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Behaviour in the Safe System

agilysis

WHITEPAPERS

Foreword

It is now 14 years since I took part in a panel reviewing Professor Frank McKenna's paper for the RAC Foundation called '*Education in Road Safety; are we getting it right?*' A profound challenge to the orthodoxy of decades in which much of the effort in road safety had focussed on addressing the behaviour of the users, with surprisingly little evidence of observable outcomes in the data on road traffic injury.

A few years later, at a global conference in Kuala Lumpur, I sat through successive presentations that argued for low-and-middle-income countries (LMICs) to desist from investing in road safety education, but to prioritise infrastructure upgrades and changes to the vehicle fleet. I probed questions of culture and norms that these technofixes ignore at their peril but was rebuffed by the argument that there is a lack of evidence that 'culture really makes a difference'.

I feel as though I have spent the last few years like a circus show rider, with a foot on each of two horses fighting furiously to retain a balance as beasts with different minds and will continually threaten to pull in completely opposing directions. My right foot planted on the strong and steady back of evidence-based practice, where the discipline is informed by robust research outcomes, before and after studies, bolstered by the glow of acceptance from academia and global institutions. Meanwhile, the other foot struggles for purchase on a more spirited animal, feisty and capricious, driven by a belief that we are unwise to throw the baby out with the behavioural bathwater, even if it is so much harder to make the case for investment in behavioural interventions.

There is a certain well-meaning tyranny (that I too have sometimes indulged in preaching) that we should just do what works and avoid what does not work. If only an issue as complex as road transport could be addressed with simple system solutions, we would probably have made these changes already. All too often we have limited insight into *why* a thing works, and we have plenty of examples of why interventions struggle to transfer across social and cultural boundaries within countries, let alone across continents. Risk disparity, acceptance, or aversion varies hugely between populations. Some seemingly well-engineered solutions don't produce the desired outcomes but generate confounding unintended consequences. And how little we really understand about the coefficient effects of the layers of protection that we consider to be central to a systemic response. I have been as guilty as anyone of looking for simple answers to complex questions, and I have sometimes indulged policy makers and fellow professionals who ask questions like 'what is the one thing that I should do?'

This whitepaper is not a set of answers. Rather, it is an invitation to take another look at the Safe System through the lens of human behaviour and ask how we might need to update our practice. It draws together challenges from within and outside the sector, laying them out like pieces of a jigsaw puzzle – a corner piece here, an edge there, sometimes an indecipherable piece of blue sky that we will only know right near the end where it could fit. You might pick up a piece, turn it around several times and then put it down, none the wiser. Maybe there is something here that catches your eye and instinctively you know where it fits to fill the gap in a section of your own thinking and practice.

Beyond the invitation for more reflective practice, there is also an imperative at the heart of this whitepaper. Progress in road safety is painfully slow, with many high-income countries floundering in a state of stagnation and confusion about how they can get progress back on track. I am convinced that some of the answers lie in a deeper understanding of how susceptible our engineered solutions and policy innovations are to being confounded by the noise of social norms, cultural expectations

and irrational individuals. We must develop a more mature relationship with these intangible elements of the system if we are going to make progress. And we are not without hope. The exponential explosion of transport data and interrogative capacity of machine learning mean that we have more power than ever to understand these complex relationships in ways never before possible.

Want to hop on for the ride? Welcome aboard!

Dan Campsall

Chairman

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PART ONE:
The Complex System

Introduction

What is the purpose of the system?

"*Every system is perfectly designed to get the result that it does.*" Dr W. Edwards Deming

Consider the wisdom of that quote – in over a century of developing our road transport system, it has ended up reflecting our shared civic priorities, even if it doesn't seem to be entirely consistent with our values.

It took a while for the penny to drop. I was a panellist at a conference in London, grappling with the concept of applying the Safe System to an ageing population. After years of thinking that the goal of the system was safety, the realisation hit me like a freight train. The goal of the system is mobility; safety is only a value.

The vast majority of users of our transport system, by whatever mode, don't embark on their journey with a goal of staying safe. They have a goal of getting somewhere and doing so without sustaining injury is assumed. The presence or absence of safety on that journey is an expression of how well the system supports their ambition; it is not a measure of the ambition itself. Indeed, it is often only the absence of safety that is noticed; when we are safe, we fail to even give any thought or appreciation to this fact; it is only at the point at which safety is compromised and we experience a threat response that we become aware of the need for enhanced safety.

For Safe System advocates, practitioners, and professionals, this creates a fundamental risk of misalignment. We are seeking to win the argument and move public discourse to embrace our ambition for a system free from injury, but the motivation of others is to achieve optimal mobility and their concern for safety is how much it inhibits the primary purpose of the system. Ask community leaders, parents on the school run, cyclists in our urban centres, or seniors as they walk to the shops, and they will explain their concerns over safety, eruditely and vociferously, but they will still make their journeys. Modal choice, time of travel, and route prioritisation might change, but the goal of mobility will persist.

As system designers and operators, we need to understand that these goals are not unimportant. Alongside sustainability, equity, inclusivity and efficiency, safety is a value that is deeply held; expressed as an expectation of how mobility should be experienced, but we cannot expect road users to adopt our preferred goal in favour of their own; we must give consideration to how wider society conceives of the road system an asset and how it serves their purposes. The acceptability of policies and interventions will be a reflection of how stakeholders conceive the purpose of the system, and the limits on our collective ability to embed our value of safety will be set by the degree to which they conflict with accepted goal of the system.

Behavioural scientists understand that this alters our approach because the motivational component of behaviour is not principally about 'safety' vs 'not safety' and our intervention planning must be much more considered about how risk, danger and response (informed by attitudes, values and beliefs) influence behaviour when the goal is all about getting somewhere.

Where are the Limits of the System?

One of the challenges that we often face in conceptualising safety of the road transport system is the way in which it is a completely different beast from safety associated with other transport modes. The contrast with air travel for example is stunning; in 2021 when B3A reported a total of 414 fatalities from air traffic, the World Health Organization was estimating 1.19m road deaths (4,589 times as many).

