.g., sitting on Bobo and hitting him with a mallet) and verbal (e.g., shouting "Sock him in the nose") (Bandura et al., 1963). Other research with children has suggested that early childhood exposure to aggressive or harsh punishment from parents can provide a situation of observational learning of aggression. Weiss, Dodge, Bates,

and Pettit (1992) found that such early childhood exposure was associated with a greater amount of aggressive behaviour from children towards others, as judged by peers, teachers, and direct observation of researchers.

Though the social learning theory of aggression stems from research with children, it has implications for adults. Early exposure to aggression and violence may contribute to children developing different cognitions associated with aggression, such as hostile attributional biases. Therefore, they may become more likely to select aggressive solutions to situations in the future. In addition, the factors proposed to influence imitation of aggression in a situation of observational learning, specifically positive reinforcement, novelty, and relevance to a given social situation, are not specific to children. For example, the internal thrill or the accolades of friends associated with trying an aggressive or risky driving behaviour seen in a movie, are examples of positive reinforcement, which can influence this adult behaviour.

Skinner's research on the development of laws governing operant conditioning was rooted in animal behaviour (1938), but he proposed that consequences associated with an action could not only predict, but control an individual's behaviour (1953). In the case of childrearing, for example, reinforcement and punishment is used to teach a child appropriate behaviour. An unwanted behaviour results in a negative consequence, such as a "time-out", while a desired response results in a positive one, such as a treat. Research on vicarious learning suggests that observing another individual experience consequences to a behaviour can also influence one's own behaviour. In a follow-up study by Bandura, Ross, and Ross (1963), children who viewed the adult model being punished for their aggressive behaviour were less likely to imitate the behaviour than children who had viewed the aggressive model being rewarded. In adults, Malamuth and Check (1981) found that vicarious learning could result in attitude change.

Young college males reported being more accepting of interpersonal violence against women following the viewing of movies depicting positive consequences associated with sexual violence.

According to social interaction theory, aggressive behaviour is considered social influence behaviour, where coercive acts are used to obtain things of value, bring about retributive justice, or promote social and self-identities (Tedeschi & Felson, 1994). Two social influences proposed to mediate aggression are socialization practices within the family and peer influences (Wiesenthal & D. Singhal, 2012). Talwar (1998) found aggression among adolescents was associated with negative parenting, which included poor family organization and functioning, as well as marital conflicts. It was suggested that young individuals adopted peer values and beliefs as a substitute for parental values and beliefs. When the peer influence was deviant and the individual was susceptible because of negative family influences, aggression increased (Talwar, 1998).

With respect to driving, the presence of others has been shown to increase aggressive and risky behaviours. Simons-Morton, Lerner, and Singer (2005) found that teenage drivers engaged in more risky driving (i.e., speeding and reduced headway) when male passengers were present, compared to no passengers or the presence of female passengers, with the male driver/male passenger combination producing approximately double the rate of risky or aggressive driving. The susceptibility to peer pressure is believed to be greatest during early adolescence, and the full development of resistance to peer pressure does not necessarily occur between late adolescence and early adulthood. This suggests that peer influences remain a mediating factor and males may be more susceptible (Steinberg & Monahan, 2007).

## **Evolutionary Theory**

Males are disproportionately involved in risky or aggressive behaviours, such as gambling, homicide, and motor vehicle collisions, which Wilson and Daly (1985) have referred to as the “young male syndrome”. Aggression, in the context of evolution, can have an adaptive value. Competitive risk taking among males is believed to have evolved as a result of reproductive competition, where males compete with other males for the valued resource of females (Wilson & Daly, 1985). When environmental resources are scarce, or unequally distributed, and when the proportion of young males in the population is disproportionately large, both risk taking and aggression have been seen to increase (Mesquida & Wiener, 1996; Wiesenthal & D. Singhal, 2012). Males engage in a social display of risk competition in order to demonstrate fitness, in an effort to secure the resources necessary to attract mates. Intra- and intergroup competition, which involves prestige, rank, and reputation, may enhance the likelihood of attracting women by elevating the male’s position on a dominance hierarchy (Wilson & Daly, 1985).

Driving is an example of a social environment where risk taking competitiveness can be displayed (Wiesenthal & D. Singhal, 2012) and, particularly among young males, can contribute to the engagement in risky or aggressive driving behaviours (Vingilis et al., 2013). Males may be at a greater risk for motor vehicle collisions because they are more likely to engage in speeding, tailgating, and responding aggressively to perceived misdeeds of other drivers (Wilson & Daly, 1985). Societal influences, such as the presence of others and individual difference variables (e.g., personality), are suggested to mediate male competitiveness and the decision to engage in risk-taking behaviours (Wiesenthal & D. Singhal, 2012; Wilson & Daly, 1985).

## **Personality Influences**

In considering personality traits that play a role in an individual's engagement in aggressive or risky behaviour, it is not surprising that trait aggressiveness has been suggested to play a moderating role, particularly when violent or aggressive media is involved (Bushman, 1995). Buss and Perry (1992), in the design of their Aggression Questionnaire, found physical and verbal aggression, hostility, and anger to be intercorrelated and suggestive of overall trait aggressiveness. They proposed that physical and verbal aggression represent the motor components of behaviour, and anger, which involves high arousal, represents the affective component. It can serve as a prelude to the behaviour, where people who are angry are more likely to aggress. Hostility involves a cognitive residual of ill will, resentment, or suspicion of others' motives and is proposed to remain after anger dissipates. Using their Aggression Questionnaire, Buss and Perry (1992) found sex differences, such that males had a higher total score, were much more physically and verbally aggressive, and somewhat more hostile.

A second personality trait suggested to play a role in engagement in aggressive or risky behaviours is sensation seeking. Zuckerman (1979) defined sensation seeking 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" (p. 10). Sensation seeking has been reported to be related to risky behaviours, such as dangerous driving practices (e.g., drunk driving and speeding) (Wiesenthal, et al., 2016), drug use, and minor criminality (Arnett, 1994). It has been suggested that sensation seekers, having a greater acceptance or a reduced perception of risk, would be more likely to engage in behaviours that are both risky and aggressive (Wiesenthal et al., 2016). Sensation seeking can serve as a biological predisposition that interacts with the



conditions of the social environment, such that less restrictive environments allow for its greater expression (Arnett, 1994).

The Arnett Inventory of Sensation Seeking (AISS) (Arnett, 1994), which measures intensity and novelty, does not measure sensation seeking based on the assumption that it needs to be expressed in antisocial or norm-breaking ways. Dahlen, Martin, Ragan, and Kuhlman (2005) found sensation seeking, as measured with the AISS, to be a significant predictor of aggressive and risky driving, including the physical and verbal expression of driver anger and using the vehicle to express anger. It was also predictive of lapses in concentration and minor losses of vehicular control. Therefore, when investigating modelling of aggressive or risky driving, it is important to consider how the personality traits of aggressiveness and sensation seeking influence such behaviour.

### **Script Theory**

The choice to engage in an aggressive or risky act may also depend on one's memory of having viewed or engaged in aggression previously. Memory of the behaviour, and its consequences, can influence the decision to engage in aggressive or risky acts again. This cognitive development of memories, and their use in future decision making, are components of the script theory of aggression. A script is a type of schema that is learned through experience and exposure, and comes to define a situation. Highly associated concepts are linked together in memory and these associations often involve causal links, goals, and action plans (Abelson, 1981). For example, the use of a gun can be associated with concepts such as anger, pain, retaliation, and the action of shooting (Anderson & Bushman, 2002). Stronger associations are formed between concepts that have similar meanings or are frequently activated or primed. When components are strongly linked, they become a unitary concept in semantic memory and

provide a guide for future behaviour. If a script becomes well-rehearsed and highly associated with other concepts in memory, it can be generalized across many situations (Anderson & Bushman, 2002). In terms of aggression, the greater the repeated exposure, through such means as mass media, the greater the likelihood of priming or activating these scripts, which could increase the likelihood of their use (Anderson & Bushman, 2002). The result of priming may not be an immediate action but may require a number of days for the scripts and memories to be appropriately activated and influence behaviour (Vitaglione, 2012).

In the context of driving, this theory suggests that the more one views media depicting acts of aggressive or risky driving, the more likely scripts, associating negative emotion and aggressive responses to provoking or frustrating driving situations, will form. In addition, further viewing of this media will continue to prime these scripts, increasing the likelihood of their use on the roads. In investigating media's role in modelling aggressive or risky driving, it is, therefore, important to consider an individual's viewing history of such media (e.g., movies or video games).

### **Cognitive-Neoassociation Theory**

The use of memories in the decision to engage in aggressive or risky acts is incorporated in the broader cognitive-neoassociation theory of aggression. Berkowitz (2012) states that the decision to act aggressively begins with an aversive event, such as frustration or provocation. This leads to negative affect, which automatically stimulates both *fight* and *flight* physiological pathways. A dominant *fight* reaction leads to irritation or anger, whereas a dominant *flight* reaction leads to fear. In addition to the activation of the physiological components of these pathways, associated memories, thoughts, and motor responses will also be activated. Once the initial, more involuntary response tendencies arise, higher order cognition can become involved

in the processing of appraisals and attributions, as well as the consideration of rules and consequences associated with certain behaviour. These can modify or even extinguish the initial reaction, serving as self-regulation or control processes. However, it is possible that an individual can become angry enough to respond aggressively, without the intervention of higher order cognition, which tends to explain hostile aggression (Berkowitz, 2012).

The strength of the initial negative affect is dependent upon a number of factors, including the nature of the aversive event (e.g., unexpected or unjustified interference versus an anticipated or legitimate barrier to a goal), prior learning, and situational influences (Berkowitz, 2012). Repeated exposure to aggression, as with harsh discipline or that depicted in movies or on television, can foster stronger linkages in memory between aggressive thoughts, tendencies, and behaviours, which could increase the likelihood of an automatic aggressive inclination the next time such negative affect is experienced (Anderson & Bushman, 2002).

### **Excitation Transfer Theory of Arousal**

According to Zillmann (1971), the physiological excitation produced from a given arousal-producing exposure, as mentioned in the cognitive neoassociation theory, does not end abruptly with the termination of the exposure. The arousal may linger for some time and be carried over to a subsequent event or experience, even one unrelated to the prior exposure. This residual arousal can influence the cognitive appraisal of the subsequent emotional state, with greater residual arousal creating a more intense subsequent emotion (Zillmann, 1971). This suggests that a potentially stronger negative affect to a provoking event could be elicited, producing an “over-intense” response to stimuli in a future scenario. For example, arousal, produced from viewing a film involving aggressive or risky driving, may create stronger aggressive emotional responses when the driver is later confronted with an anger-provoking

situation on the road. The residual arousal could “energize” or facilitate associated aggressive behaviour (Zillmann, 1971). Even though Zillmann originally proposed a short timeline for dissipation of the residual arousal (i.e., seconds to minutes), Anderson and Bushman (2002) suggest that if the individual has consciously attributed the residual arousal to feelings of anger, the person may remain primed to be aggressive, even after the residual anger has dissipated.

### **General Aggression Model (GAM)**

In an attempt to integrate the previous theories of aggression, Anderson and Bushman (2002) developed the GAM (see Figure 1). This is an episodic model that focuses on the individual in a particular situation and consists of three overall components: inputs involving person and situation factors, routes through which arousal, affect, and cognition play a role, and outcomes resulting from appraisal and decision processes (Anderson & Bushman, 2002). An advantage of the GAM is its multifaceted approach to explaining how aggressive behaviour can occur (Anderson & Bushman, 2002). It incorporates aspects from social and evolutionary theories, as well as components related to personality, cognition, and arousal.

The GAM proposes there are a variety of factors that individuals bring to a situation that contribute as inputs. These person factors can include sex differences in aggressive tendencies, personality traits, existing scripts, and attitudes and values about the use of violence and aggression. Situational factors, such as aggressive cues (e.g., weapons), provocation, frustration, and social opportunity for aggression (e.g., church environment versus a nightclub), interact with the individual’s internal state. They can influence affect, arousal, and cognition, which are interconnected, and can influence each other in a reciprocal fashion (Anderson & Bushman, 2002). Arousal contributes to aggression in different ways. Residual arousal from a previous event can energize affect in a subsequent situation, which then contributes to the heightening or

mislabelling of the current emotion. Situational variables can influence physiological arousal, as well as affect and cognition. They can increase hostile feelings and prime aggressive thoughts and motor responses that currently exist in scripts, increasing their accessibility and usage (Anderson & Bushman, 2002).

The idea of interaction and reciprocity between person, situation, and internal state factors was also suggested by Bandura (2001b) in his “triadic reciprocal causation” model of psychosocial functioning. This model includes personal, behavioural, and environmental determinants, where personal factors involve cognitive, affective, and biological events. These determinants can influence each other in a bidirectional fashion. For example, an event in the environment, such as viewing an aggressive driving movie, can influence behavioural patterns of the viewer, with past behavioural patterns and person factors, such as mood and personality, mediating the choice of response.

The output level of the GAM involves appraisal and decision processes, which can lead to either impulsive or thoughtful action (Anderson & Bushman, 2002). For the response to be a more thoughtful action, one requires sufficient resources of time and cognitive capacity to reappraise the situation. Alternative responses are considered until one is chosen, but this does not imply that aggression has been averted. In fact, it is suggested that the reappraisal process could activate memories leading to an increase in anger, which could provide justification for retaliation and interfere with other higher-order cognitive processing. Additionally, the individual could become more aware of potential damage to their social image and the need to act aggressively in order to maintain it (Anderson & Bushman, 2002).

Related to the output level of the GAM, Bandura (2001b) proposed that “human agency” (i.e., using action to intentionally make things happen) involves both self-reactiveness and self-

reflectiveness. The first involves individuals monitoring their own behaviour and being aware of the conditions under which it is produced (i.e., cognitive and environmental). The second is an individual's higher metacognitive ability to reflect and evaluate their actions, considering the resultant effects, not only for themselves, but for others.

In a social context, when one encounters a situation that is provoking, exciting, aggressive, or risky, the GAM suggests there are a number of factors that will influence an individual's choice to respond with an aggressive or risky behaviour. Person factors, such as trait aggressiveness, sensation seeking, and previous exposure to aggression or risky behaviour, will contribute to an individual's internal state. The recent viewing of media, depicting this behaviour, is a situational factor that will also influence the internal state. It can increase arousal, and influence affect and cognition, partly through the priming of previously existing scripts associated with aggressive or risky behaviour, or the formation of new scripts through observational learning. In this context, media can play an influential role in one's choice to engage in aggression. Therefore, it is important to consider research which has investigated the capacity of media to influence the modelling of aggression and, in the context of the current research, aggressive or risky driving specifically.

### **Influence of Media on Modelling Aggression**

Studies investigating the influence of media on the modelling of aggression have varied in research design. Meta-analyses have been performed in an attempt to combine data from multiple studies in order to reveal a common effect. Paik and Comstock (1994) conducted one of the largest meta-analyses investigating the effects of television violence on antisocial behaviour, with an emphasis on aggression. Effect size for this relationship was determined using 217 studies, which included measures of antisocial behaviour, such as simulated and minor

aggressive acts and illegal activities. The average correlation collapsed across all research designs was significant, but varied depending on the research design (e.g.,  $r = .40$  for laboratory experiments compared to  $r = .19$  for surveys or time series studies).

Anderson and Bushman's (2001) meta-analysis explored the influence of video games on aggressive cognitions, affect, and behaviour. This source of media is different from television or movie viewing in that individuals not only see aggressive and violent behaviour, but engage in this behaviour virtually. A small to moderate effect of aggressive video games was found on cognitions ( $r = .27$ ), affect ( $r = .18$ ), and behaviour ( $r = .19$ ) (Anderson & Bushman, 2001). These effects were present for males and females, children and adults, and experimental and nonexperimental studies. Further analyses revealed that the magnitude of the effect on aggressive behaviours did not depend on the type of measure used in either experimental (e.g., physical measures of shock intensity) or nonexperimental (e.g., self-report) studies. However, the effect was larger if the target of aggression was an inanimate object ( $r = .41$ ) versus a real person ( $r = .14$ ), suggesting that, even though these video games may influence virtual behaviour, it does not guarantee aggressive behaviour in the real world (Anderson & Bushman, 2001).

Freedman (2002; 2007) suggests a weak relationship has been demonstrated, between exposure to or preference for media violence and aggression, using surveys and correlational studies. He estimated the range of accounted variance to be 1 – 9%, consistent with the findings of Paik and Comstock (1994). He also suggested that findings from laboratory studies have been inconsistent, with fewer than half supporting media violence as a cause of aggression. Though laboratory experiments may have the benefit of control and manipulation of variables, allowing for causality, there are limitations to their implementation. The advantage of descriptive

methods is their employment in situations where the gathering of data or measuring of behaviour cannot be manipulated, but only observed. Results from the previous meta-analyses suggest that both types of designs offer useful information and can complement each other in the interpretation of media's influence on modelling aggression.

Considering specific key studies, Bandura et al.'s (1963) earlier experimental work demonstrated the modelling of aggression in children, following the video viewing of an adult displaying aggressive behaviour. Going beyond childhood, the 22-year longitudinal study (Huesmann, Lefkowitz, Eron, & Walder, 1984), widely cited and influential (Freedman, 2002), investigated whether there were long term effects of children's exposure to media violence on aggression. Television viewing preferences and exposure time were measured beginning in third grade (i.e., 8 years old), and 10 and 22 years later. The information for third grade children was provided by the mother, and self-reported for the later time periods. Level of aggression was determined using peer ratings at all time periods, with additional self-reported aggression at 10 and 22 years, using measures such as the Minnesota Multiphasic Personality Inventory and convicted criminal activity, such as traffic violations or serious crime (Eron et al., 1972; Huesmann et al., 1984).

There was a significant relationship found between third grade preferences for violent television programs and third grade peer-rated aggression, in young males. This relationship between third grade preferences for violent television programs and aggression ten years later continued to be significant for males (Eron et al., 1972). Further examining the results by level of aggression at third grade (low, medium, or high), children displaying high levels of aggression at a younger age were more likely to engage in high levels of aggression at a later age (Huesmann et al., 1984). This relationship was demonstrated in both males and females, though



it did not exist for all measures of aggression, such as traffic violations or serious crime (Huesmann et al., 1984). Freedman (2007) suggests this finding demonstrates the stability of aggression over time, which implies that aggressive tendencies and traits develop early and are maintained. According to Weiss et al. (1992), early exposure to aggression can promote childhood development of maladaptive ways of processing social information, which mediates aggression. Further mediation could come through observation of parental aggression, supported by Huesmann et al.'s (1984) finding that measures of parental aggression significantly related to the child's aggression throughout the 22-year period.

The major limitation with the 22-year study is its inability to infer cause and effect. It was not possible to determine if the violent television viewing preferences created the aggression or the individual had already developed aggressive tendencies and, therefore, chose to watch such programs. Regardless of the directionality of this relationship, the GAM suggests that further viewing of such media can engage already existing scripts for aggression, heighten arousal, and foster the choice to act aggressively in a given situation.

Using a series of field experiments, Milgram and Shotland (1973) attempted to demonstrate imitation of antisocial behaviour, including aggression, in adults. Versions of an episode of a popular television series *Medical Center*, written specifically for this study, varied in levels of antisocial behaviour and consequential punishment depicted. The most aggressive version showed the lead character making abusive phone calls and smashing open a charity donation box to steal the money. In some experiments, the viewing audience was considerable, with a version of the episode being shown throughout entire cities, such as New York and Detroit. Participants were given the opportunity to engage in similar aggressive acts within 1 – 7 days following the television viewing. Despite extensive recruitment and varied methods used

by the researchers, no significant effects of imitation of antisocial behaviour were found. Individual differences, with respect to already existing tendencies for antisocial behaviour, were not measured, making it impossible to investigate whether the small number of participants, who did demonstrate aggression, were already more likely to engage in it.

To address the lack of research investigating the role of personality as a moderator to situational influences of aggression, Bushman (1995) designed a series of experiments, using undergraduate psychology students, to investigate the role of trait aggressiveness in the relationship between exposure to violent media and aggression. As part of mass testing three weeks prior, each student completed scales measuring trait aggressiveness (i.e., Physical Aggression subscale of the Aggression Questionnaire (Buss & Perry, 1992) and Assault subscale of the Buss-Durkee Hostility Inventory (Buss & Durkee, 1957)). In Study 1, self-reported television viewing preferences and current choice of movie to view in the laboratory setting, solely based on written descriptions of 12 movies, were measured. Higher trait aggression scores were significantly related to a greater desire to watch violent films. Males expressed a significantly greater desire to watch such films and reported more habitual exposure (Bushman, 1995)

To investigate how trait aggression moderates the influence of media violence on aggressive affect, Study 2 had participants view either a violent (*Karate Kid III*) or non-violent (*Gorillas in the Mist*) 15 minute video clip, and then rate their mood using a list of adjectives (e.g., hostile, annoyed, irritated) (Bushman, 1995). As expected, viewing of the violent video clip produced significantly higher levels of aggressive affect. Interestingly, it was demonstrated that trait aggression mediated this relationship, such that it was positively correlated with aggressive affect following the viewing of the violent movie, but not the non-violent movie

(Bushman, 1995). In a previous experiment by Bushman and Geen (1990), investigating the influence of media violence on aggressive cognitions, a significant relationship was found between the level of violence in viewed segments of television episodes and the number of aggressive thoughts listed by the participants. Though it cannot not be assumed that someone who has aggressive thoughts, following the viewing of aggressive media, will commit overt acts of aggressive behaviour, the GAM suggests an increase in aggressive affect can influence the activation of previously existing aggressive memory scripts and may prime aggressive tendencies or behaviours.

Whether the interaction of trait aggression and violent movie content lead to aggressive tendencies or behaviour was investigated in Bushman's (1995) third study. Participants viewed one of the two video clips used in Study 2, and then engaged in a reaction time competition with a virtual opponent. Before each trial, participants had to choose a volume level of noise blast that the opponent would receive as punishment for a lost trial. This decision was made with feedback about the level the opponent chose. Early trials displayed the opponent's levels as low, whereas later trials showed higher levels, in an attempt to provoke the participant. Using self-reported time spent watching violent drama as a covariate in the analysis, significant main effects were still found for video content, trait aggression, sex, and provocation (low, medium, and high). Considered individually, violent video content, high trait aggression, and males all chose more intense noise blasts for their opponent. Higher provocation also lead to more intense noise blast choice, but, interestingly, choice of intense noise blasts on the very first trial (i.e. low provocation) was significantly more likely for those who watched the violent video clip and had higher levels of trait aggression. Though levels of physiological arousal were considered similar during the viewing of the two types of video clips (inferred from blood pressure and heart rate),

these results suggest that trait aggression mediates how and when arousal can influence behaviour. Collectively, Bushman's (1995) research supports the interactive and multifaceted GAM, where person traits (i.e., trait aggression) and situational factors (i.e., violent or aggressive movie content) can influence internal states (i.e., affect, arousal, and cognition), which can ultimately increase the likelihood of aggressive response choices.

Though it is important to consider research about the modelling of aggression, it is difficult to generalize Bushman's (1995) Study 3 findings to specific aggressive behaviours in a more natural social environment (e.g., driving), given the artificiality of the task and measures of aggressive behaviour used. In the context of the current research, it is necessary to consider research associated with the viewing of media depicting acts of aggressive or risky driving, and the modelling of this specific behaviour.

### **Research on Types of Media Depicting Aggressive or Risky Driving**

In order to demonstrate the capacity of aggressive or risky driving media to influence behaviour, its existence in various forms needs to be established. Research has investigated the amount of this content in television programming and movies. During the years of 1975 to 1980, Greenberg and Atkin (1983) estimated that within the 784 driving scenes analyzed from prime-time broadcasts of popular television programs, there were 1301 acts of irregular driving. The most common were speeding, quick braking, squealing brakes, tires screeching, and quick acceleration. These acts were estimated to be shown 7.44 times per hour (Greenberg & Atkin, 1983). Drivers were predominantly young males, who rarely wore seat belts, and their irregular and dangerous driving acts rarely resulted in negative consequences (e.g., death or injury, physical damage, or legal penalties) (Greenberg & Atkin, 1983).

A form of television programming specific to driving is automobile commercials. Shin, Hallett, Chipman, Tator, & Granton (2005) analyzed content from North American automobile and truck commercials aired between 1998 and 2002. Of the 349 commercials, 45% were identified as containing unsafe driving. Aggressive driving behaviour accounted for more than 80% of that content, with high speeds constituting the majority (i.e., 58%). Watson et al. (2010) analyzed 200 Canadian automobile advertisements (i.e., television, magazine, and newspaper), displayed between 2006 and 2007, and found that 18% contained some form of unsafe driving, such as speeding or hard stops. Considering television commercials, because of their ability to display motion, it was estimated that 20% contained depictions of speed (Watson et al., 2010). In each television advertisement where speed was shown, a disclaimer was also present, demonstrating the vehicle manufacturer's awareness of the unsafe or questionable driving displayed (Watson et al., 2010).

Vitaglione (2012) suggests one type of televised event that clearly depicts aggressive or risky driving is competitive automobile racing, within the National Association for Stock Car Racing (NASCAR). It is estimated that more than 75 million fans view these events each year, with tens of thousands attending in person (Vitaglione, 2012). Dangerous and risky driving is broadcast live and is encouraged and reinforced by both cheering fans and large monetary rewards. For example, the total purse for the 2015 Daytona 500 was \$18 million dollars. The winner received \$1,581,453 and the last place driver (i.e. the loser) still took home \$262,390 (Mensching, 2015). The celebratory nature surrounding awarding the winner with large sums of money creates an air of acceptance of the behaviour and a "hero" for the fans. This combination has the capacity to increase the possibility of modelling the aggressive or risky driving behaviour (Atkin, 1989; Beullens et al., 2011b).

Beullens et al. (2011b) analyzed the content of 26 popular action movies shown in Belgium between 2005 and 2006. Movies were selected based on highest box office gross and included such films as *War of the Worlds*, *Casino Royale*, and *The Fast and the Furious: Tokyo Drift*. Of the 287 driving scenes that occurred in these movies, 129 depicted risky driving, with a mean scene duration of 61 seconds. The most frequently occurring risky driving behaviour was speeding, which occurred in 34.5% of the scenes. Tires screeching, brakes squealing, and quick braking or sudden decreases in speed were each shown in approximately 25% of the scenes (Beullens et al., 2011b). Researchers also found that the risks associated with such driving behaviours were rarely shown. Only 32% were followed by a crash and only 28% showed the endangering vehicle, or its surroundings, being damaged. In none of the scenes were legal penalties shown (Beullens et al., 2011b). Risky drivers tended to be young males and lead characters, who were the heroes in the movie (Beullens et al., 2011b).

Vingilis et al. (2017) addressed the popularity of social media, specifically YouTube, in the context of media depictions of aggressive or risky driving. On this website, individuals can create a free account, post videos, and view other's videos. Using the search term "street racing", over 33 million videos were found (as of April 30, 2015) and, of the 10 most popular (i.e., averaging approximately 787,677 views), 9 were on public roads, not racetracks. Searching terms of other risky driving behaviours, such as "burnouts" or "drifting", found similar results. The availability of this information on the internet is evident, but who is watching these videos, and how they influence driving behaviour is not known, given the lack of research on this specific type of media (Vingilis et al., 2017).

### **Influence of Media on Modelling Aggressive or Risky Driving**

The influence of media on modelling aggressive or risky driving has been assessed using various types of research methods. In a meta-analysis involving 88 empirical studies investigating the effects of different types of risk glorifying media on cognitions, affect, and behaviours, small to moderate effects were found ( $g = 0.35$  for cognitions,  $g = 0.56$  for affect, and  $g = 0.41$  for behaviours) (Fischer, Greitemeyer, Kastenmüller, Vogrincic & Sauer, 2011). These effects existed across all types of research designs (e.g., experimental, longitudinal, correlational) and for both males and females, though the effect was stronger for males and younger participants (i.e., less than 24 years old) (Fischer et al., 2011). Specifically, the largest effects were found when the stimuli in the risk glorifying media matched the context of the response measured (e.g., risky driving behaviour was most strongly influenced by risky driving media) and when the media exposure was active versus passive exposure (i.e., engaging in video game play versus viewing media) (Fischer et al., 2011).

Building on previous work, which already established an influence of video games on aggressive cognitions, affect, and behaviour (Anderson & Bushman, 2001), Fischer, Kubitzki, Guter, and Frey (2007) investigated whether playing video games, specific to aggressive and risky driving (i.e., racing games), would impact risk-related cognition, arousal, and affect. Participants played either a racing (*Need for Speed*, *Burnout*, or *Midnight Racer*) or neutral game (*Tak*, *Crash Bandicoot*, or *Fifa 2005*) for 20 minutes, where winning in all racing games required the “massive” violation of traffic rules. Following game play, risk-related cognitions were measured implicitly using a homonym task. Participants offered definitions for 10 words, each of which had more than one meaning, with one being positively risk-related (e.g., “kick”, as in “to get a kick out of something” rather than to “kick a ball”). Level of arousal was measured

using Likert scale ratings of the adjectives “aroused”, “excited”, “bored”, and “experiencing a kick”, and affect was measured using Likert scale ratings of adjectives from the Positive and Negative Affect Scale (e.g., “excited” or “hostile”) (Watson, Clark, & Tellegen, 1988).

Participants who played racing games displayed more risk-promoting cognitions, as indicated by a greater number of risk-related definitions, and a higher level of arousal, as indicated by higher ratings of arousing adjectives (Fischer et al., 2007). Both video game types produced more positive than negative affect, with no differences between the groups in negative affect. Lastly, there were no sex differences for any of these findings, suggesting that this media content influenced male and females in the same manner (Fischer et al., 2007).

To further examine whether these increases in risk-related cognitions influenced behaviour more specific to driving, Fischer et al. (2007) had participants play 20 minutes of the same racing or neutral games used in the previous study, followed by assessment of their willingness to take risks in more realistic portrayals of road traffic. Using the Vienna Risk-Taking Test, videos of real life risky driving scenarios (e.g., overtaking maneuvers) were viewed in their entirety, following a verbal description. During the second viewing of the video, participants indicated at which point they would abort the maneuver, using a key press. A total of 15 different videos were used and longer reaction times were indicative of greater risk taking (Fischer et al., 2007). Lastly, participants completed the same measure of risk-related cognitions as used in the previous study. Both males and females demonstrated significantly more risk-related cognitions following the playing of a racing game, but only males demonstrated greater risk taking behaviour in the Vienna Risk-Taking Test (Fischer et al., 2007). In addition to explanations of sex differences in such things as sensation seeking or aggressiveness, the researchers also add that females may have become more risk-averse because of their poorer



performance during the racing video game play (e.g., more collisions, lower performance scores).

Fischer et al. (2009) investigated whether exposure to risk glorifying media could influence behaviour after a 24 hour period. On Day 1, participants played either a racing game (*Burnout*) or a neutral game (*Tetris*) for 30 minutes and rated it, using a Likert scale, on its arousing properties (i.e., “aroused”, “excited”, and “experienced a kick”). On Day 2, 24 hours later, participants returned and completed the Vienna Risk-Taking Test, under the impression they were testing new software for street safety. The racing game was found to be more arousing than the neutral game and participants who had played the racing game, regardless of gender, demonstrated greater risk taking in the video road traffic scenarios presented (Fischer et al., 2009).

To investigate the influence of early exposure to racing or “drive’em up” video games on later driving behaviour, Beullens, Roe, and Van den Bulck (2011a) had adolescents, aged 17 and 18, who had not yet obtained a drivers’ licence, indicate how often they played such video games (e.g., *Gran Turismo*, *Burnout*). Two years later, when the participants were 19 and 20 years old and driving, they indicated their risk taking attitudes towards, and self-reported driving behaviour for, items that were particular to speeding (e.g., “How often do you drive faster than allowed on an open road”), fun riding (e.g., “How often do you take risks when driving to make driving more fun”), and drinking and driving (e.g., “How often have you driven a car while you definitely had too much to drink”). Personality measures of intensity and physical aggression were also measured, using subscales from the AISS (Arnett, 1994) and the Aggression Scale (Buss & Perry, 1992) respectively. Even after controlling for these possible influencing personality factors, video game playing was found to be a significant predictor of both positive

attitudes towards, and actual self-reported driving behaviour of, speeding and fun riding (Beullens et al., 2011a). Further investigation of sex differences demonstrated that video game playing was a significant predictor of self-reported speeding in males only (Beullens et al., 2011a), suggesting there may be moderating effects of sex to specific aggressive or risky driving behaviours. Video game playing was not associated with positive attitudes towards, nor more self-reported, drinking and driving (Beullens et al., 2011a). This suggests that the modelling of a certain type of risky driving behaviour is specific to the content of the media to which the individual is exposed.

