Perceptions of the prevalence of self-organising amongst Australian road safety stakeholders: a comparative perspective

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Abstract

The Australian road traffic fatality rate is slowing down at a much lower rate than that of comparable high income countries. This slow rate of reduction may be attributable to a wide range of causes such as deficits in coordination and low community engagement. However, it may also be due to the absence of understanding of systems thinking in road safety in Australia. This exploratory study aimed to investigate the perceptions of Australian stakeholders about the prevalence of a principle of the Dynamic Systems Theory, namely: self-organising. The results pointed to a need to decentralize the road traffic injury prevention efforts in Australia through a range of self-organising principles and the adoption of emergent rather than deliberate strategies.

Introduction

The challenge in Australia road safety management is not its ability to head towards zero (see Corben *et al.*, 2010; Gargett *et al*, 2011). The downward trajectory of fatality rates over the last forty-five years across all jurisdictions shows that Australia is heading closer to zero from a high of 30.4 road traffic fatalities per 100,000 in 1970 (OECD and ITF, 2013). Take the State of Western Australia, for instance. It has reduced its road toll in the last four decades by four-fold through the simultaneous deployment of evidence-based road safety measures and centralisation of effort (Dieter, 2011). Likewise, the Australian Capital Territory's fatality rate, at 3.40 (Australian Bureau of Statistics, 2010) is much closer to zero than any other jurisdiction. However, the challenge in Australia road safety management is the need to accelerate the rate of reduction of road traffic fatalities (Gargett *et al*, 2011). In fact, unless the rate of road traffic fatality reduction is accelerated in Australia, simple calculation shows that its largest State (Western Australia) will need (all things being equal) another 80 years to achieve a fatality rate of 0.52 per 100,000 population**.**

To avert this slow progress pattern and in some jurisdictions reverse the trend (McIntosh, 2013), Gargett *et al*. have called for trend breaking change (2011). Likewise, Dieter (2011) has proposed the notion of co-development of strategies and policies with enhanced levels of community engagement. Similarly, Johnston (2010) has called for a constituency for safety. Furthermore, May *et al* (2008) have attributed the slow rate of reduction to the "culture of speed" in Australia. Most importantly, citing Dekker (2011) in a comparison of system models, Salmon *et al*. have concluded that in terms of systems thinking, Australian road safety strategies tend to "… go 'down and in' rather than 'up and out' to understand and rectify road traffic crashes" (2012, p. 1834). The 'up' in this case represents "…Government, road authorities, road designers, societal norms, road design, road rules etc." (Salmon *et al*., 2012, p. 1834). The 'out' signifies a concern for factors other than 'frontline behaviour' or road users (Salmon *et al*., 2012, p. 1834). In the same vein, May *et al.* (2008) have observed the fact that " … Australian public policy on road safety management remains constrained in its thinking, focusing on technical or engineering solutions or on narrow approaches to changing driver behaviour" (p. 395). Moreover, others have recommended a redesign of the Australian transport safety system (May *et al*., 2011). This redesign is said to be achieved through holistic thinking (May *et al.* 2008).

Despite various attempts to hypothesise as to what may arrest the current rate reduction trend in Australia, little research has been conducted into the nature of the Australian adoption of a systems approach. Indeed, "… modern strategies do not include essential aspects of systems theory that describe relationships and interdependencies between key components." (Hughes *et al*., 2015, p. 271). In fact, it is not known how Australia fares against other comparable countries in terms of the adoption of theories which contribute to a dynamic, resilient and flexible system. One such theory is Dynamic Systems Theory, which explains how self-organised systems build flexibility, resilience and dynamism. The origins of self-organisation, although varied, have been traced to two features of systems capable of engendering emergent order in Dynamic Systems Theory.

Dynamic Systems Theory: Self-Organising

Self–organisation is made possible by experiential learning-oriented cultures (Zohar and Borkman, 1997). In these cultures, which thrive on knowledge, an executive consciousness is developed (Kayes and Kolb, 2005). This high level of team development represents collective growth (Knapp, 2010). Self-organising can be satisfactorily explained through five dynamic systems principles, namely: *circular causality*, *continuity*, *empowerment*, *self-augmenting* and *self-maintaining*.

