

## Driver-Vehicle Interactions in 4WDs: A Theoretical Review

Smyth, T. &amp; King, M.

*Centre for Accident Research and Road Safety – Queensland (CARRS-Q), Queensland University of Technology*

## ABSTRACT

With the escalating number of four-wheel drive (4WD) vehicles present on Australian roads, it is becoming increasingly important to understand the factors contributing to 4WD crashes. While 4WDs and other cars often differ in their performance characteristics, it is also possible that there are differences in driver-vehicle interactions which go beyond performance characteristics and relate more to social and personal perceptions. This paper reviews the theoretical approaches and concepts that may be used to understand the relationship between drivers and vehicles. It is noted that in recent sociological and psychological literature the conceptualization of driving has varied across multiple theoretical approaches. Driving has been constructed as a set of social practices, embodied dispositions, cybernetic associations and physical affordances, while other approaches have viewed the vehicle as a territory (Costall, 1995; Dant, 2004; Fraine, 2003; Sheller, 2004). This review will discuss how these constructs may be applied to 4WD driver behaviour. Further, it will provide suggestions for methodology for future studies that aim to enhance knowledge of 4WD driver behaviour and the factors which contribute to 4WD crashes.

## INTRODUCTION

Recent increases in the number of four-wheel drive (4WD) vehicles present on Australian roads and their level of involvement in fatal crashes means that it is becoming increasingly important to understand the factors contributing to 4WD crashes. There is a common understanding among researchers that individual differences play a role in driving performance. For example, factors such as age, gender, risk perception and personality have demonstrated to be associated with varying risk of road accidents (Baker, Falb & Voas, 2003; Miles and Johnson, 2003). Vehicle characteristics are also implicated, such as a higher centre of gravity in 4WDs contributing to visibility and manoeuvring difficulties, resulting in 4WDs being more likely to roll over and twice as likely to reverse into another vehicle (AAMI, 2005).

However, little research has investigated the social and personal perceptions that may affect driver-vehicle interactions. For example, do people drive 4WDs differently because they view their own presence on the road as a 4WD-with-a-driver as qualitatively different to their presence as a sedan-with-a-driver, and therefore behave differently in their interactions with other road users. The purpose of the present paper is to discuss theoretical concepts that have been applied to the driver-car assembly and how these may apply to driver behaviour in 4WDs. A theme which runs through the review is the disentangling of the physical characteristics of the vehicle, as a determinant of how it is driven, from the pervasive factors of driver personality, attitude and behaviour, and from those aspects of driver behaviour which are elicited only when driving the 4WD.

Sociological and psychological literature has investigated the influences of the phenomenology of car-use on the form and content of social action. Within this body of literature, the conceptualisation of driving has varied across multiple theoretical approaches. Some have constructed driving as a set of social practices, embodied dispositions, and affordances (Costall, 1995; Dant, 2004). Other approaches have constructed the vehicle as a territory, and the vehicle as an extension of the driver's self (Fraine, 2003; Sheller, 2004). Urry (2004) has suggested abandoning the idea of the car as simply an object of production and consumption, and viewing it instead as a system of interlocking social and technical practices that has reshaped society. In these approaches, the assemblage of the driver-car is seen as a form of social being that produces a range of driving actions associated with the car, such as driving, transporting, parking, consuming and communicating (Dant, 2004). Furthering the concept of the

driver-car assembly, sociological theory has highlighted the vehicle-driver relationship as a cybernetic association (Dant, 2004).

Sociological analysis of the driver-car assembly has been conducted in order to build a theoretical account of the relationship between its components and form the basis of empirical sociological investigation of the driver-car (Dant, 2004). In his research, Dant has recognised that the assemblage of the driver-car enables a form of habitual social action, and that it is the particular ways in which the capacities of driver and vehicle are combined that impact on societies. The car, which is a product of human design, manufacture and choice, may be assembled from different components with consequent variations in behaviour (Dant, 2004). The current literature review will provide a summary of the theoretical approaches that may be used to understand the relationship between humans and cars. The review will also conduct a critical analysis of the relevant constructs in the literature, and discuss how these constructs may be applied to the human-vehicle relationship which operates when people drive 4WDs.