As I am writing this paragraph I am drawing to the end of a transcontinental flight to India. From my arrival at the airport, the system has closed around me and has created the protective layers of safety that we commonly expect from air travel. I was separated from my luggage so that it could be scanned, stacked and shipped in a way that reduces the risk from unsafe loading of large items, or potential threats contained within. My hand luggage and personal effects were scrutinised to eliminate any harm I would have the potential to inflict on board. Safety instructions before take-off, and the personal involvement of a flight attendant ensuring that my '*seatbelt is fastened, tray table stowed and seat in the upright position*'. I am not in control of this vehicle; a team of professional aviators are supported by various technical fail safes and are watched over by air traffic controllers. International codes of practice govern our air space, informed by decades of cooperation between airlines, manufacturers, and regulators on no-fault investigations to explore every system failure that could leave a residual risk.

Contrast that with the freedoms I enjoyed once I returned to my car. No supervision for my luggage. No mandatory pre-flight (or rather in this case, pre-drive) checks. A vehicle full of assistance systems that I can simply turn off or ignore. No welfare system challenging whether I am fit to drive after a long flight. And I turn out of the car park into a live lane of traffic to mix with the 40m licensed vehicles using British roads. I plan my own route, select my own lane, decide my own speed, choose my in-car entertainment, decide when I will take breaks.

That is because our roads are an open system. In natural sciences, that means it is a system that is permeable to both energy and mass. Nothing stopped me introducing 1.5 metric tonnes of vehicle onto the road, powered to deliver speeds well in excess of 100mph and therefore capable of introducing, a potentially devastating, 2 mega joules of energy into the system.

In contrast, my flight took place in a closed system. Controls ensure that the energy and mass entering the system are regulated, dispersed and monitored to minimise the possibility of conflict or harmful discharge. Its hardly surprising, the amount of energy that will be transferred in a plane crash is largely unsurvivable, so we have to remove failure, in contrast with some conflicts in the road environment where failure doesn't always equate to fatality.

Whatever our ambitions around autonomy, we have zero intentions of making our roads a closed system. We need to be able to walk to school, hop on a bike to the shops, visit relatives, move around goods – we can exercise more control around some of these activities, but the system will remain permeable. We cannot close the system.

But it is also important to consider where we might draw the dotted line around the system, indicating the boundaries of what we might influence. The wider economy will create influences over the system (e.g. increased economic activity will result in more freight), but these should be seen as being beyond the boundaries of the system. Therefore, at a certain point, we need to be cognoscente of where the boundary lies between what we can influence through the system and what lies beyond the system. When thinking about behaviour, this becomes increasing complex. There are individual, social,

economic and commercial determinants that undoubtedly influence the safety of the system, but which may appear to be beyond the boundary. We must consider carefully where we draw the line…

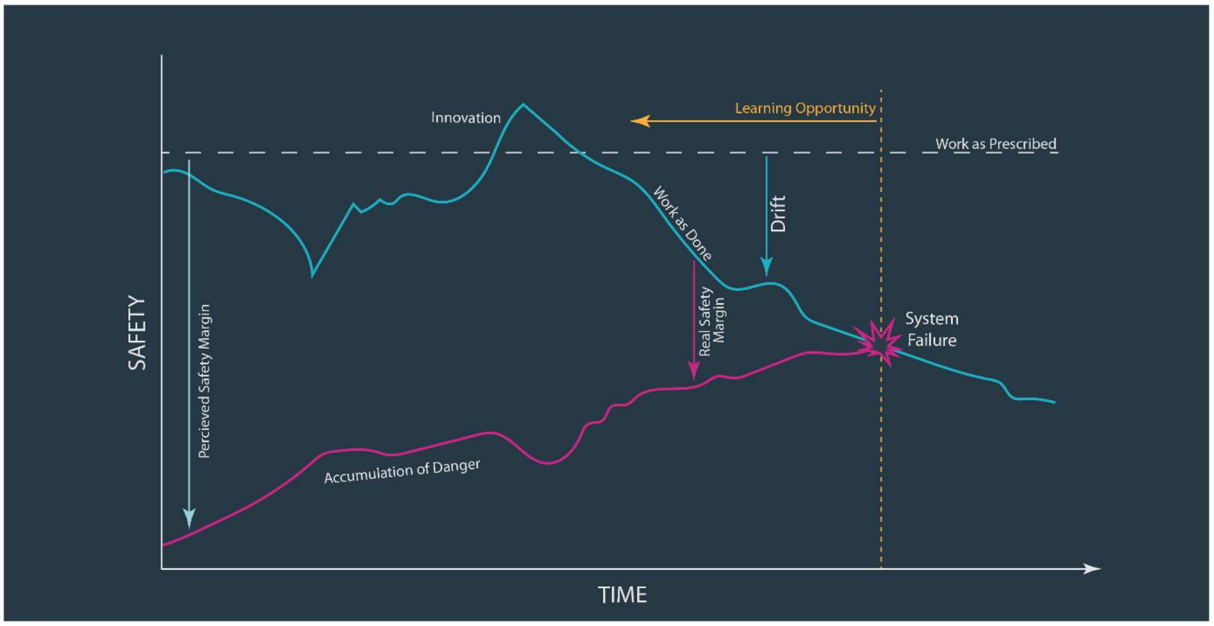

Figure 1: Adapted from Drekker, S. (2007); The Field Guide to Understanding Human Error

A Systems Failure… of our own making?

We need to start thinking about the road network as a socio-technical system. Roads are a social space, they are used by pretty much every member of society, they create conduits for community building and arteries for economic activity. They allow us to move between places, but they are also places themselves. And the ways in which we use them reflects all that social and technical complexity. This means that we cannot think about individual interventions in isolation – we need to reflect on how the environment, vehicles and road users work together, bringing understanding to why the system sometimes fails?

In a socio-technical system, there are a wide variety of reasons why failure occurs, and often it is the role of human interactions with the system, changing the boundary conditions in some way, which means that the system cannot any longer accommodate the activities taking place without resulting in crashes.

Many professionals would be quite clear in saying that we recognise that 'humans make mistakes' but how much does this principle affect our practice? Some sections of the road safety profession continue to raise questions about whether, by acknowledging human error, we are 'letting people off the hook'. The suggestion is that we fail to hold them accountable for the failure, especially where these failures have serious consequences in terms of harm to others. In sustaining this view, we potentially perpetuate a naïve understanding of human performance in complex systems, which could prevent us from generating more effective systemic responses.

Accumulating Danger

Years of research into operational safety and human factors have revealed how ineffective humans can be as operators. It isn't that humans are not capable, given that humans are amazing at managing complex tasks and our failure rate can be very low. How often have you heard someone talking about their 30-year driving career without an accident. However, the failure rate is rarely zero! And that's if we are concentrating hard.