The emergence of orderliness (in this case the reduced likelihood of road traffic crashes) can occur as a result of a combination of *self-augmenting* (positive) and *self-maintaining* (negative) feedback processes (Lewis, 2005). Positive feedback, or self-augmenting, is the vehicle for the emergence of new forms or behaviours, as new elements in the system are mobilized causing amplification of change (Lewis, 2005). Essentially, in a society where very few self-organizing institutions exist, change may remain localized. Negative feedback, on the other hand, or self–maintaining, restores orderliness as individual elements relinquish independence and embed into the system (Lewis, 2005). Self-maintaining is typical of inter-agency work patterns in emergencies, when a central, lead agency takes over whilst others surrender some of their powers. In essence, a system self-maintains when it centralizes under stress or as a contingency. In the Australian State of Western Australia, for instance, the adoption of self-maintaining was evident in the coordinating function attributed to the former Office of Road Safety (Dieter, 2011).

Continuity represents a system's ability to flexibly respond to stress with a repertoire of responses. This ability to bounce back emerges from the interaction of a system's underlying components (Rvachew and Bernhardt, 2010). In this sense, the simultaneous deployment of road safety interventions at various levels of society aids the maintenance of continuity.

Circular causality, as opposed to linear causality, identifies two parts of a system, which repeatedly impact upon each other, namely: a higher-order part (structures, hierarchies) and a lower-order part (processes, constituencies). A change in the higher order function alters the manner in which the lower-order parts of the same system function. In turn, this change in the lower-order interaction patterns gives rise to modifications in the way the higher–order functions (Lewis, 2005). This mutual dependency of cause (e.g. changes in the local processes) and effect (e.g. alterations in the global structure) diminishes the influence of the environment on a system's direction (Küppers, 1999), rendering it resilient.

The sustainability of self-organising requires *empowerment* (delegation of power) (Laihonen, 2006). *Empowerment* can be achieved through a stage-approach which aims at equipping a team with the skills to self-organise.

Whilst these principles of self-organising are often employed in the design of dynamic systems, they have not been investigated in a context of road transport systems (Young and Salmon, 2015). Accordingly, it is pertinent to address the following research questions: a) which principles of self-

organising are more frequently perceived as prevalent in the Australian road safety context?; and b) how does this Australian perception contrast with the perceptions of other comparable stakeholders?

Methods

Instrument Design

From the literature on Dynamic Systems Theory and its principle of self-organising, eleven statements were designed into an online, self-administered survey (Table 1). The statements in Table 1 were rated along a 7-point Likert scale from Always to Rarely.

Table 1: Description of Survey Variables

DST Concept	Proponent	Variable	Survey Statement
Experiential Learning	Zohar and Borkman, 1997	*Learning*	My community (i.e. clubs, schools, ethnic groups etc; not family or friends only) thrives in experiential learning, where its members are constantly looking for opportunities to learn from experience at a local level.
Executive Consciousness	Kayes and Kolb, 2005	*Advocacy*	My community has developed strong constituency (advocacy) for road safety issues at a local level
		Cohesion	My community is highly cohesive, with groups organizing around social issues at a local level.
		Interest Groups	There are a lot of interest groups in my community at a local level.
Voluntary Activities	Bacharach and Lawler, 1980	*Volunteering*	My community organises voluntary activities on a regular basis at a local level.
Self-Augmenting	Lewis, 2005	*Word Spread1*	My community is quick to spread the word about crash statistics.
		Word Spread2	When there are changes to the law or road rules, my community spreads the word very quickly about the changes.
Self-Maintaining		*Central Command*	If there is an emergency, there is a central command (either of local groups or local authorities) that is immediately formed at a local level.
Empowerment	Hut and Molleman, 1998	*Empowerment*	The local council may delegate the authority to organize behavior changing campaigns to road safety community groups at a local level.
Circular Causality	Googins and Rochlin, 2000	*Circular Causality*	If funding allocation is changed, the local Council interaction with community-based interest groups is altered with Council taking on the role of conducting behavior changing programs.
Continuity	Lewis, 2005	*Simultaneous*	In my country, road safety interventions (i.e. programs to reduce road traffic fatalities) are deployed at various levels (government, community, private sector etc.) simultaneously.

