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From Cradle to Rocking Chair: Road User Safety Investigation Framework

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ABSTRACT

The article proposes road users safety investigation (RUSI) framework. With the main idea to demote over-focusing of on-road behaviours, RUSI broadens up the scope of road users' involvement in a traffic system. Taking insights from developmental framework as its basis, from birth to death; the framework elaborates how road users enter, interact within, and exit the traffic system. Incorporating psychosocial theory of human development, RUSI framework offers a map to mark where are the gaps for interventions, and where are the potential opportunities for future investigation on road users safety.

1. Introduction

Road crashes contribute to nearly 1.25 million deaths around the globe each year [18]. Consequently, United Nation General Assembly has adopted resolution 64/2551 declaring 2011 – 2020 the Decade of Action (DOA) for road safety with the aim to reduce the forecasted road fatalities (World Health Organisation, n.d.). In turn, Malaysian government has adapted the resolution into its 2014 – 2020 national road safety plan clutching on the same five pillars. Royal Malaysia Police (PDRM) reported the number of fatalities on Malaysian road network in 2016 to be 7,152, a 446 increase from the previous year. This worrying increasing trend was evident since the past four decades.

The guiding principle and framework for DOA's action plan is safe system approach that acknowledges gullibility of human to err and thus emphasizes on systemic responsibility to accommodate the mistakes to reduce its impacts. In simpler words, crash may happen but it should not lead to any serious injury or death. Considering the vulnerability of human; in particular the amount of kinetic energy a human body can withstand during crash, the approach, therefore, focuses on shifting a major share of safety responsibility from not just road users but also to

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designers of the transport system as well. The action plan positions five pillars to support the systemic approach.

Pillar 4 of DOA emphasises on road user safety over-focuses on on-road related behaviours. Consequently, the interventions and related activities are driven to address only behaviours while people are driving. Focusing exclusively on on-road interventions may provide an immediate effect; however, it can be short-term and sporadic depending the time and place of the intervention. Enforcement, for example, is an on-road intervention. It is very effective in curbing bad driving behaviours, especially when the punishment is heavy and immediate. Enforcers, however, cannot be everywhere for all the time, making this a costly intervention to manage road users. Hence, over relying on enforcement activities is not sustainable.

In contrast, broadening the scope of the pillar would open up for more fundamental interventions targeting the causes instead of symptoms. Of course effect immediacy when addressing the cause is normally lesser than addressing the symptom, but this approach provides longer-term solution and more sustainable. Education is an example of this kind of intervention. It takes longer time for the effect of education to manifest, but when it does, it tends to be resilient to external inconsistencies and temptations.

Therefore, our suggestion is to broaden the scope of investigation (not to limit to either side): this is because on-road behaviours are not necessarily manifestation or response from on-road events during that particular driving time. More likely, it is the resultant of any off-road event prior to driving [11,17]. To guide the scope broadening (e.g. how broad?), a framework is deemed necessary. Present article aims to provide the framework: road user (RU) safety investigation framework.

2. Road Users in Malaysia

RUs are people within the population of a country. Depending on the age and functionality, they use roads with different roles to fulfil the needs of mobility. While the majority of active RUs are from the middle section of a population (i.e. licensing age until adults), the remaining others use the roads passively. The active RUs are usually with high sense of agency to control the vehicles on the roads. In contrast, the passive RUs may not have direct agency to control the vehicles, but still they move significantly from a point to another within the system to influence it in certain ways. Therefore, to understand the overview of RUs in Malaysia, is to first understand its population characteristics. Figure 1 provides a glance of Malaysian population in 2014 by age and gender.

In general, both genders have the same trend. Males, however, are more dominant at the younger age groups whereas females concur age of 60 and beyond. The shape of the plot indicates that young people make the majority of the population. Most of them are in the age bracket of 15 to 34 years old, followed by their younger counterparts of 0 to 14 years old. The trend gradually decreases as the age increases.

In Malaysia, the licensing ages for riding and driving are 16 and 17 years old, respectively. Synthesis of this legislation and the population trend reveals one of the characteristics of RUs in Malaysia: they are mostly teenagers and young adults. With an assumption that people normally stop driving by the age of 70, 53.6% of the RUs are in the age bracket of 15 to 34. Department of Statistics Malaysia forecasted a change to this trend in 2020 until 2040 (see Fig. 2).

In the next 23 years from the year this article is written, the projected populations will be 41.5 million. Males will dominate with 103 of them for every 100 of their counterparts. From the shape of the population, Malaysian RUs will shift from mostly being younger to older (see Figure 2).

