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The uptake and expected impact of Electronic Stability Program (ESC) amongst the Australian passenger vehicle fleet

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Abstract

Electronic Stability Program (ESP) is an in-vehicle active control system which acts in loss of control situations to stabilise a vehicle. Several studies have shown the road safety benefits of ESP in international contexts. However, little consideration has been given for factors which may inhibit the uptake and potential effectiveness of ESP amongst the Australian vehicle fleet. This study highlights some of these potential factors including the rate of uptake of ESP into the Australian new vehicle market, purchasing patterns, driver behaviour, culture and the media. Conclusions are drawn in terms of future research directions and good public policy to maximise the effects of ESP in Australia.

Introduction

Electronic Stability Program (ESP) is an in-vehicle active control system which acts in loss of control situations to stabilise the vehicle. ESP technology has surpassed both Antilock Brake Systems (ABS) and traction control systems in enhancing the ability of in-vehicle technology to reduce the likelihood of unintended or unsafe vehicle behaviour. In simple terms, ESP uses a combination of systems and sensors to monitor four aspects of vehicle dynamics and intervene to prevent vehicle spin (loss of control) through selective braking and acceleration (Dang, 2004; van Zanten, 2002).

In recent years, the benefits of ESP technology have received much attention in the media and many road safety experts and advocates have recognised the likely benefits to road safety in Australia. Several international studies have evaluated the crash reduction abilities of ESP. Table 1 presents a brief summary of some of the related research and their findings. As can be seen, the crash reduction ability of ESP is well supported, with every study finding a substantial reduction, most notably for single vehicle crashes and those involving SUVs. While many of these research papers have reported the effectiveness of ESP in regards to single vehicle crashes where loss-of-control is present, estimates using real-world control have also suggested a clear reduction in multiple vehicle crashes as well (Farmer, 2004).

Research limitations

There are some points worth considering which may limit the real world applicability of some of this research, particularly to the Australian context. Much of the research is based on comparisons between the crash rates of specific vehicle models before and after the introduction of standard and optional ESP technology (for example, Aga & Okada, 2003; Dang, 2004; Page & Cuny, 2006). According to Farmer (2004), there is currently insufficient evidence to take into account differences in the effectiveness of ESP technologies between different manufacturers.

Most of these vehicles are of make and model considered to be luxury, high end, or performance in the Australian vehicle market such as Mercedez-Benz, BMW and Renault. Whilst these may be increasing in popularity amongst certain vehicle segments in Australia, these vehicle makes are still in the minority. In the Australian context it appears that ESC technology has been less prevalent amongst the most common selling makes and models. Encouragingly, manufacturers are gradually increasing the inclusion of the technology (and other in-vehicle safety features) in less expensive vehicles, though perhaps not quickly enough to maximise a timely road safety benefit in Australia. It should be noted that whilst these points may limit the generalisability of the research to the current Australian context, they do not cast doubt on the technology's potential to reduce crashes.

Table 1. Summary of Recent Research into Crash Reductions Attributable to ESP

Authors	**Region**	**Scope**	**Findings**
Dang (2004)	U.S. 5 States	1997-2002 Crash data	• Passenger Cars: 35% reduction in single vehicle crashes • SUVs: 67% reduction in single vehicle crashes
	U.S. All states	1997-2003 Fatal crash data	• Passenger Cars: 30% reduction in single vehicle crashes • SUVs: 63% reduction in single vehicle crashes
Lie, Tingvall, Krafft, & Kullgren (2006)	Sweden	1998-2004 Crash data	• All crashes excluding rear-end: 16.7 (± 9.3%) reduction • Serious/fatal crashes exluding rear end: 26.9 (± 13.9%)
Aga & Okada (2003)	Japan	1994-2000 (5 year vehicle life spans in this period) Crash data	• Single car accidents: 35% reduction • Head-on collisions: 30% reduction • Severe damage crash: 50% reduction • Moderate damage crash: 40% reduction • Casualty rate, single and head-on accidents: 35% reduction.
Farmer (2006)	U.S. 10 states	2001-2003 Crash data	• Passenger Cars: 33% reduction in single vehicle crashes • SUVs: 49% reduction in single vehicle crashes
	U.S. All states	2001-2004 Fatal crash data	• Passenger Cars: 53% reduction in single vehicle crashes 25% reduction for multi-vehicle crashes • SUVs: 59% reduction in single vehicle crashes 32-37% for multi-vehicle crashes
Page & Cuny (2006)	France	2000-2003	• 44% reduction in relative risk of being involved in an ESP-pertinent accident for ESP-equipped cars than comapred to other cars

