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# Situation awareness in young novice ambulance drivers: So much more than driving

B. Scott-Parker[a,b,c,*], M. Curran[b], K. Rune[b], W. Lord[d], P.M. Salmon[e]

[a] Adolescent Risk Research Unit (ARRU), Sunshine Coast Mind and Neuroscience – Thompson Institute, University of the Sunshine Coast, Australia
[b] School of Social Sciences, Faculty of Arts, Business, and Law, University of the Sunshine Coast, Queensland, Australia
[c] Sustainability Research Centre (SRC), Faculty of Arts, Business, and Law, University of the Sunshine Coast, Queensland, Australia
[d] Paramedic Sciences, Faculty of Science, Health, Education, and Engineering, University of the Sunshine Coast, Queensland, Australia
[e] Centre for Human Factors and Sociotechnical Systems, University of the Sunshine Coast, Queensland, Australia

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ABSTRACT

*Background:* The intractable problem of young novice driver road crashes, and the critical role of emergency responders in attending road crashes, is well-recognised as is the critical role of situation awareness skills (SAS, ie. an understanding of 'what is going on' in a specific situation). Emergency responders may be young novice drivers *and* young novice ambulance drivers, therefore SAS will be required for safe road use. This project explored the SA demands upon young novice ambulance drivers ('drivers') in Queensland, Australia.

*Method:* A synthesis of literature regarding SAS relevant to drivers was followed by a hierarchical task analysis (HTA) and a perceptual cycle model (PCM) to explicate the complex emergency ambulance driver dispatch and response system and SAS requirements.

*Results:* Inadequate SA is a likely contributor to risks for drivers, patients, and other road users. The HTA revealed a plethora of opportunities for inadequate SAS to negatively impact safety. The PCM highlighted complex environmental information modifies driver 'world' schema (eg., medical procedures) which in turn directs their actions (eg., attending to radio/pager) that in a cyclical manner relies upon complex environmental information, etcetera.

*Discussion and concluding remarks:* Emergency responder SA appears quite different to 'ordinary drivers', suggesting well-developed road-related schema are required *before* young novice ambulance drivers are behind the wheel in a highly-emotive, time-critical situation. Drivers are not simply 'driving'; they are engaged in a breadth of tasks *while* driving (e.g., accessing dynamic case details) which, for safety, rely upon adequate SAS, therefore training programs should target SAS development.

## 1. Introduction

Paramedic emergency medical service (EMS) personnel are a critical component of the Australian health system; they respond to over three million emergency calls annually and provide pre-hospital emergency care and specialised transportation (Joyce et al., 2009; Maguire, 2014). Paramedic EMS personnel also play an important role in disaster management, and in health prevention and intervention programs (Maguire, 2014). Working in and out of hospital settings presents many challenges to providing safe and high quality care, particularly when human resources are limited and environmental circumstances are dynamic and unpredictable (Brice, 2012). According to recent data, Australian EMS personnel have a six times' higher risk of fatalities than the national average, with more than 85% of fatalities caused by transportation-related incidents involving paramedics driving ambulances (Maguire, 2011, 2014; Safe Work Australia, 2007). To further illustrate, Maguire (2014) found that five out of eight fatal occupational injuries in EMS were caused by vehicle crashes, with one paramedic killed and a further 30 paramedics injured in transportation-related incidents every two years in Australia. Moreover, the rate of serious workplace injuries are seven times higher in paramedics compared to the national average, with vehicle crashes comprising 2% (150 cases) of all serious workers compensation among paramedics and 62.5% (5 cases) of all fatalities, making it one of the most risky professions in Australia (Maguire, 2014). It is noteworthy also that EMS road safety is not a uniquely-Australian concern, with deaths and serious injuries in

* Corresponding author at: Adolescent Risk Research Unit, Sunshine Coast Mind and Neuroscience – Thompson Institute University of the Sunshine Coast, 12 Innovation Parkway, Birtinya, Queensland 4575, Australia.
*E-mail address:* bscottpa@usc.edu.au (B. Scott-Parker).

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road crashes a considerable road safety and workplace safety concern in all motorised jurisdictions (e.g., in the US: Becker et al., 2003; Custalow and Gravitz, 2004; Drucker et al., 2013; Saunders and Heye, 1994).

Currently in Australia there is no strategic national approach – such as driver training and driver education for new recruits – to reduce road crashes involving an ambulance driven by a paramedic (Joyce et al., 2009). Driving standards are not included in the Paramedic Professional Competency Standards which form the foundation of current education, training and practice for operational service delivery in Australia and New Zealand (Council of Ambulance Authorities, 2013). These standards are developed by the industry and are used to accredit entry-to-practice programs. As such, driving or key skills for safe driving, such as situation awareness (SA) (Salmon et al., 2014), are not normally included in undergraduate programs that are critical for preparing paramedics for practice. Instead, the ambulance service of each individual Australian state and territory (Australia comprises six states and two territories) typically includes a brief module of driver training within the organisational induction process (Council of Ambulance Authorities, 2013). In addition, recent changes to the educational pathway to become a paramedic in Australia, from an in-house post-employment model to a university based pre-employment model, has meant that new recruits are now younger (e.g., 24 years versus 27 years on average) and may be in charge of driving an ambulance while still a novice driver (Joyce et al., 2009).