A model of human error is provided in Drekker's work (Figure 1), which is helpful in thinking about how system failures occurs through suboptimal human performance.

The top line reflects work as prescribed, i.e., how the system functions when all the rules and guidelines are followed. The effect of adherence to these rules or processes is that they retain a wide margin of safety in the system.

The reality of operations is represented by the blue line, also referred to as the 'Work as Done'. This line reflects the operation of the system within the context of human imperfections, whereby human users are prone to cutting corners, operating when fatigued or distracted, or pushing the boundaries (drift arrow in the figure above). Whilst conceptually the overall margin of safety in the system is quite wide, we may be able to 'get away with' many of these indiscretions, but collectively, they represent an 'accumulation of danger' (pink line in the figure above). As such, the real margin of safety is the gap between our 'Work as Done' and these accumulations. When the level of danger exceeds the safety of the work done, this is the point when system failure occurs. In the road safety context, this relates to when a collision occurs.

This approach can prove helpful as it can assist us in thinking about the operating conditions – not only what we consider to be the rules for safe operation (work as prescribed) but also how they

system will be operated in reality (work as done) and when the system might be prone to fail (danger in the system).

Finally, the model also allows for innovation and learning – new technology or increasing the reliability of the system could increase the margin of safety and reduce 'drift'. Equally, near misses and failures should be used to reinforce the resilience of the system by looking back up the chain of events that led to the outcome and considering how the system could be improved.

A similar story emerges within the dedicated road safety literature, as demonstrated through the 'Two Pathways to Crash' model shown. As in Drekker's model you can see how danger 'accumulates' through the risk-taking behaviours exhibited by some road users, meanwhile others may exhibit 'drift' contributing to errors as a result of underperformance. These are alternative pathways to a point of failure but might also create a negative coefficient effect when drift and danger converge.

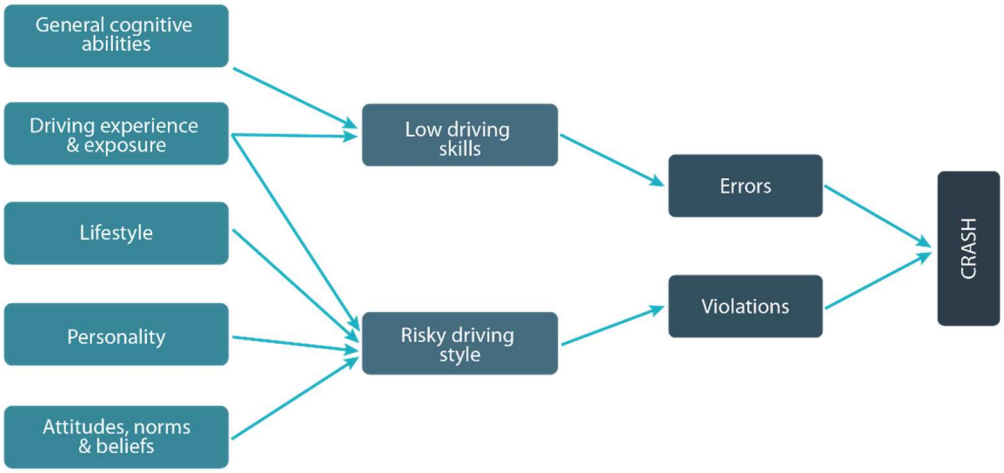

Figure 2: Two Pathways to Crash (Lajunen & Özkan, 2021)

Shifting Boundaries

These margins of safety are demonstrated well in Rasmussen's work on 'Risk Management in a Dynamic Society' (Rasmussen, 1997), where the area of safe operation is influenced by both internal and external pressures.

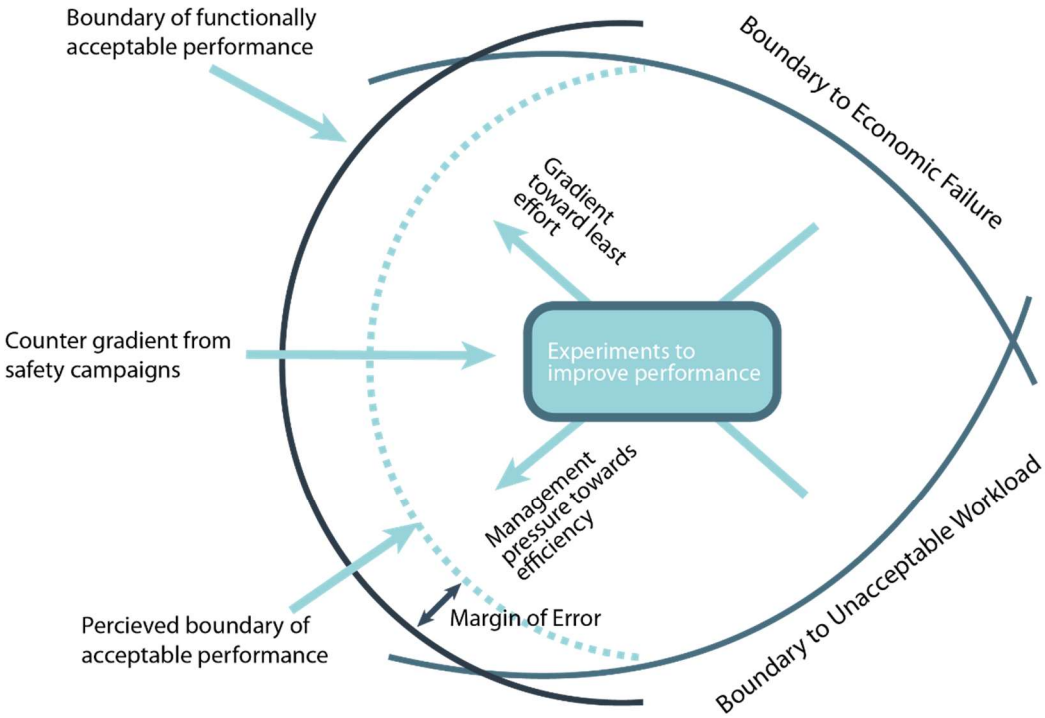

Figure 3: from Rasmussen, J. (1997); Risk management in a dynamic society: a modelling problem

Rasmussen recognised that, despite efforts to improve safety, complex socio-technical systems (such as our road networks) still witness severe failures in the form of large-scale accidents, describing why this might occur because of a range of influences on the system.