Aim

This paper will investigate how some of these limitations and other factors may impact on the potential benefits of ESP in the Australian context. Based on this brief review, suggestions about maximising the crash-reduction potential of ESP in Australia and areas of focus for research will also be outlined.

Analysis of Queensland Crash Data

Method and definitions

An analysis of serious Queensland crash data for the years 2001-2005 was undertaken to identify the number of crashes which may be related to the effectiveness of ESP. Defining an 'ESP pertinent' situation, that is defining a crash situation in which ESP may have had an intervening effect, is difficult given data limitations. This potential for error is recognised by Page and Cuny (2006). For the purpose of the current study, DCA Groups (**D**efinition for **C**oding **A**ccidents) directly related to either loss of control or those thought to be related to vehicles losing control, such as those including reference to leaving straight or curved carriageways, have been designated as ESP pertinent for the current purpose. While the analyses presented in this paper are somewhat limited, they provide an indication of those crashes likely to receive the most benefit from ESP technology.

Only those crashes involving cars/station wagons, utility/panel vans and four-wheel-drives were considered, as the focus of the current paper is on the passenger fleet as opposed to heavy vehicles. This subset of data also disregards motorcycles and scooters.

Table 2 below presents information regarding the type of crash, defined by DCA Group, as recorded in Queensland crash data reported to authorities. As can be seen, several ESP pertinent crash types are well represented amongst serious crashes. Approximately 24.9% of serious crashes (including fatalities) occurring in Queensland during 2001-2005 could be classified as ESP pertinent. Approximately 33.7% of fatal crashes could be classified as ESP pertinent in the same period.

Table 2. Count of Serious Crashes by Severity and DCA group, Queensland, 2001-2005

		Crash Severity		
DCA Group		**Fatal**	**Hospitalisation**	**Total**
Intersection; from adjacent approaches		97	3371	3468
Rear-end		41	2891	2932
Off carriageway; on straight; hit object		158	2171	2329
Opposing vehicles; turning		55	2221	2276
Pedestrian		143	1577	1720
Head-on		254	1232	1486
Off carriageway; on curve; hit object		133	1307	1440
Vehicle leaving driveway		16	624	640
Off carriageway; on straight		28	512	540
Lane changes		8	531	539
Parallel lanes; turning		8	527	535
Out of control; on straight		33	420	453
Hit parked vehicle		10	373	383
Off carriageway; on curve		27	342	369
Out of control; on curve		29	323	352
Overtaking; same direction		10	154	164
U-turn		6	137	143
Hit animal		6	106	112
Train		5	25	30
Hit permanent obstruction on carriageway		0	5	5
Other		141	1937	2078
Total		**1208**	**20786**	**21994**
Total ESP Pertinent	**No.**	**408**	**5075**	**5483**
	%	**33.7**	**24.4**	**24.9**

Source: Queensland Transport Webcrash database, accessed 23 August 2007.
NB. Highlighted rows were classified as ESP pertinent.

Further analyses were also undertaken to investigate the co-occurring contributors which could affect the ability of ESP technology to prevent crashes. Whilst further research is needed to identify the interaction between the intervention of ESP technology and other behavioural, environmental and situational factors, such as alcohol, inattention, and fatigue, these analyses provide some preliminary insight into some of these potential confounds. Appendix 1 presents the distribution of particular circumstance groups within DCA groups, including the five most prevalent DCA group associated with each circumstance. As can be seen in Appendix 1, the top two most popular DCA groupings associated with crash circumstances involving alcohol, fatigue and speed, were "off carriageway; on straight; hit object" and "off carriageway; on curve; hit object". These DCA groupings were also identified as ESP pertinent. Of particular note in this appendix is that circumstances such as alcohol and fatigue, which could severely limit the opportunity for ESP to have an impact.