Sampling Techniques

Stratified sampling techniques were adopted in this study to identify the survey takers, including initial website search and snowballing to form a sampling frame, from which respondents were randomly selected. The inclusion criteria included job role related to road safety and familiarization with the coordination of road safety at a local level. In total, 558 e-mail invitations (with a link to the survey) were sent out to all the members of the sampling frame. Seventy-six (13.6%) respondents completed the survey. Of these, nearly half (48.7%) were Australians (Table 2). Canadians represented the second largest group at 15.8 per cent.

Table 2: Sample Characteristics

Country of Residence	*N*	%
Australia	37	48.7
Brazil	1	1.3
Bulgaria	1	1.3
Canada	12	15.8
Colombia	1	1.3
Finland	3	3.9
Ireland	1	1.3
Kenya	1	1.3
Malaysia	1	1.3
Netherlands	1	1.3
New Zealand	3	3.9
Sweden	2	2.6
Uganda	1	1.3
UK	5	6.6
Uruguay	1	1.3
USA	2	2.6
Zambia	2	2.6
Zimbabwe	1	1.3
Total	76	100.0

The *Global Status Report on Road Safety 2013* (WHO, 2013) was used to group respondents other than Australians under three income levels – high, middle and low. Due to the low numbers for the last two income levels, the analyses will focus predominately on high income countries as these compare to Australia.

Data Analysis

Cross-tabulation examinations were conducted to investigate the perceived prevalence of self-organising across the three country income levels. Significance testing employed Fisher's Exact Tests with a significance level of .05.

Results

This paper aimed to address two research questions. Firstly, it sought to identify the principles of self-organising perceived by Australian stakeholders to be prevalent in the Australian road transport system. In this respect, not one principle was thought to always be present (Table 3). *Continuity* (i.e. simultaneous deployment of road safety interventions at all levels) was most commonly selected as "Always" present, by nearly a quarter (24.3%) of the Australian survey takers. Furthermore, four principles were viewed as "Often" existing in Australian responses to road traffic crashes, namely: *experiential learning* (24.3%); *executive consciousness through advocacy* (21.6%); *executive consciousness through interest groups* (24.3%) and *self-maintaining through central command* (27%). In the case of the latter principle (self-maintaining through central command), almost half of the respondents (21.6% + 27.0%) perceived of it as existing with some frequency in Australian responses to road traffic crashes. However, two principles of self-organising did not seem to be

perceived as being frequently observed in Australian responses to road traffic crashes. These were self-augmenting through the spread of a central message and empowerment through delegation (Table 3).

Table 3: Prevalence of the principles of self-organising

	Percent selecting frequency of perceived prevalence			
Variable (number of valid responses)	**Always**	**Often**	**Sometimes**	**Rarely**
Learning (N=25)	5.4	24.3	24.3	13.5
Advocacy (N=20)	10.8	21.6	16.2	5.4
Cohesion (N=17)	2.7	16.2	16.2	10.8
Interest Groups (N=21)	10.8	24.3	13.5	8.1
Word Spread1 (N=23)	2.7	18.9	18.9	21.6
Word Spread2 (N=24)	5.4	16.2	18.9	24.3
Central Command (N=26)	21.6	27.0	8.1	13.5
Empowerment (N=22)	5.4	18.9	8.1	27.0
Circular Causality (N=20)	2.7	13.5	21.6	16.2
Simultaneous (N=22)	24.3	16.2	10.8	8.1

Note: SPSS only outputs options selected by respondents (or options with values > 0). Frequency adverbs not selected by the respondents (or with values > 0) are not shown.