- Firstly, we have performance boundaries on the left that describe the functional safety of the system (the physical limits beyond which unacceptable failure is inevitable) and the perceived boundary (the limit to which we feel safe). The gap between *feeling* safe and *being* safe creates our margin of error.
- But pushing against these are other pressures from the system that jeopardises safety. So, economic pressures are persistently pushing for the system to work more efficiently so that it can deliver better value. Meanwhile, humans are constantly optimising, trying to reduce the level of effort required by using the system, introducing shortcuts and minimising the effort required (think desire lines for pedestrians, lazy loading for goods vehicles, or driving whilst tired).

- We can push back against these pressures by raising awareness or salience of risks through 'campaigns' resisting the erosion of our margin of error, although we understand that these pressures may be weak, especially where they are not clearly associated with the activities, operations or behaviours that will enhance safety.
- What does this mean in practice? We're trying to build a Safe System in a much wider system, where there is a gap between perceived and actual safety and where there are economic and workload pressures which can influence how well the system performs. We have to acknowledge these other system influences – we don't operate in a vacuum…

Observing how risk is managed within companies, Rasmussen articulates the competing pressures that are driving decision making: "Companies today live in a very aggressive and competitive environment which will focus the incentives of decision makers on short term financial and survival criteria rather than long term criteria concerning welfare, safety, and environmental impact." For operation of the road network, it would seem that there is validity to this description, not only with the corporate context by across the whole system and society. It is increasingly true for public authorities who operate under similar constraints, meanwhile changing economic practices (think 'gig economy') mean that these 'survivalist' instincts are perhaps more pervasive than we would like to acknowledge. The question then is how do we justify them, or validate the decisions that we are making?

Shifting the Burden

In systems thinking, there is a common error known as 'Shifting the Burden' (Stroh, 2015) where, faced with a choice between implementing a quick fix or a longer term, more fundamental solution to a problem, the tendency is to choose the more expedient path; selecting more accessible interventions which could worsen the systemic problem and result in deteriorating performance over time.

Education as a response to social policy challenges, such as road safety, is potentially a classic example of shifting the burden. It is the lever that we can pull! A low cost, readily accessible, uncontentious and attractive measure that does not force us to consider scaling the high barrier of implementing policy change through legislation, regulation, and environmental restructuring. It provides professionals with a programme they can point to, outputs that are measurable, and politicians are persuaded that the frailties in the system are being addressed. All of which undermines the motivation and capacity to consider more systemic responses.

In the Big Sector Survey (Agilysis, 2022), 80% of the public sector bodies that were surveyed indicated that they were investing in road safety education, meanwhile there was low engagement with apparently difficult interventions around vehicle technology and post-crash response. Is one of the reasons why we lack a more systemic approach that we have invested heavily in education as a mechanism of change, such that we have encountered sunk costs and established organisational dependency? Systems thinkers step back. They look at the whole, optimising the relationship between the parts and embracing the need for complex solutions that can lead to sustained changed.

This does not negate the need for all education, rather it forces us to look at the health of the system overall, embrace the behavioural components of the system, and ask where and how we should intervene to improve the whole.


PEDESTRIANS
push button and wait
for signal opposite
WAIT
wait
cross
with care

Complex is different to complicated

We often conceptualise systems like machines and tend to develop an approach to living systems that is reflective of our understanding of systems that are built from predictable parts that fit together in a structured way. In systems thinking, complicated and complex describe different types of systems, each requiring different approaches to understand, manage, and solve.

A complicated system is something like an aircraft. It is made up of a great many parts; it requires significant expertise to understand how they integrate, but you can break the system down into its constituent parts, study them individually, and then piece them back together. In complicated systems, there are clear and direct cause-and-effect relationships, making the system predictable, even if it can be hard to understand. Complex systems are not of the same order. Consider whole ecosystems, social networks, or the national economy. Complex systems have many interconnected and interdependent parts with relationships that are not always obvious and where the interactions are dynamic and changeable over time. All of which leads to behaviours that are unpredictable and interventions, which may have disproportionally large effects or create unexpected and undesirable side-effects.

A useful framework for describing the difference between system types, how they might be explored, and how we could intervene is The Cynefin Framework for Sensemaking, illustrated in Figure 4.

Developed by systems theorist, Dave Snowden, to help leaders and managers understand and respond to different types of problems and situations, Cynefin categorises situations into five domains based on the complexity and predictability of the environment.

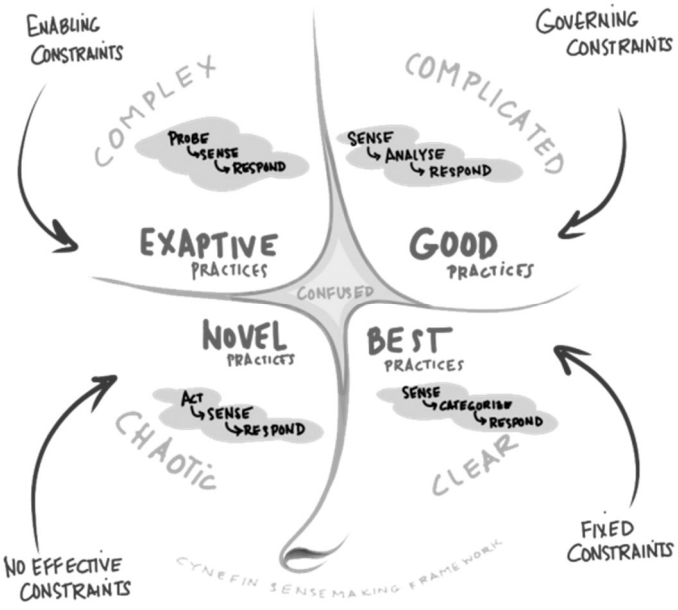

Figure 4: The Cynefin Framework for SenseMaking (https://thecynefin.co)

- In the **'Clear'** domain problems are simple, well-understood, and predictable, with clear cause-and-effect relationships. This allows us to follow best practices; identify the problem, categorise it, and respond with established solutions.
- In the domain is **'Complicated'**, it involves problems that have a clear cause-and-effect relationship but may require expert analysis to understand fully. These systems will require expert advice; there may be multiple right answers, so analysis and expertise are needed to find the best solution.
- **'Complex'** domains (such as the socio-technical system that is the road network) have interconnected parts and unpredictable outcomes, and cause and effect can often only be determined in hindsight. These emergent properties require experimentation to probe the environment; encourage feedback and adapt as patterns and solutions emerge.