Given evidence for the relationship between exposure to active forms of media depicting acts of aggressive or risky driving (i.e., video games) and the modelling of this behaviour, it is important to consider research which has investigated the influence of more passive types of media (i.e., in movies and television) on the modelling of aggressive or risky driving. Vingilis et al. (2015) assessed whether brief exposure to risky driving in television advertisements influenced attitudes, emotions, and risky driving inclinations. Participants viewed an entire television episode of *Modern Family*, which contained a total of five advertisements. One of the five was manipulated by the researchers, such that it contained either risky driving, non-risky driving, or no driving content. Risk-positive attitudes were assessed using the Implicit Association Test, where participants' categorized and associated modified vehicles (e.g., addition of rear spoilers) and unmodified vehicles with excitement-related words (e.g., speed, wild) or boredom-related words (e.g., dull, slow). Risk-positive emotions were assessed using the Driver Thrill Seeking Scale, where participants indicated their level of agreement to statements such as "I like to raise my adrenaline levels while driving". Lastly, the Vienna Risk-Taking Test was used to assess risky driving inclinations. No significant effect of exposure to risky driving

television advertisements was found for any of these measures, though there were sex differences, such that males had a higher driver thrill seeking mean score and higher risky driving inclinations (Vingilis et al., 2015).

A limitation of this study was the very brief exposure to risky driving content and Vingilis et al. (2015) suggest future research use longer exposure times. In addition to this, there was a delay between the viewing of the television material and the completion of the risk measures, during which participants completed other questionnaires about their thoughts on the television episode. In order to capture any short-term, immediate effects, delays between media exposure and measures of their influence should be minimized. Vingilis et al. (2015) mentioned their inability to establish pre-existing differences in measures such as driver thrill seeking, since all risk measures were completed after risky driving exposure. A counterbalanced approach, with different participants completing scales before or after exposure, could address this issue. Lastly, it was suggested that future research assess correlations between media risky driving exposure in a real world setting and its effects on driving behaviour (Vingilis et al., 2015). Viewing history of such content (e.g., in movies or video games), provided by participants, could be incorporated into analyses assessing its influence on driving behaviour.

Kostermans, Stoolmiller, de Leeuw, Engels, and Sargent (2014) were interested in whether exposure to reckless driving (e.g., fast, careless) depicted in movies could influence adolescents' self-reported driving behaviour four years later. Participants, between the ages of 10 and 14, indicated which movies they had seen from a list of 50 top box office hits released during the prior five years. From those selected, level of reckless driving exposure was determined by the proportion of characters the participant viewed engaging in acts of reckless driving. Sensation seeking was also measured, using the AISS (Arnett, 1994). Approximately

four years after the initial interview, participants with driving experience indicated their level of unsafe driving behaviour, using six items from the National Traffic Safety Administration's *National Survey of Speeding and Other Unsafe Driving Actions* (Kostermans et al., 2014). Items included content such as exceeding the speed limit, waving in and out of traffic, and driving without a seatbelt fastened. Adolescents' exposure to movie reckless driving content had a significant positive effect on their self-reported unsafe driving four years later (i.e., greater exposure was related to greater unsafe driving), even after controlling for age, sex, and frequency of watching movies (Kostermans et al., 2014). Higher levels of sensation seeking were also a significant predictor of reckless driving. Both of these findings were true of males and females, though males with higher sensation seeking were more likely to report driving without the use of a seatbelt, compared to females or those with lower levels of sensation seeking (Kostermans et al., 2014).

Self-reporting of driving behaviour, particularly behaviours considered aggressive or risky, may not produce accurate results. Participants may alter their responses in order to appear more socially desirable. This could produce under-reporting of aggressive or risky behaviour (e.g., more acceptable to society as a whole), as well as over-reporting (e.g., an attempt to match a personal ideal of a "cool" driver within a social circle of friends). Rather than have participants self-report driving behaviour, Fischer, Guter, and Frey (2008) investigated the effects of watching risk glorifying media on simulated driving. Participants watched either a risk-promoting movie scene (e.g., a segment from a James Bond movie), or a neutral scene from a local talk show. Following the viewing, participants drove on a simulator within the context of the racing video game *Need for Speed*. They were instructed to drive in an "appropriate" way throughout the entire course, and measures of risky driving included speeding, number of

collisions, and time to completion. Controlling for experience with racing games, significant differences were found between the risk-promoting and neutral viewing conditions, such that the risk-promoting condition produced higher maximum speeds and more collisions for both males and females, and less time to complete the entire course for males (Fischer et al., 2008).

Though this experimental research used a measure closer to realistic driving and controlled the exposure to risky glorifying media, the media content was not specific to aggressive or risky driving behaviours. Additionally, the simulated driving was in the context of a racing video game, which could have influenced participants' behaviour through expectations of performance and a lower perceived risk for driving aggressively. Lastly, this research did not consider other mediating factors of arousal, sensation seeking, trait aggression, or driving history.

Using archival data in the context of a descriptive research approach, Vitaglione (2012) analyzed aggressive driving accident reports (i.e., needless dangerous behaviours or increased risk of harm to other drivers), in relation to the timing of televised NASCAR events (i.e. passive media). West Virginia was selected as the test state because it was ranked first in the United States for the number of NASCAR fans per capita and it does not have its own NASCAR track (i.e., predominant source of viewing of these events is television) (Vitaglione, 2012). A period of one week surrounding each of the 156 broadcasted NASCAR events, between 2003 and 2006, was used to investigate the cumulative modelling effects of mass-media viewing of aggressive driving. This included the day before the event, day of the event, and only 5 days immediately following the event, since NASCAR races could occur within one week of each other. Using a time-series regression analysis, the rate of accidents and injuries, due to aggressive driving, were regressed onto NASCAR dates.

The number of aggressive driving accidents were found to significantly decrease on the day of the NASCAR events, which Vitaglione (2012) speculated was because fans were watching the televised event and not engaging in much driving that day. Both accidents and injuries, due to aggressive driving, significantly increased on the fifth day, but not immediately following the race. During this same time period, alcohol-related accidents and injuries did not change in the same way, suggesting that the specific media content was associated with the modelling of specific risky and aggressive driving behaviours (Vitaglione, 2012). Vitaglione suggests that the delay in the effects of the media content may have been due to resulting arousal from viewing a NASCAR race becoming associated with dangerous or aggressive driving behaviours over time. In the context of the GAM, the more an individual watches these races, the stronger the linkages become between arousal and associated aggressive memories, which include thoughts, feelings, and behaviours. When an individual experiences similar arousal in a driving scenario, as the result of provocation, the associated aggressive driving memory script may be activated or primed and become consciously accessible. It may require a number of days for these to be sufficiently activated in order to influence engagement in dangerous and risky driving (Vitaglione, 2012). However, an alternative explanation is that more immediate risky and aggressive driving behaviour was occurring, but drivers had escaped undetected until the passage of time, resulting in an accident or injury days later. Therefore, the measure used in this research was not sensitive enough to detect more immediate modelling effects (e.g., speeding) of this aggressive or risky driving media content.

A body of research, using various methodologies, has demonstrated that risk glorifying media, some including content depicting acts of aggressive and risky driving, has the capacity to increase risk-promoting cognitions, arousal, affect, willingness to take risks in observed driving

scenarios, and risky driving behaviour. These effects have been shown to last 24 hours, and even as long as several days. This body of research has not consistently demonstrated sex differences nor influences of personality traits of sensation seeking or aggressiveness. Few studies have incorporated participants' history of driving and exposure to driving or racing movies and video games. The next step is to conduct research which attempts to better understand how these factors fit into an aggression model, and interact with media exposure, to influence the modelling of aggressive or risky driving behaviour. Additionally, it is important to use measures sensitive to modelling effects (i.e., relevant to actual demonstrations of aggressive and risky driving behaviour) and have the capacity to detect the influences of media on driving behaviour immediately following exposure.

### **The Current Study**

The objective of the current research was to investigate the influence of motion pictures, depicting aggressive or risky driving, on subsequent driving behaviour. Both experimental and descriptive research approaches were employed in an attempt to demonstrate the robustness of this relationship. The main independent variable in the experimental design of Study 1 was video condition, where exposure to different types of content was controlled. Three video conditions differed in the level of aggressive and risky driving or arousal, which allowed for the investigation of modelling effects as a function of media content and arousal level. Aggressive or risky driving behaviour was assessed on a driving simulator, using measures such as speed and overtaking or passing actions as indicators of aggressive or risky driving. Factors of age, sex, sensation seeking, trait aggression, driver anger, driver vengeance, driving history, and movie and video game history were included in the analyses.

Figure 2 shows how these factors fit into Anderson and Bushman's (2002) GAM, and how they could interact and influence the modelling of aggressive or risky driving behaviour. A strength of the present research is the consideration of all of these factors together in a single study. Drivers who are young, male, and have higher levels of sensation seeking, trait aggression, driver anger, and driver vengeance may be more susceptible to the situational factor of media exposure to content specifically depicting aggressive or risky driving. The existence of previous scripts associated with aggressive driving, inferred from driving history (i.e., number of violations and collisions) and movie and video game history, may also increase the likelihood of modelling this media content.

Study 2 builds on the descriptive research approach of Vitaglione (2012), who used accidents associated with aggressive driving as a measure of modelling driving behaviour depicted in broadcasts of NASCAR media. However, not all aggressive or risky driving results in an accident or collision, and, therefore, using this measure would underestimate the amount of aggressive or risky driving on the roads following such media exposure. A frequent antecedent driving behaviour to accident or collision is speeding, which is considered risky and, sometimes, aggressive (Transport Canada, 2011). Study 2 uses archival speeding infraction data from the City of Edmonton, Alberta, to investigate whether increases in this specific risky driving behaviour occurred following the theatrical release of motion pictures, depicting acts of aggressive or risky driving. Pre-movie release speeding behaviour was compared to post-movie release speeding behaviour, with an emphasis on assessing effects immediately following movie release. This included factors of time (e.g., opening weekend and later movie playing time periods) and distance (i.e., close proximity to the theatres). Speeding infraction time of day was included as a variable, to assess differences in speeding in relation to popular movie viewing



times (e.g., weekends and evenings). Though Study 2 does not have the same cause and effect capacity as Study 1, its strengths are the use of real driving data and the ability to time-link speeding infractions to movie release dates and general viewing periods. It builds on the experimental findings of Study 1 and adds to the investigation of the relationship between aggressive or risky driving media exposure and the modelling of this behaviour on the roads.

### **Pilot Work**

#### **Level of Arousal for Video Conditions**

Prior to Study 1, pilot work was required to measure the levels of arousal associated with the three different video clips used in the experiment. In order to be able to infer that differences in aggressive driving behaviour were due to modelling media content, rather than simply resulting from heightened arousal, it was necessary to demonstrate that the level of arousal for the aggressive or risky driving video clip and the arousing content video clip were not significantly different. Additionally, in order for the neutral content video clip to serve as a control, it was necessary to demonstrate that its level of arousal was significantly lower than both the aggressive or risky driving video clip and the arousing content video clip. Though Study 1 participants could have rated their level of arousal after viewing the video material, previous research suggests that, when individuals become aware of their level of arousal, particularly when it is heightened, their subsequent behaviour can be influenced (Berkowitz, 2012). Given that the procedure for Study 1 required participants to drive immediately after viewing the video content, this would have produced a potential confounding factor.

The AGGressive Driving video clip (AGGD) contained scenes from the movies *Ronin*, *Bourne Identity*, *Death Proof*, *The Fast and the Furious*, and *Bullit*. The content depicted excessive speeding, driving off road, squealing of tires, and screeching of brakes. Negative

consequences, such as police involvement, collisions, or injuries, were not shown. The ARousing Non-Driving video clip (ARND) contained scenes from the movies *Twister*, *Poseidon*, *Indiana Jones and the Temple of Doom*, *Jurassic Park III*, and *Jaws II*. The material was highly arousing, depicting behaviours such as people running from threats or imminent danger. None of this material involved aggressive or risky driving. The NEUTral video clip (NEUT) contained scenes from a series of YouTube videos (Campus MovieFest, 2014; Chess.com, 2014; JCVdude, 2011; Plaza, 2010; Simon, 2010). It depicted real life activity, such as lane swimming and people walking in a market. Each of the five scenes in each video clip faded into the subsequent scene, resulting in a smooth transition. All video clips were approximately 15 minutes in length and were matched for level of sound. See Appendix A for a more detailed description of the video content used in each video clip.

Ten participants from the University of Alberta volunteered for this pilot study (four males and six females; mean age = 23.1 years,  $SD = 3.98$ ). All were either undergraduate or graduate students, recruited via email. The purpose of establishing arousal ratings for video clips, to be used in a later study, was explained to each participant. After providing verbal consent, each participant viewed the three video clips in the same setting used in Study 1 (i.e., soundproof room on a 40 inch widescreen television) and the order of viewing was counterbalanced across all participants. Immediately after each video clip, participants rated the level of arousal using a 5-point Likert scale, which ranged from 1 (not arousing) to 5 (extremely arousing). To limit any arousal carryover effects from one viewing to the next, participants spent approximately 5 minutes working on a neutral content word search task between each viewing (see Appendix B). A repeated measures ANOVA found a significant main effect of video clip condition on level of arousal ( $F(2, 8) = 47.4, p < .001, \eta_p^2 = 0.92$ ). Mean arousal ratings are

shown in Table 1. Post hoc comparisons, using the t-test with Bonferroni correction, indicated that perceived level of arousal was significantly lower for NEUT, compared to AGGD and ARND, and AGGD was not significantly different from ARND (see Table 1). This demonstrated that the level of arousal created by the AGGD condition was matched in the ARND condition, and the NEUT condition was a suitable control.

### **Simulated Driving Performance Parameters**

In order to determine whether Study 1 participants had learned to adequately manage the controls of the driving simulator and successfully complete required driving maneuvers, baseline driving performance parameters needed to be determined for the simulated driving practice run used in Study 1. The driving simulator used in Study 1 was the proprietary driving simulator from STISIM Drive™ (Systems Technology, Inc.). The physical apparatus of the simulator consisted of an accelerator and brake pedal, mounted on a floor plate, a steering wheel, mounted on a table, and a 40 inch widescreen television, which displayed the driving scene. Participants drove through the simulated driving scene while seated in a chair, in front of the steering wheel and television, in a soundproof room (see Figure 3).

The driving practice run was created using the STISIM Drive™ programming software, which allowed for the creation of unique, high resolution, driving courses. It contained two and four lane roads, with posted speed limits of either 60 or 80 km/hr. There were left and right road curves and hills, set within a mountainous background, mimicking a potential drive from Calgary to Banff National Park in Alberta, Canada. It covered a distance of 5.1 kilometres and took approximately six minutes to complete, when driven at posted speed limits. The scene was predominantly rural, with some city buildings, such as tall office buildings and stores, displayed at various positions throughout the course. There was one pedestrian crosswalk, two stop signs,

and two traffic light intersections where a stop was required (see Figure 4 for examples of the driving scene). Opposing traffic existed throughout the course and cyclists were shown riding on the shoulder in one location. There were two separate incidents of a vehicle pulling out in front of the driver and driving slowly, as well as one passing vehicle, which decelerated once in front of the driver. Vehicle types included cars, buses, pickup trucks, and motorcycles, with no police vehicles being shown. If a collision occurred, feedback was both visual (i.e., a cracked windshield) and auditory (i.e., sound of a crash). Following this 3 – 4 second collision feedback, a lane position reset allowed the driver to continue the run.

Six participants from the University of Alberta volunteered for this pilot study (three males and three females; mean age = 26.0 years,  $SD = 9.88$ ). All were either undergraduate or graduate students, recruited via email, who held a valid driver's licence. The purpose of establishing baseline measures of simulated driving performance, to be used in a later study, was explained to each participant. After providing verbal consent, each participant completed one driving practice run after receiving the following instructions: "For the driving session, you do not need to use any of the buttons on the steering wheel. The left floor pedal is the brake and the right pedal is the gas. Drive as you normally would, obeying appropriate traffic laws. While driving, there are a few things to watch out for: 1) pedestrians – stop to let pedestrians cross, 2) stop signs – do a complete full stop (i.e., move up to the sign and stop for ~2 – 3 seconds), 3) traffic lights – go when it is green and complete a full stop when it is red, and 4) other vehicles that may get in the way - you may pass slower vehicles if you feel it is necessary".

A summary of driving measures was produced by the STISIM Drive™ software following the completion of each participant's driving practice run. Mean speed was determined by averaging all speed values, recorded approximately every 0.01 seconds. This included values

of 0 km/hr, corresponding to whenever the vehicle came to a complete stop throughout the course. Percentage of driving time across the centre line and percentage of driving time off road was also provided. The mean values for these measures, across all participants, are shown in Table 2. Previous research with the current STISIM Drive™ simulator apparatus found that mean speed, plus or minus two standard deviations, produced an acceptable range of driving performance for this measure (Chan & A. Singhal, 2013, 2015; Chan, Madan, & A. Singhal, 2016). Therefore, the same rule was applied to the current mean speed data, and plus two standard deviations was applied to the mean percentage of driving time across the centre line and mean percentage of driving time off road. Therefore, the acceptable driving performance parameters for these latter two measures ranged from zero to this calculated maximum value. The resulting acceptable ranges for mean speed, percentage of driving time across the centre line, and percentage of driving time off road were 37.38 – 67.22 km/hr, 0 – 3.33, and 0 – 0.05 respectively (see Table 2).

### **Study 1**

This study used an experimental approach to investigate the modelling of aggressive or risky driving behaviour in young individuals, following motion picture exposure specific to this content, with comparison conditions of arousing (non-driving) and neutral content. Measures of driving behaviour were obtained through simulated driving, which occurred immediately following media exposure. This study also investigated the influence of age, sex, sensation seeking, trait aggression, driving history, and movie and video game history on the modelling of aggressive or risky driving. Measures of driver anger and driver vengeance, where participants indicated how they would respond to certain driving situations, provided additional information about previously existing aggressive or risky driving scripts. The protocol for this study was

reviewed for its adherence to ethical guidelines and approved by the Research Ethics Board 3 at the University of Alberta. It also received ethics review and approval by the Human Participants Review Sub-Committee of York University's Ethics Review Board.

### **Hypotheses**

1) Participants exposed to motion picture content depicting acts of aggressive or risky driving would demonstrate higher levels of risky driving during the subsequent simulated driving task, compared to those exposed to arousing or neutral content. This would be reflected in measures such as speeding, time taken to complete the driving course, and overtaking or passing actions.

2) This effect would be larger in males and those exhibiting higher trait aggression, sensation seeking, driver anger, and driver vengeance.

3) Those with a history of more self-reported violations and collisions, as well as self-reported viewing of aggressive driving movies and video game playing, would demonstrate higher levels of risky driving during the subsequent simulated driving task.

### **Method**

#### **Participants**

Eighty-one undergraduate students, enrolled in Introductory Psychology at the University of Alberta, were participants in the current study. They were recruited through the Undergraduate Research Pool website and received course credit for their participation. All participants had normal to corrected-to-normal vision and held a valid driver's licence. The first 13 participants run through the procedure were excluded from the study because of an early decision to change a portion of the driving instruction protocol. These changes did not allow for an appropriate comparison between these 13 participants and those run after the procedural

changes (see Procedure section below). Of the remaining 68 participants, five were excluded for driving at extremely slow speeds. This affected the triggering of timed programmed driving events within the driving course, leading to the experience of a different driving scenario (e.g., not witnessing other cars racing away because of a delay in reaching the required distance along the course within a certain amount of time). One additional participant was excluded for not completing the TAS, due to a protocol error (i.e., TAS was mistakenly not included in the protocol for this participant). The resulting group of 62 participants consisted of 24 males and 38 females, with a mean age of 20.3 years ( $SD = 1.8$ ) and mean length of time with a driver's licence equal to 3.89 years ( $SD = 1.9$ ). The distribution of males and females across the three video conditions (AGGD, ARND, and NEUT) is shown in Table 3.

### **Measures and Procedures**

The same three video clips, driving simulator (i.e., STISIM Drive<sup>TM</sup>), apparatus, and driving practice run used in the pilot work were employed in Study 1. A driving test run was created using the STISIM Drive<sup>TM</sup> programming software. This run contained two and four lane roads, with posted speed limits of 60, 80, and 100 km/hr. There were left and right road curves, hills, and the scenery background was mountainous, mimicking a potential drive from Calgary to Banff National Park in Alberta, Canada. There were urban sections, with business buildings and traffic lights, and rural sections, with open roads. The entire run covered a distance of 11 kilometers and took approximately 11 minutes to complete, when driven at posted speed limits. It contained two pedestrian crosswalks, one 4-way stop sign, and six traffic lights, two of which turned red and required a stop. Figure 5 depicts a map of the entire driving test run and Figure 6 shows some examples of the driving scene. Driving responses of braking or passing a slow moving vehicle, in order to maintain the speed limit, were required for events such as a bus

pulling out from the shoulder, cyclists moving into the road lane, and vehicles merging into the driver's lane because of construction or the termination of a lane. Drivers witnessed a pickup truck run a stop sign, other vehicles pass them and speed away, and one instance of a sports car speed away and race with another sports car. Opposing traffic, consisting of cars, buses, pickup trucks, and motorcycles, existed throughout the course, with no police vehicles shown. If a collision occurred, feedback was solely auditory (i.e., sound of a crash) with no lane reset, in order to lessen the impact of negative consequences associated with aggressive or risky driving.

For the simulated driving, various measures of driving performance were recorded by the STISIM Drive<sup>TM</sup> software, such as speed and acceleration. Later review of the driving test run was possible using the playback feature of the driving simulator software. This allowed for a more thorough visual inspection of driving behaviour for analysis, such as determining the distance at which the driver begins passing another vehicle.

Sensation seeking was measured using the 20 items within the novelty and intensity subscales of the Arnett Inventory of Sensation Seeking (AISS) (Arnett, 1994). Trait aggression was measured using the 29 items within the physical and verbal aggression, hostility, and anger subscales of the Aggression Questionnaire (TAS) (Buss & Perry, 1992). The original order of the TAS items was scrambled so that items from any one subscale were not clustered together. Driver anger was assessed using the Driving Anger Scale – Short Form (DAS) (Deffenbacher, Getting, & Lynch, 1994), which contains 14 driving anger items, describing different driving situations. Participants rate the amount of anger each situation would provoke in them (Deffenbacher et al., 1994). Driving vengeance was measured using the Driving Vengeance Questionnaire (DVQ) (Wiesenthal, Hennessy, & Gibson, 2000), which contains 15 multiple choice questions, each describing common situations encountered by drivers. Participants choose



how they would respond to each situation from a list of four available options, ranging in the level of aggression displayed. A fifth option of “Other” is offered for each question, where the participant can manually enter a different response. These types of responses require an interpretation of level of aggression displayed, in relation to the available listed options for that particular question (Wiesenthal et al., 2000). The DVQ also gathers information about age, sex, and years of driving experience (i.e., having a license). A summary of each of these four scales, including corresponding subscales, examples of items, type of response scale used, and reported reliability, is shown in Table 4. All four scales can be found in Appendix C.

Information about driving history information was collected in a survey asking participants to indicate frequency of driving, weekly number of kilometres driven, and number of traffic violations and collisions within the last two years (see Appendix D). Recent movie viewing preferences were obtained by having participants indicate which movies they had seen, from a list of 21 movies, all of which were in theatres between the years of 2013 and 2016 (see Appendix E). Some of the movies contained aggressive or risky driving content, while others were action/adventure movies, with no explicit risky or aggressive driving, or dramas. History of video game playing was obtained by having participants indicate how many and how often they played 16 listed video games (see Appendix F). Almost half of the video games primarily involved aggressive or risky driving content, while others varied in the amount of aggression depicted. Some involved highly aggressive first-person shooter positions, whereas others involved action based on music or sport. Participants were also able to list any additional games they played and how often. The order of completion of all scales and surveys was counterbalanced across all participants. Details of order administration are provided next, within the context of the full experimental procedure.

A between subjects-design was used, where participants were randomly assigned to one of the three video conditions, AGGD, ARND, or NEUT. Given that the University of Alberta's Psychology undergraduate population has a larger proportion of females, and the current study proposed to investigate media effects by sex, an attempt to ensure an equal number of males and females in each condition was made by using random assignment separately for males and females. For example, the first female participant to volunteer was assigned to the AGGD video condition, as was the first male. The next female participant was assigned to the ARND video condition, as was the next male, and so on.

At the beginning of each session, the participant was briefed on the purpose of the research (i.e., to investigate the behavioural patterns present when people drive after viewing a series of video clips), the tasks they were required to complete (i.e., surveys and simulated driving), and how long the session would take (i.e., 50 minutes). Each participant then read the Letter of Information and Consent Form (see Appendix G). Once consent was obtained, each participant began the session by completing the driving history survey. The order of completion of all four scales (i.e. pre- or post-video clip viewing and simulated driving) was counterbalanced for males and females separately (see Appendix H). Pre-video clip viewing and simulated driving, participants completed one driving scale (i.e., DAS or DVQ) and one personality scale (AISS or TAS). The order of completion of these pairs of scales was also counterbalanced within the overall pre/post counterbalancing, such that half completed the driving scale first, while the other half completed it second (see Appendix H). The remaining pair of scales was completed post-video clip viewing and simulated driving.

Following the completion of the first pair of scales, participants were read the instructions for completing their driving practice run on the simulator (see Appendix I for complete

experiment protocol). Mean speed, percentage of driving time across the centre line, and percentage of driving time off road needed to be within the acceptable ranges of performance, as determined in the pilot work (see Table 2). If adequate performance was not achieved, a second practice run was completed. Participants then watched one of the three video clips (AGGD, ARND, or NEUT), which was shown on the same television screen as the driving simulation. Immediately following the viewing of the video clip, participants were read the instructions for completing the driving test run. Once their driving was finished, participants completed the last pair of scales, followed by the surveys on movie viewing preferences and history of video game playing.

All subjects were debriefed, with an explanation of the hypotheses of the research, and how the survey measures (e.g., trait aggressiveness, driving anger/vengeance, and sensation seeking) related to the study of driving performance. The societal importance of understanding how aggressive and arousing media could influence driving behavioural patterns was emphasized, as well as how this research could have implications for driver training protocols and accident analysis and prevention (see Appendix J for the Debriefing Form).

Early in the running of participants, low speeds (i.e., below posted speed limits) and extremely cautious driving were observed, regardless of video condition. It was believed that certain components of the instruction protocol were influencing driving performance. First, the survey on driving history, which included reporting the number and type of violations, as well as collisions, in the last two years, was completed at the beginning of the session, prior to any simulated driving. This may have created a perception of a judgemental experimental environment and the desire to demonstrate good driving. Secondly, instructions read to participants, prior to driving sessions, included specifics on how to respond to certain situations,

such as making a complete full stop, lasting approximately 2 – 3 seconds, at a stop sign. This may have emphasized the performance assessment aspect of the driving and, therefore, produced more cautious driving behaviour. To correct for these possible influencing factors, the experimental protocol was revised, such that the completion of the driving history survey occurred after the completion of all scales and simulated driving. Also, the driving instructions were made more general, removing the specifics about how to respond to certain situations (see Appendix K for the revised protocol).

## **Results**

Prior to analyses involving measures of driving performance, preliminary analyses of scale and survey data were conducted to investigate the presence of order of completion effects. Additional analyses were conducted with this data to ensure that the participants in the three video conditions were not significantly different in the measures of sensation seeking, trait aggression, driving anger, and driving vengeance, driving history, movie viewing history of aggressive driving movies, and video game history of playing aggressive driving games. Sex differences in these measures were also investigated.

To address Hypothesis 1, differences in driving measures of mean speed (i.e., entire course and by section), time to completion, and passing frequency and acceleration, by video condition, were assessed, in order to investigate the influence of video content on driving performance. Course time to completion (s) is a measure that indirectly reflects certain aggressive or risky driving behaviours. Faster speeds, greater passing frequency, and shorter stop times at stop signs and pedestrian crosswalks would produce a shorter time to complete the driving course. The influence of video condition on acceleration during a provoking racing scenario was also investigated.

To address Hypotheses 2 and 3, the role of scale and survey factors on the various driving measures was investigated. Factors found to be significant predictors were analyzed for evidence of interactive effects with video condition and sex.

### **Preliminary Analysis of Scale and Survey Data**

A total of 62 participants completed the various scales and surveys, and all measures had  $N = 62$ , except TAS and years driving. Two participants omitted a single item during their completion of the TAS (i.e.,  $N = 60$ ), and one participant did not provide information for the number of years driving (i.e.,  $N = 61$ ). To investigate the presence of order effects in the scale data, a separate Welch test was performed for each of the four scales, comparing data collected pre- and post-simulated driving. Though TAS, AISS, and DAS data met all assumptions for a one-way analysis of variance (ANOVA) (including tests of normality, homogeneity of variance-covariance matrices, and multicollinearity), Shapiro-Wilks test results indicated that the DVQ data were not normally distributed ( $W = .94$ ,  $df = 62$ ,  $p = .003$ ), due to the presence of two outliers. The Welch test is considered to be very robust to violations of normality and homogeneity of variance (Laerd Statistics, n.d.-a) and, therefore, was chosen for the current analyses. For each scale, results did not reveal a significant effect of order of completion. As a result, all scale data used in further analyses were collapsed across the various orders of completion.

Differences in scale and survey data between the three video conditions were assessed, in order to ensure there were no significant differences in aggression, sensation seeking, driving anger, driving vengeance, driving history, movie viewing history of aggressive driving movies, and video game history of playing aggressive driving games between the AGGD, ARND, and

NEUT groups. To investigate any differences in these measures for males versus females, sex was also included as a factor.

To test for differences in TAS, AISS, and DAS scale data, a 3 (video condition: AGGD, ARND, NEUT) x 2 (sex: male vs. female) multivariate analysis of variance (MANOVA) was conducted. All assumptions were tested and met, and no significant main effects of video condition or sex were found for the TAS or AISS. There was a significant sex difference for the DAS ( $F(1,54) = 9.40$ ,  $p = .003$ ,  $\eta_p^2 = .15$ ), such that females ( $M = 42.7$ ,  $SD = 8.9$ ) scored higher than males ( $M = 35.9$ ,  $SD = 6.7$ ). For the DVQ analysis, previous Shapiro-Wilks test results indicated that the DVQ data were not normally distributed ( $W = .94$ ,  $df = 62$ ,  $p = .003$ ), therefore, two separate Welch tests were conducted to investigate the effects of video condition and sex. No significant main effects were found. Table 5 shows the means and standard deviations for all measures, by video condition and sex.

Survey measures of driving history (i.e., years driving, weekly kilometers driven, number of violations, and number of collisions), number of aggressive driving movies seen in the last two years, and number of aggressive driving video games played all violated the assumption of normality (see Table 6 for Shapiro-Wilks test results). Individual Welch tests were conducted to investigate the effects of video condition and sex for each of the survey measures. A significant main effect of sex was found for number of aggressive driving video games played ( $F(1,37.73) = 7.78$ ,  $p = .008$ ), such that males reported playing a greater number (see Table 5 for means and standard deviations).

## Hypothesis 1 Analyses

### **Influence of video condition on course mean speed and time to completion.**

Differences in course mean speed (i.e., entire course and by section) and time to completion, by video condition, were assessed to investigate the influence of aggressive driving video content on these measures of driving behaviour. Shapiro-Wilks test results indicated that course mean speed data (km/hr) and time to completion data (s) were not normally distributed, due to the presence of four outliers, all having slower speeds ( $W = .93$ ,  $df = 62$ ,  $p = .001$  for both variables). Data transformations (e.g., log, square root) did not resolve the issue, therefore, to test for differences in these variables by video condition (AGGD, ARND, NEUT), two separate Welch tests were performed. No significant main effect of video condition was found for either course mean speed or time to completion, though medium effect sizes were found and the AGGD condition had a higher course mean speed and lower time to completion (see Table 7 for means, standard deviations, and nonsignificant test results). These findings did not support Hypothesis 1, suggesting that participants, who were exposed to motion picture content depicting acts of aggressive or risky driving, did not demonstrate significantly higher course mean speeds or shorter times to completion, compared to those exposed to arousing or neutral content.