#### 4WDs ON THE ROAD

The popularity of 4WDs has increased significantly over the last ten years, with 4WDs representing a 5% increase in all new car sales from the period 1990 – 1998 (ATSB, 2002). This increase in popularity has contributed to an increased interest in 4WD safety. Four-wheel drive crash statistics reveal that the incidence of fatal 4WD crashes increased by 85% between 1990 and 1998 (ATSB, 2002). The ATSB (2002) has considered this increase to be due possibly to the increase in number of kilometres travelled by 4WDs, rather than decline in vehicle safety characteristics of 4WDs. When taking into account the level of activity, 4WDs had a higher fatal crash involvement than passenger cars and light trucks, but a lower involvement than motorcycles and heavy trucks (ATSB, 2002).

Compared with passenger cars in all fatal crashes, a significantly higher proportion of 4WD vehicles rolled over (35% of 4WDs, and 13% of passenger cars), and previous research has indicated that this is likely to be due to 4WDs having a higher centre of gravity than sedans (Fildes, Kent, Lane, Lenard & Vulcan, 1996). It has been suggested that it is unlikely that the increased incidence of roll-overs can be fully explained by different road environments used by 4WDs compared with other vehicles (ATSB, 2002). For crashes where the 4WD driver contributed to the crash, road user impairment was the most common contributory factor involved, including alcohol (62%), drug and alcohol use (13%), fatigue (13%), with the remaining 12% unclassified (ATSB, 2002). It is clear from these statistics that there is a strong justification for investigating the factors which contribute to the crash profile of 4WDs.

#### THEORETICAL PERSPECTIVES

This review addresses the theories that might apply to the way that people drive 4WDs in comparison to other vehicles. The focus is not on the physical characteristics of the driving task or the vehicle's handling characteristics, but on the psychology and sociology of the behaviour produced by the driver, and how this might contribute to an understanding of why people might drive 4WDs differently to sedans irrespective of the performance characteristics of the vehicle.

#### FIELD OF SAFE TRAVEL

In an initial attempt to understand the driving process, Gibson (1982) developed the concept of the 'field of safe travel'. In this approach to the driver-car relationship, there is a clear distinction between the vehicle and the driver. The 'field of safe travel' refers to what is presumed to be present in the perception of the competent driver.

Within the field are the parameters of the vehicle, the area projecting in front of the vehicle which the driver would have some sight of, and the minimum stopping zone indicating the point at which the driver knows they could stop the vehicle. Gibson's approach provides a disembodied view in which the driver is separate to the vehicle and context. However, there is some discussion of the perceptual engagement of the driver, for example, when expanding visual attention to cover a large area of the road in assessing distance and speed while driving. The different characteristics of 4WDs (on average) could contribute to a different field of safe travel in comparison with sedans, which might in turn affect crash risk.

## TERRITORY

The concept of territory has also been applied to explain aspects of driver behaviour and the relationship between humans and cars, and the surrounding road space (Fraine, 2003; Ruback & Juieng, 1997). According to Altman (1975), territoriality involves psychosocial bonds between humans and objects. It involves using and controlling places and objects in ways that support and contribute to several psychological functions associated with ownership, identity, regulation of social systems, and control of sociability and seclusion (Altman, 1975). This refers to themes such as amount of time spent in a place (or vehicle), qualities of the space (for example, providing freedom, convenience, independence), marking behaviour and intentions, extent of use, defence, etc (Fraine, 2003).

Altman (1975) identified three different types of territory: primary, secondary, and public. Primary territories are the most important or central and are usually under long-term control of the territory holders (for example, home). Secondary territories have a moderate degree of centrality and are used regularly and often shared (for example, with co-workers), while public territories have little psychological centrality and are temporary (for example, when occupying a table at a restaurant). While roads are public territories, cars may be considered as primary or secondary territories and it is argued that this perception has the potential to clash with the public territory of the road. Thus it has been proposed that aggressive driver behaviour may be a result of a territorial defence mechanism, with drivers reacting as if the public territory of the road is primary territory because their car is primary territory (Whitlock, 1971).