- In **'Chaotic'** situations, there is no discernible cause-and-effect relationship, and the environment is highly unstable. Immediate action is needed to stabilise the situation and establish order before a more structured response can be applied.

Given that the road transport system is a complex system, involving interactions that will not always react predictably when we intervene, we may need to take a different approach to our actions in the system.

System Design for Humans

That humans are both fragile and fallible has been a central tenet of Safe System thinking for many years; people make mistakes and when they do the consequences of exposure to high impact forces can be devastating. This might lead us to a conviction that we must therefore eradicate the mistakes or exclude the error prone humans from the system.

As we have already explored, the goal of the system is mobility and safety malfunctions are not necessarily an expression of the system failing in its primary purpose. They impact upon its function; they reduce confidence in the system and they inspire intervention. However, the system exists to support the social, economic, emotional and spiritual goals of people, and the way we therefore deal with users of the system has to recognise that the value of the system is more than an expression of its safety. Does it deliver for its users?

Steven Shorrock highlights four approaches to human factors (adapted in Figure 5), with an increasing emphasis on the prosperity of the system users, which is not simply a measure of how they experience the safety of the system, but whether it is optimised to accommodate their aspirations and deliver their multifaceted ambitions.

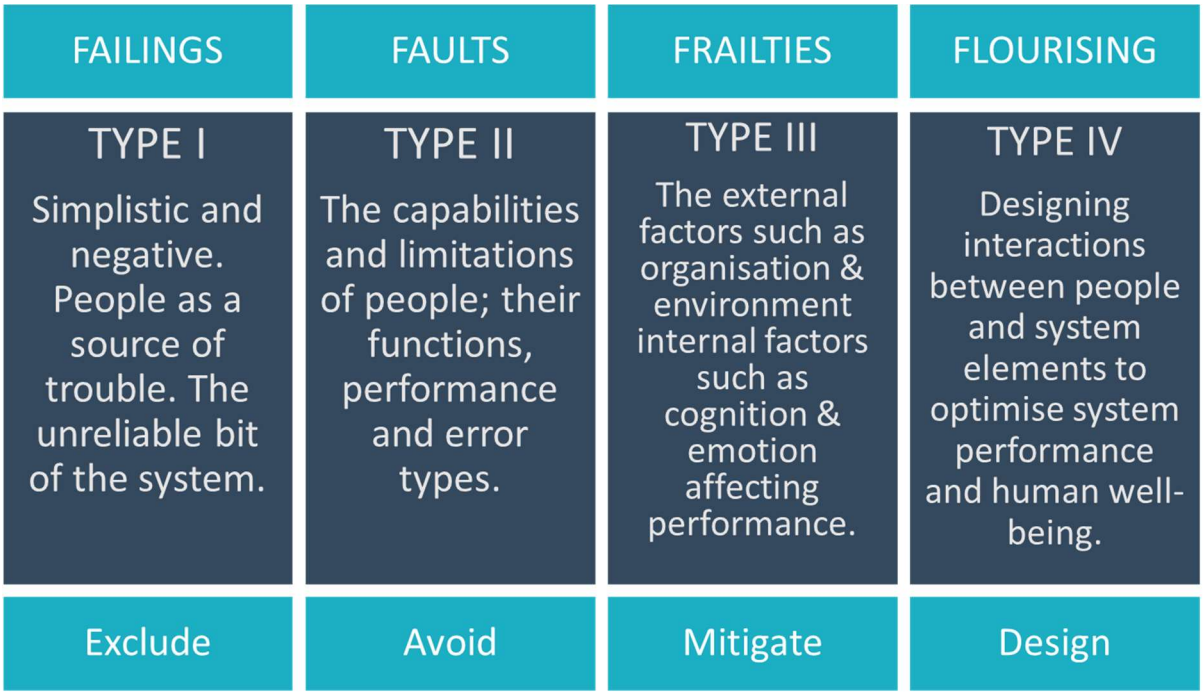

Figure 5: Based on Four Kinds of 'Human Factors' - Steven Shorrock

The Challenge of Interdisciplinarity

Several years ago, we ran a webinar on behaviour change in road safety and talked through a model of interdisciplinary working for intervention design. Whilst talking through the model, I put out a poll to participants to ask which of the roles they were operating in. It was multi-select, so they could identify any and all of the roles that they inhabited. These roles were Commissioner, Researcher, Translator, Designer, Deliverer, and Evaluator. Out of the 71 colleagues who participated, nearly 90% identified that they undertook more than one role, with 33.8% saying that they carried out 4 or more. In many road authorities, staff are forced down a road of becoming a 'Jack of all Trades'. This is particularly true when we are working in small and under resourced organisations, which you could argue characterises an increasing body of organisations after public sector cuts in recent years.

Doing a significant amount of work in the charity sector over the years, these traits are easily recognisable; the outstanding efforts of a group of highly motivated and committed people who will turn their hand to anything in order to achieve corporate goals. Whilst this is extremely commendable, it often means that there is a lack of specialism and sometimes the necessary professionalism to do the job to the highest level.

This gives rise to an interesting question: are we really operating with a multidisciplinary mindset in addressing the Safe System?

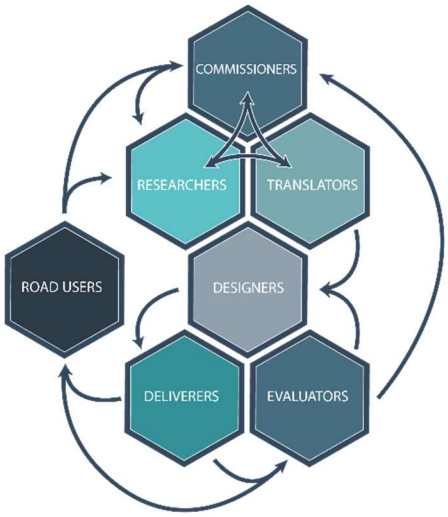

Figure 6: An Interdisciplinary Approach to Intervention Design (Campsall, 2018)

After many conversations with colleagues and industry leaders, as well as being involved in the design of some quite substantial behavioural programmes, the model depicted in Figure 6 emerged as a way of recognising that there are some distinct roles in the intervention design process; many of which require discreet skillsets.