To investigate the influence of video condition on mean speed in specific regions of the driving course, four different sections of the course were selected. Each section represented different posted speed limit zones (e.g., 60, 80, and 100 km/hr) located throughout the course (i.e., beginning, middle, and end). Each contained continuous driving (i.e., no stop signs, traffic lights, or pedestrians), and was approximately two kilometers long (see Table 7). Shapiro-Wilks test results indicated that mean speed data for Section #1 and #4 were not normally distributed ( $W = .71$ ,  $df = 62$ ,  $p < .001$  and  $W = .95$ ,  $df = 62$ ,  $p = .02$  respectively). For Section #1, the lack

of normality was due to the presence of the four previously mentioned slower speed outliers, plus one high speed outlier. Section #4 had three outliers, two slow and one high speed, all from the group of outliers in Section #1. Data transformations (e.g., log, square root) did not resolve the issue, therefore, to test for differences in mean speed for each section by video condition (AGGD, ARND, NEUT), four separate Welch tests were performed. All other assumptions of the test were met, except for homogeneity of variance for Section #1 (Levene's test  $F(2,59) = 3.29, p = .04$ ). Though the AGGD mean speed was higher in each section, no significant effect of video condition on mean speed for any of the four sections was found (see Table 7 for means, standard deviations, and nonsignificant test results). These findings also did not support Hypothesis 1.

**Influence of video condition on passing behaviour.** Throughout the driving test run, there were four opportunities for drivers to pass slower moving vehicles. Hypothesis 1 suggests that participants, who were exposed to the aggressive driving video content, would pass more vehicles when given the opportunity. Figure 7 displays the frequency of total number of vehicles passed for each video condition (AGGD, ARND, NEUT). In order to conduct a Chi-square test of independence, meeting the requirement of expected cell counts equal to 5 or greater, frequency data were aggregated into two pass categories (0 – 2 and 3 – 4 vehicles passed). Even though the AGGD condition had a greater number of drivers passing 3 – 4 vehicles, the frequencies between video conditions were not significantly different ( $\chi^2(2) = 3.12, p = .21$ ), which did not support the hypothesis (see Table 8 for frequencies by video condition).

Another measure of risky driving in a passing scenario is the mean acceleration through the passing maneuver. Hypothesis 1 suggests that participants, who were exposed to the aggressive driving video content, would have a higher mean acceleration during this action. To



investigate differences in mean acceleration ( $\text{ft/s}^2$ ), the first passing opportunity was selected, since almost all drivers passed this vehicle ( $n(\text{AGGD}) = 21$  (100%),  $n(\text{ARND}) = 20$  (95%),  $n(\text{NEUT}) = 16$  (80%)). Of the five who did not pass, three were previous outliers in the course mean speed and time to completion analyses. This passing scenario occurred early in the driving test run (i.e., within the first kilometer), allowing for the investigation of immediate effects of video condition. This passing opportunity occurred on a two lane portion of road, requiring the driver to move into the opposing traffic lane, pass the vehicle, and merge back into their driving lane. Following the visual review of each driver's passing response, from the beginning of the pass to the merge back into the driving lane, a 180 m distance was selected for analysis. To test for differences in mean acceleration over this distance by video condition (AGGD, ARND, NEUT), an analysis of variance (ANOVA) was conducted. All assumptions of the test were met, and, even though the AGGD condition had a higher mean acceleration, no significant effect of video condition was found, which did not support Hypothesis 1 (see Table 7 for means, standard deviations, and nonsignificant test results).

**Influence of video condition in provoking racing scenario.** A provoking racing scenario occurred in the 100 km/hr zone for all drivers. When the driver approached a slower moving blue sports car from the rear, the sports car moved from the outer lane into the inner fast lane and sped away. Additionally, if the driver had progressed through the previous portions of the driving test run at appropriate speeds and passed all slower moving vehicles, the driving simulator program triggered the addition of a second, yellow sports car to this scenario. This second sports car approached the driver from behind and, when the blue sports car sped away, the yellow car passed the driver and chased after the blue sports car. This complete scenario occurred for 42 of the 62 drivers. Though the AGGD condition had more drivers experiencing

the additional passing yellow sports car, a Chi-square test of independence did not reveal a significant difference in frequencies between the groups ( $n(\text{AGGD}) = 17$ ,  $n(\text{ARND}) = 12$ ,  $n(\text{NEUT}) = 13$ ).

Hypothesis 1 suggests that participants, who were exposed to the aggressive driving video content, would be more influenced by this racing scenario. Mean acceleration through the first 300 m, immediately following the initiation of the blue sports car maneuver, was calculated and used as the dependent variable in a 3 (video condition: AGGD, ARND, NEUT)  $\times$  2 (passing yellow car: yes vs. no) ANOVA. The presence of the passing yellow car was included as a variable to assess its influence on participants' driving behaviour in the racing scenario. All assumptions of the test were met and a significant main effect of passing yellow car was found, such that those who witnessed the passing yellow car as part of the racing scenario had a greater mean acceleration, compared to those who did not. Even though AGGD mean acceleration was higher and there was a medium effect size, there was no main effect of video condition, which did not support the hypothesis (see Table 9 for means, standard deviations, and test results).

### **Hypotheses 2 and 3 Analyses**

**Role of scale and survey factors in course mean speed.** Correlation analysis was performed to assess relationships between course mean speed and age, scale data, and survey data. Higher course mean speed was significantly related to greater trait aggression (TAS), sensation seeking (AISS), and driving vengeance (DVQ), which supported Hypothesis 2. It was also significantly related to a higher number of aggressive driving video games played, which supported Hypothesis 3 (see Table 10 for correlation results). Significant positive correlations were also found between certain scale measures and survey measures. Of interest, greater trait aggression and sensation seeking were related to greater driving anger, driving vengeance, and a

higher number of violations. Greater sensation seeking and driving vengeance were related to a higher number of aggressive driving movies viewed in the last two years, and greater driving vengeance was significantly related to a higher number of violations. Appendix L contains the complete correlation matrix.

A stepwise multiple regression analysis was conducted to evaluate whether any of the scale (TAS, AISS, DAS, DVQ) or survey measures (driving history (i.e., years driving, weekly kilometers driven, number of violations, and number of collisions), number of aggressive driving movies seen in the last two years, and number of aggressive driving video games played) were significant predictors of course mean speed. Sex was also entered into the analysis as a dummy variable, with 1 denoting male and 0 denoting female. The assumptions of little or no multicollinearity, little or no autocorrelation, and linearity between the independent and dependent variables were met. Shapiro-Wilks test results had previously indicated that course mean speed data were not normally distributed ( $W = .93$ ,  $df = 62$ ,  $p = .001$ ), due to the presence of four outliers, all having slower speeds. This also influenced homoscedasticity. Data transformations (e.g., log, square root) did not resolve the issue, therefore, in order to comply with test assumptions, an analysis was conducted with the four outliers removed, resulting in normality and homoscedasticity. Removal of outliers can create a selection bias (e.g., three of the four outliers were in the NEUT video condition), therefore, a follow-up analysis, comparing the results with the inclusion of these outliers, was performed.

With outliers excluded, AISS was the only significant predictor that entered into the regression model, and was significantly related to course mean speed ( $F(1,53) = 12.24$ ,  $p = .001$ ). The multiple correlation coefficient was .43, indicating that sensation seeking accounted for approximately 18.8% of the variance in course mean speed. The comparison regression analysis,

with the four outliers included, resulted in both AISS and TAS being significant predictors of course mean speed. At step 1, AISS entered into the regression equation and was significantly related to course mean speed ( $F(1,57) = 8.75, p = .004$ ). The multiple correlation coefficient was .37, indicating that sensation seeking accounted for approximately 13.3% of the variance. At step 2 of the analysis, TAS entered into the regression equation and was significantly related to course mean speed ( $F(2,56) = 7.24, p = .002$ ). The multiple correlation coefficient following step 2 was .45, with trait aggression accounting for an additional 7.2% of the variance. The combined variance accounted for by these two significant predictors was 20.5%. Investigation of the TAS scores associated with the four slower speed outliers revealed that three had lower scores (50, 51, and 58), each being one full standard deviation below the mean ( $M = 71.8, SD = 13.8$ ). Their inclusion in the model strengthened the relationship between trait aggression and course mean speed. The results from both of these analyses offered further support for Hypothesis 2.

Based on the significant findings of the regression analysis, analyses were conducted to investigate if the significant course mean speed predictors of sensation seeking and trait aggression interacted with video content to influence driving speed. AISS and TAS were transformed into nominal variables (i.e. low vs. high levels) using a median split (AISS:  $Mdn = 51$ , TAS:  $Mdn = 71$ ), since data for both variables were normally distributed. With outliers excluded, only AISS was entered into the 2 (AISS: low vs. high) x 3 (video condition: AGGD, ARND, NEUT) ANOVA model. All assumptions of this test were met and a significant main effect of AISS was found ( $F(1,52) = 5.53, p = .02, \eta_p^2 = .10$ ), such that those with greater sensation seeking had faster speeds, compared to those with lower levels, however, there was no significant interaction between AISS and video condition (see Table 11 for means and standard

deviations). With outliers included, a comparable ANOVA was conducted, with the addition of the nominal TAS variable (low vs. high). All assumptions of the test were met, except for normality in course mean speed data. It is suggested, however, that ANOVA models are quite robust to violations of normality (Laerd Statistics, n.d.-b). There was a significant main effect of AISS ( $F(1,49) = 4.68, p = .04, \eta_p^2 = .09$ ), but TAS was not significant. Again, there were no significant interactions (see Table 11 for means and standard deviations). The significant main effect for sensation seeking offered further support for Hypothesis 2, however, the lack of an interaction with video condition suggested that the aggressive driving video content did not influence the driving speed of those with greater sensation seeking differently than the other two video conditions.

**Role of scale and survey factors in time to completion.** Correlation analysis was performed to assess relationships between time to completion, age, and scale and survey data. Shorter time to completion was significantly related to greater trait aggression (TAS), sensation seeking (AISS), driving anger, and driving vengeance (DVQ), which supported Hypothesis 2. It was also significantly related to a higher number of violations and aggressive driving movies viewed in the last two years, which supported Hypothesis 3. As expected, there was a strong significant negative correlation between time to completion and mean course speed (see Table 10 for correlation results).

A stepwise multiple regression analysis was conducted to evaluate whether any of the scale (TAS, AISS, DAS, DVQ) or survey measures (driving history (i.e., years driving, weekly kilometers driven, number of violations, and number of collisions), number of aggressive driving movies seen in the last two years, and number of aggressive driving video games played) were significant predictors of time to completion. Sex was also entered into the analysis as a dummy

variable, with 1 denoting male and 0 denoting female. For this regression analysis, like the course mean speed regression analysis, the assumptions of little or no multicollinearity, little or no autocorrelation, and linearity between the independent and dependent variables were met. Shapiro-Wilks test results had previously indicated that time to completion data were not normally distributed ( $W = .93$ ,  $df = 62$ ,  $p = .001$ ), due to the presence of the same four outliers in the course mean speed data, all having a longer time to completion. This also influenced homoscedasticity. Data transformations (e.g., log, square root) did not resolve the issue, therefore, in order to comply with test assumptions, an analysis was conducted with the four outliers removed, resulting in normality and homoscedasticity. A follow-up analysis, comparing the results with the inclusion of these outliers, was performed.

With outliers excluded, AISS was the only significant predictor that entered into the regression model, and was significantly related to time to completion ( $F(1,53) = 8.00$ ,  $p = .007$ ). The multiple correlation coefficient was .36, indicating that sensation seeking accounted for approximately 13.1% of the variance. The comparison regression analysis, with the four outliers included, resulted in both AISS and TAS being significant predictors of time to completion. At step 1, AISS entered into the regression equation and was significantly related to time to completion ( $F(1,57) = 10.26$ ,  $p = .002$ ). The multiple correlation coefficient was .39, indicating that sensation seeking accounted for approximately 15.2% of the variance. At step 2 of the analysis, TAS entered into the regression equation and was significantly related to time to completion ( $F(2,56) = 9.59$ ,  $p < .001$ ). The multiple correlation coefficient following step 2 was .51, with trait aggression accounting for an additional 10.3% of the variance. The combined variance accounted for by these two significant predictors was 25.5%. Again, the presence of the four shorter time to completion outliers, with lower TAS scores, strengthened the relationship

between trait aggression and time to completion. The results from both of these analyses offered further support for Hypothesis 2.

Based on the significant findings of the regression analysis, further analyses were conducted to investigate if the significant time to completion predictors of sensation seeking and trait aggression interacted with video content to influence the amount of time taken to drive the entire course. With outliers excluded, only the nominal AISS variable was entered into the 2 (AISS: low vs. high) x 3 (video condition: AGGD, ARND, NEUT) ANOVA model. All assumptions of this test were met and a significant main effect of AISS was found ( $F(1,52) = 7.12, p = .01, \eta_p^2 = .12$ ), such that those with greater sensation seeking had a shorter time to completion, compared to those with lower levels. No significant interaction between AISS and video condition (see Table 12 for means and standard deviations). With outliers included, a comparable ANOVA was conducted, with the addition of the nominal TAS variable (low vs. high). All assumptions of the test were met, except for normality in course mean speed data. Only a significant main effect of AISS was found ( $F(1,49) = 5.40, p = .02, \eta_p^2 = .10$ ), such that those with greater sensation seeking had a shorter time to completion, compared to those with lower levels. As in the previous analysis, there was no significant interaction between AISS and video condition (see Table 12 for means and standard deviations). The significant main effect for sensation seeking offered further support for Hypothesis 2, however, the lack of an interaction with video condition suggested that the aggressive driving video content did not influence the time to completion of those with greater sensation seeking differently than the other two video conditions.

**Role of scale and survey factors in passing behaviour.** Differences in passing frequency were assessed for the variables of sex, AISS, TAS, DAS, DVQ, number of violations,

number of collisions, number of aggressive driving movies seen in the past two years, and number of aggressive driving video games played. A series of Chi-square tests of independence were conducted, each using the passing categories of 0 – 2 and 3 – 4 vehicles passed. Nominal variables were created for AISS, TAS, DAS, and DVQ (i.e. low vs. high levels) using a median split (AISS:  $Mdn = 51$ , TAS:  $Mdn = 71$ , DAS:  $Mdn = 39$ , DVQ:  $Mdn = 38$ ). Nominal variables for number of violations and number of collisions were created with categories of 0 and 1 or more. Aggressive driving movie categories were 0 – 2 and 3 – 7 ( $Mdn = 2$ ), and aggressive driving video game categories were 0 – 2 and 3 – 5 ( $Mdn = 2$ ). Each test conducted met the requirement of expected cell counts equal to 5 or greater. Differences in passing frequency were significant for AISS ( $\chi^2(1) = 4.13, p = .04$ ), such that those with a higher level of sensation seeking passed more vehicles (i.e. 3 – 4), compared to those with lower levels (see Table 8 for frequencies). This finding supported Hypothesis 2.

Mean acceleration ( $\text{ft/s}^2$ ) through the first 180 m of the first passing opportunity, previously used to assess the influence of video condition, was used to further assess the influence of age, and scale and survey measures on this aspect of passing behaviour. Mean acceleration through the 180 m distance was significantly and positively related to trait aggression (TAS) ( $r = .24, p = .04$ ), which supported Hypothesis 2. It was also significantly related to age ( $r = .31, p = .01$ ) and years driving ( $r = .33, p = .008$ ).

A stepwise multiple regression analysis was conducted to evaluate whether age and any of the scale or survey measures were significant predictors of mean acceleration. Sex was also entered into the analysis as a dummy variable, with 1 denoting male and 0 denoting female. All assumptions of the regression analysis were met. At step 1 of the analysis, years of driving experience entered into the regression equation and was significantly related to mean



acceleration ( $F(1,52) = 6.13, p = .02$ ). The multiple correlation coefficient was .33, indicating that years driving accounted for approximately 10.5% of the variance. At step 2 of the analysis, weekly number of kilometers driven entered into the regression equation and was significantly related to mean acceleration ( $F(2,51) = 5.61, p = .006$ ). The multiple correlation coefficient following step 2 was .43, with weekly number of kilometers driven accounting for an additional 7.5% of the variance. Therefore, for mean acceleration, the combined variance accounted for by these two significant predictors was 18.0%. These results suggested that driving experience factors significantly contributed to mean acceleration in this passing scenario, however, none of the findings supported Hypothesis 2 or 3.

Based on the significant findings of the regression analysis, further analyses were conducted to investigate if the significant mean acceleration predictors of years driving and weekly kilometers driven interacted with video content to influence mean acceleration during this first passing opportunity. Nominal variables for the two predictors were created, using a median split (years driving:  $Mdn = 4$ , weekly kilometers:  $Mdn = 135$ ). A 2 (years driving: 1 – 4 vs. 5 – 9) x 2 (weekly kilometers driven: 0 – 135 vs. 136 – 500) x 3 (video condition: AGGD, ARND, NEUT) ANOVA was conducted. All assumptions of this test were met and no main effects nor interactions were found (see Table 13 for means and standard deviations).

**Role of scale and survey factors in provoking racing scenario.** Correlation analysis was performed to assess relationships between mean acceleration through the first 300 m of the racing scenario, age, and scale and survey data. Mean acceleration was significantly and positively related to sensation seeking (AISS) ( $r = .24, p = .04$ ), which supported Hypothesis 2, and number of violations ( $r = .28, p = .02$ ), which supported Hypothesis 3. A stepwise multiple regression analysis was conducted to evaluate whether any of the scale (TAS, AISS, DAS, DVQ)

or survey measures (driving history (i.e., years driving, weekly kilometers driven, number of violations, and number of collisions), number of aggressive driving movies seen in the last two years, and number of aggressive driving video games played) were significant predictors of this 300 m mean acceleration. Sex was also entered into the analysis as a dummy variable, with 1 denoting male and 0 denoting female. All assumptions of this test were met and number of violations was the only significant predictor that entered into the regression model, significantly related to mean acceleration ( $F(1,57) = 4.72, p = .03$ ). The multiple correlation coefficient was .28, indicating that number of violations accounted for 7.7% of the variance. These findings supported Hypothesis 3. Approximately 50% of the participants ( $n = 30$ ) reported having violations, with speeding accounting for 80% of those violations.

Based on the significant findings of the regression analysis, further analyses were conducted to investigate if the significant mean acceleration predictor of number of violations interacted with video content and the presence of the passing yellow car to influence mean acceleration during this racing scenario. A nominal variable for number of violations was created and entered into a 2 (number of violations: 0 vs. 1 or more) x 3 (video condition: AGGD, ARND, NEUT) x 2 (passing yellow car: yes vs. no) ANOVA. All assumptions of the test were met and a significant main effect of number of violations was found ( $F(1,50) = 4.26, p = .04, \eta_p^2 = .08$ ), such that those with 1 or more violations had a greater mean acceleration (see Table 14 for means and standard deviations). This main effect is shown in Figure 8, which displays the mean acceleration by video condition and number of violations. The additive effect of violations was relatively consistent across the three video conditions, which supported Hypothesis 3. Though AGGD mean acceleration was the highest, there was no significant main effect of video condition.

There was also a significant main effect of passing yellow car ( $F(1,50) = 6.26, p = .02, \eta_p^2 = .11$ ), such that those who witnessed this as part of the racing scenario had a greater mean acceleration. This main effect is shown in Figure 8, which displays the mean acceleration by video condition and presence of passing yellow car. The influence of the passing yellow car appeared to be greatest for the ARND and NEUT conditions, which suggested its addition to the racing scenario may have prompted aggressive driving memory scripts in these participants. The small difference in mean acceleration for the AGGD participants, who did or did not witness the passing yellow car, suggested that these scripts may have already been activated during the viewing the AGGD video clip, lessening the influence of the additional yellow car to the racing scenario. Though the three-way interaction between video condition, passing yellow car, and number of violations approached significance ( $F(2,50) = 3.11, p = .054$ ), the number of observations in each category was too small to draw reliable conclusions (e.g., there was only one participant in the category of AGGD/1 or more violations/no passing yellow car).

### **Discussion**

This study used an experimental approach to investigate the modelling of aggressive or risky driving behaviour in young individuals, following their exposure to motion picture content displaying this behaviour. Hypothesis 1 predicted that participants, who were exposed to motion picture content depicting acts of aggressive or risky driving, would demonstrate higher levels of risky driving during the subsequent simulated driving task, compared to those exposed to arousing or neutral content. The results, however, did not provide strong evidence to support this. Differences in the behavioural measures of aggressive driving were in the expected direction (e.g., higher mean speed, shorter time to completion, and greater passing frequency),

however, they were not significant. In cases where medium effect sizes were found, a larger number of participants may have resulted in significant differences between the video conditions.

The small differences between video conditions may have also been due to the short 15 minute aggressive driving video clip not matching the level of engagement one would experience watching a full movie. The video clip depicted frequent portrayals of risky driving behaviour, in the absence of negative consequences, and the content was arousing and positively reinforced. All of these factors should have enhanced observational learning (Atkin, 1989; Bandura, 1971; Beullens et al., 2011b; Vitaglione, 2012). What was limited, however, was the inclusion of a more comprehensive plot and context for the behaviour. It may be that participants did not affiliate or empathize with the characters to the same extent and, therefore, did not have the same level of justification for the risky driving behaviour, deeming it appropriate or warranted. This could also have limited their emotional investment in the content. As Vitaglione (2012) suggested, observing behaviour performed by someone that viewers can identify with and feel similar to is more likely to influence behaviour. Also, the situational factor of observing the risky driving behaviour via media may have required a greater influence of internal state (i.e., arousal, affect, and cognition) to result in the modelling of aggressive driving behaviour. Pilot work demonstrated that the video clip increased arousal, however, it may not have increased affect or activated appropriate aggressive driving cognition sufficiently for the modelling of risky driving behaviour.

Hypothesis 2 predicted that males would demonstrate more aggressive driving behaviour following the viewing of the aggressive driving video clip, however, no sex differences were found for the behavioural measures of aggressive driving. There were fewer males than females in the current study, a ratio of 1:2, and, perhaps, more males were needed to demonstrate the

expected sex difference. The males were young, which should have contributed to the likelihood of more aggressive driving, however, there may have been other personality factors (e.g., sensation seeking), related to being male, that better predicted aggressive driving behaviour. Males did report playing more aggressive driving video games, compared to females, however, females demonstrated a higher level of driving anger. In the development of the Driving Anger Scale, Deffenbacher et al. (1994) found sex differences on some of the subscales. Females were more angered by illegal behaviours (e.g., speeding) and traffic obstructions, whereas males were more angered by police presence. The significant sex difference found in the current study may reflect characteristics of the driving culture in the City of Edmonton. For example, speed detection is primarily monitored through the use of automated enforcement, which may not produce the same level of driving anger in males, and the higher level of driving anger in females may reflect an observation of more illegal behaviours on the road.

The relationships found between scale and survey factors provided insight into how certain personality factors were related to driving and movie viewing history. Higher levels of sensation seeking and trait aggression were both related to higher levels of driving anger, driving vengeance, and number of violations, suggesting these personality factors played a role in aggressive driving cognition and behaviour. Sensation seeking was also related to the number of aggressive driving movies viewed in the past two years, which could suggest that those with higher levels actively sought out these types of movies. The greater viewing of these movies was associated with higher levels of driving vengeance, which was related to a higher number of violations, with speeding accounting for the majority of these. Given the correlational nature of this finding, it is not possible to determine whether the movies contributed to the development of driving vengeance, leading to violations, or whether those with greater driving vengeance and

violations chose to view these movies more. The relationships found with these measures and driving vengeance offer further validation of the Driving Vengeance Questionnaire (Wiesenthal, et al., 2000).

Hypothesis 2 also predicted that more aggressive driving would be exhibited by those with higher trait aggression, sensation seeking, driver anger, and driver vengeance. The results supported this hypothesis, with the exception of driving anger. Higher trait aggression, sensation seeking, and driving vengeance were all related to higher course mean speed and shorter time to completion, and regression analyses found trait aggression and sensation seeking to significantly contribute to these measures. Higher trait aggression was related to higher mean acceleration during a pass and higher sensation seeking was related to higher mean acceleration during a racing scenario. Lastly, those with higher sensation seeking passed more vehicles throughout the driving course.

These findings offered support for the contribution of personality factors and aggressive-promoting driving cognition (i.e., driving vengeance) on the choice to drive aggressively or risky. This suggests that individuals with these characteristics may be more susceptible to aggressive and risky driving content found in movies. No interaction between these factors and video condition was found in the current study, but this may have been due to the video clip issues mentioned previously.

Hypothesis 3 predicted that those with a history of more self-reported violations and collisions, as well as self-reported viewing of aggressive driving movies and video game playing, would demonstrate higher levels of risky driving. Of these measures, only violations was found to be significantly related to, and contributed to, a higher mean acceleration during the observation of a racing scenario. The increase in mean acceleration was relatively consistent

across all video condition groups. Given that the majority of violations reported were for speeding, this suggested that drivers, with a history of speeding, were more influenced by environmental cues associated with racing. The presence of an additional race-engaging yellow car also produced a higher mean acceleration across the three video conditions, however, this increase was not consistent across the groups. The greatest influence was observed for the arousing and neutral video conditions, with minimal difference for the aggressive driving video condition (i.e., mean acceleration during the racing scenario was very similar regardless of witnessing the additional yellow car). Though these differences between the groups were not significant, the trend suggests that the aggressive driving video condition was less influenced by the additional race-engaging cue (i.e., yellow car) possibly because participants had already been exposed to this type of content prior to driving. The earlier exposure had already activated aggressive driving cognition and influenced driving behaviour throughout the course. The overall effect of the additional presence of the yellow car provides support for the influence of situational factors, associated with racing, on driving behaviour.

### **GAM Revisited**

A modified GAM (Anderson & Bushman, 2002) was created to propose how the factors included in this study could interact and contribute to the modelling of aggressive or risky driving behaviour (see Figure 2). The research supported the inclusion of personality factors of trait aggression and sensation seeking when considering why and how aggressive or risky driving occurs. Evidence was also provided for the consideration of aggressive driving cognitive factors of driving vengeance and history of violations (e.g., speeding). Lastly, it was demonstrated that situational factors of race provoking cues increased the modelling of risky driving behaviour. Though the current study did not provide strong evidence for the influence of

viewing media containing aggressive or risky driving content, trends suggest that this may have potential to influence the modelling of this behaviour.

### **Limitations and Future Directions**

A major strength of the current research was the consideration of multiple intervening factors together in a single study. In considering future directions, however, the limitations of the current study should be addressed. As mentioned previously, the video clips used did not contain detailed plot and context for the aggressive or risky driving behaviours portrayed. In future research, it is recommended to use either a segment from a single movie, containing more plot development and a clear indication of who the hero of the story is, or the viewing of an entire aggressive or risky driving movie. It must also be understood that the viewing of a movie in an experimental context is socially different from the typical context of movie viewing in a theatre with others.

Another limitation of this study was that driving behaviour was measured using a driving simulator, which did not match the level of optic flow and vestibular feedback one would experience during real-world driving. Simulated driving also limits the threat of negative consequences associated with risky driving that could cause collision and injury in the real world. Though it might be expected that this would have increased the risk-taking behaviour of drivers, social desirability bias may have prevented this from occurring. Prior to participation, individuals were aware that the study was investigating the influence of media on driving performance, and may have chosen to drive more cautiously and obey driving rules in order to be good drivers. For example, early in the study, it was evident that participants were influenced by the completion of the driving history questionnaire at the beginning of the session. The prior self-reporting of violations and collisions appeared to produce more cautious drivers.



Driving in this experimental study was not a social event, which is more likely to exist in the real world, where the presence of others in a vehicle can influence a driver's behaviour (Simons-Morton et al., 2005; Steinberg & Monahan, 2007). Though simulated driving has its limitations, there are ethical limits to conducting an experiment where participants demonstrate risky driving in a real world environment. Study 2 attempts to overcome this issue by investigating the influence of aggressive driving media on real world driving, through the use of archival speeding data.

The test course created for simulated driving included scenarios that were typical to driver experiences on the road (e.g., stop signs, pedestrian crosswalks, slower vehicles). It is possible that the course did not provide enough opportunities for the driver to freely speed and perform risky actions on more open roads. It is recommended that future development of test courses for simulated driving include more of these "free" driving areas, where drivers may be more likely to demonstrate aggressive or risky driving, such as speeding.

Participants in the current study were recruited via the Undergraduate Research Pool at the University of Alberta, which resulted in a participant demographic that was young and two thirds female. This limited the ability to investigate the influence of age on modelling aggressive driving over a larger range (younger (e.g., 16 – 25) versus older (e.g., 30 – 40) drivers). Future work could recruit an older group of drivers to be used for comparison. In order to create equal numbers of males and females, selective recruitment of males could be used. Also, it may be of interest to include a group of "movie-goers", who have viewed specific aggressive and risky driving movies, which would promote capturing the characteristics of those who seek out and view this content.

## **Study 2**

This study used a descriptive research approach (i.e., event study) to investigate the association between motion pictures in theatres, depicting aggressive or risky driving, and the modelling of speeding behaviour. Linkages in time between the release of these motion pictures and speeding infractions was possible. This time series approach was used previously to investigate the association between aggressive or risky driving depicted on television (i.e., NASCAR races) and the modelling of such behaviour, causing collision (Vitaglione, 2012). Speeding may be an antecedent behaviour to collision and therefore, this study used a more sensitive indicator of modelling aggressive or risky driving in association with motion picture content and exposure.

### **Hypotheses**

- 1) Increases in aggressive or risky driving behaviour (i.e., speeding) would be observed when motion pictures, depicting acts of aggressive or risky driving, were released and playing in theatres.
- 2) The increase in speeding behaviour would be greatest closer to the movie release date (i.e., first week post-movie release) and throughout the first month (i.e., four weeks post-movie release).
- 3) Not only would the number of speeding infractions increase while the aggressive or risky driving motion picture was in theatres, but, the speed differential (i.e., the amount over the speed limit) would also increase.

## Method

### Participants

Participants included any driver who was the registered owner of a vehicle identified as speeding, by automated photo radar, within the City of Edmonton, Alberta, between January 1, 2013, and December 31, 2015. Speeding infractions were issued to the registered owner of the vehicle, rather than the driver, since the vehicle was identified as being involved in the offense. According to the Traffic Safety Act, the vehicle's owner, who may or may not have been the speeding driver, is, therefore, guilty of the offense (City of Edmonton, 2015). Personal identifiers in the data, such as licence plate of vehicle, were not obtained for the purposes of the current study, in accordance with the Privacy of Information Act and the research agreement between the researcher and the City of Edmonton. This information would have allowed linkages to other databases containing more detailed personal information (e.g., name of owner of registered vehicle). The lack of this information prevented the reporting of the demographics of the speed violators.

### Measures and Procedures

Motion pictures, released between January 1, 2013 and December 31, 2015 were reviewed for content focused on aggressive or risky driving. Four movies were identified as containing content specific to car chases, racing, and excessive speeding: *Fast and Furious 6*, *Furious 7*, *Need for Speed*, and *Rush*. Domestic box office performance (where the vast majority of revenue comes from the United States and Canada (B. Nash, personal communication, February 28, 2017)) indicated that the two *Fast and Furious* franchise movies were the most popular (approximately \$239 - \$353 million) (Nash Information Services, 2017b), followed by *Need for Speed* (approximately \$44 million) (Nash Information Services, 2017c), and *Rush*

(approximately \$27 million) (Nash Information Services, 2017d). *Fast and Furious 6* and *Furious 7* each had an opening weekend domestic box office gross that accounted for approximately 41% of their total domestic box office gross (approximately \$97 million and \$147 million, respectively) (Nash Information Services, 2017b). The opening weekend domestic gross for each of these two movies was larger than the combined total domestic gross for *Need for Speed* and *Rush*. These two movies were released during similar times of the year (spring), compared to *Need for Speed* (late winter) and *Rush* (early fall). Given the seasonal similarity and the greater popularity of *Fast and Furious 6* and *Furious 7*, the current study narrowed the focus of the investigation of changes in speeding behaviour associated with aggressive and risky driving movies playing in theatres to these two movies.