Relative to the red lines (2014 profile), purple lines (2040 profile) extended to the right extensively from the age of 35 and above. This trend is less evident in 2020, but noticeable beginning 2030.

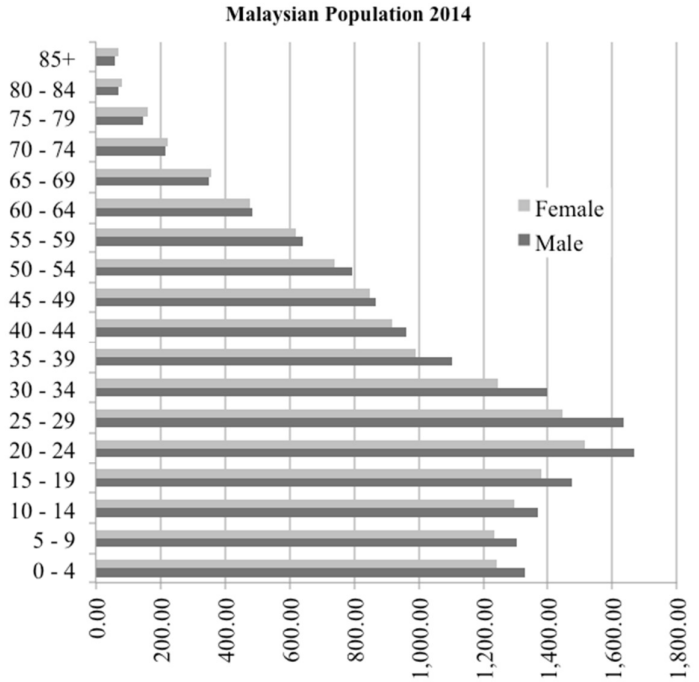

Fig. 1. Malaysian populations of 2014 (Department of Statistics, Malaysia)

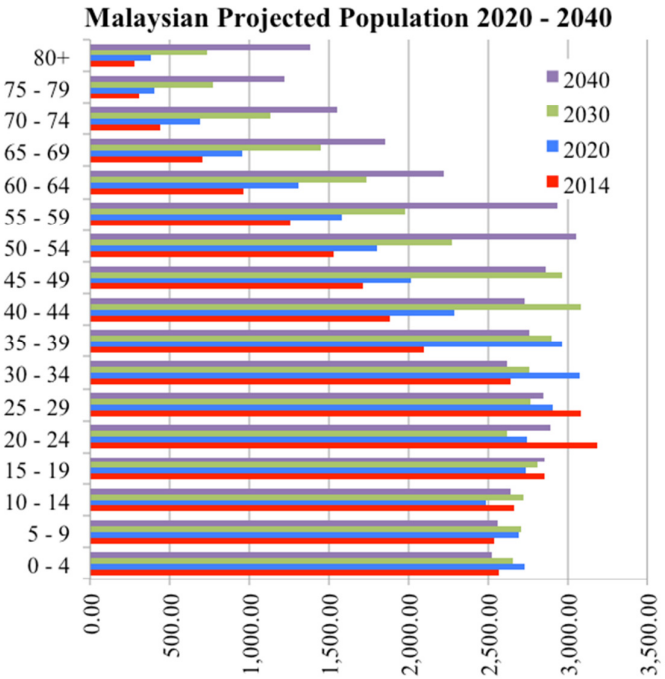

Fig. 2. Malaysia population projections 2010–2040 (Department of Statistics Malaysia)

Considering the age bracket of 15 to 34: They amounts to 40.1% in 2030, a reduction of 13.5% from 2014 profile. While this is a huge change, this group is projected to regain back their magnitude in 2040 (51.2%, assuming driving age limit of 70). Concurrently, the trend for older age RUs moves at the same rate and direction. Nevertheless, in the nearer future (2020), population profile is relatively in proportion with 2014 profile, albeit different magnitude especially within the age bracket of 35 to 39 years old.

3. Road User Safety Investigation (RUSI) Framework

Being human, the beginning and the end of every RU is the same: from birth to death. What makes each and every RU differ is what they do within this time frame, and the way they reach death. Figure 3 illustrates this. Central to the framework is traffic system. As a continuous cycle, traffic system has three entry points (black dots marked with 'i') for RU to join; and also three exit points (black dots marked with 'o').