Commissioning demands an understanding of procurement processes for sure, but if we are looking to procure a programme that will impact on the behaviour of citizens then we need to engage with the ethical considerations, the current state of the art, the evidence underpinning the design and appropriate evaluation methodologies. Meanwhile, the design task is an interdisciplinary effort in itself as it may involve psychologists, educators, marketers, graphic designers, brand consultants, and software developers to name a few.

We may be able to turn our hand to a few things, but it seems obvious that we must consider whether we are developing the right skills and standards as a profession to deliver effectively across all of these roles, and it will no doubt limit our capability to influence the whole system effectively.

This gives rise to some structural and strategic challenges for those intervening in the system. For example, when a local authority only has one or two people engaged in their road safety activity, building an interdisciplinary approach necessitates going outside the organisation, often encountering barriers of bureaucracy and cost. Are there ways in which we can really develop skills and specialism across the system or through professional special interest groups that will move us forward? Are there more advantageous value chains that can be co-developed with academia and the private sector to improve the quality, reliability, and scale of our work?

"Anything a person does in response to internal or external events. Actions may be overt (motor or verbal) and directly measurable, or covert (e.g. physiological responses) and only indirectly measurable; behaviours are physical events that occur in the body and are controlled by the brain."

(Michie & Johnston, 2012)

Behaviour in the Safe System

First, let's clarify what we mean by behaviour, before we go on to explore our understanding of the System within which that behaviour occurs.

> *"Anything a person does in response to internal or external events. Actions may be overt (motor or verbal) and directly measurable, or covert (e.g. physiological responses) and only indirectly measurable; behaviours are physical events that occur in the body and are controlled by the brain."* - (Michie & Johnston, 2012)

The sheer number of the 'physical events' that are detectable and measurable across the road network begins to reveal just how complex the system becomes – every time a cone is laid out, a line is painted, a vehicle slows down, a pedestrian crossing activated, a taxi hailed, a bus ticket purchased, a brake depressed, a driving lesson booked, a speeding ticket issued, a traffic scheme approved, a speed limit reduced, a radio advert broadcast, an ambulance dispatched, a coroners findings released, a child walks to school, a barrier installed, a road is gritted… these are all behaviours; amenable (if not easy) to measurement, that say something about the operation of the system.

For all road authorities looking to create safe networks, the internationally accepted approach is the Safe System. Moving away from traditional approaches that relied heavily on adherence to the rules of the road, the Safe System is based on a much more rigorous understanding of the underlying causes of road fatalities and serious injuries. The Safe System is not a monolith, there is no singular description of the approach that is universally accepted; however, it is consistently viewed through three lenses that are reflected in the circular model shown in Figure 7.

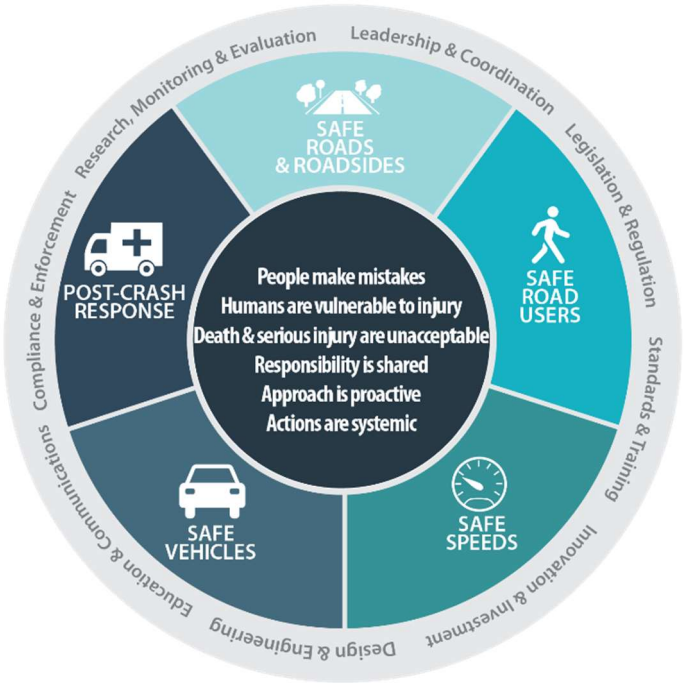

Figure 7: The Safe System (Fosdick et al., 2024a), adapted from various international models)

Lens 1: System Principles

The system represents the interaction of users of different modes within the road space, and the safety of that system requires an understanding about the nature of humanity, the effects of these interactions, and a shared expectation about minimum standards for system operation.

Figure 8: Principles of the Safe System

- People make mistakes

  Humans are fallible. We cannot expect their behaviour to be completely consistent and performance will vary through factors such as personality, energy, and mood.

- Humans are vulnerable to injury

  Human physiology facilitates our movement at speeds of up to 20mph, and our bodies cannot really tolerate forces from speeds beyond that level. This means that impacts at higher speeds or with extremely heavy objects (such as vehicles) will almost certainly result in serious or catastrophic injury.

- Death and serious injury are unacceptable

  We cannot accept a system in which these catastrophic outcomes are experienced. We have a moral responsibility to manage the system and eradicate the most severe effects.

- Responsibility is shared

  Injuries suffered while using or working on the system don't necessarily indicate that an individual was at fault; it is an indication of the system overall failing to protect users. This means that strengthening the system to make it more resilient requires efforts from designers, operators and users.

- Our approach is proactive

  Historical practices of waiting for the system to malfunction before addressing any points of potential failure is no longer considered to be appropriate. Data about safety performance should be used to strengthen the system, proactively reducing any risks for the future.

- Our actions are systemic

  All parts of the system must be strengthened to multiply their effects. Improving relationships among parts of the system will support the optimisation of the whole.

Lens 2: Safe System Components

When Manchester University Professor James Reason was considering accident causation in a range of industries, he identified that they are rarely independent events. More likely, there are a range of interconnected factors that collectively accounted for a moment of failure. Whilst that might sound depressing – how on earth do we deal with all of these independent events? - it can be viewed positively. If we can put multiple layers of protection in place, then we can prevent this accumulation of small errors that lead to a major failure with catastrophic consequences. He imagined these layers of protection like slices of Swiss cheese, each imperfect in their own right because they each have holes in, but if we put enough of them in place, we get overlaps between the holes and the harms are slowly and systematically removed.