These two *Fast and Furious* movies varied in the total length of time shown in seven Edmonton theatres, identified as playing first-run movies (see Appendix M for theatre location). The greatest growth in profit at the domestic box office was experienced during the first month. Figure 9 shows the daily cumulative domestic box office for the eight *Fast and Furious* movies (Nash Information Services, 2017b). The dotted line estimates the point at which the movies had played in theatres for approximately 30 days. Given the early steep trend, a four week post-movie release time period was selected and compared to a four week pre-movie release time period (see Table 15 for detailed information about release dates and time periods used for these two movies). This also guaranteed these two movies were playing in all seven theatres. All four of the previously mentioned movies were released on DVD at a later time, however, the dates of DVD release did not coincide with any of the time periods used in the current analyses.

Speeding infractions, between the dates of January 1, 2013, and December 31, 2015, were provided by the Office of Traffic Safety, in the City of Edmonton, Alberta. All infractions

resulted from automated enforcement, which included the use of both stationary cameras (i.e., permanently mounted, operating 24 hours a day, seven days a week) and mobile cameras (i.e., vehicle based and free to move location and vary in enforcement schedule). Violators were photographed as they passed the enforcement camera (City of Edmonton, 2015), and tickets were usually received within one week of the violation (Li, El-Basyouny, & Kim, n.d.). The amount of the fine was proportional to the number of kilometres over the speed limit the vehicle was travelling (City of Edmonton, 2015).

In a review of camera enforcement scheduling data, provided by the Office of Traffic Safety, it was determined that mobile camera enforcement schedules were too variable, and not consistent through pre-movie run and movie run time periods. Therefore, in order to ensure stable enforcement, only speeding data from stationary cameras were included in the analyses. All stationary cameras had a minimum threshold of 15 km/hr, meaning violators needed to be travelling that amount, or greater, over the speed limit to be issued an infraction. In some cases, tickets could not be issued due to a compromised image of the licence plate (e.g., covered in dirt or physically occluded by another vehicle). All records of infraction, regardless of whether a ticket was issued, were included in the analyses, as each represented a speeding violation.

Camera proximity to theatre location was calculated using theatre latitude and longitude, and it was determined that each of the 50 stationary enforcement cameras was within five kilometers of one of the seven theatres (see Appendix M for camera location). All stationary cameras were located along city streets and boulevards that varied in the number of lanes (i.e., minimum of two, maximum of six) and speed zones (i.e., 50 – 70 km/hr). Given their close proximity to theatres, the assessment of more immediate modelling effects of movie content was possible, though it was understood that closer distances were confounded with time (i.e.,

speeding detected closer to a theatre could also reflect speeding which occurred a short time after movie viewing). In the City of Edmonton, there is one main expressway that circles the city limits, however, all camera enforcement along this expressway was mobile. Previous research, assessing more immediate effects of the introduction of beer sales in a Toronto stadium on motor vehicle accidents, defined a geographical region within a five mile radius of the ball park (Vingilis, Liban, & Blefgen, 1992), which is beyond the current study five kilometer distance. Though the study did not find differences in accidents between this experimental area and a comparison Metro area, researchers speculated this may have been due to the timeframe used (i.e., 2 hours) to assess the number of accidents (Vingilis et al., 1992). The current study did not impose such a timeframe and assessed changes in speeding behaviour over a 24 hour (i.e., daily) period.

Variables in the speeding infraction data included type of infraction (i.e., speeding or red light running), date and time of infraction, infraction location, posted speed limit, recorded speed of vehicle at time of infraction, speed differential, camera type (stationary or mobile), and camera location. Date of infraction was used to create a day of week variable, which allowed infractions to be aggregated by weeks and weekends. Other variables of daily precipitation (mm), accessed from Alberta Agriculture and Forestry (Alberta Agriculture and Forestry, 2017), and traffic volume, provided by the Office of Traffic Safety, were included in the analyses, due to their influence on speeding (World Health Organization, 2004). Total daily traffic volume was determined by tallying the individual stationary camera traffic volumes, collected on the same speeding enforcement schedule (i.e., 24 hours a day, seven days a week). The volume from each camera represented the total number of vehicles detected at each site within a 24 hour period.

## Results

An interrupted time series ARIMA approach was used for both movie release time periods. The speeding infraction data were linked in time, such that data points were recorded consecutively on a daily basis. The interrupted approach was chosen because it was expected that the movie release would act as an intervention, which would interrupt the speeding infraction time series and be associated with change in this driving behaviour. This approach allowed for the coding of specific intervention time periods (e.g., first weekend post-movie release) that were used to assess patterns of behaviour change post-intervention. Within a time series, autocorrelation (i.e., the relationship between data points that are separated by a given time lag) can be present and needs to be accounted for (Montgomery, Peck, & Vining, 2001). When appropriate, an autoregressive (AR) lag coefficient was added. The use of other ARIMA components, such as differencing/integrated approach (I) or moving average (MA) approach, were also considered.

A control time series model was created first, for each movie time series, using the pre-movie release time period of 28 days. This was produced in an attempt to fit the speeding infraction data, using certain control variables (e.g., precipitation). Interrupted times series models were created for both movies using the control model, plus various intervention dummy variables (e.g., post-week movie release weeks 1 – 4). This model was applied to the entire time series to assess changes in speeding infractions for specific post-movie release time periods.

### **Hypotheses 1 and 2 Analyses**

The total number of speeding infractions for the pre- and post-movie release time periods, for both movies, are shown in Table 16. Each week included seven days (Friday to Thursday) and each weekend included Friday to Sunday. Each week began on a Friday, and the weekend

definition included a Friday, because both movies were released on this day of the week. The infraction count data suggested the post-movie release speeding infraction total was greater than the pre-movie release total for both *Fast and Furious 6* and *Furious 7*. Observing the post-movie release data by weeks and weekends for *Furious 7*, the speeding infraction total for Week 1 was greater than Weeks 2 – 4, and the total for Weekend 1 was greater than Weekends 2 – 4. Similar trends were not observed for *Fast and Furious 6*.

The time series plot for each movie suggested that the number of speeding infractions increased each Saturday and Sunday. In an attempt to fit the data, a dichotomous dummy variable was created for each of these days and entered into the model. The value of 1 denoted that day of the week (i.e. Saturday or Sunday), and all other days were coded as 0. In a previous investigation of possible models, every day of the week was coded using 1 – 7, however, only Saturday and Sunday were found to be significant contributors. Precipitation and traffic volume were also entered into the model. To assess the existence of autocorrelation in the speeding infraction data, the Durbin-Watson statistic was calculated for each movie time period, using the four variables in the current model (i.e., Saturday, Sunday, precipitation, and traffic volume). The value of this statistic was 1.10 for *Fast and Furious 6* and 1.11 for *Furious 7*, each indicating a significant positive autocorrelation ( $p \leq .05$ ). As a result, an autoregressive factor or lag of  $p = 1$  was added to the model. Values greater than 1 did not result in a significant contribution to the model.

Differencing of the data was not performed given the low value of the resulting AR(1) estimate in the control models for *Furious 7* and *Fast and Furious 6* (0.59 and 0.26 respectively), which suggested the data were stationary after accounting for serial correlation. In addition, visual inspection of the data did not demonstrate a persistent trend and the cyclic peaks within



the data were accounted for using Saturday and Sunday dummy variables. To assess whether a moving average (MA) coefficient needed to be added to the model, the Bayesian Information Criterion (BIC) was determined for ARMA (p, q) models using  $p = 1$  and  $q = 1$  or  $2$ . The BIC incorporates the goodness of fit for a given model and imposes a penalty to resolve issues of overfitting, due to the addition of more parameters to the model (Fabozzi, Focardi, Rachev, & Arshanapalli, 2014). The most appropriate model maximizes the fit to the data, while minimizing the number of parameters, which is indicated by a lower BIC value (Fabozzi, et al., 2014). The calculated BIC values indicated that, once autocorrelation was accounted for, adding an MA component did not improve the control model for either movie time series (see Appendix N for BIC values). The control time series model chosen was an ARIMA (1, 0, 0), with the four added variables of precipitation, traffic volume, Saturday, and Sunday. The Ljung-Box Q test result, for both movies, was nonsignificant (17.3 for *Furious 7* and 16.0 for *Fast and Furious 6*), demonstrating that the residuals were random and the model did not demonstrate a lack of fit. The time series plot of speeding infractions for *Furious 7* and *Fast and Furious 6*, along with the control model fit for the pre-movie release period, is shown in Figure 10 ( $R^2 = 0.77$  and  $0.72$ , respectively). The Friday of the theatrical movie release (i.e., Day 29) is marked by a solid black line.

To assess the association between movie release and changes in speeding infractions, two separate interrupted time series models were created. Each contained the same control model, but used different post-movie release time periods. Model #1 investigated changes by week, incorporating four intervention dichotomous dummy variables, each representing one post-movie release week (i.e., Week 1 – 4). The value of 1 denoted each day of the given week, and all other days of the post period were coded as 0. Model #2 investigated changes by weekend,

incorporating four intervention dichotomous dummy variables, each representing one post-movie release weekend (i.e., Weekend 1 – 4). The value of 1 was assigned to the Friday, Saturday, and Sunday of a given weekend, and all other days of the post period were coded as 0. This model allowed for the specific investigation of more immediate changes associated with the movie release (i.e., opening weekend). Both Model #1 and #2 contained 56 observations and 8 predictors. Separate interrupted time-series regression analyses were conducted for each movie, with the number of speeding infractions regressed on movie release date.

*Furious 7*. Speeding infraction data associated with *Furious 7* time periods were analyzed first, given the greater popularity of this movie, based on the domestic box office gross. The time series plot of speeding infractions is shown in Figure 11, and displays the observed speeding infraction data and the fit data, generated by Model #1 and #2. The Friday of the theatrical movie release (i.e., Day 29) is marked by a solid black line, and every other Friday is marked with a gray line. Results for the time series analyses for Model #1 and #2 are shown in Table 17.

Model #1 resulted in an  $R^2$  of 0.82, which suggested that the eight predictors accounted for 82% of the variance in speeding infractions. The control variables of precipitation, Saturday, and Sunday were found to be significant predictors. The model estimated that, on average, one additional mm of precipitation resulted in a decrease of approximately 13 speeding infractions, and a Saturday and a Sunday resulted in an increase of approximately 125 and 117, respectively. With respect to the association between movie release and speeding infractions by week, the results indicated a significant change during the first week post-movie release, with an estimated increase of approximately 84 speeding infractions. This increase in speeding infractions is

reflected in a better fit of the data for this time period in the Model #1 time series plot, compared to the control model fit.

Model #2 resulted in a  $R^2$  value of 0.84, suggesting the eight predictors accounted for 84% of the variance in speeding infractions, which was very similar to Model #1. The control variables of precipitation, traffic volume, and Saturday were found to be significant predictors. The model estimated that, on average, one additional mm of precipitation resulted in a decrease of approximately 13 speeding infractions, 1000 additional cars in traffic volume resulted in a decrease of approximately 309, and a Saturday resulted in an increase of approximately 103. With respect to the association between movie release and speeding infractions by weekend, the results indicated a significant change during the first weekend post-movie release (i.e., opening weekend), with an estimated increase of approximately 102 speeding infractions. This increase in speeding infractions is reflected in a better fit of the data for this first post-movie release weekend in the Model #2 time series plot, compared to the control model fit.

These findings supported Hypotheses 1 and 2, such that a significant increase in the number of speeding infractions was associated with the release of *Furious 7*, and this change in speeding infractions was significant for opening weekend and the first week post-movie release.

***Fast and Furious 6.*** The time series plot of speeding infractions for *Fast and Furious 6* is shown in Figure 12, and displays the observed speeding infraction data and the fit data, generated by Model #1 and #2. The Friday of the theatrical movie release (i.e., Day 29) is marked by a solid black line, and every other Friday is marked with a gray line. Results for the time series analyses for Model #1 and #2 are shown in Table 18.

Model #1 resulted in an  $R^2$  of 0.79, suggesting the eight predictors accounted for 79% of the variance in speeding infractions. The control variables of precipitation, Saturday, and

Sunday were found to be significant predictors of speeding infractions. The model estimated that, on average, one additional mm of precipitation resulted in a decrease of approximately six speeding infractions, a Saturday resulted in an increase of approximately 158, and a Sunday resulted in an increase of approximately 124. With respect to the association between movie release and speeding infractions by week, the results indicated a significant change during the second, third and fourth week post-movie release. The model estimated an increase of 67, 87, and 90 speeding infractions, per respective week.

Model #2 resulted in an  $R^2$  of 0.77, suggesting the eight predictors accounted for 77% of the variance in speeding infractions. The control variables of precipitation, traffic volume, Saturday, and Sunday were found to be significant predictors of speeding infractions. The model estimated that, on average, one additional mm of precipitation resulted in a decrease of approximately six speeding infractions, 1000 additional cars in traffic volume resulted in a decrease of approximately 320, a Saturday resulted in an increase of approximately 133, and a Sunday resulted in an increase of approximately 81. With respect to the association between movie release and speeding infractions by weekend, none of the post-movie release weekends were found to be significant.

The finding of a significant increase in the number of speeding infractions for the second, third, and fourth week post-movie release supported Hypothesis 1, however, the lack of significance for the first week and/or weekend post-movie release was different than what was found for *Furious 7*, and did not support Hypothesis 2. It was expected that the most noticeable difference in speeding infractions would occur within the first week post-movie release.

### Hypothesis 3 Analyses

The mean speed differential (km/hr), and standard deviation, for the pre- and post-movie release time periods, for both movies, is shown in Table 19. Each week included seven days (Friday to Thursday) and each weekend included Friday to Sunday. The data suggested that the difference between the overall pre and post-movie release mean speed differential was greater for *Fast and Furious 6*, compared to *Furious 7*, however, *Furious 7* had the highest mean speed differential for the first weekend post-movie release, compared to any other pre or post-movie release weekends.

To investigate if the mean speed differential increased during the post-movie release time periods, interrupted time series regression analyses were conducted for both movies, with mean speed differential regressed on movie release date. The time series plots suggested that mean speed differential was not as predictable on a daily cycle as the number of speeding infractions, though there still appeared to be higher values for weekend days. In an attempt to fit the data, the previous speeding infraction control variables were maintained (i.e., precipitation, traffic volume, Saturday, and Sunday). The value of the Durbin-Watson statistic for *Furious 7* and *Fast and Furious 6* was 2.1 and 2.0 respectively, which suggested no significant autocorrelation in the data. As a result, the autoregressive factor or lag was not included in either model. The time series plot of mean speed differential for *Furious 7* and *Fast and Furious 6*, along with the control model fit for the pre-movie release period, is shown in Figure 13 ( $R^2 = 0.40$  and  $0.14$ , respectively). The Friday of the theatrical movie release (i.e., Day 29) is marked by a solid black line.

***Furious 7.*** The time series plot of mean speed differential is shown in Figure 14, and displays the observed mean speed differential data and the fit data, generated by Model #1 and

#2. The Friday of the theatrical movie release (i.e., Day 29) is marked by a solid black line, and every other Friday is marked with a gray line. Results for the time series analyses for both models are shown in Table 20.

Model #1 resulted in an  $R^2$  of 0.21, suggesting the eight predictors accounted for 21% of the variance in mean speed differential. The control variable of precipitation was found to be a significant predictor, such that, on average, one additional mm of precipitation resulted in an estimated decrease of approximately 0.06 km/hr. Saturday was also significant, such that this day of the week, on average, resulted in an estimated increase of approximately 0.22 km/hr. With respect to the association between movie release and mean speed differential, none of the post-movie release weeks were significant.

Model #2 accounted for 10% more of the variance in mean speed differential ( $R^2 = 0.31$ ), compared to Model #1. The control variables of precipitation, traffic volume, Saturday, and Sunday were all found to be significant predictors of mean speed differential. On average, one additional mm of precipitation resulted in an estimated decrease of approximately 0.05 km/hr, and an additional 1000 vehicles on the road resulted in an estimated decrease of 2.00 km/hr. On average, a Saturday and a Sunday resulted in an estimated increase of approximately 0.28 and 0.59 km/hr, respectively. With respect to the association between movie release and mean speed differential by weekend, the results indicated a significant change during the first weekend post-movie release (i.e., opening weekend), with an estimated increase of approximately 0.38 km/hr. This finding supported Hypothesis 3, such that a significant increase in mean speed differential occurred post-movie release of *Furious 7*, and this change was significant for opening weekend.

The magnitude of the estimated increase in mean speed differential, though statistically significant, was small, as was the range of mean speed differential scores. Approximately 20%

of daily speed differential values used to calculate the daily mean, consisted of the value of 15 km/hr, which was the set threshold for all automated enforcement cameras used in this study. This consistent lower value may have limited the reflection of higher speed differential values in the calculated daily mean, post-movie release. In order to emphasize these expected higher values, the daily mean speed differential was recalculated using the upper 25% and 10% of the speed differential data. The same Model #2 was applied to both datasets and, though the estimated increase in mean speed differential was larger for the first post-movie release weekend (i.e., 0.80 and 1.32 km/hr respectively), it was not significant. Model #2 was also applied to the corresponding standard deviations for the upper 25% and 10% datasets and, again, the first post-movie release weekend was not significant. This suggested that the significant association between the release of *Furious 7* and mean speed differential for opening weekend, found previously with all data included, was not due to extreme speeders with higher speed differentials.

***Fast and Furious 6.*** The time series plot of mean speed differential is shown in Figure 15, and displays the observed mean speed differential data and the fit data, generated by Model #1 and #2. The Friday of the theatrical movie release (i.e., Day 29) is marked by a solid black line, and every other Friday is marked with a gray line. Results for the time series analyses for both models are shown in Table 21. Model #1 resulted in an  $R^2$  of 0.16, suggesting the eight predictors accounted for 16% of the variance in mean speed differential. None of the control variables nor post-movie release weeks were found to be significant predictors of mean speed differential. The results from Model #2 were very similar, in that  $R^2$  was 0.17 and, again, none of the variables in the model were found to be significant predictors. These findings did not support Hypothesis 3.

## Robustness Analyses

***Furious 7* speeding infraction comparison analyses.** A concern surrounding the *Furious 7* analyses was that opening weekend for this movie coincided with the 2015 Easter holiday, with the release day being Good Friday. In order to assess if this holiday impacted the current findings, comparable 56 day time periods (i.e., four weeks pre- and four weeks post-movie release) surrounding the previous two Easter holidays were analyzed, with Good Friday marked as the first day of the post-period (i.e. Day 29) (see Table 22 for dates and time periods used). To investigate speeding infractions during these Easter time periods, the same *Furious 7* models were applied in the interrupted time-series regression analyses, with the number of speeding infractions regressed on the date of Good Friday (see Table 23 for the results of the time series analyses).

For both Easter 2013 and 2014, Model #1 and Model #2 produced comparable  $R^2$  values and the same significant control variables as in the *Furious 7* analyses. This suggested a good replication of the *Furious 7* models. None of the Easter 2013 and 2014 analyses resulted in significant findings for any of the post-period weeks (i.e., Model #1) or weekends (i.e., Model #2). These Easter comparison findings suggested that the significant increase in speeding infractions observed the first weekend, and first week, post-movie release for *Furious 7* was not associated with Good Friday and the Easter holiday.

***Fast and Furious 6* speeding infraction comparison analyses.** To assess the robustness of the finding of a significant increase in the number of speeding infractions for the second, third, and fourth week post-movie release, comparison analyses, using data from a different year, were conducted. The same 56 day time period (i.e., four weeks pre- and four weeks post-movie release) in 2014 was selected for analyses. Comparable data from 2015 could not be used



because the time period coincided with the theatrical release of *Furious 7*. The post-period began on May 23, a shift of one day, in order to begin the pre and post time periods on a Friday (see Table 22 for dates and time periods used). To investigate changes in speeding infractions, the same *Fast and Furious 6* models were applied in the time-series regression analyses, with the number of speeding infractions regressed on Day 29 (i.e. the first Friday of the post period) (see Table 24 for the results of the time series analyses).

Model #1 produced an  $R^2$  value of 0.87, which was greater than that for the *Fast and Furious 6* analysis. A similar pattern of significant results was found for the control variables, with the addition of traffic volume. The second, third, and fourth week post-period were also found to be significant, which was the same for the *Fast and Furious 6* analysis. Model #2 produced an  $R^2$  value of 0.86, which was greater than that for the *Fast and Furious 6* analysis. A similar pattern of significant results for the control variables was found, however, precipitation was not significant. In addition, the second and third weekend post-period were significant, which was different from the *Fast and Furious 6* analysis. The findings from these comparison analyses suggested that the significant increase in speeding infractions observed post-movie release of *Fast and Furious 6* was not unique to the release of the movie.

***Furious 7* mean speed differential comparison analyses.** To assess the robustness of the increase in mean speed differential during the first weekend post-movie release, the time series Model #2 was applied to the mean speed differential data for the Easter 2013 and 2014 time periods. The results suggested the model did not fit the Easter 2013 or 2014 data as well as the *Furious 7* data. This was evident in the lower  $R^2$  values (0.13 and 0.22 respectively, compared to 0.31 for *Furious 7*) and the lack of significance for any of the control variables (see Table 25). In addition, the first post-movie release weekend was not significant for either year.

These Easter comparison findings suggested that the significant increase in mean speed differential observed the first weekend post-movie release for *Furious 7* was not associated with Good Friday and the Easter holiday.

### **Discussion**

The current study investigated the association between the release of two widely viewed motion pictures, depicting acts of aggressive or risky driving, and the modelling of speeding behaviour. Previous research by Vitaglione (2012) found an association between televised depictions of such behaviour (i.e., NASCAR racing) and collisions due to aggressive driving. This effect, however, was not evident until the fifth day following exposure to the televised content. This study attempted to demonstrate earlier evidence of modelling of aggressive driving behaviour by using a measure of speeding, which is often an antecedent to collision. The City of Edmonton was a good choice for this study because of its wide use of automated enforcement. With a large number of stationary cameras operating on a 24 hour/7 days a week schedule, any observed changes in speeding behaviour related to theatrical movie release could not be attributed to changes or fluctuations in enforcement.

The speeding infraction time series results for *Furious 7* supported Hypotheses 1 and 2, which predicted that increases in aggressive or risky driving behaviour (i.e., speeding) would be observed when motion pictures, depicting acts of aggressive or risky driving, were released and playing in theatres, and this increase would be greatest closer to the movie release date (i.e., first week post-movie release). The mean speed differential time series results for *Furious 7* supported Hypothesis 3, which predicted this measure would also increase post-movie release. The results suggested that early modelling effects of aggressive driving (i.e., speeding) occurred following the release of *Furious 7*. These effects were significant even after controlling for

precipitation, traffic volume, Saturdays, Sundays, and autocorrelation in the data. Significant increases in speeding infractions were found for the first weekend (i.e. opening weekend) and first week, post-movie release. A significant increase in mean speed differential for the first weekend, post-movie release, was also found. Though *Furious 7* was released during an Easter holiday, comparison analyses, using time periods surrounding the previous two Easter holidays, failed to demonstrate the same significant changes in speeding infractions and mean speed differential, during the post-period. This lack of significance for comparison post-periods adds to the confidence of the *Furious 7* findings and the interpretation of modelling effects.

Though the *Fast and Furious 6* analyses revealed significant increases in speeding infractions for the second, third, and fourth week post-movie release periods, comparable analyses using the same time period in 2014 (i.e., one year later) found the same significant effects. This suggests the *Fast and Furious 6* findings were not unique to the release of the movie. Additionally, no significant association between the release of the movie and mean speed differential was found. Of the two movies, *Furious 7* had a larger domestic and worldwide box office gross (Nash Information Services, 2017a, 2017b), suggesting a greater viewership. Also, this movie received greater news coverage due to the accidental death of one of the lead actors (Paul Walker), prior to the completion of filming his role in *Furious 7* (Ying, 2015). Walker was killed in a high-speed collision, unrelated to the movie production. Curiosity surrounded how the director would handle the actor's death in the movie and the ongoing storyline of the franchise. Even though the most recent franchise installment *Fate of the Furious* broke the global box office record for an opening weekend (April 14, 2017) (Nash Information Services, 2017e), it did not surpass the domestic box office gross for the opening weekend of *Furious 7* (approximately \$98 million compared to \$147 million) (Nash Information Services, 2017f).

## Limitations and Future Directions

A limitation of the current study was the inability to determine if those who committed a speeding infraction had actually seen the aggressive or risky driving movie. Knowing this, the conclusions from this study are limited to stating there is an association or relationship between the theatrical release of the aggressive or risky driving movie and speeding behaviour. Each time series model used in this study resulted in a high  $R^2$  value, suggesting that a large proportion of the variability in the speeding infraction data was accounted for (77 – 84% across all models). Drawing conclusions about behaviour by observing how responses change over time, following an event, is similar to what has occurred in research using operant conditioning paradigms. Skinner (1938) drew conclusions about laws governing learning by simply observing behaviour change in response to applied schedules of reinforcement (e.g., interval or ratio, fixed or variable). Though his research was experimental, limited statistical analyses were applied to the data to draw these conclusions. The current time series plots and analyses clearly demonstrate changes in speeding behaviour post-movie release, which, despite accounting for a great deal of variability due to other factors, remained statistically significant.

Though automated enforcement data from stationary cameras ensured stable and consistent enforcement through the pre- and post-movie release periods, it limited the investigation of modelling effects to city streets within 5 km of a theatre. Though this fostered the assessment of more immediate modelling, it did not allow for the assessment of speeding behaviour on open roadways with higher speed limits (e.g., 80 – 100 km), such as Edmonton's ring road, circling the city. Another limitation associated with the use of automated enforcement data was the inability to directly link to driver demographics and investigate their role in speeding behaviour. Driver characteristics were unknown, as the speeding ticket was issued to

the registered owner of the vehicle, using licence plate identification. There is no guarantee that the registered owner was the driver at the time of the infraction.

Future work could investigate the role of vehicle demographics (e.g., newer versus older vehicle, sports car versus family van) on speeding in the city. This would require linking the speeding infraction data to the provincial vehicle registry. This would allow for the assessment of speeding by type of vehicle, with an interest in sport cars or pickup trucks. Also, with advanced planning, and cooperation with the Office of Traffic Safety in Edmonton, consistent mobile camera enforcement schedules could be established for pre- and post-movie release time periods for the next *Fast and Furious* movie release. This would add the ability to investigate speeding in higher speed zone locations, such as highways, to the already available stationary camera data within the city.

### **Public Policy Implications**

The current study, though correlational in nature, supports the previous anecdotal reporting of modelling aggressive and risky driving, depicted in motion pictures. This research can play an important role in how we strategize about decreasing the amount of aggressive or risky driving on the roads. Given the large fan base and profits associated with the release of motion pictures depicting this type of content, it is highly likely that the movie industry will continue to use such depictions of driving in their movies. The results from the current study certainly support increasing enforcement on opening weekends of the theatrical release of such movies. Alternate strategies could be more proactive, targeting the movie-goer and raising their awareness of the potential for modelling the unsafe driving behaviour. This could include messages from the actors themselves, urging people to be responsible and smart on the roads and drive safe. Universal Studios has done this in the past for the *Fast and Furious* franchise

(Orwall, 2001) and could incorporate these messages into the credits of the movie, following its completion. It may intrigue the movie-goer to view additional footage of the actors and the message may be meaningful coming from these individuals, who are clearly revered in their role. This may also delay the movie-goers from returning to their vehicles immediately following the end of the movie, potentially allowing for some decrease in their immediate level of arousal.

Speeding is considered a risk factor in road traffic injuries and fatalities, because of the increased risk of collision and severity of the resulting consequences. It is estimated that 30 - 50 percent of mortality on the roads is associated with this driving behaviour (World Health Organization, 2004). The current research suggests that portrayals of this behaviour in the movies can have a significant impact on real-world speeding behaviour. This is no reason to believe that this effect would be specific to the City of Edmonton, and future research could attempt to corroborate its existence in other cities within Canada and the United States.

### **General Discussion**

The objective of the current research was to investigate the influence of motion pictures, depicting aggressive or risky driving, on the subsequent modelling of this type of driving behaviour. Both experimental and descriptive research approaches were employed in an attempt to demonstrate the robustness of this relationship. While Study 1 implemented an experimental approach, using simulated driving and aggressive and risky driving motion picture material, Study 2 implemented a descriptive research approach (i.e., event study), which involved the assessment of changes in real-world speeding behaviour following the theatrical release of two aggressive and risky driving movies, from the popular *Fast and Furious* franchise (i.e., *Fast and Furious 6* and *Furious 7*). Both studies anticipated an increase in aggressive and risky driving (i.e., modelling), following the exposure to this type of movie content.

## **Modelling of Aggressive or Risky Driving**

Support for the modelling hypothesis was found in Study 2, which revealed an increase in both the number of speeding infractions and the magnitude of speed differential, in the City of Edmonton, following the release of the most popular *Fast and Furious* movie, *Furious 7*. As expected, these changes in speeding behaviour were evident during the period of time closest to the movie release (i.e., first week and weekend). This timeline of change was different from that reported for aggressive driving accidents following exposure to televised NASCAR races (Vitaglione, 2012), which, as mentioned previously, was likely due to the use of a more sensitive measure of modelling aggressive or risky driving. A strength of Study 2 was built in replication, such that the lack of significant changes in speeding behaviour for the comparison analyses, using different years, added robustness to the findings. This early impact on speeding infractions, post-movie release, supports the implementation of increased enforcement surrounding the release of movies depicting aggressive or risky driving, as well as the use of public service messages and warnings to raise awareness regarding the potential influence these movies have on driving behaviour and the risks associated with aggressive and risky driving.

In Study 1, those who had viewed the aggressive driving video clip did demonstrate more aggressive driving, such as greater course mean speeds, greater acceleration during a pass and provoking racing scenario, and greater passing frequency. The differences between the video conditions, however, were not significant, despite evidence of medium effect sizes. An increase in the number of participants could increase the power of the experiment and result in significant differences. Other issues were previously suggested for the lack of significant findings, such as the use of videos with low plot content, a driving simulator test course with too few opportunities for speeding, and undergraduate psychology students as participants. Results from previous

research on modelling and the influence of media have been mixed. For example, Bandura (Bandura, 1971; Bandura et al., 1963) demonstrated the imitation of aggressive behaviours in children, following the video observation of an adult model acting aggressively, whereas, Milgram and Shotland's (1973) numerous attempts to demonstrate modelling of aggression in adults, following television exposure to such content, were not successful. Other research investigating the modelling of celebrity suicides has shown an increase in the number of suicides, and the methods used, following media coverage of the event (Hegerl et al., 2013; Jeong et al., 2012; Koburger et al., 2015; Phillips, 1974; Phillips & Carstensen, 1988), but it is important to note that, although more people committed suicide, not everyone exposed to this content did. It is likely that those who chose to do so were already depressed or in an extreme state of despair, such that this media exposure simply provided additional information in the consideration of possible actions to take or activated scripts already in place for this response. This suggests that the modelling effects of media depictions of certain types of behaviours are more likely to be seen in individuals with certain predispositions or susceptibilities for the behaviour. In the case of the current research, those with higher sensation seeking, trait aggression, driving vengeance, and a history of violations were more likely to model aggressive and risky driving depicted in the movies. This supports the interactionism between individual factors and the viewing of depictions of anti-social (i.e., aggressive) behaviour.

### **Theories of Modelling of Aggression Revisited**

Both Study 1 and Study 2 offered support for the various theories of modelling aggression, mentioned previously, which were integrated within the modified GAM (see Figure 2). The finding that those with higher trait aggression and sensation seeking modelled more aggressive and risky driving in Study 1 provided support for the contribution of personality



factors to aggressive driving (Arnett, 1994; Buss & Perry, 1992). Those with higher driving vengeance and a history of violations, particularly speeding, also engaged in more aggressive and risky driving, supporting the contribution of internal state factors to aggressive driving. Additionally, those with a history of violations were more likely to be influenced by a provoking racing scenario, supporting the interactivity of internal state and situation factors associated with aggressive driving. These Study 1 results supported the script and cognitive-neoassociation components in the modelling of aggression (Anderson & Bushman, 2002; Berkowitz, 2012), contained within the internal factor component of the modified GAM (see Figure 2). The fact that individuals, who chose more vengeful responses in the DVQ and had a history of violations, engaged in more modelling of risky driving behaviour in the simulator, demonstrated the existence and activation of memory scripts for this behaviour.