A recent study by Fraine (2003) investigated whether the relationship with the car is linked with concepts of territoriality, and if so, whether this affects the way in which drivers respond to situations on the road. Fraine found that respondents defined their relationship with the car in terms of the autonomy, identity and centrality provided by the car, and that they could view the car as defensible space. These concepts are strongly associated with territoriality. According to the results of Fraine's study, young drivers experienced the car as a primary territory, with drivers of work vehicles reporting the least degree of territoriality. Further, the size of the territory was found to increase with the size of the car. As 4WDs are generally larger than the average sedan, this may result in 4WDs having a larger 'defensible space' and thus impact on 4WD driver behaviour.

## AFFORDANCE

Gibson (1982), noted above for his 'field of safe travel' concept, later developed the concept of affordance in order to understand how people relate to their environment. The construct of affordance refers to the way an object is integrated with and affords particular things to its environment (Gibson, 1982). For example, a 4WD would afford off-road driving, the ability to drive over kerbs more readily, and perhaps a better view of the road. Gibson's (1982) focus, interpreted in the context of driving, is on characteristics of the vehicle first and foremost, even when discussing their interaction with drivers.

A limitation of this interpretation of affordance is that it fails to define the social relations with objects, such as designing, producing, adapting and maintaining.

Cars afford mobility, but the range of ways in which they do so is not accounted for by the concept of affordance. This interpretation also does not account for the ways in which a vehicle's mobility is dependent on the "affordability" of the driver. As such, Costall (1995) elaborated on the concept of affordance by highlighting the interaction between objects and people, which gives objects meaning and functions. Thus, Costall (1995) maintained that it is the driver-car assembly (or embodiment), rather than simply the vehicle itself, that affords mobility. This theoretical development highlighted the importance of considering the relationship between the vehicle and the driver.

## THE DRIVER-CAR ASSEMBLY AS A CYBORG

The collaboration of person and motor vehicle has also been conceptualised as creating a new social being, the 'car-and-driver' attracting the term 'cyborg' (Dant, 2004; Haraway, 1991). Initially the term cyborg was quite specific in its application, referring to feedback structures integrated into the body that could be used to replace or enhance human body parts (Dant, 2004; Haraway, 1991). It is related to the concept of embodiment discussed earlier, in that the integrated human-machine system functions as a unified organism. On getting into a vehicle to drive it, the driver becomes part of an extended body that behaves in its own way, with the driver becoming absorbed into an entity which is aware of where its boundaries are, and how to move and stop.

In recent years the use of the term cyborg has become quite broad, applying to virtually all tools used by humans, and even to non-material tools. For example, Clark (2003) asserted that language was the first phase of cyborg existence, which has evolved to integrate other technologies such as pens and mobile phones. Clark (2003) argued that when humans engage with technologies, extended systems are formed, with each such extended system becoming a new self. However, as Dant (2004) notes, the driver-car is a temporary assemblage that is capable of undergoing continuous reform and comes apart when the driver leaves the car. For this reason, Dant (2004) has argued that the term 'cyborg' is inappropriate because a 'self' is a persistent construct. In the driver-car assembly, the person remains complete in his or her self (Dant, 2004). This debate ultimately devolves on whether or not a self can be a temporary arrangement.

## VEHICLES AND EMOTIONS

Sheller (2004) has argued that a disregarded aspect of car cultures is the emotional investments people have in the relationships between the car, themselves and others. According to Sheller, these emotional investments create affective contexts that are manifest in particular types of vehicles, homes, and communities. In the co-modification process, car manufacturers are seen to manipulate brand desire through emotional meaning in their advertising campaigns, and the feelings generated can be strong indicators of emotions embedded within car cultures.