Secondly, this paper aimed to compare the perceptions of the Australian respondents to those of comparable stakeholders. In this regard, there were no significant differences (p <.05) between the Australian respondents and others on all but one principle of self-organising: only *self-maintaining through central command* (p = .02) appeared to set Australians apart. In this sense, Australian stakeholders were slightly more likely to perceive this principle to be "always" or "often" in evidence in the responses to road traffic crashes (Table 4) when compared to high income country respondents. Both Australian and high income country respondents seemed to perceive *self-maintaining through central command* far more often than middle and low income country survey takers, thus suggesting that this principle is typical of countries comparable to Australia.

Table 4: Central command (frequency)

	Country of residency				
	Australia	**High Income**	**Middle Income**	**Low Income**	**Total**
Always	8	7	0	0	15
Often	10	5	0	1	16
Sometimes	3	4	3	2	12
Rarely	5	1	3	0	9
Unknown	11	12	1	0	24
Total	37	29	7	3	76

When asked how fast the setup of central command occurred in emergencies related to road traffic crashes in their communities (Table 5), the respondents from high income countries were slightly more likely than the Australians to perceive this to occur quickly (p<.01). Australians were twice as likely as high income country respondents to view the speed of the establishment of central command in road traffic crashes as slow.

Table 5: Central command setup (speed of adoption)

	Country of residency				
	Australia	**High Income**	**Low Income**	**Middle Income**	**Total**
Quickly	21	23	1	1	46
Neither	9	4	1	1	15
Slowly	7	2	1	5	15
Total	37	29	3	7	76

Discussion

Significance

The results suggest that across the income divide for countries there are no significant statistical differences in the perceived application of Dynamic Systems Theory constructs except for *self-maintaining through centralisation of command*. In this sense, the Australian road transport system is perceived to self-maintain slightly more than other comparable high income countries such as Sweden, Canada, the UK, New Zealand, the Netherlands, Finland and Ireland. Given the State-based management of road safety in Australia, such centralisation presumably applies at State rather than national level. Importantly, the establishment of local level central command in Australia in response to a road traffic crash emergency does not seem to be perceived to be as quick as in other comparable countries.

It is equally apparent that the Australian respondents do not appear to perceive the Australian road transport system to self-augment or empower constituent system parts e.g. community groups. In this sense, it may be hypothesised that there might be little spread of a central message in road safety in Australia. The consequence of a lack of self-augmenting may include a reduced likelihood of the existence of public approval for system reforms, especially changes related to speed, alcohol, drugs and mobile telephone use (see Canoquena and King, under review). For this and other reasons such as high levels of distracted driving (Young and Salmon, 2015), the average car occupant fatalities (2007-2011) in Australia are amongst the highest in the OECD (OECD and ITF, 2013).

In essence, the road safety system in Australia appears to be too centralised, unlike other comparable countries. In the UK, for instance, innovative plans by associations such as TyreSafe typify executive consciousness of interest groups or communities of practice. Over holiday periods, TyreSafe, a knowledge-oriented institution reaches out to its members and issues warnings and advice. The emergent order constitutes the adherence by drivers to the counsel in the way of voluntary periodical checks of the air pressure and status of tyres.

The significance of these findings may be said to be twofold. Firstly, this new knowledge about the Australian road safety system has the potential to identify areas for improvement (Hughes *et al.*, 2015). For instance, it is known that continuity alone can be responsible for 20-30% fatality rate reduction (Corben *et al.*, 2010). In fact, Graham (2013) has attributed 50% of the reduction in the number of teenage drink-driving offences to a package of measures (i.e. continuity) in a country often compared to Australia - i.e. New Zealand. These interventions included regulatory changes, Police enforcement, mass media advertising, public attitude surveys and crash data reports (Graham, 2013). Nonetheless, less than half the respondents in this study perceived continuity to be prevalent in the Australian context. Therefore, due to the effectiveness rate attributed to continuity, it ought to feature more prominently in Australian road safety management.

Likewise, the fact that there is '… substantial rhetoric … about the desirability of active involvement of community members …' in traffic safety policy development (Howat *et al.*, 2001, p. 267), it is surprising that nearly a quarter of the Australian respondents perceived self-augmenting to rarely be prevalent. Elsewhere, self-augmenting has been widespread (see Appendix).