The significant relationships found in Study 1 between the above mentioned variables, as well as the relationships between sensation seeking, driving vengeance, and the number of self-reported aggressive driving movies seen in the past two years, suggested that those with sensation seeking personalities may seek out and view more aggressive and risky driving movies. This, in turn, contributes to the formation of aggressive and risky driving scripts, which can produce certain susceptibilities for the activation of these scripts at a later time, with further viewing of aggressive and risky driving movie content. The eventual engagement in the modelling of this behaviour may be more likely when the driver is exposed to a provoking driving scenario (e.g., racing or vengeance related). These relationships support the interactivity of the person, situation, and internal factors of the modified GAM (see Figure 2) in the modelling of aggressive and risky driving, and also support Bandura's (2001b) triadic reciprocal causation model of psychosocial functioning.

The social learning theory of modelling aggression (Bandura, 1971) was supported by the significant findings from Study 2, and trends in Study 1. Evidence of greater speeding, surrounding the release of *Furious 7*, suggested that the modelling of aggressive or risky driving behaviour was associated with the release of this movie, which portrayed this behaviour being performed by a relatable “hero” and, predominantly, in the absence of negative consequences. Study 1 trends provided likewise support for this theory of modelling aggression, though differences between the video conditions were not significant. It is important to consider that Study 1 and Study 2 used different cohorts (i.e., undergraduate psychology research pool versus speed violators). The Study 2 cohort would have been more likely to possess the characteristics found in Study 1 to contribute to aggressive or risky driving (e.g., higher trait aggression, sensation seeking, and driving vengeance). Had the Study 1 sample consisted solely of violators, the aggressive driving movie exposure may have produced stronger, significant findings of modelling.

Young males in Study 1 did not demonstrate more modelling of aggressive or risky driving behaviours, compared to females. This may have been partly due to the lower number of males than females in the study, which reflected the demographics of the undergraduate psychology research pool at the University of Alberta. It is more likely, however, that aggressive driving behaviours were limited or inhibited in the laboratory setting because of the awareness of observation of performance. Demographics for the speed violators in Study 2 were not known, but, according to the evolutionary theory of modelling aggression (Mesquida & Wiener, 1996; Wiesenthal & D. Singhal, 2012; Wilson & Daly, 1985; Vingilis et al., 2013), the majority of these individuals were likely young males, who experienced a higher level of anonymity on the roads, compared to driving in a laboratory setting. Other factors, such as immaturity, poor risk

assessment, and a greater likelihood of car fanaticism, would have also contributed to greater speeding behaviour following exposure to a movie depicting acts of aggressive or risky driving.

The early modelling of speeding behaviour found in Study 2 supported the excitation transfer theory of arousal (Zillmann, 1971), such that speeding increases occurred soon after the release of the movie. This theory of transferring arousal could also account for why the aggressive driving video condition was not different from the arousing video condition in Study 1. Given the limited plot content in the aggressive driving video clip used, lower emotional engagement possibly resulted. Without this, the level of arousal was likely comparable between these two video conditions, as pilot work had shown, which resulted in similar excitation and arousal effects and a lack of significant differences in risky driving measures.

### **Limitations**

As mentioned previously, Study 1 had various limitations. This experimental approach used a driving simulator and did not have a real world comparison. Though the use of simulators can overcome certain ethical issues associated with risks to the driver (e.g., engaging in aggressive driving behaviour), this can limit the generalizability of the findings. Both movie viewing and driving are typically social events. The current study had participants do both activities alone, which did not allow for the influence and investigation of social factors on driving behaviour, such as the presence of peers. Given the evidence of medium effect sizes for differences between the video conditions for certain aggressive driving measures, a low number of participants likely contributed to the nonsignificant findings. This may have been particularly true for the lack of significant differences in aggressive driving between males and females. As mentioned previously, participants were limited to students from an undergraduate psychology

research pool, which may not have been representative of the typical aggressive driving movie goer or speed violator. It also limited the ability to investigate differences between more diverse age groups (i.e., younger (18 – 25 years) versus older (40 – 50 years)).

The use of time series in Study 2 limited the ability to infer cause and effect, since this approach was correlational in nature. The findings were limited to suggesting an association between the increases in speeding behaviour and the release of *Furious 7*. Given the nature of the speeding infraction data, the demographics of the driver and vehicle were not known. It was also not known whether the violator had recently viewed the aggressive driving movie. The time series analyses were able to account for variability associated with factors of precipitation, traffic volume, and weekend days, none of which accounted for the significant increases in speeding infractions associated with the release of *Furious 7*. Additionally, comparison analyses using previous Easter weekends did not demonstrate the same increases.

Further exploration of different time series ARIMA models could have been conducted for Study 2. The current models accounted for autocorrelation and BIC values did not suggest an additional benefit of using a moving average approach. Other models, which incorporate differencing or integration and moving average approaches, without an autocorrelation coefficient, could have been trialed in an attempt to better account for any seasonal trends in the data. Study 2 also did not investigate concurrent speeding infraction data (i.e., hour before movie run time versus hour after). Time of day for each speeding infraction was available, however, movie run times were frequent and variable across the seven Edmonton theatres, particularly during the first two weeks of movie release. Given the proximity of stationary cameras to multiple theatres, considerable overlap in pre- and post-movie run times would have

existed, making it difficult to draw conclusions about differences in speeding behaviour between these time periods.

### **Future Directions**

To expand on the methodology of Study 2, consistent mobile camera enforcement schedules could be established for pre- and post-movie release time periods for the next *Fast and Furious* movie release, as mentioned previously. This would add the ability to investigate speeding in higher speed zone locations, such as highways, to the already available stationary camera data within the city. If speeding increases occurred soon after movie release on these roadways, it would add robustness to the current findings of Study 2. It may also be possible to analyze speeding infraction data by time of day, to investigate if there are times when infractions are higher than others, particularly for weekend days. It would also be interesting to replicate the findings of Study 2 in another city. There is no reason to believe that the results of Study 2 are specific to the city of Edmonton. Another large urban centre, with automated stable enforcement schedules, could be used as a comparison.

It would be interesting to combine aspects of Study 1 and Study 2 in future research. To demonstrate the existence of certain person and internal characteristics in speed violators (e.g., sensation seeking, trait aggression, driving vengeance, and violation history), a random sample of violators could be obtained and asked to complete the various scales and surveys used in Study 1. This could provide additional demographic information to investigate sex and age influences. This same sample could be used in an experimental study where the participants are exposed to one of the three types of video content used in Study 1. The revised video content would contain a larger, plot developing segment taken from a single movie, and *Furious 7* could be used for the aggressive driving video condition. Participants would drive through a test

course on the simulator, immediately following the movie exposure. The test course would be redesigned to include fewer obstructions, which would provide more opportunities for speeding, and more race engaging cues, to investigate how situational factors contribute to the modelling of aggressive driving. This research could further demonstrate that those with a history of violations, who have higher sensation seeking, trait aggression, driving vengeance, and a history of viewing aggressive or risky driving movies, are more susceptible to modelling motion picture content containing aggressive or risky driving.

An additional component that could be added to a simulator study is social context. Individuals could view the movie content, and drive the simulator, with others present (e.g., peers). The amount of interaction among the group could be varied from minimal communication to a great deal of positive feedback and encouragement to drive aggressively.

## **Conclusion**

Given the profits associated with movies containing aggressive or risky driving content, a halt in their production is not likely to occur. The large domestic box office gross associated with the *Fast and Furious* franchise demonstrates that a large fan base exists for this genre of movie. The next installment, *Fast and Furious 9*, has already been announced and projected for release on April 19, 2019 (IMDb, 2017). There are also indications of popularity for other forms of media depicting acts of aggressive and risky driving. As mentioned previously, the top ten YouTube videos containing this content, particularly street racing, are large in number and average over 700,000 views and “likes” (Vingilis et al., 2017). These videos, which can be freely accessed and repeatedly viewed, are unlike movies in that the majority depict real-world extreme driving events that were not performed by professionals in a staged environment. Research has not even begun to understand how this content influences a person’s driving

behaviour (Vingilis et al., 2017). Almost 20 years ago, Bandura (2001a) recognized the “accelerated growth of video delivery technologies” (p. 271) and how they facilitate exposure to a wide range of behaviours and “models”. Social media has expanded that substantially since then.

The purpose of this research was not to suggest a complete halt in production of movies, such as *Furious 7*, or other forms of media depicting acts of aggressive or risky driving, as a realistic solution to combatting the modelling of aggressive and risky driving behaviour. However, the proliferation of this content makes it extremely important to raise awareness about the association between this material and one’s driving behaviour, and the dangers associated with modelling aggressive and risky driving. As mentioned previously, increased enforcement surrounding the release of movies depicting aggressive or risky driving, as well as the use of public service messages and warnings, are important changes that should be implemented, however, we should not remove accountability from the viewer.

Bandura’s early work (Bandura, 1971; Bandura et al., 1963) demonstrated the basic principles of observational learning and modelling, and his later reflections emphasized that human behaviour is not simply the result of stimulus-response relationships. We, as humans, have “functional consciousness”, part of which involves regulating and evaluating the actions we choose to take (Bandura, 2001b). The two core features of Bandura’s (2001b) proposed “human agency” are self-reactiveness and self-reflectiveness, mentioned previously. It is these two elements that are emphasized to viewers of aggressive and risky driving media content. Viewers make choices to expose themselves to this content and, therefore, have a responsibility to be aware of how this content can possibly influence their behaviour, and to evaluate their actions accordingly (e.g., considering driving laws and the safety of others). Essentially, Bandura

(2001b) is highlighting the appraisal and decision making process of the modified GAM, as shown in Figure 2. Having viewers engage in self-reactiveness and self-reflectiveness could lessen the likelihood of an impulsive action and increase the probability of a thoughtful one. This would, ultimately, hamper the modelling of aggressive and risky driving following exposure to such content in the media.

Drivers must be cognizant of the fact that they share the road with other drivers, vehicle occupants (e.g., children), cyclists, and pedestrians. With this in mind, all drivers should consider characteristics that constitute a “good” driver. Qualities which lessen the occurrence of factors that contribute to aggressive driving would be encouraged. For example, forethought, in the context of driving, would involve allowing sufficient time to arrive at a final destination, which could prevent the development of frustration when confronted with delays in traffic or other hampering driver actions. Forbearance (i.e., self-restraint and tolerance) and forgiveness of other driver’s minor mistakes (e.g., driving too slowly in the fast lane) could lessen the choice of an aggressive driving response. Factors such as these, in addition to being aware of the possibility of aggressive driving motion picture content to influence driving behaviour, are encouraged in all drivers. Just as drinking and driving campaigns target the driver in emphasizing the dangers and potentially tragic consequences of impaired driving (Brière, 2017; MADD, 2017), this research highlights the need for drivers to keep their safety, and the safety of the public, at the forefront when considering to engage in a potentially aggressive or risky driving behaviour.



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Table 1

## Study 1: Results for Level of Arousal for Video Clip Conditions

Video Clip Condition	Mean	<i>SD</i>	$\alpha$ (Post Hoc Comparisons)
AGGressive Driving (AGGD)	3.40	1.08	.334 (ARND comparison) < .001 (NEUT comparison)
ARousing Non-Driving (ARND)	4.00	0.82	< .001 (NEUT comparison)
NEUTral (NEUT)	1.30	0.48	

Table 2

## Study 1: Results for Simulated Driving Performance Parameters

Driving Measure	Mean	<i>SD</i>	Acceptable Performance Range
Mean Speed (km/hr)	52.30	7.46	37.38 – 67.22
% of run time across centre line	2.29	0.52	0 – 3.33
% of run time off-road	0.01	0.02	0 – 0.05

Table 3

## Study 1: Distribution of Males and Females by Video Condition

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*N* = 62

	Video Condition		
	AGGD	ARND	NEUT
Sex			
Female	13	14	11
Male	8	7	9
Total	21	21	20

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Table 4  
Study 1: Scale Summaries

Scale	Subscale	Item Example	Response Scale
Arnett Inventory of Sensation Seeking (AISS)*	Novelty	“I can see how it would be interesting to marry someone from a foreign country.”	4-point Likert scale A (describes me very well) to D (does not describe me at all)
	Intensity	“When I listen to music, I like it to be loud.”	
Aggression Questionnaire (TAS)**	Physical	“I get into fights a little more than the average person.”	5-point Likert scale 1 (extremely uncharacteristic of me) to 5 (extremely characteristic of me)
	Verbal	“I tell my friends openly when I disagree with them.”	
	Anger	“I sometimes feel like a powder keg ready to explode.”	
	Hostility	“I sometimes feel that people are laughing at me behind my back.”	
Driving Anger Scale (DAS)***	N/A	“Someone runs a red light or stop sign.”	5-point Likert scale for amount of anger provoked 1 (none at all) to 5 (very much)
Driving Vengeance Questionnaire (DVQ)****	N/A	“A driver passes you and makes an obscene gesture at you.”	Multiple choice, ranging in level of aggression displayed a) “Give the driver an obscene gesture” to d) “Do nothing”

\* Alpha reliability of 0.70 (Arnett, 1994)

\*\* Alpha reliability of 0.89 (Buss & Perry, 1992)

\*\*\* Alpha reliability of 0.80 (Deffenbacher et al., 1994)

\*\*\*\* Alpha reliability of 0.83 (Wiesenthal et al., 2000)



Table 5

## Study 1: Mean and Standard Deviation for Scale and Survey Measures

<i>N</i> = 62*										
Scale or Survey	Video Condition						Sex			
	AGGD		ARND		NEUT		Males		Females	
	Mean	<i>SD</i>	Mean	<i>SD</i>	Mean	<i>SD</i>	Mean	<i>SD</i>	Mean	<i>SD</i>
TAS	74.2	13.9	70.6	14.8	70.4	12.7	75.1	14.2	69.8	14.2
AISS	51.9	6.5	50.3	7.3	49.5	6.2	51.0	5.6	50.3	7.3
DAS	41.4	8.9	38.8	9.3	40.1	8.1	35.9**	6.7	42.7**	8.9
DVQ	40.4	5.6	39.3	5.2	37.7	4.6	39.8	5.3	38.8	5.2
Driving History:										
Years driving	3.7	1.6	4.1	2.4	4.0	1.7	4.3	2.0	3.7	1.8
Weekly km	165.0	140.2	150.7	95.6	141.3	119.4	133.1	105.7	164.7	125.3
# Violations	0.8	1.3	1.1	1.3	0.8	1.1	1.0	1.3	0.8	1.2
# Collisions	0.3	0.6	0.2	0.5	0.2	0.5	0.1	0.4	0.3	0.6
Movie Viewing History:										
# Aggressive Driving	2.9	2.0	1.8	2.1	2.2	1.9	2.8	2.1	2.0	1.9
Video Game History:										
# Aggressive driving	1.5	1.1	1.3	1.4	2.1	1.1	2.2	1.3	1.3	1.0

\* TAS: *N* = 60, Years driving: *N* = 61

\*\* Significantly different at  $p < .01$

Table 6

## Study 1: Assumption Testing Significant Results for the Various Survey Measures

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Normality: Shapiro-Wilks Test	
Driving History:	
Years driving	$W = .95, df = 61, p = .02$
Weekly km	$W = .91, df = 61, p < .001$
# Violations	$W = .72, df = 61, p < .001$
# Collisions	$W = .46, df = 61, p < .001$
Movie Viewing History:	
# Aggressive driving	$W = .90, df = 62, p < .001$
Video Game History:	
# Aggressive driving	$W = .91, df = 62, p < .001$

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Table 7

Study 1: Means and Standard Deviations for Course Mean Speed and Time to Completion by Video Condition and Sex

<i>N</i> = 62	Course Mean Speed (km/hr)			Time to Completion (s)		
	AGGD	ARND	NEUT	AGGD	ARND	NEUT
<b>Full Course</b>						
Mean	34.96	34.23	33.03	667.8	686.1	705.0
SD	2.77	3.20	3.86	56.0	60.4	72.9
	(F(2,38.3) = 1.65, <i>p</i> = .21, $\eta_p^2$ = .06)			(F(2,38.6) = 1.69, <i>p</i> = .20, $\eta_p^2$ = 0.06)		
<b>Section #1</b>						
Course section: 60 – 1900 m						
Total distance: 1.84 km						
Speed zone: 60 km/hr						
Mean	59.17	57.03	54.05			
SD	5.99	4.81	8.54			
				(F(2,37.2) = 2.46, <i>p</i> = .10, $\eta_p^2$ = 0.10)		
<b>Section #2</b>						
Course section: 2950 – 4970 m						
Total distance: 2.02 km						
Speed zone: 80 km/hr						
Mean	73.00	70.61	70.24			
SD	8.53	9.51	7.60			
				(F(2,39.2) = 0.65, <i>p</i> = .53, $\eta_p^2$ = 0.02)		
<b>Section #3</b>						
Course section: 6050 – 8050 m						
Total distance: 2.00 km						
Speed zone: 60 to 80 km/hr						
Mean	71.17	68.14	67.68			
SD	10.05	9.67	10.14			
				(F(2,39.2) = 0.73, <i>p</i> = .49, $\eta_p^2$ = 0.03)		
<b>Section #4</b>						
Course section: 8200 – 9950						
Total distance: 1.75 km						
Speed zone: 100 to 80 km/hr						
Mean	95.62	92.22	90.94			
SD	9.34	7.69	10.88			
				(F(2,38.2) = 1.27, <i>p</i> = .29, $\eta_p^2$ = 0.05)		

Table 8

## Study 1: Passing Data by Video Condition, Sex, and Scale and Survey Factors

	Passing Frequency ( $N = 62^*$ )		Mean Acceleration (ft/s <sup>2</sup> ) During First Pass ( $N = 57$ )	
	0 – 2 vehicles	3 – 4 vehicles	Mean	<i>SD</i>
Video Condition				
AGGD	7	14	.60	.33
ARND	11	10	.63	.28
NEUT	12	8	.59	.20
			(F(2,54) = 0.13, p = .88, $\eta_p^2 = 0.01$ )	
Sex				
Male	11	13		
Female	19	19		
AISS				
Low**	19	12		
High**	11	20		
TAS				
Low	16	14		
High	12	18		
DVQ				
Low	18	14		
High	12	18		
DAS				
Low	17	15		
High	13	17		
# Violations				
0	18	14		
1 or more	12	18		
# Collisions				
0	25	26		
1 or more	5	6		
# Aggressive Driving				
Movies				
0 – 2	20	15		
3 – 7	10	17		
# Aggressive Driving				
Video Games				
0 – 2	24	26		
3 – 5	6	6		

\* TAS:  $N = 60$ \*\* Frequencies significantly different at  $p < .05$

Table 9

Study 1: Mean Acceleration in a Racing Scenario by Video Condition and Presence of Passing Yellow Car

<i>N</i> = 62			
	Mean Acceleration (ft/s <sup>2</sup> )		
	Mean	<i>SD</i>	
Video Condition			
AGGD	.48	.16	$(F(2, 56) = 2.35, p = .11, \eta_p^2 = .08)$
ARND	.49	.30	
NEUT	.38	.20	
Passing Yellow Car			
Yes	.52*	.22	$(F(1, 56) = 13.06, p = .001, \eta_p^2 = .19)$
No	.30*	.18	

\* Significantly different at  $p = .001$

Table 10

Study 1: Significant Correlations Between Driving Measures and Scale and Survey Measures

	Course Mean Speed	Time to Completion
Course Mean Speed	-	-.91**
Time to Completion	-.91**	-
TAS	.32**	-.38**
AISS	.37**	-.39**
DAS	n.s.	-.22*
DVQ	.29*	-.37**
# Aggressive Driving Movies	n.s.	-.25*
# Aggressive Driving Video Games	.23*	n.s.
# Violations	-	-.26*

\*  $p \leq .05$   
\*\* $p \leq .01$

Table 11

Study 1: Course Mean Speed by Video Condition, AISS, and TAS

Video Condition	Course Mean Speed (km/hr) Outliers Removed ( $N = 58$ )		Course Mean Speed (km/hr) Outliers Included ( $N = 62$ )	
	Mean	<i>SD</i>	Mean	<i>SD</i>
AGGD	35.0	2.7	35.0	2.8
ARND	34.7	2.5	34.2	3.2
NEUT	34.4	2.1	33.0	3.9
AISS				
Low (35 – 51)	33.9*	2.0	35.1*	3.2
High (52 – 64)	35.5*	2.6	33.1*	3.2
TAS				
Low (41 – 71)	--	--	34.9	3.2
High (42 – 99)	--	--	33.2	3.4

\* Significantly different at  $p < .05$

Table 12

Study 1: Time to Completion by Video Condition, AISS, and TAS

Video Condition	Time to Completion (s) Outliers Removed ( $N = 58$ )		Time to Completion (s) Outliers Included ( $N = 62$ )	
	Mean	<i>SD</i>	Mean	<i>SD</i>
AGGD	667.8	56.0	667.8	56.0
ARND	678.1	49.2	686.1	60.4
NEUT	678.4	33.4	705.0	72.9
AISS				
Low (35 – 51)	692.0**	38.1	707.7*	61.5
High (52 – 64)	658.1**	49.9	664.3*	59.9
TAS				
Low (41 – 71)	--	--	702.0	67.6
High (42 – 99)	--	--	668.8	58.4

\* Significantly different at  $p < .05$ \*\* Significantly different at  $p = .01$



Table 13

Study 1: Mean Acceleration During First Pass by Video Condition, Years Driving, and Weekly Kilometers

<i>N</i> = 57	Mean Acceleration (ft/s <sup>2</sup> )	
	Mean	<i>SD</i>
Video Condition		
AGGD	.60	.33
ARND	.63	.28
NEUT	.59	.20
Years Driving		
1 – 4	.56	.29
5 – 9	.71	.23
Weekly Kilometers		
0 – 135	.64	.28
136 – 500	.58	.28

Table 14

Study 1: Mean Acceleration in a Racing Scenario by Video Condition, Presence of Passing Yellow Car, and Number of Violations

<i>N</i> = 62		
	Mean Acceleration (ft/s <sup>2</sup> )	
	Mean	<i>SD</i>
Video Condition		
AGGD	.48	.16
ARND	.49	.30
NEUT	.38	.20
Passing Yellow Car		
Yes	.50*	.22
No	.35*	.18
Number of Violations		
0	.36*	.19
1 or more	.49*	.25

\* Significantly different at  $p \leq .05$

Table 15

Study 2: Release Dates and Time Periods Used for Aggressive and Risky Driving Movies

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## 1) Fast and Furious 6

Theatrical Release Date: May 24, 2013  
Four Week Pre-Movie Release Period: April 26 – May 23, 2013  
Four Week Post-Movie Release Period: May 24 – June 20, 2013

## 2) Furious 7

Theatrical Release Date: April 3, 2015  
Four Week Pre-Movie Release Period: March 6 – April 2, 2015  
Four Week Post-Movie Release Period: April 3 – April 30, 2015

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Table 16

Study 2: Number of Speeding Infractions for Pre- and Post-Movie Release Time Periods

Time Period	<i>Fast and Furious 6</i>		<i>Furious 7</i>	
	Pre-movie release	Post-movie release	Pre-movie release	Post-movie release
Four week total	12022	13645	8999	10258
Week 1	2861	3217	2252	3029
Week 2	3219	3387	2515	2464
Week 3	2868	3529	1924	2398
Week 4	3074	3512	2308	2367
Weekend 1	1205	1557	1176	1656
Weekend 2	1652	1700	1315	1216
Weekend 3	1526	1649	739	1288
Weekend 4	1497	1805	1012	1282

Table 17

Study 2: *Furious 7* Time Series Results for Speeding Infractions

Model #1 (df=48); R <sup>2</sup> = 0.82					Model #2 (df=48); R <sup>2</sup> = 0.84				
Variable	Estimate	SE	t	Sign.	Variable	Estimate	SE	t	Sign.
Constant	443.4	120.2	3.69	p = .001	Constant	527.7	112.4	4.70	p < .001
Autoregressive lag	0.5	0.1	3.74	p = .001	Autoregressive lag	0.5	0.1	3.23	p < .01
Precipitation	-12.9	4.2	-3.06	p < .01	Precipitation	-13.0	4.0	-3.22	p < .01
Traffic Volume	-213.0	157.0	-1.36	n.s.	Traffic Volume	-309.0	150.0	-2.06	p < .05
Saturday	124.9	20.4	6.11		Saturday	103.4	19.8	5.22	p < .001
Sunday	117.4	38.8	3.03	p < .01	Sunday	72.8	38.0	1.92	n.s.
Post-Week 1	84.2	34.7	2.43	p < .05	Post-Weekend 1	102.4	36.8	2.78	p < .01
Post-Week 2	35.4	32.5	1.09	n.s.	Post-Weekend 2	32.0	32.5	.99	n.s.
Post-Week 3	15.1	32.5	0.46	n.s.	Post-Weekend 3	50.8	32.5	1.56	n.s.
Post-Week 4	32.4	33.9	0.96	n.s.	Post-Weekend 4	63.8	32.6	1.96	n.s.

Table 18

Study 2: *Fast and Furious 6* Time Series Results for Speeding Infractions

Model #1 (df=48); R <sup>2</sup> = 0.79					Model #2 (df=48); R <sup>2</sup> = 0.77				
Variable	Estimate	SE	t	Sign.	Variable	Estimate	SE	t	Sign.
Constant	515.7	100.1	5.15	p < .001	Constant	621.0	104.9	5.92	p < .001
Autoregressive lag	0.3	0.2	2.04	p < .05	Autoregressive lag	0.5	0.1	3.67	p = .001
Precipitation	-6.3	2.9	-2.15	p < .05	Precipitation	-6.3	2.8	-2.24	p < .05
Traffic Volume	-207.0	152.0	-1.37	n.s.	Traffic Volume	-320.0	139.0	-2.03	p < .05
Saturday	157.9	23.5	6.72	p < .001	Saturday	133.3	25.5	5.23	p < .001
Sunday	124.1	36.5	3.40	p = .001	Sunday	80.5	39.7	2.03	p < .05
Post-Week 1	58.8	31.0	1.90	n.s.	Post-Weekend 1	69.4	46.1	1.51	n.s.
Post-Week 2	67.3	29.1	2.32	p < .05	Post-Weekend 2	56.6	42.4	1.34	n.s.
Post-Week 3	87.2	29.2	2.98	p < .01	Post-Weekend 3	38.8	41.7	.931	n.s.
Post-Week 4	90.1	31.1	2.90	p < .01	Post-Weekend 4	66.3	45.0	1.47	n.s.

Table 19

Study 2: Mean Speed Differential (km/hr) for Pre- and Post-Movie Release Time Periods

Time Period	<i>Fast and Furious 6</i>		<i>Furious 7</i>	
	Pre-movie release	Post-movie release	Pre-movie release	Post-movie release
Four week total	18.36 (4.18)	18.42 (4.20)	18.39 (4.14)	18.41 (4.29)
Week 1	18.20 (4.05)	18.42 (4.10)	18.44 (4.45)	18.44 (4.35)
Week 2	18.40 (4.17)	18.43 (4.35)	18.54 (4.27)	18.39 (4.12)
Week 3	18.38 (4.10)	18.38 (4.14)	18.11 (3.74)	18.34 (4.18)
Week 4	18.45 (4.36)	18.46 (4.21)	18.42 (4.01)	18.46 (4.49)
Weekend 1	18.13 (4.11)	18.47 (4.14)	18.37 (4.20)	18.64 (4.63)
Weekend 2	18.49 (4.24)	18.51 (4.41)	18.61 (4.31)	18.58 (4.27)
Weekend 3	18.44 (4.23)	18.43 (4.38)	18.05 (3.48)	18.32 (3.96)
Weekend 4	18.60 (4.76)	18.58 (4.44)	18.54 (4.02)	18.42 (4.34)
Number shown in brackets is the <i>SD</i>				

Table 20

Study 2: *Furious 7* Time Series Results for Mean Speed Differential (km/hr)

Model #1 (df=48); R <sup>2</sup> = 0.21					Model #2 (df=48); R <sup>2</sup> = 0.31				
Variable	Estimate	SE	t	Sign.	Variable	Estimate	SE	t	Sign.
Constant	17.67	0.66	26.83	p < .001	Constant	16.82	0.66	25.39	p < .001
Precipitation	-0.06	0.02	-2.53	p < .05	Precipitation	-0.05	0.02	-2.20	p < .05
Traffic Volume	1.00	1.00	1.10	n.s.	Traffic Volume	2.00	1.00	2.33	p < .05
Saturday	0.22	0.11	1.98	p = .05	Saturday	0.28	0.11	2.41	p < .05
Sunday	0.36	0.23	1.57	n.s.	Sunday	0.59	0.23	2.55	p < .05
Post-Week 1	0.01	0.11	0.10	n.s.	Post-Weekend 1	0.38	0.16	2.32	p < .05
Post-Week 2	-0.06	0.11	-0.56	n.s.	Post-Weekend 2	0.10	0.15	0.66	n.s.
Post-Week 3	-0.09	0.11	-0.88	n.s.	Post-Weekend 3	-0.21	0.15	-1.41	n.s.
Post-Week 4	0.04	0.11	0.33	n.s.	Post-Weekend 4	-0.06	0.15	-0.40	n.s.



Table 21

Study 2: *Fast and Furious 6* Time Series Results for Mean Speed Differential (km/hr)

Model #1 (df=48); R <sup>2</sup> = 0.16					Model #2 (df=48); R <sup>2</sup> = 0.17				
Variable	Estimate	SE	t	Sign.	Variable	Estimate	SE	t	Sign.
Constant	18.42	0.40	46.15	p < .001	Constant	18.59	0.42	44.46	p < .001
Precipitation	-0.02	0.01	-1.49	n.s.	Precipitation	-0.02	0.01	-1.25	n.s.
Traffic Volume	0.00	1.00	-0.27	n.s.	Traffic Volume	0.00	1.00	-0.59	n.s.
Saturday	0.14	0.09	1.49	n.s.	Saturday	0.08	0.11	0.74	n.s.
Sunday	0.08	0.16	0.54	n.s.	Sunday	-0.01	0.17	-0.05	n.s.
Post-Week 1	0.12	0.10	1.15	n.s.	Post-Weekend 1	0.10	0.14	0.70	n.s.
Post-Week 2	0.09	0.09	0.98	n.s.	Post-Weekend 2	0.13	0.13	0.98	n.s.
Post-Week 3	0.07	0.09	0.77	n.s.	Post-Weekend 3	0.04	0.13	0.30	n.s.
Post-Week 4	0.14	0.10	1.41	n.s.	Post-Weekend 4	0.22	0.14	1.59	n.s.

Table 22

Study 2: Dates and Time Periods Used for *Furious 7* and *Fast and Furious 6* Comparison Analyses

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*Furious 7*

## 1) Easter 2013

Date:	March 31, 2013
Good Friday:	March 29, 2013
Four Week Pre Period:	March 1 – March 28, 2013
Four Week Post Period:	March 29 – April 25, 2013

## 2) Easter 2014

Date:	April 20, 2014
Good Friday:	April 18, 2014
Four Week Pre Period:	March 21 – April 17, 2014
Four Week Post Period:	April 18 – May 15, 2014

*Fast and Furious 6*

## 1) 2014

First Post Period Friday:	May 23, 2014
Four Week Pre Period:	April 25 – May 22, 2014
Four Week Post Period:	May 23 – June 19, 2014

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Table 23

Study 2: *Furious 7* Comparison Time Series Results for Speeding Infractions for Easter 2013 and 2014

Easter 2013

<b>Model #1 (df=48); R<sup>2</sup> = 0.78</b>					<b>Model #2 (df=48); R<sup>2</sup> = 0.77</b>				
<b>Variable</b>	<b>Estimate</b>	<b>SE</b>	<b>t</b>	<b>Sign.</b>	<b>Variable</b>	<b>Estimate</b>	<b>SE</b>	<b>t</b>	<b>Sign.</b>
Constant	575.5	213.8	2.69	p = .01	Constant	788.5	196.2	4.02	p < .001
Autoregressive lag	0.7	0.1	6.93	p < .001	Autoregressive lag	0.7	0.1	7.66	p < .001
Precipitation	-26.3	8.3	-3.18	p < .01	Precipitation	-31.4	8.4	-3.75	p < .001
Traffic Volume	-381.0	308.0	-1.24	n.s.	Traffic Volume	-620.0	294.0	-2.11	p < .05
Saturday	131.6	33.2	3.97	p < .001	Saturday	109.5	33.5	3.27	p < .01
Sunday	138.7	63.3	2.19	p < .05	Sunday	81.5	62.5	1.30	n.s.
Post-Week 1	109.9	79.7	1.38	n.s.	Post-Weekend 1	17.2	71.0	0.24	n.s.
Post-Week 2	149.0	81.3	1.83	n.s.	Post-Weekend 2	88.1	69.5	1.27	n.s.
Post-Week 3	146.2	82.7	1.77	n.s.	Post-Weekend 3	70.9	66.4	1.07	n.s.
Post-Week 4	94.6	87.9	1.08	n.s.	Post-Weekend 4	-10.5	66.1	-0.16	n.s.