This is perhaps demonstrated by the sexualisation of the vehicle by the media. Inherent in this view is the car as an extension of the driver's body, as found in advertising and pop culture, such as song lyrics, music videos and motor shows (Sheller, 2004). In such contexts, the vehicle is seen to possess a personality and contributes to the ego-formation of the driver as competent, powerful and sexually desirable. Car consumption, then, is not a rational choice, but rather it reflects a result of the interaction between aesthetic, emotional and sensory responses to driving, as well as daily living, work and social patterns. Accordingly, Sheller argues that new approaches to viewing automobility are required in order to expand the current view of the driver as a 'rational actor' towards the more complex reality that includes emotional and affective factors.

An important question to be considered is whether there is a reflexive aspect to vehicle personality. That is, when a car that is perceived by the driver to have a particular image is being driven, does the driver behave in a way which they see as being consistent with the image?

Bradsher (2002) argued that this has been assumed to be the case by the marketers of 4WDs in the US (where they are known as SUVs) and cited a range of supporting evidence from market research and other sources, most of which lie outside the scientific literature.

## SOCIAL COGNITION

How people perceive themselves and their cars can also be explained by social cognition theory. Much of the research in social cognition has been concerned with individual conceptions of the self, that is, the person's mental representations of their own personality attributes, social roles, etc (Fiske & Taylor, 2000). Most theoretical perspectives consider the self to be a collection of related and highly domain-specific knowledge structures, referred to as self-schemas. These are cognitive-affective structures that represent one's experience in a given domain, and organise the processing of information relevant to the self-schema (Fiske & Taylor, 2000).

Self-schema theory proposes that the self concept is a relatively stable cognitive representation, while self-categorisation theory argues that self-perception is highly context-dependent (Onorato & Turner, 2004). Kihlstrom and Cantor (1984) have argued that mental self representations consist of a hierarchy of context-specific self-concepts, with each representing one's beliefs about oneself in different situations. Driving a vehicle, even a specific vehicle such as one's own car or a 4WD, could be one of these contexts which elicits a context-specific self-concept, presumably with its own particular influence on behaviour.

It has been demonstrated that people usually make predictions about their behaviour consistent with their self-schemas (Sheeran & Orbell, 2000). Self-schemas are particularly influential if drawing inferences about others requires inferences beyond the information provided (Fiske & Taylor, 2000). Whether this occurs because people use self-relevant constructs to perceive others, or whether certain constructs are more accessible and are thus used to describe the self and others is the subject of current debate (Fiske & Taylor, 2000).

While aspects of the self-concept may be relatively stable, it has also been demonstrated that situational contexts can lead people to think about themselves in ways that are at variance with their stable self-concept (Onorato & Turner, 2004). Also, stable self-conceptions may contain inconsistent elements, as people may have multiple self-conceptions with varied features and a particular self-concept may be activated at a particular time due to situational factors that may be at variance with other stable aspects of the self-concept (Fiske & Taylor, 2000; Onorato & Turner, 2004). It would therefore be possible for people who regard themselves as generally passive and law-abiding to become aggressive and non-compliant in the driving situation, and even to have different self-concepts activated by driving different types of vehicle.

## SUMMING UP THEORETICAL APPROACHES

At the heart of this review lies a question about whether the same person would drive a 4WD differently to another vehicle, since this might be a contributing factor to the 4WD crash problem. The theoretical approaches discussed above offer different means for understanding how this might happen, and therefore how it might be studied. The concepts of field of safe travel, territory and affordance tend to focus too much on the physical characteristics of the vehicle rather than the driver, although the concept of affordance has been extended to include individual driver-vehicle interactions. The cyborg concept is more explicit in placing weight on the vehicle-driver combination, but the concept has become diffuse and the breadth of its application is contested. Work on the emotional aspects of vehicles provides more promise, especially if the reflexive link is made between the image of a particular vehicle as the object of desire and purchase, and the self-image of the purchaser/driver and the consequent production of behaviour. Social cognition theories which allow for context-specific self-schemas provide a better-developed theoretical basis for this approach.