The Safe System recognises that there are a variety of interdependent system elements or components that work together to protect road users from serious harm. Historically, these have been referred to as 'pillars' but this fails to grasp the interconnected nature of the system. For example, improving the Safe Vehicles component (our preferred term) only works if the driver assistance technology is specified by purchasers, correctly understood by vehicle owners, and used by drivers and their passengers. Likewise, enhanced road layouts designed to reduce the potential for high-speed impacts will have limited efficacy if road users don't understand how to navigate them safely.

Figure 9: Components of the Safe System

The different components of the Safe System are:

Safe Roads

Roads are designed to reduce the risk of crashes occurring and roadsides are sufficiently forgiving for occasions when mistakes occur. Segregating traffic to protect vulnerable road users is prioritised and the treatment of dangerous roads is proactive, improving both the actual and perceived risks to road users.

Safe Road Users

Road users are educated or regulated in their use of the roads, according to their modes of transport and levels of risk. Drivers receive high quality training and testing. Additionally, they are expected to comply with road traffic laws. Meanwhile, provision is made to support children, pedestrians, and cyclists to travel in safety.

Safe Speeds

Road users' ability to avoid crashes and their survival in the event of a collision is directly affected by the speed and consequent energy involved in the system. Safe speeds recognise human frailty, either in decision making or in surviving an impact, and ensure that higher speeds are only feasible where the environment and infrastructure, and vehicles can support and protect them.

Safe Vehicles

Vehicles offer a high level of safety to both occupants and other road users. Fundamental safety systems, such as seatbelts, are augmented by more advanced active safety measures, like autonomous emergency braking and electronic stability control. Routine checks for all vehicles ensure that they are maintained to the highest safety standards.

Post-Crash Response

In the event of an incident, emergency medical response should reach any injured parties quickly, transit to high quality trauma care is rapid, rehabilitation services are readily available, and victim support is on hand. After the incident, data on the causes of the collision feed into systems to rehabilitate roads and evaluate how the system can be strengthened.

Lens 3: System Operators

It is common to come across examples of practice where organisations state that they are implementing 'Safe System'. This is denoted by having activities in each of the boxes of safe roads, vehicles, speeds and road use. But it is quite feasible that they are still carrying on with siloed areas of work rather than implementing in a more systemic way. Throughout the best international models, there are a number of things that are identifiable as being key.

Most Safe System Models have a number of functions or system operators around the outside. The ones in Figure 6 have been synthesised and grouped based on leading models in the international literature; we refer to these as the System Operators. Nevertheless, they are often overlooked in practice as organisations and groups of organisations focus heavily on the elements described under Lens 2.

System Operators are the mechanisms by which the system works. Without the design and engineering component, there are no roads or vehicles; without legislation and regulation, there would be no established norms or expectations around how they could be used; without research,

monitoring and evaluation we would have no idea of traffic flow, collision densities, road user risk of the efficacy of defensive measures.

Where is behaviour important?

We have often made the mistake of seeing education as the unique and ubiquitous intervention of choice to address the Safe Road Use component. This narrow view results in an imbalance because we neither see the need to address behavioural components of the wider system in operation, nor do we consider the depth of the behaviour toolkit from which we can draw.

Focussing for a moment on the 'Operators' of the Safe System model (the means of operationalising our systemic response), we can identify a wide range of behavioural expectations and actions that are legitimately the target for 'interventions' every bit as much as the traditional focus on road users. Here are just some of the behaviours that we would expect to see exemplified in a Safe System:

Leadership & Coordination

- Articulating a compelling vision and direction which targets the eradication of serious harm from the system
- Working collaboratively with all relevant agencies, and involving the public at large, to achieve the overarching goal
- Defining areas of responsibility, accountability and performance expectations

Legislation & Regulation

- Designing legislation that is cognoscente of human frailty
- Establishing expectations around compliance and consequences
- Generating awareness of rules and expectations for road user groups and the underpinning rationale

Standards & Training

- Creating meaningful standards for designers, operators and users of the system, acknowledging the realistic limits of human capability and capacity
- Recognising the integrated nature of the system and interrogating where conflicts could occur between standards, producing adverse results
- Training system actors to comply with reasonable expectations that are consistent with their role, risks, and degree of professionalism – from young cyclists to HGV drivers, to the engineers designing schemes

Innovation & Investment

- Encouraging wide participation from across all sectors to find innovative solutions that enhance safety outcomes
- Selectively investing in actions that either have proven efficacy or which are contributing to the evidence base
- Creating an enabling environment for evidentially effective innovations to achieve scale, delivering improved safety and associated benefits

Design & Engineering

- Setting expectations around human-centred design including the boundary conditions consistent with Vision Zero
- Piloting and testing solutions to ensure that performance over time is consistent with safety ambitions

- Building environments that are consistent and reliable, reducing the need for interpretation and complex processing to navigate

Education & Communications

- Addressing relevant knowledge deficits in all system actors at an appropriate stage including where there are changes to the operation of the system (such as the introduction of new legislation, regulation or standards)
- Cultivating a wide appreciation for shared responsibility and its application
- Communicating the introduction or prevalence of compliance measures
- Validating and advocating for interventions necessary to ensure the safe operation of the system

Compliance & Enforcement

- Warning system actors of augmented risks associated with non-compliant behaviour, providing mechanisms to address this
- Penalising dangerous behaviour which jeopardises the safety and security of system actors
- Denying persistent offenders access to the system in such a way so that they could no longer cause serious harm

Research, Monitoring & Evaluation

- Informing the continued development of the system by identifying areas of improvement and innovation
- Rigorously testing the efficacy of actions to evidence their role in enhancing system safety
- Providing guidance to system designers and operators by producing relevant data to inform future action

Are we really ready for a Safe System?

This wider view of behaviour in the Safe System gives rise to some important questions that we need to grapple with – like "are we really willing to aim for zero?!"

This is not just a question of whether we think that zero is achievable, but even to get close the necessary behaviours of road users, operators, regulators, educators, employers, fleet managers, insurers, politicians and the media will need to change.

For example, the speeds at which we currently permit heavy vehicles to interact with and indeed conflict with frail humanity are unsustainable in a Safe System context, so we need a much more rigorous debate about the acceptable speed of our network if we want to address the emergent properties of death and injury.

Similarly, I recently heard a national leader, responsible for a major road network say that they '*had done everything they possibly could*' to address the safety of their roads; this was followed by their regulator publicly acknowledging their great effort, and saying accepting that missing their target was reasonable in the circumstances. Of course, there are constraints on investment and the speed at which improvements can be made, but this tacit agreement to permit continued system failures without accountability is utterly inconsistent with the behaviour that will deliver a system which is inherently safe.