Easter 2014

<b>Model #1 (df=48); R<sup>2</sup> = 0.82</b>					<b>Model #2 (df=48); R<sup>2</sup> = 0.82</b>				
<b>Variable</b>	<b>Estimate</b>	<b>SE</b>	<b>t</b>	<b>Sign.</b>	<b>Variable</b>	<b>Estimate</b>	<b>SE</b>	<b>t</b>	<b>Sign.</b>
Constant	537.0	116.3	4.62	p < .001	Constant	697.4	120.0	5.81	p < .001
Autoregressive lag	0.3	0.1	1.73	n.s.	Autoregressive lag	0.4	0.1	2.58	p < .05
Precipitation	-8.1	3.0	-2.67	p = .01	Precipitation	-7.8	2.9	-2.70	p = .01
Traffic Volume	-281.0	159.0	-1.76	n.s.	Traffic Volume	-488.0	164.0	-2.97	p < .01
Saturday	138.9	20.5	6.75	p < .001	Saturday	113.8	21.2	5.38	p < .001
Sunday	129.1	39.0	3.31	p < .01	Sunday	69.9	40.6	1.72	n.s.
Post-Week 1	44.9	26.6	1.69	n.s.	Post-Weekend 1	-9.7	37.4	-0.26	n.s.
Post-Week 2	38.6	24.4	1.58	n.s.	Post-Weekend 2	63.7	34.6	1.84	n.s.
Post-Week 3	24.1	24.5	0.99	n.s.	Post-Weekend 3	34.9	34.0	1.03	n.s.
Post-Week 4	5.0	24.9	0.20	n.s.	Post-Weekend 4	36.0	35.3	1.02	n.s.

Table 24

Study 2: *Fast and Furious 6* Comparison Time Series Results for Speeding Infractions for Matched Timeline in 2014

Model #1 (df=48); R <sup>2</sup> = 0.87					Model #2 (df=48); R <sup>2</sup> = 0.86				
Variable	Estimate	SE	t	Sign.	Variable	Estimate	SE	t	Sign.
Constant	691.2	79.2	8.73	p < .001	Constant	705.0	83.8	8.42	p < .001
Autoregressive lag	0.1	0.2	0.52	n.s.	Autoregressive lag	0.3	0.2	1.61	n.s.
Precipitation	-7.3	2.3	-3.25	p < .01	Precipitation	-3.8	2.0	-1.91	n.s.
Traffic Volume	-450.0	107.0	-4.20	p < .001	Traffic Volume	-450.0	112.0	-4.02	p < .001
Saturday	119.3	17.9	6.66	p < .001	Saturday	107.1	18.5	5.78	p < .001
Sunday	92.1	27.7	3.32	p < .01	Sunday	80.9	28.9	2.80	p < .01
Post-Week 1	23.8	17.6	1.35	n.s.	Post-Weekend 1	-13.3	23.9	-0.56	n.s.
Post-Week 2	70.2	19.2	3.66	p = .001	Post-Weekend 2	67.0	25.0	2.68	p = .01
Post-Week 3	65.5	16.6	3.94	p < .001	Post-Weekend 3	51.4	24.3	2.11	p < .05
Post-Week 4	40.8	16.9	2.41	p < .05	Post-Weekend 4	39.9	24.2	1.65	n.s.

Table 25

Study 2: *Furious 7* Comparison Time Series Results for Mean Speed Differential for Easter 2013 and 2014

<b>Model #2</b>	<b>Easter 2013 (df=48); R<sup>2</sup> = 0.11</b>				<b>Easter 2014 (df=48); R<sup>2</sup> = 0.22</b>			
<b>Variable</b>	<b>Estimate</b>	<b>SE</b>	<b>t</b>	<b>Sign.</b>	<b>Estimate</b>	<b>SE</b>	<b>t</b>	<b>Sign.</b>
Constant	17.38	0.70	24.67	p < .001	18.30	0.66	27.54	p < .001
Precipitation	0.54	0.03	1.96	n.s.	-0.01	0.02	-0.41	n.s.
Traffic Volume	1.00	1.00	1.30	n.s.	0.00	1.00	-0.13	n.s.
Saturday	0.05	0.12	0.45	n.s.	0.16	0.11	1.45	n.s.
Sunday	0.32	0.24	1.35	n.s.	0.13	0.23	0.56	n.s.
Post-Weekend 1	0.17	0.17	0.96	n.s.	0.19	0.17	1.12	n.s.
Post-Weekend 2	-0.30	0.16	-1.85	n.s.	0.04	0.15	0.25	n.s.
Post-Weekend 3	-0.05	0.16	-0.33	n.s.	0.17	0.15	1.18	n.s.
Post-Weekend 4	0.07	0.16	0.47	n.s.	0.11	0.15	0.70	n.s.

Figure 1

Study 1: Anderson and Bushman's General Aggression Model

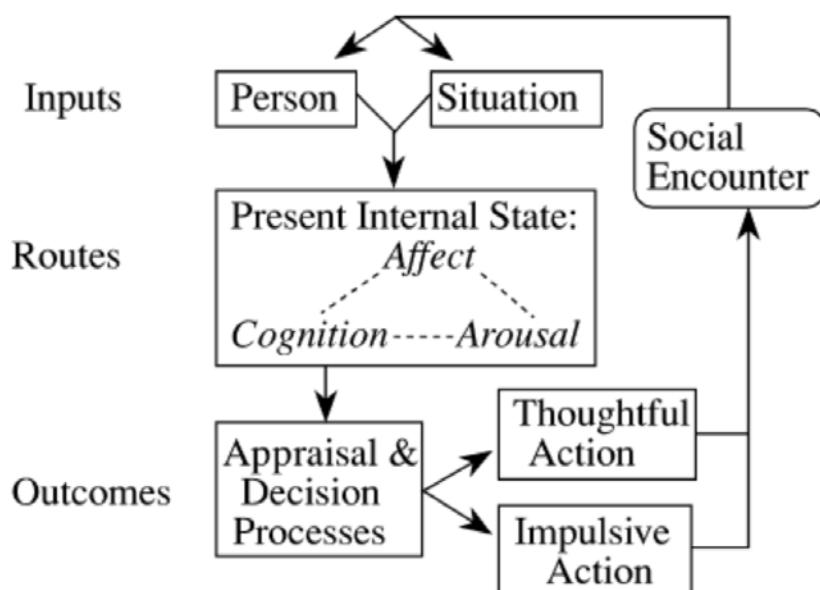


Figure 2

Study 1: GAM Factors Included in the Investigation of Modelling of Aggressive or Risky Driving

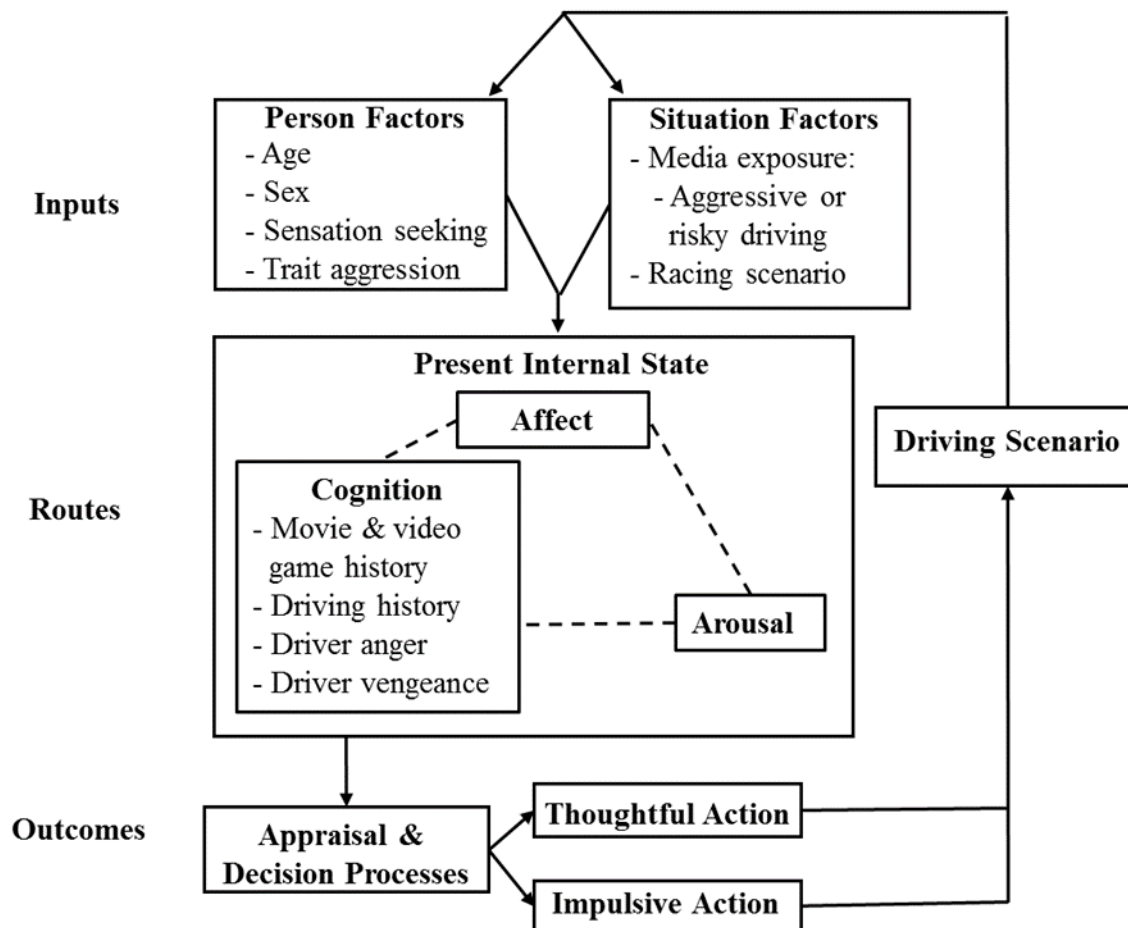


Figure 3

## Study 1: Driving Simulator Apparatus



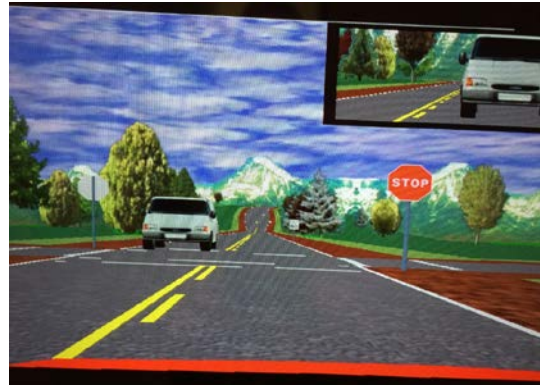


Figure 4

Study 1: Driving Practice Run Scenes



Scene 1: Rural view



Scene 2: Stop sign



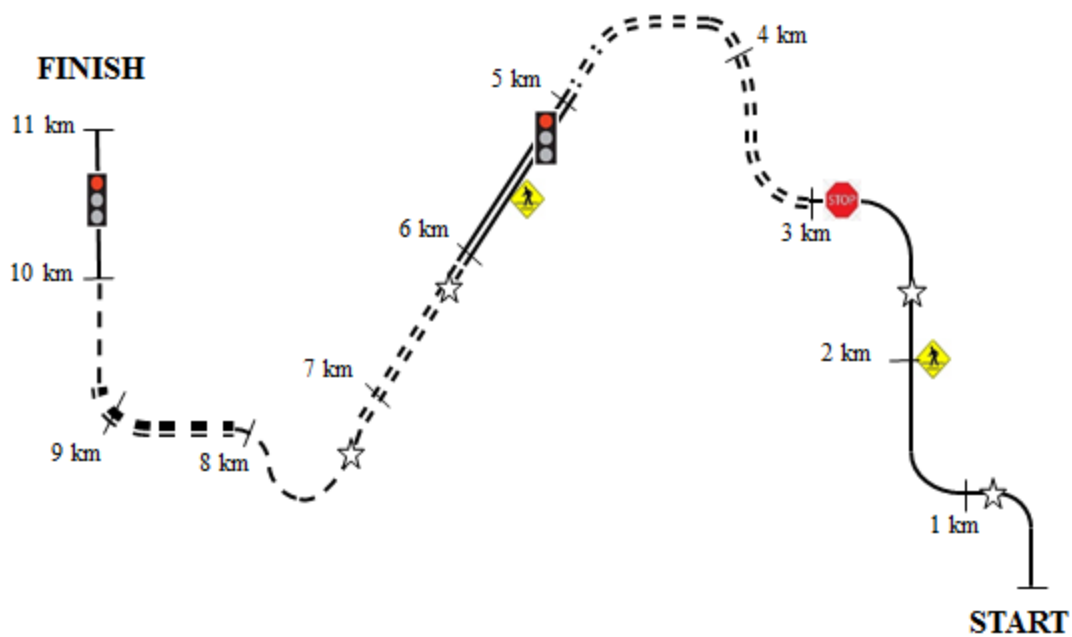
Scene 3: Traffic light



Scene 4: Cyclists

Figure 5

## Study 1: Map of Driving Test Run



- Single lane - 60 km/hr
- - - Single lane - 80 km/hr
- == Double lane - 60 km/hr
- === Double lane - 80 km/hr
- ≡≡ Double lane - 100 km/hr
- 🚦 Red traffic light
- 🛑 Stop sign
- 🚶 Pedestrian crosswalk
- ☆ Overtake/Pass opportunity

Figure 6

## Study 1: Driving Test Run Scenes



Scene 1: Urban view



Scene 2: Four-way stop sign



Scene 3: Pedestrian crosswalk



Scene 4: Passing opportunity

Figure 7

Study 1: Total Number of Vehicles Passed by Video Condition

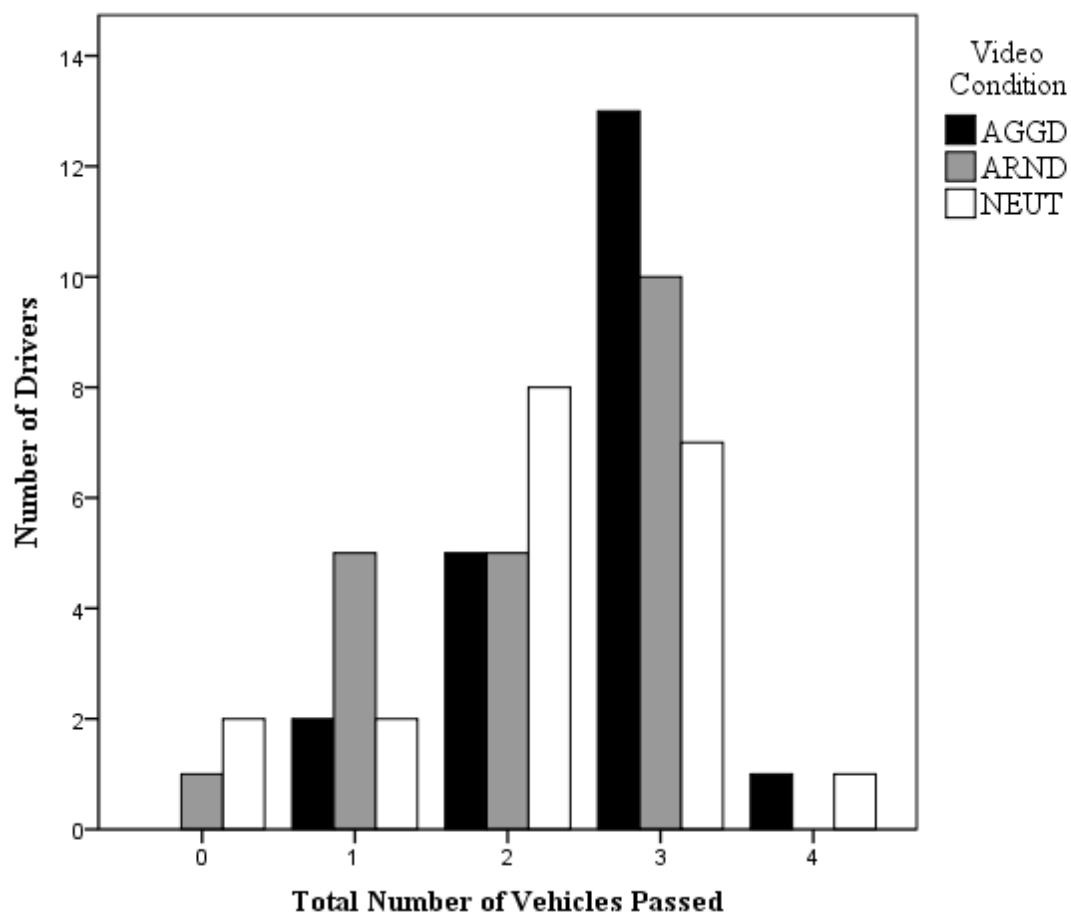
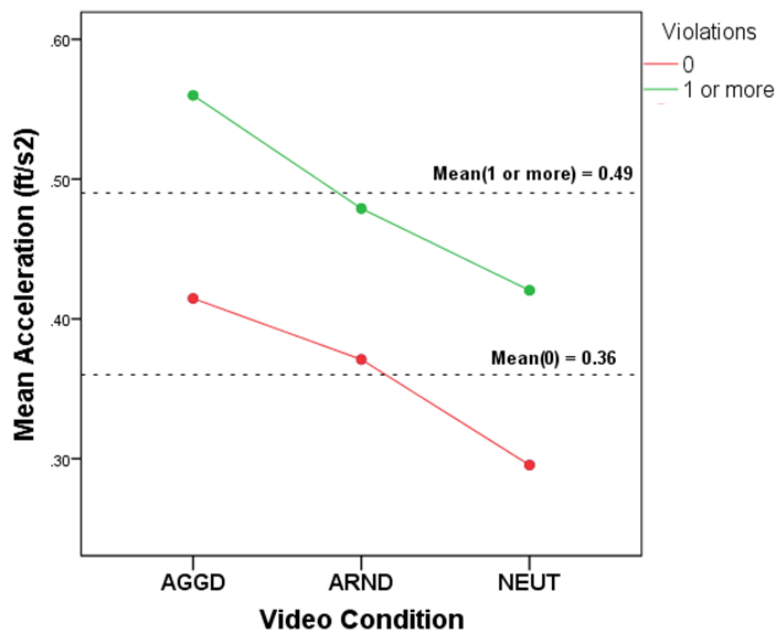


Figure 8

## Study 1: Main Effect of Number of Violations and Passing Yellow Car

## Number of Violations



## Passing Yellow Car

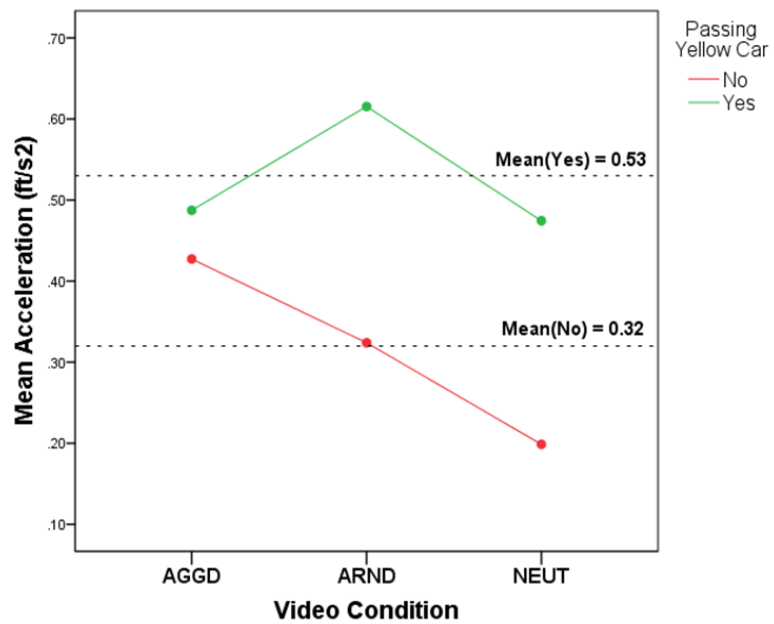


Figure 9

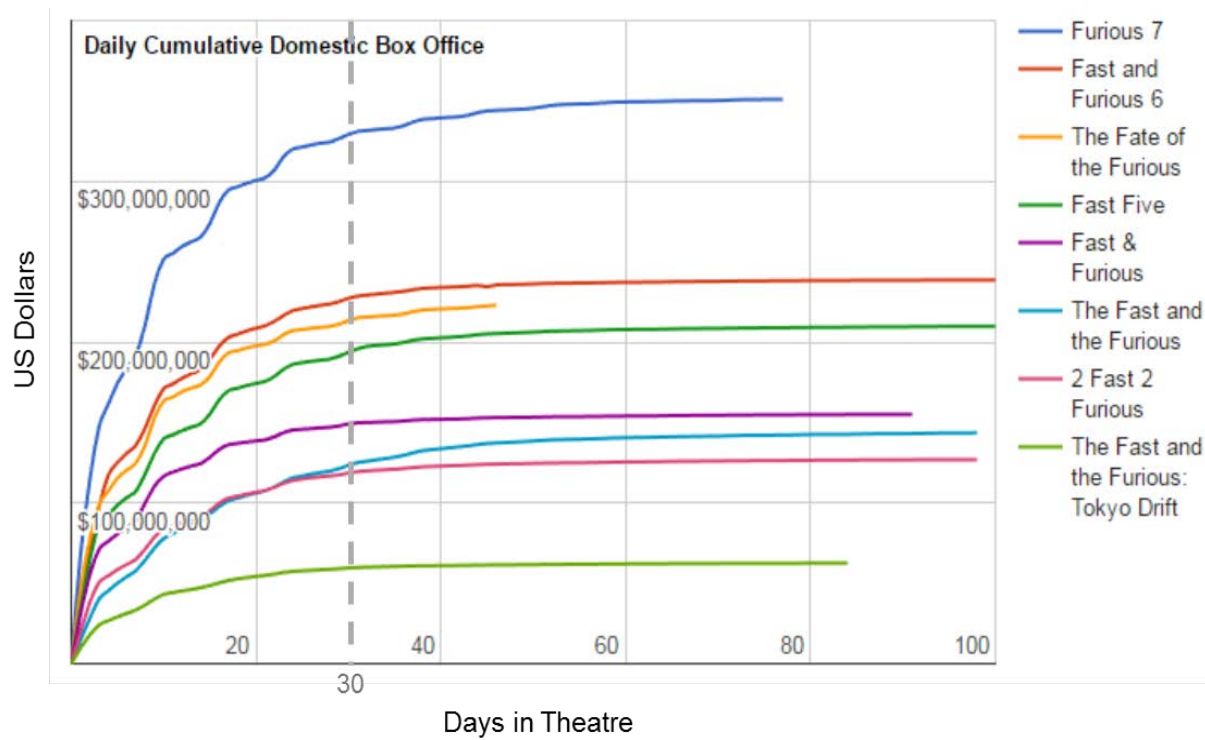
Study 2: Domestic Box Office History for the *Fast and Furious* Movies

Figure 10

Study 2: Control Model Fit (Pre-movie Release Period) for *Furious 7* and *Fast and Furious 6*  
Times Series Plot of Speeding Infractions

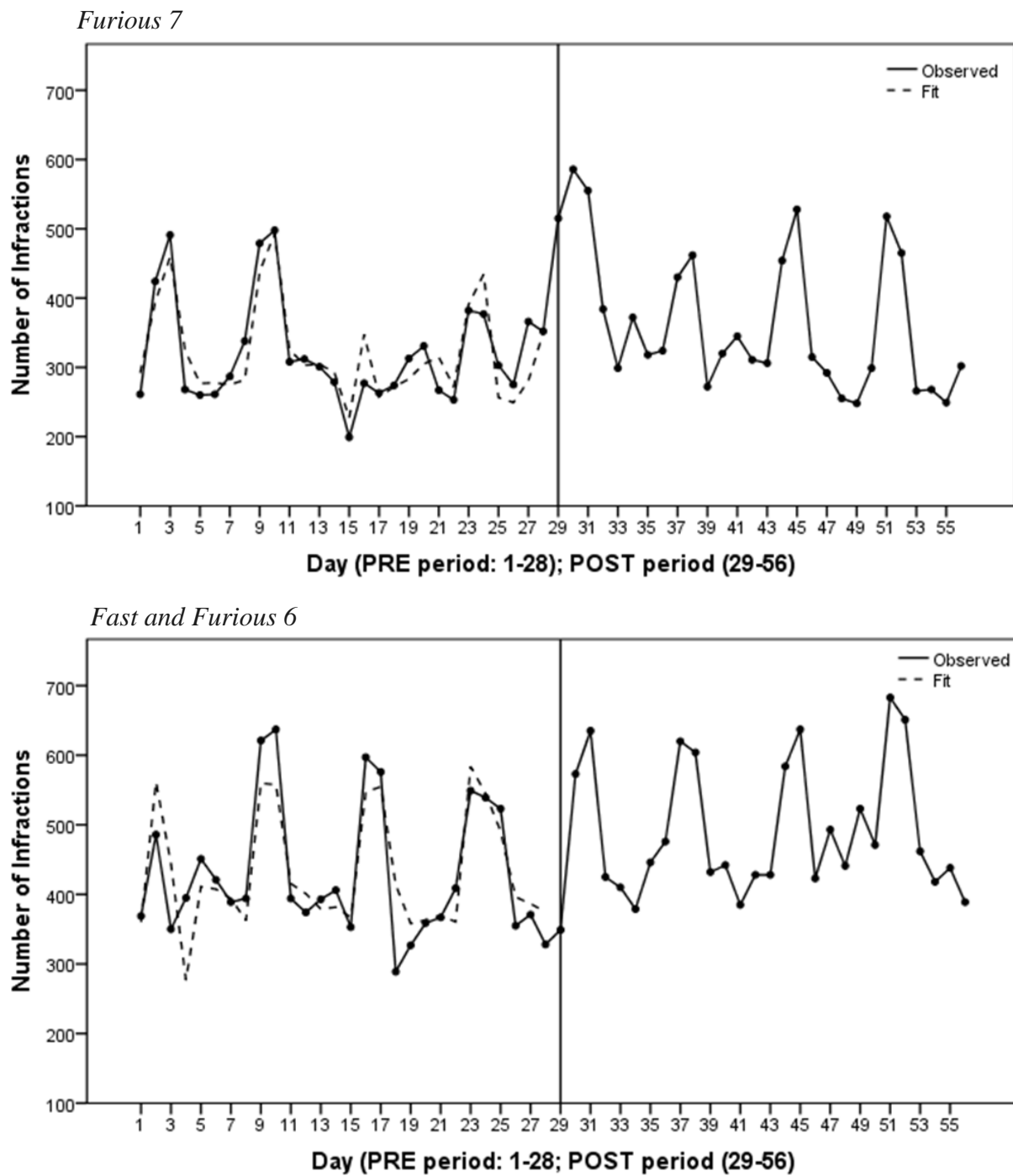


Figure 11

Study 2: *Furious 7* Times Series Plot of Speeding Infractions Generated by Model #1 and #2

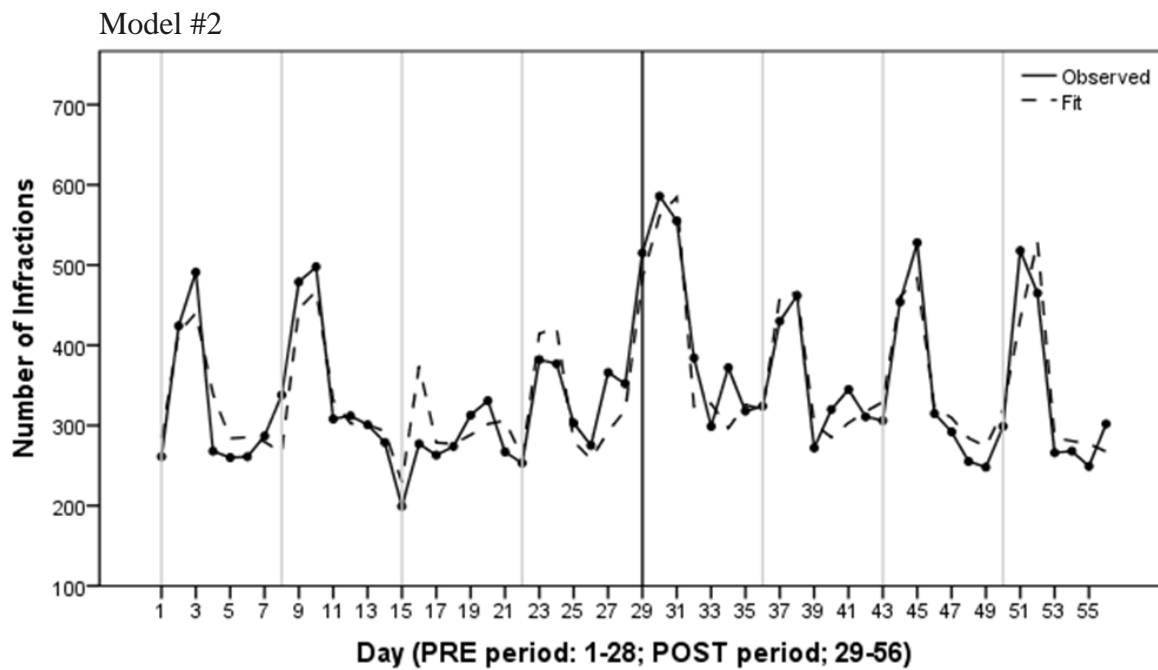
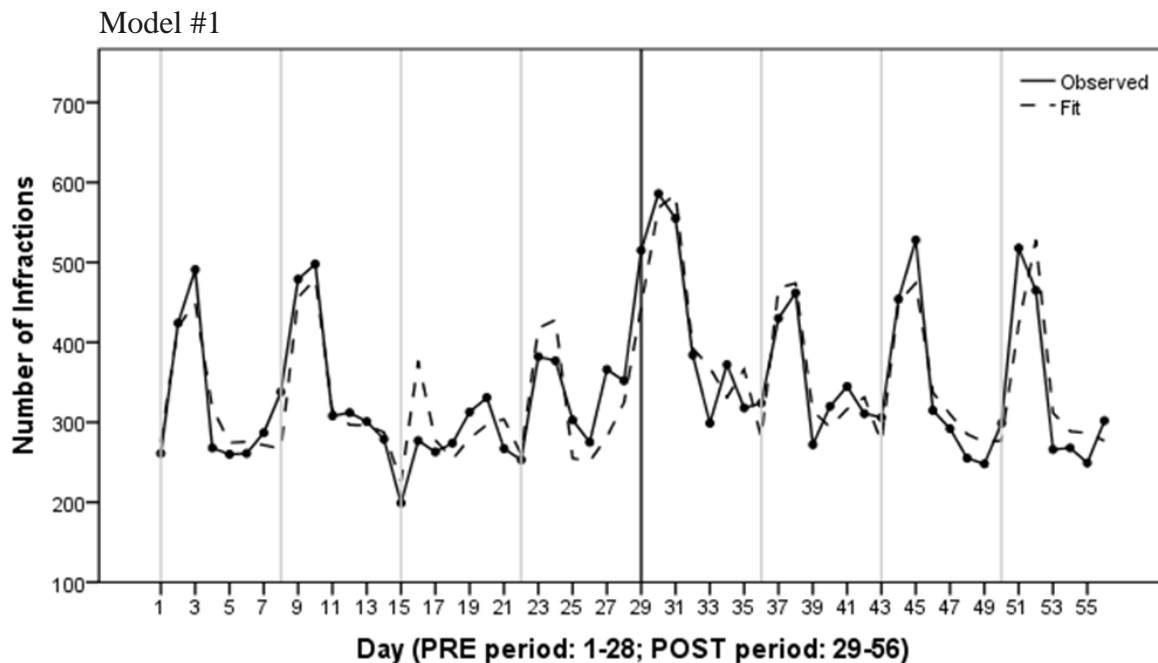