Appendix 2 presents serious crashes divided into age groups and gender, showing the top five DCA categories for each age and gender segment. The only group that appears to include a substantial amount of ESP pertinent groupings was amongst the 17-24 year age group for males. This is in line with previous research findings which have highlighted the particular overrepresentation of young males in such crashes (Tavris, Kuhn, & Layde, 2001).

Possible Confounding Factors and Future Directions

Purchasing patterns

As seen with the introduction of any new vehicle technology, ESP has not had immediate proliferation amongst the new vehicle market. Over the past 12-18 months ESP technologies (labelled with various names dependent upon the manufacturer) have become increasingly popular. However, most of these have been introduced into both larger vehicles and more expensive models. For example, often the technology is a standard feature of the six cylinder version of top selling large/medium cars, but not in the four cylinder version of the same model. Similar trends can be seen where luxury/premium models have standard ESP, but the lower priced models of the same cars do not. The Australian Transport Council have suggested including ESP technologies in Australian Design Standards for all new vehicles. In the US, the National Highway Traffic Safety Administration (NHTSA) recently mandated that by 2012, all new vehicles will have ESP.

Research has shown that the vehicle choices of young drivers are often influenced more by factors such as vehicle availability and price, with safety being a concern in only a very small proportion of such purchases (Ferguson, 2003). A review of recent literature regarding motor vehicle consumer perceptions by Spalding and King (2006) noted that although safety features are regularly considered in the purchase process, other factors like performance, reliability and available vehicle features may be considered relatively more important.

There is also qualitative research conducted across six European countries indicating a number of factors which can influence the adoption of active vehicle systems such as ESP. This specific report noted that the three most important factors in order were: expense of the vehicle’s purchase and servicing, uncertainty about the reliability of the vehicle and false feelings of security instilled by the technology (Eurobarometer, 2006a). New technologies are often expensive for early adopters, and there is a potential barrier that these are less likely to be adopted if they are perceived to not work as intended or their benefits misunderstood.

Another survey conducted on behalf of the European commission suggested that car manufacturers make a greater effort to not only be involved in outreach to promote the values of electronic safety systems, but also to offer the features on a wide price-range of cars to complement the information campaigns (eSafety Forum Working Group, 2007). Increasing the availability of ESP on low price-range vehicles is of particular interest as research suggests that young drivers are more likely to purchase less expensive vehicles and be involved in more loss of control crashes (eSafety Forum Working Group, 2007).

On the other hand, large companies and government fleets should, logically, not be constrained to the same degree as public consumers in managing the interaction between cost and vehicle safety (Dreyfus & Viscusi, 1995). Many state governments in Australia have introduced vehicle safety policies which give a purchase preference for vehicles fitted with ESP and other safety technologies/features. As with private vehicle purchasers, there are a number of constraints and economic considerations influencing fleet purchasing decisions. However, given that almost half of all new passenger vehicles sold in Australia each year are purchased for commercial or government use, Australian organisations are in a unique position to implement policy that could help to influence both manufacturer priorities and in the longer term, the safety of the national fleet. Further efforts may focus on developing strategies for encouraging fleets to devise and implement such policies, such as incentive schemes.

Behaviour, culture and the media

Whilst it is recognised that ESP will have positive road safety impacts by significantly reducing crash rates and the associated injuries and fatalities, it should also be recognised that there are a number of behavioural factors which contribute significantly towards serious crashes. In many cases, ESP may not have the opportunity to intervene due to a confounding effect of such behaviours. Examples include serious crashes involving fatigue, alcohol, inattention, speeding and inexperience. The interaction between risky behaviours such as these, road conditions and ESP intervention has not received significant attention in the research literature, if any. The cultural and geographical context of the research may also be an important factor to consider when applying international research to the Australian context.