## EMPIRICAL EVIDENCE

Little research has been done in this area, and it tends to have a limited theoretical basis. However, there is some evidence that personal and vehicle characteristics can influence driver behaviour independently. In an exploration of the impact of various driver characteristics on driver behaviour, Krahe and Fenske (2002) explored the role of personality, age and power of car as predictors of aggressive driving behaviour. The study utilised the Hypermasculinity Inventory as a measure of macho personality, and self-reports of aggressive driving behaviour based on the Driver Behaviour Questionnaire. Information about participants' age, annual mileage, power of their vehicle and factors that influence their choice of car was also obtained.

Krahe and Fenske (2002) hypothesised that males endorsing the macho personality image would report more aggressive driving behaviour than men not endorsing the macho image, that aggressive driving behaviour would decrease with age, that aggressive driving behaviour would be shown more frequently by drivers of high-performance cars, and that macho personality would be reflected in the aspects males considered important in buying a car (for example, power, speed). In evidence of vehicle-type influencing driver behaviour independently of personality characteristics, the results of the study revealed that aggressive driving was significantly more common among younger drivers, drivers endorsing a macho personality image, and drivers owning high-performance cars. That is, in reference to the last-mentioned group (drivers owning high-performance cars), simply owning the vehicle was associated with aggressive driving, irrespective of personality or age. This implies that the vehicle itself influenced the behaviour of the driver. While this is an important finding, the relationship between the vehicle and driver in terms of theories of self-concepts was not articulated. The current paper seeks to investigate this relationship in order to provide insights into the relationship and provide a starting point for future research.

## PROPOSED METHODOLOGY

It is evident from the research and theories discussed that it is necessary to consider driver characteristics, vehicle characteristics, and the driver-vehicle interaction in order to better understand the factors that contribute to the high rate of 4WD crashes. With respect to the driver-vehicle interaction it is important to know the extent to which this is determined by the performance characteristics of the vehicle, and the extent to which it is determined by the driver's pursuit of different behaviours in a different vehicle, because of its image or other assumptions about it.

The research proposed here is part of a broader program of research in which a sample of drivers who are experienced in driving both sedans and 4WDs will drive both types of vehicles on a designated route. Both vehicles will be instrumented, allowing for an uninterrupted study of on-going driver behaviour, as well as the context in which the behaviours occur. The participants will be given a questionnaire based on existing surveys of driver behaviour, sensation seeking, personality and aggression. In addition, focus groups will be conducted to probe for differences in driving 4WDs and sedans which are not accounted for by the vehicles themselves or the more pervasive personality and behaviour factors.

By incorporating self-report data from driver surveys and objective data on actual driver behaviour, this methodology will provide an opportunity to investigate driver behaviour more thoroughly than would be possible with only one type of data. This will allow the detection and analysis of any discrepancies between self-report data and actual performance data. The comparison of driver behaviour in 4WD vehicles versus sedans will allow the exploration of differences in driver behaviour according to vehicle type. This will enable researchers to analyse the interaction between driver and vehicle, and also the differences in this relationship according to vehicle type.

The use of focus groups and/or in-depth interviews is necessary because of the uncertainty about the application of existing theories to the research. A sound qualitative approach to the focus groups and interviews should elicit issues and connections between experiences and attitudes which will shed light on how people perceive themselves when driving, and how this affects their behaviour.

There are limitations associated with the suggested methodology, such as an over-reliance on self-report data, as has been remarked by Dahlen, Martin, Ragan and Kuhlman (2005). It has been identified that there is a tendency for participants to engage in impression management and self-deception when completing traffic behaviour inventories, which may lead to the under-reporting of dangerous, illegal or socially inappropriate driving behaviour (Lajunen et al. 1997). The current study will validate the self-report data with actual driver-behaviour data as much as possible, and so it is hoped that any self-report bias will be minimised. Another possible limitation is that the participants will be aware of the recording devices and that their driving behaviour is under observation. The reactivity associated with presence of in-vehicle observer and recording devices may confound the results of the study. However, the use of the same driver in two different kinds of vehicle should eliminate a substantial amount of extraneous variability.