Figure 12

Study 2: *Fast and Furious 6* Time Series Plot of Speeding Infractions Generated by Model #1 and #2

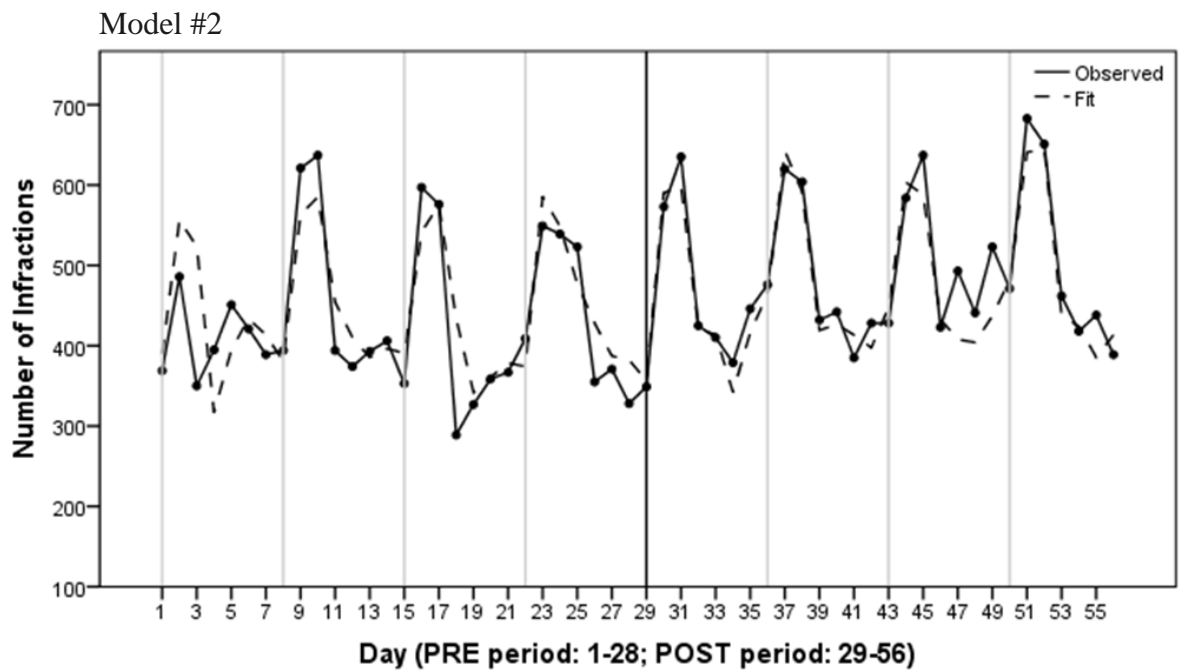
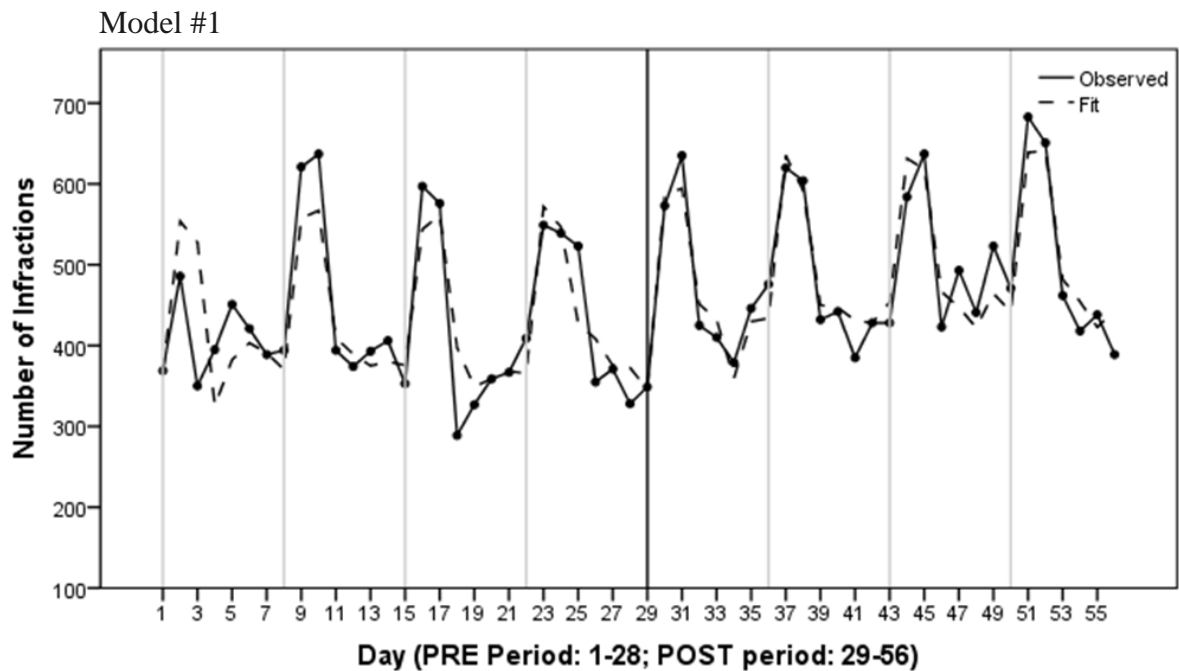


Figure 13

Study 2: Control Model Fit (Pre-movie Release Period) for *Furious 7* and *Fast and Furious 6*  
Times Series Plot of Mean Speed Differential

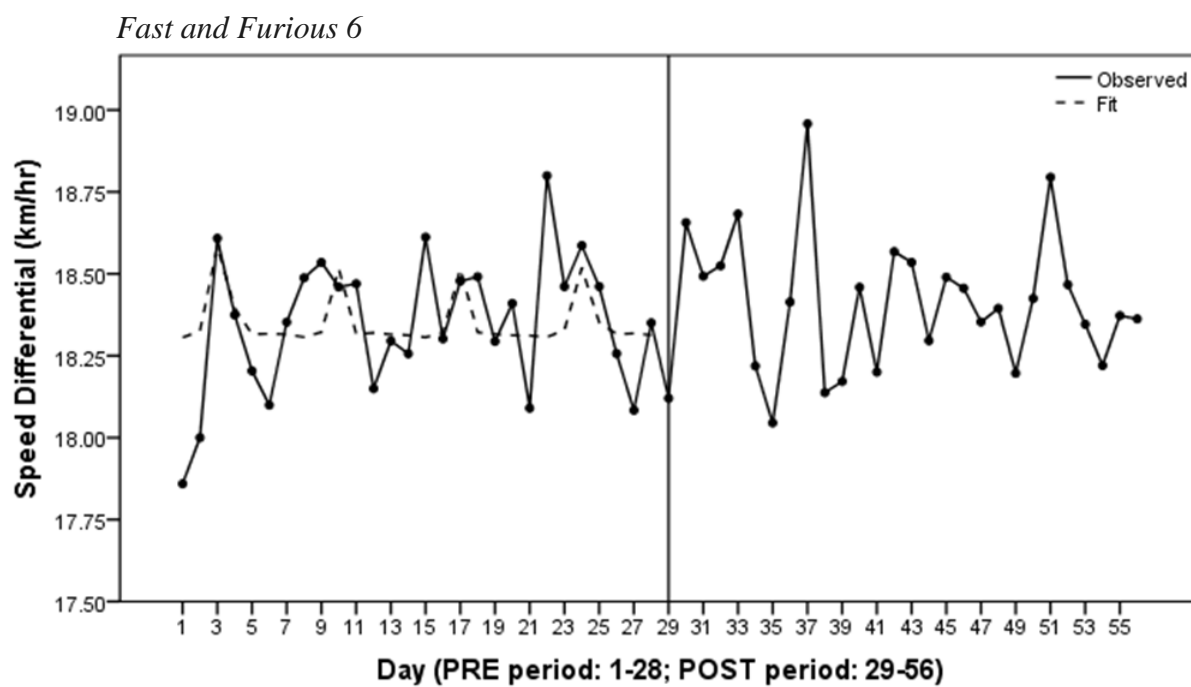
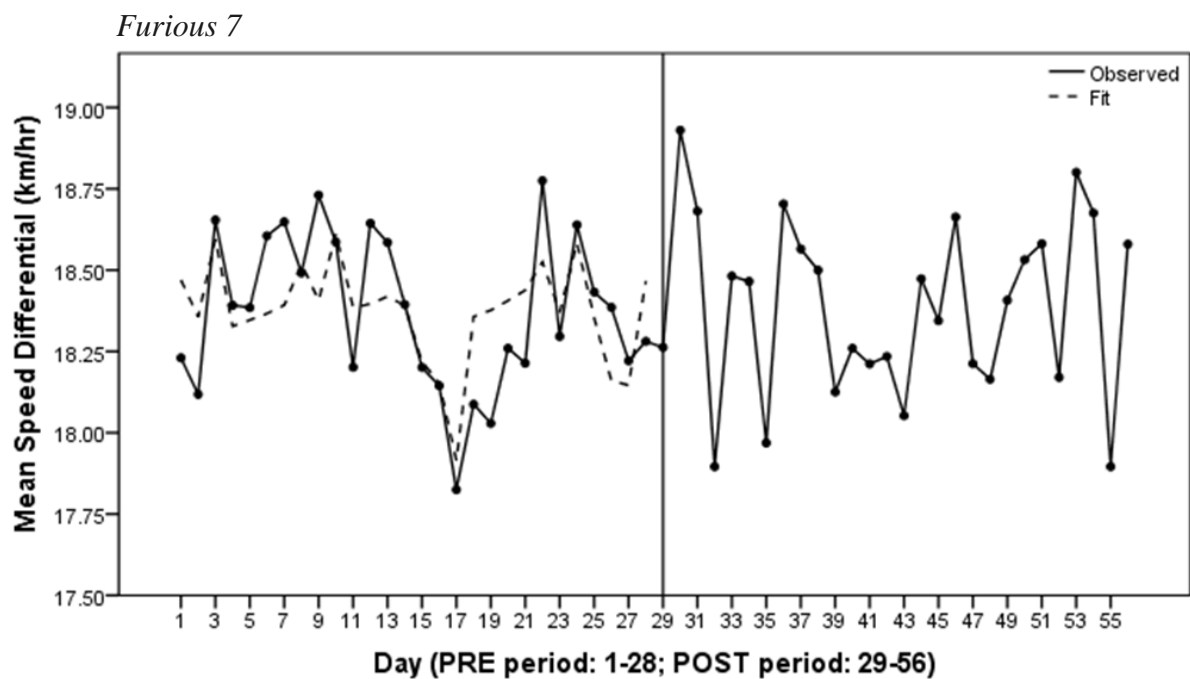


Figure 14

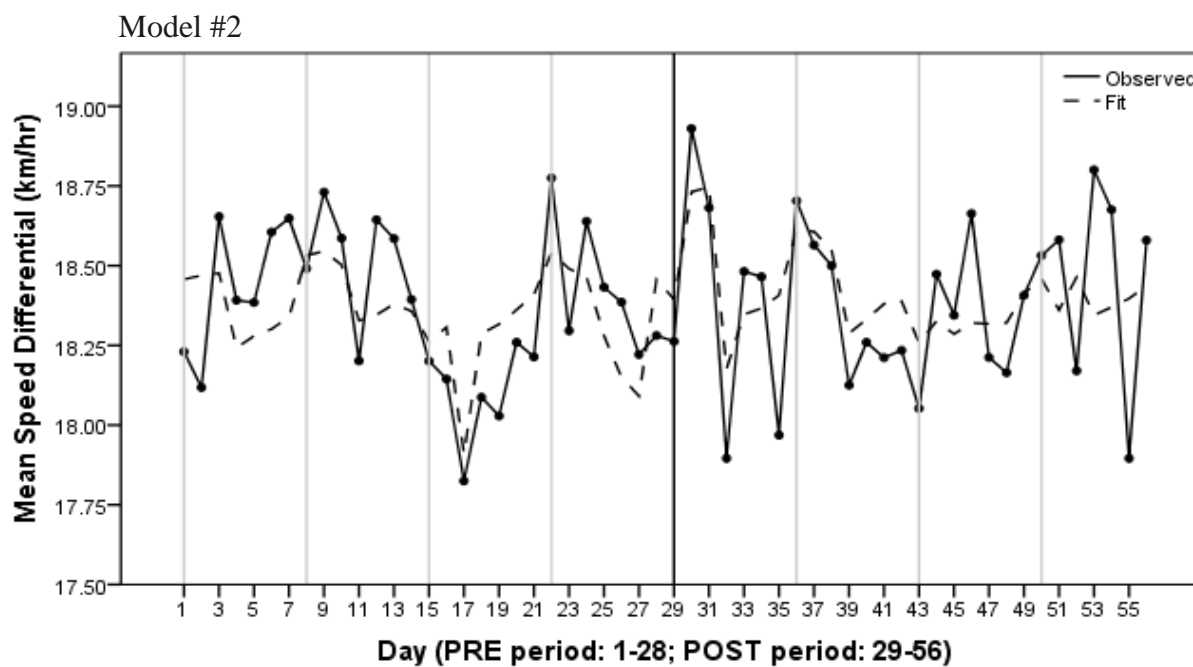
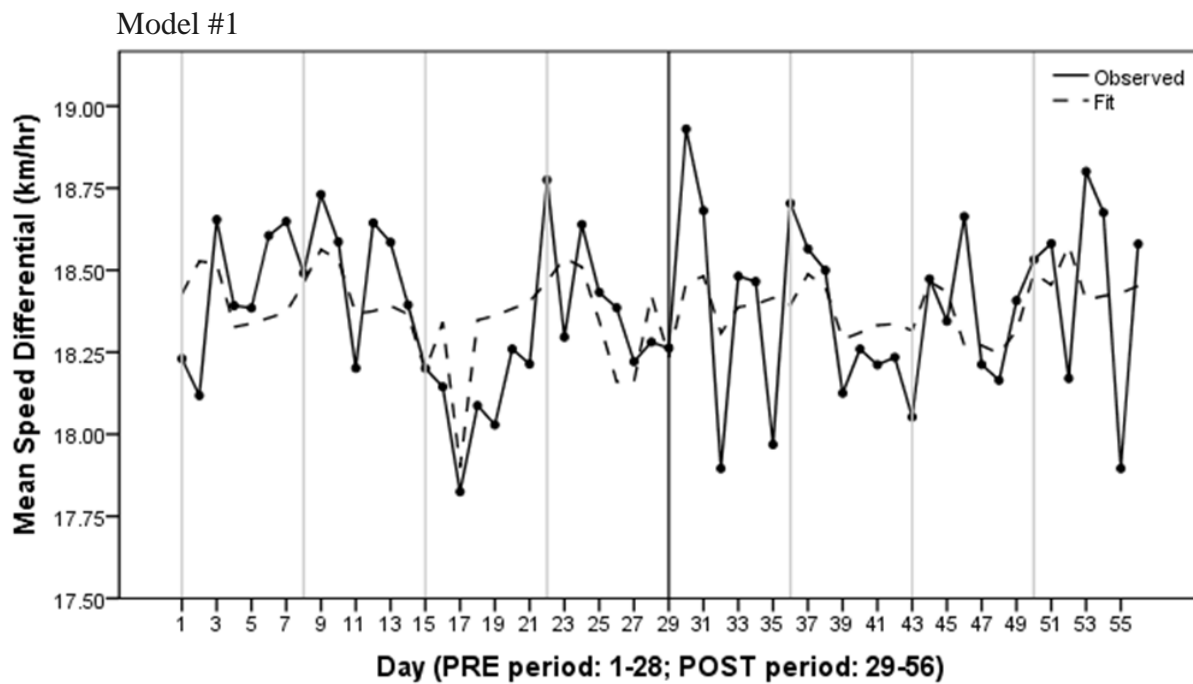
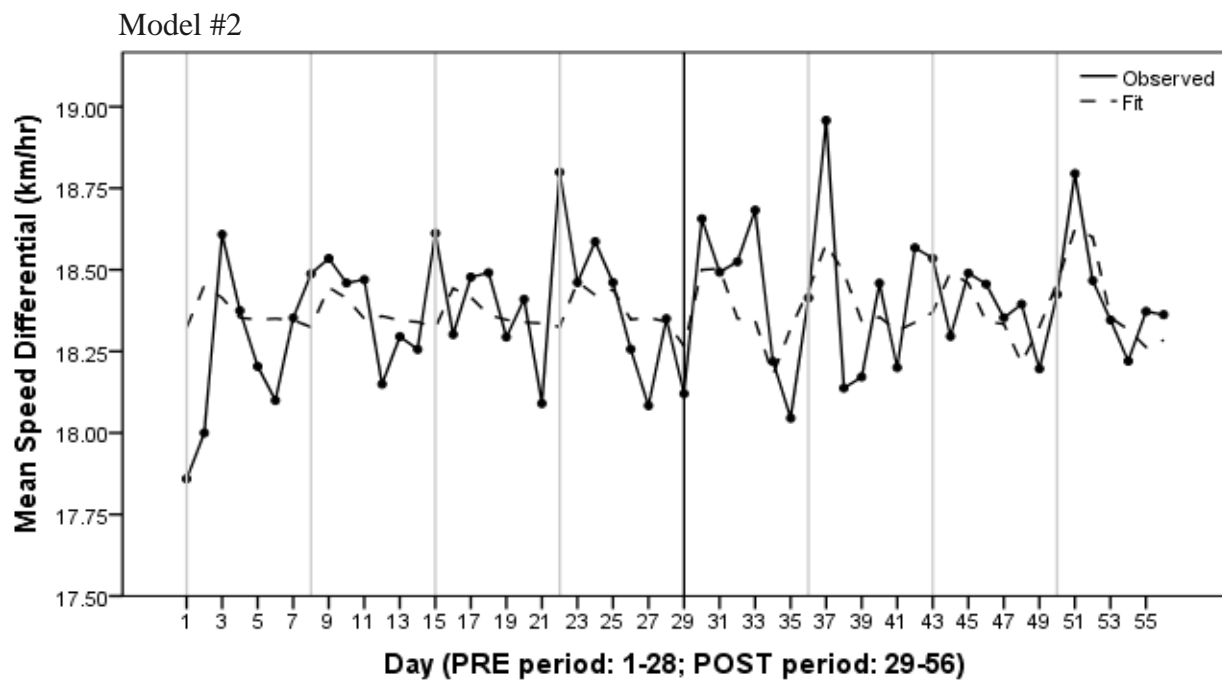
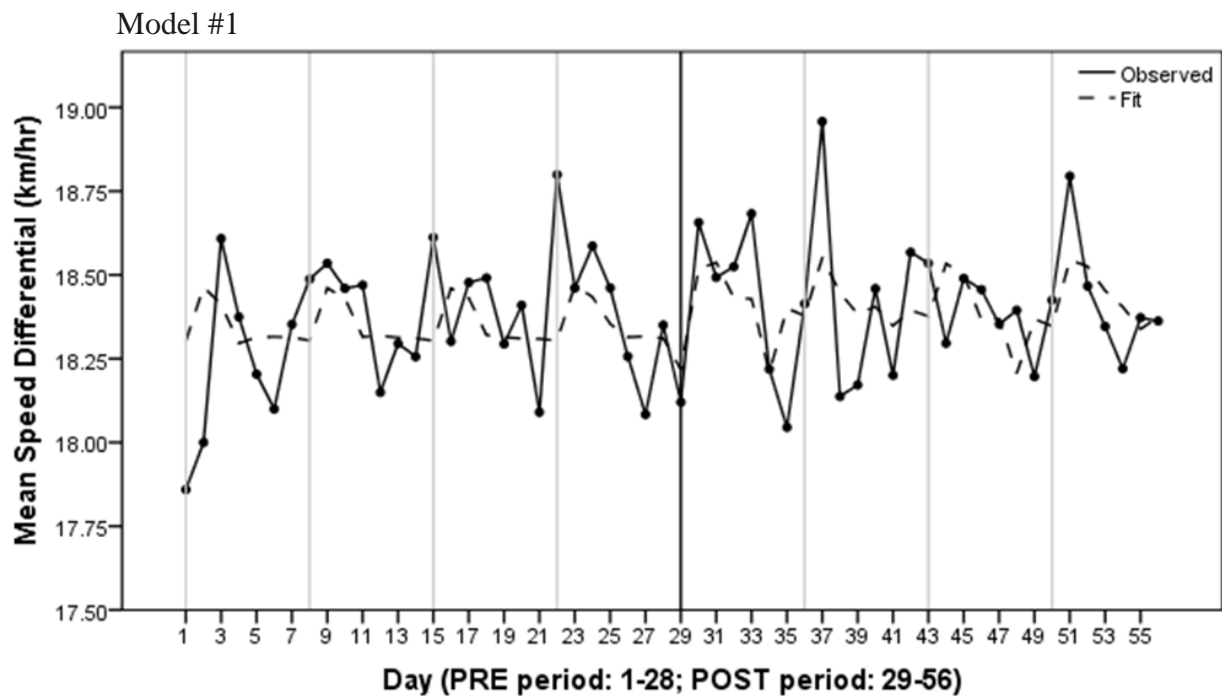
Study 2: *Furious 7* Time Series Plot of Mean Speed Differential Generated by Model #1 and #2

Figure 15

Study 2: *Fast and Furious 6* Time Series Plot of Mean Speed Differential Generated by Model #1 and #2



## Appendix A

## Study 1 Video Clip Descriptions

## 1) Aggressive/Risky Driving (AGGD)

Total duration: 14 minutes 48 seconds

Total number of movie scenes included: 5

Mean dB level: 58.12

All scenes shown in this video clip involve aggressive/risky driving behaviours, such as excessive speeding, driving off road, squealing of tires, and screeching of brakes. Each scene shown fades into the subsequent scene, resulting in a smooth transition.

- Scene #1: *Ronin*  
Duration: 2 minutes 25 seconds  
dB range: 44.8 – 70.5, mean = 57.65  
Description: One vehicle chases another through the streets of Paris.
- Scene #2: *The Bourne Identity*  
Duration: 2 minutes 55 seconds  
dB range: 45.5 – 71.2, mean = 58.35  
Description: Two people in a vehicle drive hazardously through Paris in order to evade the police.
- Scene #3: *Death Proof*  
Duration: 4 minutes 7 seconds  
dB range: 45.7 – 70.5, mean = 58.1  
Description: Three people in one vehicle drive recklessly in order to hit another car, whose driver must also drive recklessly in order to get away.
- Scene #4: *The Fast and the Furious*  
Duration: 2 minutes 21 seconds  
dB range: 46 – 71.6, mean = 58.8  
Description: Two drivers street race and attempt to speed across train tracks before an impending train hits them.
- Scene #5: *Bullit*  
Duration: 2 minutes 58 seconds  
dB range: 44.5 – 70.9, mean = 57.7  
Description: Two cars drive recklessly, one chasing the other, through the streets of San Francisco.

## 2) Arousing – Non-driving (ARND)

Total duration: 14 minutes 57 seconds

Total number of movie scenes included: 5

Mean dB level: 58.38

All scenes shown in this video clip involve highly arousing content, none of which includes vehicle or human aggression. Each scene shown fades into the subsequent scene, resulting in a smooth transition.

- Scene #1: *Twister*  
Duration: 2 minutes 7 seconds  
dB range: 45.5 – 71, mean = 58.25  
Description: Two people attempt to flee a tornado by running through a corn field and into a barn, which they must also eventually flee as the tornado progresses.
- Scene #2: *Poseidon*  
Duration: 4 minutes 25 seconds  
dB range: 45.5 – 71, mean = 58.25  
Description: A giant wave strikes a cruise ship and the resulting on-board chaos is shown as the ship turns upside-down.
- Scene #3: *Indian Jones and the Temple of Doom*  
Duration: 2 minutes 25 seconds  
dB range: 45.2 – 70.8, mean = 58  
Description: Two people are trapped in a room full of spikes as the ceiling lowers to crush them, while another person must walk through a bug infested tunnel in order to try to help their trapped friends.
- Scene #4: *Jurassic Park III*  
Duration: 3 minutes  
dB range: 46.7 – 71.3, mean = 59  
Description: A group of people are trapped in a broken plane while a dinosaur begins attacking. In their attempt to run away, they encounter a T-Rex, are forced to turn back, and attempt to hide and eventually run away as the two dinosaurs fight.
- Scene #5: *Jaws II*  
Duration: 2 minutes 59 seconds  
dB range: 45.8 – 71, mean = 58.4  
Description: One woman drives a boat while another water skis. A shark attacks the water skier and pulls her under and then returns to attack the woman in the boat. The woman tries to fight back with a gas tank and a flare gun, but ends up creating an explosion.

### 3) Neutral (NEUT)

Total duration: 14 minutes 43 seconds

Total number of movie scenes included: 5

Mean dB level: 52.76

All scenes shown in this video clip involve neutral content, none of which includes vehicle or human aggression nor highly arousing stimuli. Each scene shown fades into the subsequent scene, resulting in a smooth transition.

- Scene #1: *Arthritis Walkathon* (Simon, 2010)  
Duration: 3 minutes 16 seconds  
dB range: 46.2 – 63, mean = 54.6  
Description: This scene shows various individuals walking along a path in a park for an arthritis walkathon fundraiser.
- Scene #2: *Granville Island Market* (JCVdude, 2011)  
Duration: 4 minutes 10 seconds

dB range: 46 – 57.75, mean = 51.75

Description: People explore and purchase items from various vendors at the Granville Island Market.

- Scene #3: *Chess Match* (Chess.com, 2014)  
Duration: 3 minutes 20 seconds  
dB range: 45.2 – 57, mean = 51.1  
Description: Two young people engage in a chess match during a chess tournament.
- Scene #4: *Lane Swimming* (Plaza, 2010)  
Duration: 3 minutes 1 second  
dB range: 46.6 – 60, mean = 53.5  
Description: An older man is shown swimming lanes in an outdoor public swimming pool.
- Scene #5: *University Campus Market Event* (Campus MovieFest, 2014)  
Duration: 1 minute  
dB range: 44.5 – 61.6, mean = 53.05  
Description: People casually walk around a university campus market event.

## Appendix B

## Study 1 Pilot Work Word Search Task

Words can go horizontally, vertically and diagonally in all eight directions.  
Words may overlap and share 1 or more letters.

```

m x n q n n c w z c r k c x w v x r j m k n k v q
y k l n o g m r v h m n b a n a n a a l v r t p b
g t k r l c j w p a e p a r g m b w r e l g i q x
n e c w e f b n n b x n p t v l y t t z p n q t d
e n g h m j p d f n q f a z z n b c k j e g a k j
e m t n e t a w t t m y p w t h n m j a k u l l k
h p b b a r b z e t a n a r g e m o p m q k l f m
c k q k i r r p n g j k y k r w e p r m k m b h x
y p l n t f o y k z l y a h n k l q u g w w d r t
l l o k r x h k v m r r r a b e p k k j z w x y g
j u q p b n f c e r k x w j w h p h c z t t r n n
z m u z j t t d e r d o z d m r a k m p d r x t n
m n a l v r l h d q r l l x z k t r p z e w d t m
k a t n t a c h g k f a p r i c o t r b j x x p z
z m n j r e d y r c l m p w m f h a w t h o r n r
p r k g k k k j e n i r e g n a t a f z p w l p c
m k x o o l d r u j x y z r k r r m p w x l t q j
x r h n n x n e g n y t k l l t l l c l y r p t m
l c g n n r i c l q e l v z s r t i k l p e y m r
c e t k g f r n w f w b b v q m n m v z a h q t w
x d m z q q a i a r r a e y j p n e w c q b n n n
b m v o g n m u f v x w p r t l d y h x k a l a s
g t q l n g a q k c a r k w r t z w k t r g x r t
r b n k t d t p t k f u b q a y l r t m l y h w p
b p g r a p e f r u i t g t r p x r t w q t n m b

```

apple	melon	juneberry	
apricot	orange	kumquat	
banana	papaya	lemon	
cherry	pawpaw	lime	quince
chokecherry	peach	loquat	rowan
grape	pear	lychee	salak
grapefruit	pineapple	mandarin	strawberry
guava	plum	mango	tamarind
hawthorn	pomegranate	medlar	tangerine



## Appendix C

## Study 1 Scales

## 1) Arnett Inventory of Sensation Seeking (AISS) (Arnett, 1994)

For each item, indicate which response best applies to you:

- A) Describes me very well
- B) Describes me somewhat
- C) Does not describe me very well
- D) Does not describe me at all

- \_\_\_ 1. I can see how it would be interesting to marry someone from a foreign country.
- \_\_\_ 2. When the water is very cold, I prefer not to swim even if it is a hot day.
- \_\_\_ 3. If I have to wait in a long line, I'm usually patient about it.
- \_\_\_ 4. When I listen to music, I like it to be loud.
- \_\_\_ 5. When taking a trip, I think it is best to make as few plans as possible and just take it as it comes.
- \_\_\_ 6. I stay away from movies that are said to be frightening or highly suspenseful.
- \_\_\_ 7. I think it's fun and exciting to perform or speak before a group.
- \_\_\_ 8. If I were to go to an amusement park, I would prefer to ride the rollercoaster or other fast rides.
- \_\_\_ 9. I would like to travel to places that are strange and far away.
- \_\_\_ 10. I would never like to gamble with money, even if I could afford it.
- \_\_\_ 11. I would have enjoyed being one of the first explorers of an unknown land.
- \_\_\_ 12. I like a movie where there are a lot of explosions and car chases.
- \_\_\_ 13. I don't like extremely hot and spicy foods.
- \_\_\_ 14. In general, I work better when I'm under pressure.
- \_\_\_ 15. I often like to have the radio or TV on while I'm doing something else, such as reading or cleaning up.
- \_\_\_ 16. It would be interesting to see a car accident happen.
- \_\_\_ 17. I think it's best to order something familiar when eating in a restaurant.
- \_\_\_ 18. I like the feeling of standing next to the edge on a high place and looking down.
- \_\_\_ 19. If it were possible to visit another planet or the moon for free, I would be among the first in line to sign up.
- \_\_\_ 20. I can see how it must be exciting to be in a battle during a war.

## 2) Aggression Questionnaire (TAS) (Buss &amp; Perry, 1992)

Please rate each of the following items in terms of how characteristic they are of you. Use the following scale for answering these items.