Other psychological factors which have not received attention in the research literature, and are particularly pertinent in Australia, are driver attitudes and beliefs relating to the nature of arising technologies such as ESP. For example, will increasing awareness about active in-vehicle safety features (such as ESP) have positive impacts upon driver attitudes and behaviours about intervening technologies? How do negative attitudes confound the potential road safety benefits of such technologies?

The purchase and use of safer vehicles, or specific safety features, may not be valued amongst those groups of drivers who take part in deviant or risky driving. Research has suggested that there may be a potential link between risk taking whilst driving and choosing a vehicle that facilitates such behaviours (Horswill & Coster, 2002). This is an important consideration, given that in the US it has been suggested that vehicle manufacturers should provide an option to disable ESP in vehicles to allow circumstances such as driving on gravel or legal racetracks (National Highway Traffic Safety Administration, 2006). Amongst certain groups, such as young males with an interest in car culture, a sense of technical mastery both in terms of mechanical and driving ability is considered paramount (Walker, Butland, & Connell, 2000). For this subculture, features such as ESP may be considered more of an obstacle than a beneficial and desirable feature. Further research may also be needed to address the risk associated with such groups of drivers and strategies for maximising the effectiveness and acceptance of such technologies amongst these groups. Some European research and public consultation has outlined concerns that ESP technology may encourage drivers to take more risks due to an inflated sense of protection and intervention from in-vehicle technology (Eurobarometer, 2006b). Further research considering factors such as risk perceptions may also be beneficial.

Linder et al. (2007) note that along with little information on the learning and adaptation effects related to the installation of systems like ESP, drivers' level of knowledge about active safety systems like ESP is limited. However, indications from international comparisons of motor vehicle advertising content suggests that, as a nation, Australia is more likely to promote vehicle safety aspects than comparable nations such as the UK and the US (Steinhardt, Sheehan, & Schonfeld, In press). Indeed, industry bodies and manufacturers alike have been enthusiastic in their promotion of the inclusion of ESP in specific models and the vehicle fleet more generally (FCAI, 2006; Holden, 2006). Raising public awareness may be an integral part in communicating the benefits of such systems. Governments, manufacturers and industry bodies should continue to liaise with one another to release timely information that can aid consumers.

Conclusions

The maximisation of ESP and similar in-vehicle safety technologies in the Australian vehicle fleet will have significant beneficial effects and improve road safety in Australia. Whilst the currently available research may have some limitations, it is clear that ESP technology is a substantial leap forward for vehicle safety. There are however, a number of areas requiring further research, including extending the research to the Australian cultural and environmental context, comparing the effectiveness of different makes of ESP, considering the possible interactions between driver behaviours, attitudes, risk perceptions and the technology. From a policy perspective, there are further actions that governments and other organisations can take to help maximise the benefits of the technology, such as continued efforts to encourage manufacturers to include ESP in all of their models, incentives for fleets, public education, strategies for addressing problematic target groups, and further collaboration between researchers, manufacturers and governments.

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Appendix 1

Count of circumstances by DCA group (including top five ranking), Serious Crashes, Queensland, 2001-2005