Regarding novice drivers, in Australia as in a number of other motorised jurisdictions such as the US, Canada and New Zealand, all new (i.e., 'novice') drivers must progress through a sequenced graduated driver licensing (GDL) program of increasing driving privileges in which driving practice is obtained under conditions of increasing exposure to driving risk (Scott-Parker and Rune, 2016). In the Queensland context, a learner licence can be gained at age 16 years after passing a driving theory test, and must be held for a minimum of 12 months. After submission of a logbook with 100 h of certified supervised driving practice, the learner driver may undertake the practical driving assessment, and if successful, proceed to independent (provisional/intermediate) licensure (see Scott-Parker et al., 2011 for an overview of Queensland's GDL). Perhaps unsurprisingly given the compulsory presence of an experienced driver as the supervisor, the learner phase is associated with the least risk of crash: in Queensland in 2016, learner drivers were involved in 1.2% of all road fatalities (TMR, 2017) despite comprising 5.0% of the licensed population (TMR, 2016). In stark contrast, the provisional (intermediate) phase is associated with the greatest risk of crash: in Queensland in 2016, provisional drivers were involved in 14.3% of all road fatalities (TMR, 2017), despite comprising 5.8% of the licensed population (TMR, 2016). Moreover, novice drivers tend to be *younger* drivers: 90.1% of drivers with a provisional 1 or provisional 2 (the second provisional licence within this novice phase) licence in Queensland in 2016 were aged 17–24 years (TMR, 2016), with 24.6% of fatalities in 2016 involving a young driver aged 17–24 years (TMR, 2017) despite them comprising only 12.7% of Queensland's licensed population (TMR, 2016). Again these road crash outcomes are not unique to the Australian context, with the persistent overrepresentation of young novice drivers in road crashes widely-recognised as an intractableglobal road safety problem (e.g., in developing nations such as Colombia, Scott-Parker and Oviedo-Trespalacios, 2017; in developed nations such as Sweden, Hasselberg and Laflamme, 2009; New Zealand, Weiss et al., 2014; and the US, Curry et al., 2015). It is also notable that a trend of delayed licensure appears evident in some jurisdictions such as the US in which young drivers are older at first licensure (e.g., see Sivak and Shoettle, 2016).

Despite the clearly inherent danger of having *young novice drivers* behind the wheel during emergency call-outs, surprisingly little research has investigated the impact that a lack of experience in driving – let alone driving an ambulance – under emergency response conditions, while a *young novice paramedic*, has upon road crashes. A study which examined emergency vehicle collisions in the United States (US) between 1989 and 1997 revealed that most ambulance crashes involved male drivers (82%) and in 37% of collisions the driver had less than 3 years of driving experience. While these results may reflect that the paramedic workforce in the US is predominantly male (> 70%), it does suggest that the risk of a road crash is accentuated in younger paramedic drivers with less driving experience as they may be more likely to engage in reckless driving and may overestimate their driving abilities (Custalow and Gravitz, 2004). Further, in 71% of incidents the responsible driver had a history of multiple crashes, with 20% of drivers having a second collision within a year of the first collision (Custalow and Gravitz, 2004). Similarly, using a national sample of 1297 EMS professionals in the US, Studnek and Fernandez (2008) found that over a 12 month period, 111 (8.6%) EMS professionals were involved in an ambulance crash, with the chance of being in a road crash significantly higher for the youngest paramedics. Such findings are consistent with the pervasive young driver crash statistics which persistently reveal that novice drivers, and in particular young inexperienced male drivers, remain overrepresented in road crashes and fatalities (e.g., BITRE, 2016; CDC, 2017; Department for Transport, 2015).

## 2. Study aim

The aim of this paper is to present the findings of a two-part study. Part One comprises a synthesis of the situation awareness literature relevant to young novice ambulance driver road safety, including a synthesis of recent research by the authors, and situation awareness-specific, peer-reviewed, and thus relevant literature, the knowledge of which had been gleaned through their respective research experience. Part Two comprises a hierarchical task analysis to describe the ambulance driving task in a manner which would enable further analysis of the situation awareness requirements during ambulance driving via a perceptual cycle model (PCM), based on the collective knowledge and research experience of the authors. The paper closes with a general discussion regarding risks specific to young novice ambulance drivers.

## 3. Part one. Situation awareness and the road safety of the young novice driver

### 3.1. What is situation awareness?

Situation awareness, as defined by Endsley (1995), is "the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future" (p. 36), thus referring to an individual's understanding of *what is going on* in a specific situation. SA skills (SAS) are a key component of successful management of complex, dynamic situations and have long been acknowledged as a critical safety element within aviation (e.g., Sorensen et al., 2010), air traffic control (e.g., Kaber and Endsley, 2004), and the military (e.g., Salmon et al., 2010). More recently, the important role of SAS in safe driving has been recognised (e.g., Salmon et al., 2014). While many factors contribute to the increased risk posed by young novice emergency vehicle drivers (e.g., personality and mood factors, intentional risky driving behaviour, Scott-Parker et al., 2012, 2013), inadequate SAS is likely an important contributor, particularly when driving under highly emotionally-charged situations, oft at high speed. Recent studies undertaken by the authors have shown key differences in SAS between novice and more experienced drivers (e.g., Salmon et al., 2013a,b,c; Young et al., 2015), both during day-time (Scott-Parker et al., 2016) and night-time (Scott-Parker and Caldwell, 2017) driving. Indeed, the finding that experienced emergency responders have been found to have greater hazard perception and response skills than non-emergency drivers with comparable driving experience (Johnston and Scialfa, 2016) suggests that a breadth of SAS play an essential on-road driver and passenger safety role for both paramedics and their patients.

Recent research has also identified the key role that driving