	1	2	3	4	5
	Extremely uncharacteristic of me	Uncharacteristic of me	Neither characteristic nor uncharacteristic of me	Characteristic of me	Extremely characteristic of me
1) My friends say that I'm somewhat argumentative.	1	2	3	4	5
2) I get into fights a little more than the average person.	1	2	3	4	5
3) I tell my friends openly when I disagree with them.	1	2	3	4	5
4) I sometimes feel that people are laughing at me behind my back.	1	2	3	4	5
5) If I have to resort to violence to protect my rights, I will.	1	2	3	4	5
6) I know that "friends" talk about me behind my back.	1	2	3	4	5
7) I have trouble controlling my temper.	1	2	3	4	5
8) I often find myself disagreeing with people.	1	2	3	4	5
9) If somebody hits me, I hit back.	1	2	3	4	5
10) Some of my friends think I'm a hothead.	1	2	3	4	5
11) I wonder why sometimes I feel so bitter about things.	1	2	3	4	5
12) There are people who pushed me so far that we came to blows.	1	2	3	4	5
13) I am sometimes eaten up with jealousy.	1	2	3	4	5
14) Sometimes I fly off the handle for no good reason.	1	2	3	4	5
15) Given enough provocation, I may hit another person.	1	2	3	4	5
16) I am suspicious of overly friendly strangers.	1	2	3	4	5
17) When frustrated, I let my irritation show.	1	2	3	4	5
18) I am an even-tempered person.	1	2	3	4	5
19) Other people always seem to get the breaks.	1	2	3	4	5
20) I have become so mad that I have broken things.	1	2	3	4	5
21) At times I feel I have gotten a raw deal out of life.	1	2	3	4	5
22) Once in a while I can't control the urge to strike another person.	1	2	3	4	5
23) I can't help getting into arguments when people disagree with me.	1	2	3	4	5
24) I have threatened people I know.	1	2	3	4	5
25) I sometimes feel like a powder keg ready to explode.	1	2	3	4	5
26) I can think of no good reason for ever hitting a person.	1	2	3	4	5
27) When people annoy me, I may tell them what I think of them.	1	2	3	4	5
28) When people are especially nice, I wonder what they want.	1	2	3	4	5
29) I flare up quickly but get over it quickly.	1	2	3	4	5

### 3) Driving Anger Scale (DAS) (Deffenbacher, Getting, & Lynch, 1994)

Imagine that each situation described below was actually happening to you and rate the amount of anger that would be provoked.

	none at all 1	a little 2	some 3	much 4	very much 5
1. Someone is weaving in and out of traffic.	1	2	3	4	5
2. A slow vehicle on a mountain road will not pull over and let people by.	1	2	3	4	5
3. Someone backs right out in front of you without looking.	1	2	3	4	5
4. Someone runs a red light or stop sign.	1	2	3	4	5
5. You pass a radar speed trap.	1	2	3	4	5
6. Someone speeds up when your try to pass him/her.	1	2	3	4	5
7. Someone is slow in parking and is holding up traffic.	1	2	3	4	5
8. You are stuck in a traffic jam.	1	2	3	4	5
9. Someone makes an obscene gesture toward you about your driving.	1	2	3	4	5
10. Someone honks at you about your driving.	1	2	3	4	5
11. A bicyclist is riding in the middle of the lane and is slowing traffic.	1	2	3	4	5
12. A police officer pulls you over.	1	2	3	4	5
13. A truck kicks up sand or gravel on the car you are driving.	1	2	3	4	5
14. You are driving behind a large truck and you cannot see around it.	1	2	3	4	5

## 4) Driving Vengeance Questionnaire (DVQ) (Wiesenthal, Hennessy, &amp; Gibson, 2000)

Age: \_\_\_\_ Sex: \_\_\_\_ Years of driving experience (i.e., having a license): \_\_\_\_

The following are some common situations encountered by drivers. Please indicate the response that you would most likely make in that situation.

1. After stopping at a STOP sign, a motorist fails to yield the right of way to you when it is your turn to proceed through the intersection. You would:
  - a) Pull out quickly to block their way.
  - b) Give the driver an obscene gesture (e.g., the finger).
  - c) Honk your horn.
  - d) Do nothing.
  - e) Other:\_\_\_\_\_.
  
2. While driving on an expressway a vehicle cuts in front of you, forcing you to apply the brakes. You would:
  - a) Cut in front of their vehicle forcing them to apply the brakes.
  - b) Give the driver an obscene gesture.
  - c) Honk your horn.
  - d) Do nothing.
  - e) Other:\_\_\_\_\_.
  
3. A driver passes you and makes an obscene gesture at you. You would:
  - a) Force the other vehicle off the road.
  - b) Give the driver an obscene gesture.
  - c) Honk your horn.
  - d) Do nothing.
  - e) Other:\_\_\_\_\_.
  
4. Immediately after passing you, the driver slows down or applies his brakes. You would:
  - a) Pull in front of their vehicle and slow down.
  - b) Give the driver an obscene gesture.
  - c) Honk your horn.
  - d) Do nothing.
  - e) Other:\_\_\_\_\_.
  
5. While driving at night, the vehicle immediately behind you has its high beam headlights on. You would:
  - a) Let the vehicle pass and turn on your high beams.
  - b) Apply your brakes.
  - c) Honk your horn.
  - d) Do nothing.
  - e) Other:\_\_\_\_\_.

6. A driver persistently honks at you. You would:
- Force the other vehicle off the road.
  - Give the driver an obscene gesture.
  - Honk your horn.
  - Do nothing.
  - Other:\_\_\_\_\_.
7. A driver gets out of his vehicle at a traffic signal and approaches you in a threatening manner. You would:
- Get out of your vehicle and confront him/her.
  - Give the driver an obscene gesture.
  - Honk your horn.
  - Drive away.
  - Other:\_\_\_\_\_.
8. A vehicle bypasses a queue of vehicles and remains in the merge lane until the lane ends, and then tries to cut in front of your vehicle. You would:
- Block the vehicle so that it can't get in.
  - Give the driver an obscene gesture.
  - Honk your horn.
  - Do nothing.
  - Other:\_\_\_\_\_.
9. A slowly moving vehicle is occupying the left lane on an expressway, slowing traffic. You would:
- Tailgate the vehicle until it moves.
  - Give the driver an obscene gesture.
  - Honk your horn.
  - Do nothing.
  - Other:\_\_\_\_\_.
10. The driver in a vehicle directly in front of yours frequently applies the brakes, although no vehicle or pedestrians is in front of it. You would:
- Pass the vehicle and apply your brakes.
  - Give the driver an obscene gesture.
  - Honk your horn.
  - Do nothing.
  - Other:\_\_\_\_\_.
11. Garbage thrown from another vehicle hits your vehicle. You would:
- Throw garbage at the offending vehicle.
  - Give the driver an obscene gesture.
  - Honk your horn.
  - Do nothing
  - Other:\_\_\_\_\_.

12. Another driver takes a parking space that you have been waiting for. You would:
- a) Get out of your vehicle and tell the driver to move his vehicle.
  - b) Give the driver an obscene gesture.
  - c) Honk your horn.
  - d) Do nothing.
  - e) Other:\_\_\_\_\_.
13. The car in front of you doesn't proceed on an advanced green signal. You would:
- a) Bump into the other car.
  - b) Give the driver an obscene gesture.
  - c) Honk your horn.
  - d) Do nothing.
  - e) Other:\_\_\_\_\_.
14. You want to turn right at a red light and the car in front of you, also making a right turn, does not proceed when the way is clear. You would:
- a) Bump into the other car.
  - b) Give the driver an obscene gesture.
  - c) Honk your horn.
  - d) Do nothing.
  - e) Other:\_\_\_\_\_.
15. A vehicle stops on the roadway to pick up, or let out, a passenger causing a traffic delay. You would:
- a) Stop and tell the driver off.
  - b) Give the driver an obscene gesture.
  - c) Honk your horn.
  - d) Do nothing.
  - e) Other:\_\_\_\_\_.

## Appendix D

## Study 1 Driving History Survey

1) How frequently do you drive?

- Once a month
- Few times a month
- Once a week
- Few times a week
- (Almost) Everyday

2) Estimate your weekly number of kilometres driven: \_\_\_\_\_

3) Have you had any traffic violations/infractions in the last two years (e.g., speeding)?

Number: \_\_\_\_\_

Type: \_\_\_\_\_

4) Have you had any collisions in the last two years?

Number: \_\_\_\_\_

## Appendix E

## Study 1 Survey for Movie Viewing Preferences

Please indicate, with an 'X', which of the following movies you have seen.

- \_\_\_ 1) Furious 7
- \_\_\_ 2) Need For Speed
- \_\_\_ 3) The Transporter: Refueled
- \_\_\_ 4) Rush
- \_\_\_ 5) Fast & Furious 6
- \_\_\_ 6) Spectre
- \_\_\_ 7) Mission Impossible: Rogue Nation
- \_\_\_ 8) Mad Max: Fury Road
- \_\_\_ 9) Jurassic World
- \_\_\_ 10) Star Wars: Force Awakens
- \_\_\_ 11) Guardians of the Galaxy
- \_\_\_ 12) Avengers: Age of Ultron
- \_\_\_ 13) The Man from U.N.C.L.E
- \_\_\_ 14) The Divergent Series: Insurgent
- \_\_\_ 15) The Big Short
- \_\_\_ 16) Brooklyn
- \_\_\_ 17) Joy
- \_\_\_ 18) The Grand Budapest Hotel
- \_\_\_ 19) Inside Out
- \_\_\_ 20) The Revenant
- \_\_\_ 21) The Martian



## Appendix F

## Study 1 Survey for Video Game Playing History

For each of the following video games, indicate how often you play any version of them using the following scale:

Never	Sometimes	Few times a month	Few times a week	(Almost) Everyday		
1	2	3	4	5		
1)	Grand Theft Auto	1	2	3	4	5
2)	Need for Speed	1	2	3	4	5
3)	Gran Turismo	1	2	3	4	5
4)	Driveclub	1	2	3	4	5
5)	Project CARS	1	2	3	4	5
6)	Forza Motorsport	1	2	3	4	5
7)	Mario Kart	1	2	3	4	5
8)	Fallout	1	2	3	4	5
9)	Batman (Arkham series)	1	2	3	4	5
10)	Call of Duty	1	2	3	4	5
11)	Minecraft	1	2	3	4	5
12)	The Sims	1	2	3	4	5
13)	Super Mario	1	2	3	4	5
14)	Super Smash Bros	1	2	3	4	5
15)	Rock Band	1	2	3	4	5
16)	Just Dance	1	2	3	4	5

Please list any other video games that you play and how often (using the same scale):

## Appendix G

### Study 1 Letter of Information and Consent Form

**Date:** February 11, 2016

**Study Name:** Simulated Driving and Video Exposure

**Researchers:** Dr. Anthony Singhal (Principal Investigator – University of Alberta)  
Deanna Singhal (Doctoral Student – York University)  
Dr. David Wiesenthal (PhD Supervisor – York University)  
Maggie Salopek (Research Assistant – University of Alberta)

**Sponsors:** University of Alberta

**Purpose of the Research:**

You are being invited to participate in a research study investigating the behavioural patterns present when people drive after viewing a series of video clips.

**Research procedures:**

This study involves one experimental session lasting approximately 1 hour and is worth 1 research credit. During testing, you will view a series of video clips, following which you will operate a driving simulator with a steering wheel and gas and brake pedals. You will be instructed to drive as you normally would and adhere to traffic rules, such as maintaining the speed limit and stopping for pedestrians. Throughout the testing period, you will also be asked to fill out a few surveys.

Specific instructions will be given for the experiment before you begin. You will be in constant contact with the investigator during testing.

**Risks:**

We do not foresee any risks or discomfort from your participation in the research. There are no known risks or complications that have occurred while using the driving simulator, however, mild motion sickness with any simulator use is a possibility, though rare. In the unlikely event that the apparatus or any of the conditions in this experiment make you uncomfortable, please inform the experimenter and the session will be stopped.

**Benefits:**

There is no direct benefit to you from participating in this study. The results from this study may help us better understand how video stimuli affect driving patterns.

**Voluntary participation:**

Participation in this study is voluntary. At any time during the testing session, you may opt out without consequence and for any reason, with no explanation needed. If you opt out, you must participate in an alternative task in order to receive course credit. The alternative task lasts no

longer than the research participation itself and involves reading a published research article relevant to this study and answering questions about it.

**Participant exclusion criteria:**

You should not participate in this study if you do not have a driver's license and do not have normal or corrected-to-normal vision.

**Confidentiality:**

Any information obtained from this study will be kept confidential. Any data resulting from your participation will be identified only by case number, without any reference to your name or personal information. The data will be stored on a secure computer, which is password protected, in a locked room. Both the computer and the room will be accessible only to the experimenters. After completion of the experiment, data will be archived on storage disks and stored in a locked room for five years, after which they will be destroyed. The results of this study may be presented at scholarly conferences or published in professional journals. However, any report of the results of this research will be presented only in the form of typical or general patterns of responses. Following the completion of the experimental session, if, for any reason, you decide that you do not wish for your data to be included in the study, you may request that it be withdrawn and destroyed up to 6 months following your participation, without any consequence nor explanation needed.

**Estimate of participant's time and number of participants:**

The experiment will last approximately 1 hour and will require approximately 60 participants.

**Consent form:**

You do not waive any legal rights by signing the consent form. You will be provided with a copy of this letter of information and the consent form.

**Contact information:**

If you have questions about the research in general or about your role in the study, please feel free to contact the Principal Investigator, Dr. Anthony Singhal, [REDACTED]. You may also contact Deanna Singhal, [REDACTED], who is a doctoral student at York University, in the Department of Psychology [REDACTED], conducting this study as part of her dissertation research with her PhD supervisor, Dr. David Wiesenthal, [REDACTED].

This study has been reviewed for its adherence to ethical guidelines and approved by the Research Ethics Board 3 at the University of Alberta. It has also received ethics review and approval by the Human Participants Review Sub-Committee, York University's Ethics Review Board, and conforms to the standards of the Canadian Tri-Council Research Ethics guidelines. If you have any questions about this process, your rights as a participant in the study, or ethical conduct of research, you may contact the University of Alberta's Research Ethics Office, [REDACTED], or York University's Sr. Manager & Policy Advisor for the Office of Research Ethics, [REDACTED].

**Consent Form**

**Title:** Simulated Driving and Video Exposure

I have read the letter of information, have had the nature of the study explained to me, and I agree to participate. All questions have been answered to my satisfaction.

\_\_\_\_\_  
Name of Research Participant (please print)

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date

\_\_\_\_\_  
Age

Handedness? (please circle)

Left-handed / Right-handed / Ambidextrous

Do you have a driver's license? (please circle)

Yes / No / Learner's only

\_\_\_\_\_  
Signature of Investigator or Designee

## Appendix H

## Study 1 Scale Counterbalancing

FEMALES**						
Participant Number	AGGD		ARND		NEUT	
	PRE	POST	PRE	POST	PRE	POST
1	DAS - TAS	DVQ - AISS	DAS - TAS	DVQ - AISS	DAS - TAS	DVQ - AISS
2	TAS - DAS	AISS - DVQ	TAS - DAS	AISS - DVQ	TAS - DAS	AISS - DVQ
3	DVQ - TAS	DAS - AISS	DVQ - TAS	DAS - AISS	DVQ - TAS	DAS - AISS
4	TAS - DVQ	AISS - DAS	TAS - DVQ	AISS - DAS	TAS - DVQ	AISS - DAS
5	DAS - AISS	DVQ - TAS	DAS - AISS	DVQ - TAS	DAS - AISS	DVQ - TAS
6	AISS - DAS	TAS - DVQ	AISS - DAS	TAS - DVQ	AISS - DAS	TAS - DVQ
7	DVQ - AISS	DAS - TAS	DVQ - AISS	DAS - TAS	DVQ - AISS	DAS - TAS
8	AISS - DVQ	TAS - DAS	AISS - DVQ	TAS - DAS	AISS - DVQ	TAS - DAS
9*	DAS - TAS	DVQ - AISS	DAS - TAS	DVQ - AISS	DAS - TAS	DVQ - AISS
10	TAS - DAS	AISS - DVQ	TAS - DAS	AISS - DVQ	TAS - DAS	AISS - DVQ
11	DVQ - TAS	DAS - AISS	DVQ - TAS	DAS - AISS	DVQ - TAS	DAS - AISS
12	TAS - DVQ	AISS - DAS	TAS - DVQ	AISS - DAS	TAS - DVQ	AISS - DAS
13	DAS - AISS	DVQ - TAS	DAS - AISS	DVQ - TAS	DAS - AISS	DVQ - TAS
14	AISS - DAS	TAS - DVQ	AISS - DAS	TAS - DVQ	AISS - DAS	TAS - DVQ
15	DVQ - AISS	DAS - TAS	DVQ - AISS	DAS - TAS	DVQ - AISS	DAS - TAS
16	AISS - DVQ	TAS - DAS	AISS - DVQ	TAS - DAS	AISS - DVQ	TAS - DAS

\* Series is unique to 8 participants, then repeats.

MALES**						
Participant Number	AGGD		ARND		NEUT	
	PRE	POST	PRE	POST	PRE	POST
1	DAS - TAS	DVQ - AISS	DAS - TAS	DVQ - AISS	DAS - TAS	DVQ - AISS
2	TAS - DAS	AISS - DVQ	TAS - DAS	AISS - DVQ	TAS - DAS	AISS - DVQ
3	DVQ - TAS	DAS - AISS	DVQ - TAS	DAS - AISS	DVQ - TAS	DAS - AISS
4	TAS - DVQ	AISS - DAS	TAS - DVQ	AISS - DAS	TAS - DVQ	AISS - DAS
5	DAS - AISS	DVQ - TAS	DAS - AISS	DVQ - TAS	DAS - AISS	DVQ - TAS
6	AISS - DAS	TAS - DVQ	AISS - DAS	TAS - DVQ	AISS - DAS	TAS - DVQ
7	DVQ - AISS	DAS - TAS	DVQ - AISS	DAS - TAS	DVQ - AISS	DAS - TAS
8	AISS - DVQ	TAS - DAS	AISS - DVQ	TAS - DAS	AISS - DVQ	TAS - DAS
9*	DAS - TAS	DVQ - AISS	DAS - TAS	DVQ - AISS	DAS - TAS	DVQ - AISS
10	TAS - DAS	AISS - DVQ	TAS - DAS	AISS - DVQ	TAS - DAS	AISS - DVQ
11	DVQ - TAS	DAS - AISS	DVQ - TAS	DAS - AISS	DVQ - TAS	DAS - AISS
12	TAS - DVQ	AISS - DAS	TAS - DVQ	AISS - DAS	TAS - DVQ	AISS - DAS
13	DAS - AISS	DVQ - TAS	DAS - AISS	DVQ - TAS	DAS - AISS	DVQ - TAS
14	AISS - DAS	TAS - DVQ	AISS - DAS	TAS - DVQ	AISS - DAS	TAS - DVQ
15	DVQ - AISS	DAS - TAS	DVQ - AISS	DAS - TAS	DVQ - AISS	DAS - TAS
16	AISS - DVQ	TAS - DAS	AISS - DVQ	TAS - DAS	AISS - DVQ	TAS - DAS

\* Series is unique to 8 participants, then repeats.

\*\* Assign video condition to participants as they arrive. Do this random assignment separately for females and males.

Movie and video game lists are to be completed at the end of every session.

## Appendix I

## Study 1 Driving Experiment Instruction Protocol

## Order of experimental items:

- a. Consent Form
- b. Driving History Survey
- c. One Personality Scale (AISS or TAS) and one Driving Scale (DAS or DVQ) – see counterbalance sheet
- d. Practice Driving Session
- e. Video Watching (AGGD, ARND, NEUT) – see counterbalance sheet
- f. Test Driving Session
- g. One Personality Scale (AISS or TAS) and one Driving Scale (DAS or DVQ) – see counterbalance sheet
- h. Movie Viewing List
- i. Video Game Preferences
- j. Debriefing Form

## Running the session

- 1) Have the participant sit at the table in the main area. Present them with the consent form. Once consent is obtained, read the following GENERAL instructions:

“This experiment will take approximately 50 minutes. During that time, you will watch a 15 minute video, complete a variety of questionnaires, and drive through two sessions on a driving simulator. One of the driving sessions will be a practice run, allowing you to familiarize yourself with the simulator. It will take approximately 6 minutes to complete. During that session, I will sit beside you to watch and answer any questions you may have. If, upon completion of the practice run, your driving measures, such as speed and lane deviation, are not within set limits, you will be requested to repeat the practice run one more time. The second driving session is the experimental run and will take approximately 10 minutes to complete. I will not be present in the simulator room during this session.”

- 2) Before moving the participant to the driving simulator room, have them complete the following items (in this order):
  - a. Driving History Survey
  - b. One Personality Scale (AISS or TAS) and one Driving Scale (DAS or DVQ) – see counterbalance sheet
- 3) Move the participant into the driving simulator room. Have them get comfortable in the chair and make sure they can reach the gas and brake pedals comfortably. Once ready, read the following PRACTICE DRIVING instructions before the practice run:

“For the driving sessions, you do not need to use any of the buttons on the steering wheel. The left floor pedal is the brake and the right pedal is the gas. Drive as you normally

would, obeying appropriate traffic laws. While driving, there are a few things to watch out for:

- a. Pedestrians – Stop to let pedestrians cross
  - b. Stop signs – Do a complete full stop (i.e., move up to the sign and stop for ~2 – 3 seconds)
  - c. Traffic lights – Go when it is green and complete a full stop when it is red
  - d. Other vehicles that may get in the way - You may pass slower vehicles if you feel it is necessary”
- 4) The practice run file “Practice Run (FINAL) - Shorter Version” is in “Shortcut to STISIM\Projects\Deanna\Final STISIM Driving Files”. Before running the simulation:
- a. choose *Options* from the task bar and click on *Configuration*. Choose the *Roadway Scenery* tab and click on *Mountains*. Then click *Apply*.
  - b. click on *Run Simulation*. Make sure to enter unique participant identifiers into the blue/green textbox that appears prior to the loading of the simulation. This ensures that previously saved files are not overwritten.
- 5) Allow the participant to complete the practice run and ensure they are within the speed and lane deviation limits.
- 6) Have the participant watch the video (AGGD, ARND, or NEUT).
- 7) Once the video is complete, read the following TEST DRIVING instructions before the test run:
- “Drive as you normally would, obeying appropriate traffic laws. While driving, there are a few things to watch out for:
- a. Pedestrians – Stop to let pedestrians cross
  - b. Stop signs – Do a complete full stop (i.e., move up to the sign and stop for ~2 – 3 seconds)
  - c. Traffic lights – Go when it is green and complete a full stop when it is red
  - d. Other vehicles that may get in the way - You may pass slower vehicles if you feel it is necessary”
- 8) The test run file “Test Driving Run (FINAL)” is in “Shortcut to STISIM\Projects\Deanna\Final STISIM Driving Files”. Maintain the same configuration as the practice run and use unique identifiers to label this test run.
- 9) Once the test session is complete, bring the participant into the main area and have them complete the following items (in this order):
- a. One Personality Scale (AISS or TAS) and one Driving Scale (DAS or DVQ) – see counterbalance sheet
  - b. Movie Viewing List
  - c. Video Game Preferences
- 10) Complete the experimental session by giving the participant the Debriefing Form.

## Appendix J

## Study 1 Debriefing Form

## Debriefing: Simulated Driving and Video Exposure

The experiment you just participated in involves operating a driving simulator following exposure to a series of video clips. You were also asked to fill out some questionnaires.

In this study, we are investigating how people drive after they are primed with video clips depicting either neutral, aggressive/risky driving, or highly arousing content. The scales included in this study measured trait aggressiveness, driving aggression/vengeance, and sensation seeking.

We hypothesize that driving performance will be altered (i.e., more aggressive/risky driving) when one is exposed to either the aggressive/risky driving or the highly arousing content, but not altered when exposed to the neutral content. Additionally, it is anticipated that the greatest amount of aggressive/risky driving behaviour will be demonstrated for those who viewed the aggressive/risky driving content. Subjects' levels of trait aggressiveness, driving aggression/vengeance, and sensation seeking will be used to determine how these factors interact with aggressive/risky driving media to influence subjects' driving behaviour.

Understanding how aggressive and arousing media influences driving behavioural patterns is of great importance to society and will have implications regarding driver training protocols and accident analysis and prevention. If, for any reason, you decide that you do not wish for your data to be included in the study, you may request that it be withdrawn and destroyed up to 6 months following your participation, without any consequence nor explanation needed.

We would like to thank you very much for participating. Without your help, we could not empirically address the most important questions in psychology. We have one last request: Please do not tell other people about what we asked you to do in this study, since other students may still participate in this study. It is very important that they approach it as you originally did, i.e., without expectations or full awareness of our objectives. This is the only way we can obtain objective and valid information.

If, after this session, you have any questions about this study, please contact Dr. Anthony Singhal, [REDACTED], or Deanna Singhal, [REDACTED]. If you have general questions about your research participation, contact the Research Participation Coordinator [REDACTED], or e-mail questions to the Research Participation Coordinator [REDACTED].



## Appendix K

### Study 1 Revised Driving Experiment Instruction Protocol

Changes in the original protocol have been **bolded**.

Order of experimental items:

- a. Consent Form
- b. One Personality Scale (AISS or TAS) and one Driving Scale (DAS or DVQ) – see counterbalance sheet
- c. Practice Driving Session
- d. Video Watching (AGGD, ARND, NEUT) – see counterbalance sheet
- e. Test Driving Session
- f. One Personality Scale (AISS or TAS) and one Driving Scale (DAS or DVQ) – see counterbalance sheet
- g. Driving History Survey**
- h. Movie Viewing List
- i. Video Game Preferences
- j. Debriefing Form

Running the session

- 1) Have the participant sit at the table in the main area. Present them with the consent form. Once consent is obtained, read the following GENERAL instructions:

“This experiment will take approximately 50 minutes. During that time, you will watch a 15 minute video, complete a variety of questionnaires, and drive through two sessions on a driving simulator. One of the driving sessions will be a practice run, allowing you to familiarize yourself with the simulator. It will take approximately 6 minutes to complete. During that session, I will sit beside you to watch and answer any questions you may have. The second driving session is the experimental run and will take approximately 10 minutes to complete. I will not be present in the simulator room during this session.”

- 2) Before moving the participant to the driving simulator room, have them complete the following items:
  - a. Driving History Survey removed
  - b. One Personality Scale (AISS or TAS) and one Driving Scale (DAS or DVQ) – see counterbalance sheet
- 3) Move the participant into the driving simulator room. Have them get comfortable in the chair and make sure they can reach the gas and brake pedals comfortably. Once ready, read the following PRACTICE DRIVING instructions before the practice run:

**“For the driving sessions, you do not need to use any of the buttons on the steering wheel. The left floor pedal is the brake and the right pedal is the gas. Drive as you normally would, according to basic traffic laws. While driving, you will encounter pedestrians, stop signs, traffic lights, and other vehicles that may get in the way.**

**You may pass slower vehicles if you choose. There is no signal button that you need to use to indicate your intention to pass.”**

- 4) The practice run file “Practice Run (FINAL) - Shorter Version” is in “Shortcut to STISIM\Projects\Deanna\Final STISIM Driving Files”. Before running the simulation:
  - a. choose *Options* from the task bar and click on *Configuration*. Choose the *Roadway Scenery* tab and click on *Mountains*. Then click *Apply*.
  - b. click on *Run Simulation*. Make sure to enter unique participant identifiers into the blue/green textbox that appears prior to the loading of the simulation. This ensures that previously saved files are not overwritten.
- 5) Allow the participant to complete the practice run and ensure they are within the speed and lane deviation limits.
- 6) Have the participant watch the video (AGGD, ARND, or NEUT).
- 7) Once the video is complete, read the following TEST DRIVING instructions before the test run:

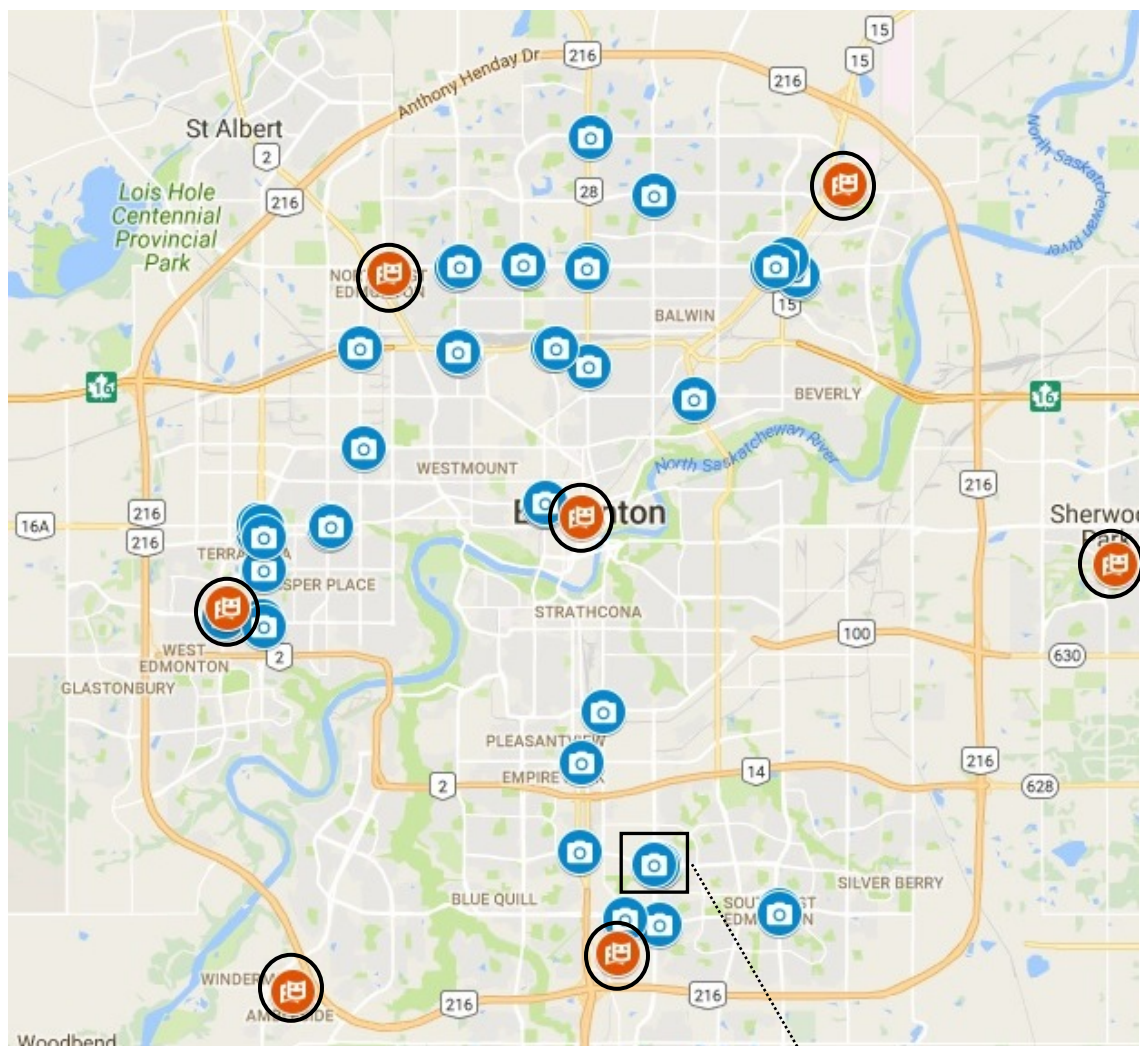
**“For the driving sessions, you do not need to use any of the buttons on the steering wheel. The left floor pedal is the brake and the right pedal is the gas. Drive as you normally would, according to basic traffic laws. While driving, you will encounter pedestrians, stop signs, traffic lights, and other vehicles that may get in the way. You may pass slower vehicles if you choose. There is no signal button that you need to use to indicate your intention to pass.”**

- 8) The test run file “Test Driving Run (FINAL)” is in “Shortcut to STISIM\Projects\Deanna\Final STISIM Driving Files”. Maintain the same configuration as the practice run and use unique identifiers to label this test run.
- 9) Once the test session is complete, bring the participant into the main area and have them complete the following items (in this order):
  - a. One Personality Scale (AISS or TAS) and one Driving Scale (DAS or DVQ) – see counterbalance sheet
  - b. Driving History Survey**
  - c. Movie Viewing List
  - d. Video Game Preferences
- 10) Complete the experimental session by giving the participant the Debriefing Form.

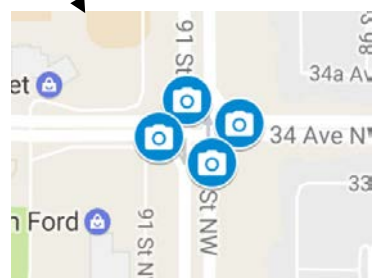


## Appendix M

## Study 2 City of Edmonton: Movie Theatres and Stationary Camera Enforcement Locations



Note: A single camera icon can represent more than one camera at an intersection, each detecting speeding in a different direction (e.g., northbound versus southbound).



## Appendix N

## Study 2 BIC values for ARMA (p, q) Models

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*Furious 7* (based on 28 day pre-movie release period)

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	q = 0	q = 1	q = 2
p = 1	8.11	8.21	8.39
p = 2	8.13	8.17	8.35

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*Fast and Furious 6* (based on 28 day pre-movie release period)

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	q = 0	q = 1	q = 2
p = 1	8.80	8.88	9.04
p = 2	8.88	9.04	9.21

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