## IMPLICATIONS OF FUTURE RESEARCH

It is anticipated that the results of the current research study will have important implications for public health and education. In examining the differences in driver behaviour across vehicle types, the study will yield information that will enhance current knowledge of how driver behaviour may vary across certain vehicle types to produce specific driver behaviour patterns in 4WDs and sedans. This in turn may contribute to the development of driver behaviour questionnaires, and driver education programs, particularly where there may be current deficits in 4WD driver training. Ultimately it is hoped that this will contribute to decreasing the burden of road trauma-related harm within society.

## REFERENCES

- Altman, I. (1975). *The environment and social behaviour: Privacy, personal space, territory, crowding*. Monterey, CA: Brooks/Cole.
- Australian Associated Motor Insurers Limited (2005). Four-wheel-drive backlash: The great divide. *Media Release, 2*.
- Australian Transport Safety Bureau. (2002). *Four wheel drive crashes* (Monograph No. 11). Canberra: Australian Transport Safety Bureau.
- Baker, T. K., Falb, T., & Voas, R. (2003). Older women drivers: Fatal crashes in good conditions. *Journal of Safety Research, 34*(4), 399-405.
- Bradsher, K. (2002). *High and mighty: SUVs - the world's most dangerous vehicles and how they got that way*. New York: Public Affairs.
- Clark, A. (2003). *Natural-born cyborgs: Minds, technologies, and the future of human intelligence*. New York: Oxford University Press.
- Costall, A. (1995). Socializing affordances. *Theory and Psychology, 5*(4), 467-481.
- Dahlen, E. R., Martin, R. C., Ragan, K., & Kuhlman, M. M. (2005). Driver anger, sensation seeking, impulsiveness, and boredom proneness in the prediction of unsafe driving. *Accident Analysis and Prevention, 37*, 341-348.
- Dant, T. (2004). The driver-car. *Theory, Culture and Society, 21*(4/5), 61-79.
- Fildes, B., Kent, S., Lane, J., Lenard, J., & Vulcan, P. (1996). *Vehicle Occupant Protection: Four Wheel Drives, Utilities and Vans* (CR150). Canberra: FORS.
- Fiske, S. T., & Taylor, S. E. (1991). *Social Cognition*. New York: McGraw-Hill.
- Fraine, G. (2003). *At home on the road? Territoriality and Driver Behaviour*. Unpublished doctoral dissertation, Queensland University of Technology, Brisbane.
- Gibson, J. J. (1982). *Reasons for realism: selected essays of James J. Gibson*. Hillsdale, N.J.: L. Erlbaum.

- Haraway, D. (1991). *Simians, cyborgs and women: The reinvention of nature*. London: Free Association Books.
- Kihlstrom, J. F., & Cantor, N. (1984). Mental representations of the self. In L. Berkowitz (Ed.). *Advances in Experimental Social Psychology*, 17, 1-47.
- Krahe, B., Fenske, I. (2002). Predicting aggressive driving behavior: The role of macho personality, age, and power of car. *Aggressive Behavior*, 28, 21-29.
- Lajunen, T. Corry, A., Summala, H., & Hartley, L. (1997). Impression management and self-deception in traffic behaviour inventories. *Personality and Individual Differences*, 22(3), 341-353.
- Miles, D. E., & Johnson, G. L. (2003). Aggressive driving behaviors: Are there psychological and attitudinal predictors? *Transportation Research, Part F*, 6, 147-161.
- Onorato, R. S., & Turner, J. C. (2004). Fluidity in the self-concept: The shift from personal to social identity. *European Journal of Social Psychology*, 34, 257-278.
- Ruback, R. B., & Juieng, D. (1997). Territorial defense in parking lots: Retaliation against waiting drivers. *Journal of Applied Social Psychology*, 27, 821-834.
- Sheeran, P. & Orbell, S. Self schemas and the theory of planned behavior. *European Journal of Social Psychology*, 30(4), 533-550.
- Sheller, M. (2004). Automotive emotions: Feeling the car. *Theory, Culture and Society*, 21(4/5), 221-242.
- Urry, J. (2004). The 'system' of automobility. *Theory, Culture and Society*, 21(4/5), 25-39.
- Whitlock, F. A. (1971). *Death on the road: A study in social violence*. London: Tavistock.