DCA Group	Alcohol	Rk	Fatigue	Rk	Speed	Rk	Inexp.	Rk	Inatten.	Rk
Off carriageway; on straight; hit object	19.9%	(1)	31.9%	(1)	20.6%	(1)	12.6%	(3)	9.8%	(2)
Off carriageway; on curve; hit object	10.9%	(2)	15.7%	(2)	18.7%	(2)	7.6%	(5)	5.3%	(4)
Rear-end	10.1%	(3)	1.7%		7.1%	(4)	20.7%	(1)	47.9%	(1)
Intersection; from adjacent approaches	9.5%	(4)	0.5%		7.3%	(3)	13.5%	(2)	6.2%	(3)
Opposing vehicles; turning	5.8%	(5)	0.1%		3.0%		11.0%	(4)	3.2%	
Pedestrian	5.5%		0.0%		0.5%		3.1%		1.1%	
Head-on	5.0%		2.6%		6.0%	(5)	3.4%		2.9%	
Hit parked vehicle	4.7%		1.9%		3.3%		2.6%		4.5%	(5)
Off carriageway; on curve	2.9%		5.2%	(5)	4.5%		2.0%		1.5%	
Off carriageway; on straight	2.4%		10.6%	(3)	2.4%		2.0%		1.8%	
Out of control; on straight	2.2%		6.4%	(4)	2.1%		1.7%		1.2%	
Out of control; on curve	2.1%		4.4%		3.4%		1.6%		1.0%	
Lane changes	1.9%		0.4%		2.0%		1.9%		2.4%	
Vehicle leaving driveway	1.3%		0.1%		1.6%		2.9%		1.2%	
Parallel lanes; turning	1.3%		0.1%		0.8%		2.3%		1.7%	
Overtaking; same direction	0.5%		0.1%		0.6%		0.6%		0.3%	
U-turn	0.4%		0.0%		0.4%		0.6%		0.5%	
Hit animal	0.3%		0.0%		0.1%		0.5%		0.0%	
Train	0.1%		0.0%		0.1%		0.0%		0.1%	
Hit permanent obstruction on carriageway	0.0%		0.0%		0.0%		0.0%		0.0%	
Other	13.3%		18.1%		15.4%		9.4%		7.4%	
Total	**100.0%**		**100.0%**		**100.0%**		**100.0%**		**100.0%**	

Source: Queensland Transport Webcrash database, accessed 23 August 2007.
NB. Highlighted rows were classified as ESP pertinent.

Appendix 2

Five Most Frequently Attributed DCA Group codes by Age Group and Gender of Controller, Serious Crashes, Queensland, 2001-2005

Age Group	Male	%	Female	%
≤16	Pedestrian	38.7%	Pedestrian	50.2%
	Intersection; from adjacent approaches	17.0%	Intersection; from adjacent approaches	15.2%
	Vehicle leaving driveway	12.1%	Vehicle leaving driveway	10.9%
	Head-on	3.3%	Opposing vehicles; turning	2.7%
	Opposing vehicles; turning	3.0%	Off carriageway; on straight; hit object	2.6%
17-24	Intersection; from adjacent approaches	16.5%	Rear-end	19.9%
	Rear-end	15.5%	Intersection; from adjacent approaches	19.2%
	Opposing vehicles; turning	12.9%	Opposing vehicles; turning	14.5%
	Off carriageway; on straight; hit object	7.9%	Pedestrian	8.5%
	Pedestrian	7.9%	Head-on	6.9%
25-39	Rear-end	19.1%	Rear-end	22.6%
	Intersection; from adjacent approaches	18.1%	Intersection; from adjacent approaches	19.7%
	Opposing vehicles; turning	12.4%	Opposing vehicles; turning	13.2%
	Head-on	9.4%	Pedestrian	8.6%
	Pedestrian	8.2%	Head-on	8.1%
40-59	Rear-end	20.6%	Rear-end	22.9%
	Intersection; from adjacent approaches	20.5%	Intersection; from adjacent approaches	21.5%
	Opposing vehicles; turning	12.6%	Opposing vehicles; turning	13.4%
	Head-on	10.4%	Head-on	8.7%
	Pedestrian	7.8%	Pedestrian	8.1%
≥60	Intersection; from adjacent approaches	24.8%	Intersection; from adjacent approaches	27.0%
	Rear-end	15.5%	Rear-end	15.9%
	Opposing vehicles; turning	13.8%	Opposing vehicles; turning	15.5%
	Pedestrian	8.9%	Pedestrian	10.4%
	Head-on	8.0%	Head-on	7.4%

Source: Queensland Transport Webcrash database, accessed 23 August 2007.
NB. Highlighted rows were classified as ESP pertinent.