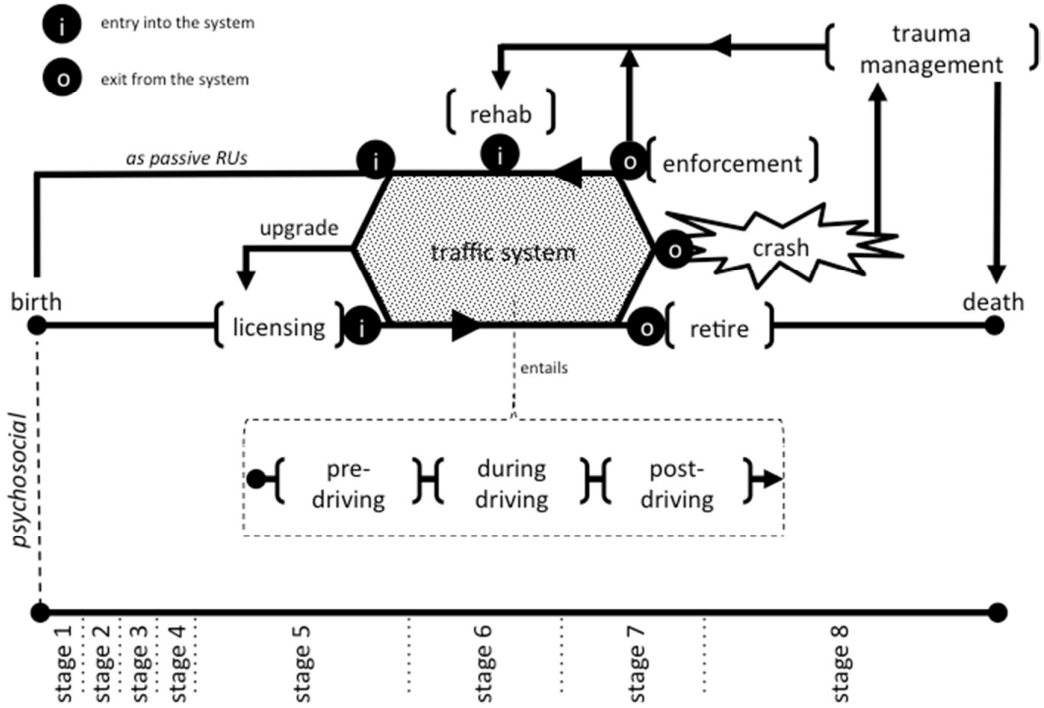

Fig. 3. RUSI Framework

The first entry point for any person to join the system is as passive RUs. Even a one-day old baby is eligible to becoming a passive RU when he or she rides in a vehicle as a passenger. Of course he or she has no direct control towards the behaviour of the vehicle, but indirectly it influences the way a driver operates the vehicle within the system.

The second entry point is of course via the licensing system. In Malaysia, licensing system falls under the jurisdiction of Jabatan Pengangkutan Jalan (Road Transport Department), a department within the Ministry of Transport. Malaysian licensing process entails four stages; beginning with training, testing, and if passed, drivers continue with probationary license before obtaining the competent driving license. Many improvements have been made to the driving system [14] to ensure only good RUs enter the system. After all, "ikan seekor rosakkan ikan setajau. ". RUs who pass through this entry point are normally active – driving within the traffic system. Of course,

entering the system as active RUs indicates a substantial control over any mode of transportation. In Malaysia, the most popular mode of transport is private car or motorcycle. Consequently, vehicle purchasing preference is significant for investigation [10].

RUs travel within the system to fulfil needs, either personal, social, or work related. These connections contribute not only healthy society but also encourage growth of the economy. When traveling within the system, RUs face three stages: before driving, during driving, and after driving. The second stage is when they interact with each other and the environments. They share the same roads, and follow the same rules. While they are expected to maintain the stability and harmony of the system by communicating and respecting each other, some RUs, sometimes, bend the rules for individualistic gain – short cut to obtain their needs. These bad behaviours upset the system and very disruptive to its effectiveness. To combat this, the enforcement agencies, among others, play a big role.

An element of enforcement system in Malaysia is Automated Awareness Safety System (AWAS) – an integration of the Automated Enforcement System (AES) cameras and Demerit Points System (KEJARA). Drivers who are found guilty of traffic offences will incur demerit points based on the nature of the offence committed. Upon reaching certain threshold, their licenses will be suspended for certain period of time, exiting the system temporarily (see Fig. 3).

Some RUs successfully negotiate within the system and survive until their retirement, i.e. when they do not need to travel anymore. In this case, they exit the system voluntarily and face death naturally. Some others, however, exit the system involuntarily through crash experience. When crashes happen, the possible outcomes are that the involved RUs either facing death, or sustaining injuries. While the former means a permanent exit of the system, the latter may not be. As injured RUs receive treatments, both physically and physiologically, they can re-join the system through the third entry point. Of course their competency and fit to drive are the noteworthy safety issues.