Secondly, the results in this study point to the slow uptake of self-maintaining in Australia when it is most required (i.e. coordination of emergencies). Whilst McIntosh (2013) and Deller (2010) have identified deficits in the coordination of effort to explain the slow update of coordinated responses (i.e. self-maintaining), the issue with Australia does not appear to be the mere existence of deficits in coordination per se as these are unlikely to impact directly on fatality rates. Other issues may be at play. For instance, the fact that States and Territories manage and are accountable for road safety in Australia (Job and Cook, 2012) should make self-maintaining more effective in Australia. However, this does not seem to be the case because it has not generated an emergent order. In other words, self-maintaining in Australia is not restoring orderliness. This might be explained by the fact that Australia is adopting *deliberate* (hence the delay in the adoption of self-maintaining) as opposed to *emergent* strategies (Mintzberg and Waters, 1985). In this sense, intentions or goals ought not to direct the course of action (Mintzberg and Waters, 1985). Rather, the interaction between the environment and the parts of a system shape the course of action (Mintzberg and Waters, 1985). This means working more from an emergent order perspective as opposed to deliberately planned strategies.

In essence, Australia will need to adopt self-augmenting strategies to spread scientific knowledge about contributing risk factors to road traffic crashes within the community and empowerment of community groups to redesign its cultural arrangements (May *et al*., 2008; Johnston, 2010).

Limitations

This study is not without limitations. The relevant sample was relatively small (37 for Australia and 29 for high income countries). Future research ought to broaden the comparison and engage a larger number of respondents from both Australia and a much wider range of OECD countries, especially high performers such as Iceland and Germany (OECD and ITF, 2013). This comparison is useful to help explain the existence of the wide gap amongst OECD countries in terms of road traffic fatality rates from a systems thinking perspective (OECD and ITF, 2013).

Most importantly, the missing values in the Australian responses limited the ability of the study to be definitive in its generalisations about the Australian stakeholders, thus the use of tentative language in the discussion and conclusion.

Conclusion

Australia appears to be centralising road traffic injury prevention more than it needs to. Whilst the centralisation of command through a lead agency is often called for by the WHO and the UN, adopting this inflexibly may not suit Australia as it wrestles with the need for grass-root cultural shifts to modify road user attitudes. In this sense, the Australian road transport system should be more flexible and dynamic so as to only quickly self-maintain when is required such as in road traffic crashes. When it does not need to self-maintain, it should self-augment and spread a core evidence-based message about injury prevention; empower community groups; and allow local level structures to impact on and shape the course of action. Essentially, Australia will be best served by viewing the road transport system as one component of a much broader, dynamic and unpredictable system in its pursuit to arrest the slow rate of reduction in road traffic fatalities through attitudinal changes.

Greater gains in road traffic injury reduction may arise from decentralised yet coordinated responses to road traffic risk factors. This decentralisation within a coordinated framework will be achieved through a systems theory such as Dynamic Systems Theory, which focuses on the interplay amongst the system components (Young and Salmon, 2015) and provides a holistic appraisal of the factors contributing to road traffic crashes (Scott-Parker *et al.*, 2015).

Future research into the road transport system in Australia from a systems perspective should seek to identify actual gains in the adoption of the principles of self-organising. In this respect, it is pertinent to investigate the magnitude of the impact of self-maintaining, self-augmenting, circular causality or empowerment upon a country's ability to reduce its death toll.

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Appendix: Institutions Contributing to Self-Augmenting in Road Safety outside Australia

- Royal Society for the Prevention of Accidents (UK)
- RoadPeace (UK)
- Community Road Safety Councils (UK)
- Associazione Italiana Familiari e Vittime della Strada (Italy)
- Association Nationale des Victimes de la Route (Luxembourg)
- Safe Kids (NZ)
- Congressional Caucus on Global Road Safety (USA)
- Mothers Against Drinking Driving (USA)
- National Society for Road Safety (Sweden)
- Institute for Road Safety Research (Netherlands)