4. RUSI Driven Intervention

The safe system approach encourages collective responsibility. While engineering based intervention, in particular to the vehicles and the road environments, are more effective in preventing both injury and crash, human based interventions can only focuses on preventing crash.

The intervention avenues based on RUSI are wide: from birth until they permanently exit the traffic system (i.e. including off road situation); accommodating both schools of thoughts – either addressing symptoms or causes. Unlike the quick-wins (immediate) based interventions, fundamental driven interventions demand understanding of the behaviour formation mechanism and contributing factors beforehand.

Many studies have determined influencing factors for RUs' behaviours; driving anger and aggression [7], driving experience, training and hazard perception [1,2], marital status and tailgating [1], violations and errors [4], inter alia. Further, there are also theories proposed as guidance. Examples are, theory of planned behaviour [3], protection motivation theory [16], and health belief model [13]. These theories, however, explain certain behaviour as a snapshot across time; whereas there are studies that suggest behaviours during older age are the manifestations of childhood experience [5,6,15]. To the best of authors' knowledge, the attempt to use developmental theories to explain behaviour on road is not widely available.

Therefore, in line with RUSI framework, we propose for any review, interventions, or studies to refer to psychosocial theory [8,9] as potential guidance to explain RUs' behaviours in the perspective of human development: from a cradle to a rocking chair.

Erikson posited that every human experiences eight stages of psychosocial crises as they move across the age continuum, and how they address those crises affect their development and personality. In each stage, human faces unique crises – internal emotional conflict, or challenge, or struggle to develop and grow. Erikson highlighted two extreme contrary dispositions (or emotional forces) to represent the crisis in each stage. He termed them as 'syntonic' and 'dystonic': the former refers to the apparent positive attribute while the latter represents the opposition. Table 1 summarises these stages, and its corresponding opposing dispositions (the leftmost column).

A successful passing of crisis in each stage results to the acquisition of basic virtue that will influence characteristics of that person. In contrast, his or her characteristics will also be influenced by either maladaptive/malignancy if he or she unsuccessfully passing of the stage. These negative outcomes (either maladaptive, or malignancy) then become a baggage for that person to the future until he or she revisit the crisis, and successfully deal with it. Erikson defined a success as a healthy dose of both syntonic and dystonic. If a person is having too much of "good things", the resultant is maladaptive characteristics; whereas insufficient of goodness will result to malignant characteristics (column 2 and 3 from left of Table 1, respectively).

Table 1
Stages of Psychosocial Theory

Crisis stages ***Syntonic vs. Dystonic***	**Maladaptive**	**Malignancy**	**Basic virtue**
Stage 1 (Infancy): *Trust vs. Mistrust*	Sensory distortion	Withdrawal	Hope and Drive
Stage 2 (Toddler): *Autonomy vs. Shame and doubt*	Impulsivity	Compulsion	Willpower and Self Control
Stage 3 (Preschool): *Initiative vs. Guilt*	Ruthless	Inhibition	Purpose and Direction
Stage 4 (Schoolchild): *Industry vs. Inferiority*	Narrow virtuosity	Inertia	Competence and Method
Stage 5 (Adolescence): *Identify vs. Role confusion*	Fanaticism	Repudiation	Fidelity and Devotion
Stage 6 (Young Adulthood): *Intimacy vs. Isolation*	Promiscuity	Exclusivity	Love and Affiliation
Stage 7 (Middle Adulthood): *Generativity vs. Stagnation*	Overextension	Rejectivity	Care and Production
Stage 8 (Late Adulthood): *Integrity vs. Despair*	Presumption	Disdain	Wisdom and Renunciation

In the context of RUs' safety, they have to face four stages before start to enter the system as active RUs (see Figure 3). In other words, the behaviours of adolescents RUs, according to the theory, are the manifestations of their experiences facing the crises before. Therefore, to conduct an intervention at that stage, an understanding of RUs previous performances facing the crises may improve its effectiveness.

For instance, RUs who unsuccessfully pass the second stage will carry the baggage of impulsive characteristics in his personality. Having this trait increase the tendency to behave recklessly including on the road when they are given the opportunity (i.e. after obtaining the license). Coupled with an angering situation, these RUs are more likely to manifest aggression while driving which in turn upsetting the traffic system.

5. Conclusion

The main idea behind this article is the demotion of over-focusing on on-road behaviours when designing for any interventions. Of course given the limited resources (such as fund and manpower), it is not totally a bad move to opt for the quick-wins; this trend however, should not persist, and need to be changed to avoid the trap of unsustainability in the future. The keyword is indeed a balance between addressing the symptom and also understanding the causes. Regardless of either direction, RUSI framework offers a map to mark where are the gaps for interventions, and where are the potential opportunities.

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