We must ask ourselves how far we are willing to go in a genuine attempt to tackle the current dysfunctions. How much political capital will we risk, how far are we willing to refactor our built environment, what limitations would we countenance on personal freedoms, how invasive will we

allow the compliance technologies to be, what constraints will we put on organisational leaders to ensure that they fulfil their duties.

Without giving consideration to these behavioural components of the system, we will end up tweaking at the edges, rather than striving for genuine systemic change.

PART TWO:
Changing Behaviour

Peculiarity of Humans

By now, it is established that humans are indeed peculiar creatures. While we have the capacity to process complex information, we often make irrational decisions. For example, we might purchase a fitness plan but fail to follow through, despite the financial investment. Similarly, we underestimate how long it will take to reach a destination, then justify speeding to make up time. Yet, when we observe others speeding, we might recognise it as unsafe behaviour. This inconsistency between our actions and intentions highlights our susceptibility to common cognitive biases and the requirement for some form of intervention to support safe behaviours and resist those which elevate risk.

Given that our behaviour can be influenced by numerous contextual factors, it is crucial to adopt a broader perspective and think creatively beyond traditional approaches. Equally important is the need for an evidence-informed approach to thoroughly test and understand behavioural factors that influence our actions. By grounding our interventions in research and evaluation, we can develop and evaluate interventions that are both targeted and effective. Below are some of the key behavioural factors commonly examined within our sector.

Perceived behavioural control plays a pivotal role in various behaviour change models, and its impact on driving behaviour has been well-documented. The sense of control individuals believe they have over events is linked with our driving behaviour (Huang & Ford, 2012). Another prevalent approach in road safety research has been to examine how personality traits influence driving behaviour and explain individual differences in collision involvement and risk-taking on the road (Pereira et al., 2022). Despite good intentions, overconfidence can often skew one's self-assessment of driving ability, an issue particularly noticeable among young adults.

Overconfidence, especially in driving, is a well-established concept (Moore & Healy, 2008; Svenson, 1981). Drivers frequently overestimate their ability to detect changes in their environment, and this overconfidence is most pronounced in young male drivers, who often underestimate their chances of being involved in a collision (Gunnell et al., 2019). Similarly, risk perception has been shown to correlate with driving behaviour; drivers who perceive risk differently are likely to engage in more hazardous behaviours (Jing et al., 2023; Liu et al., 2021).

We have only scratched the surface of behavioural factors, but it is already clear how critical these insights are in the development of our interventions. If we aim to fully embrace the Safe System, we need to consider the complex behavioural mechanisms at play and systematically audit them. Many practitioners are eager to integrate these factors into interventions but often struggle with where to begin. Some preliminary resources to consider include:

The Driver Behaviour Questionnaire (DBQ) is a key resource in the road safety sector. It was groundbreaking in its ability to measure everyday driving behaviours by distinguishing between errors and violations, further categorised through Rasmussen's 'skill-rule-knowledge' taxonomy (Özkan & Lajunen, 2005). Now, there is also some clarity in the difference between intention and action, revealing that slips and lapses were due to action, while mistakes stemmed from intention (Özkan & Lajunen, 2005). Some other behavioural questionnaires include the Driver Aggression Indicators Scale (DAIS), Driving Style Questionnaire, Driver Attitude Questionnaire and more.

While we have made significant progress in incorporating behavioural science and developing validated tools, the true challenge lies in effectively evaluating this behavioural data. There is a tendency to rely on instinct rather than evidence-based strategies, and the broader, system-level thinking often gets overlooked.

The principle statutory position with respect to road safety in the UK was laid out in the provisions of the Road Traffic Act 1988, a period in which the dominant view among leading countries in traffic safety was that 90% of collisions were caused by human error and the countermeasures focussed on road user behaviour. Consequently, Section 39.3.b articulates the role of local authorities in addressing the 'dissemination of information' (publicity), 'advice relating to the use of roads' (education) and the 'giving of practical training to road users' (training). This triumvirate of Education, Training and Publicity (ETP) has continued to inform the expectations of local road safety delivery for nearly 40 years, despite the fact that international guidance around systemic responses has moved theory and practice away from the road user centric approach where countermeasures are mainly aimed at changing behaviour to adapt the road user to the system. For example, in the following quote from the Swedish Vision Zero Bill:

> *"Many traffic safety measures introduced in the past had focused on adapting the individual to the road transport system rather than adapting the road transport system to the individual and his/her capacities" Swedish Government, 1997*

Even if we look beyond ETP, as a sector we find it hard to avoid reducing behavioural approaches to a simplistic trio of education, enforcement, and engineering (the so-called 3 E's). Rather than considering addressing behaviours across the system, influencing design choices, maintenance routines, standards for investigation or organisational culture could strengthen our approach. Behavioural science is a far more expansive field; it encompasses a wide range of interventions that go beyond these conventional methods that include but are not limited to habit formation, social norms, incentives, environmental restructuring, reducing friction of performing the behaviour, and more.

Perhaps we as practitioners are influenced by the status quo and overconfidence bias, clinging to 'what we have always done' and being overly confident in our assumptions about what works? A part of the challenge may come from a constrained understanding of behavioural science itself. For years, research in this field has focused predominantly on cognitive biases, often neglecting the broader and more intricate dimensions of human behaviour, such as the cultural context (Halonen, 2024). Behaviour is multi-faceted, influenced by various cross-sectional domains such as the cultural context, neuroscience, evolutionary biology and more. To fully appreciate the value that behavioural science can bring to the Safe System, we must challenge these preconceptions and create a new understanding of how these mechanisms can be applied to drive change. In this pursuit, to reflect the comprehensive nature of the behaviour change process we are engaging with, we have developed our own definition.

Defining Behaviour Change

> *"Behaviour Change is the systematic application of social research and scientific enquiry to understand human behaviour within a population and the reliable mechanisms for sustaining or changing it for social benefit."*

Systematic application – Too many behaviour change programmes in the past were built on anecdote and assumption. Whilst Behaviour Change is not a discreet branch of the sciences, the methods should nonetheless be applied and evaluated in a systematic way to increase understanding and demonstrate value.

Social research and scientific enquiry – Behaviour change demands an understanding of the way people behave within certain cultures and contexts, under a defined set of conditions. This requires social researchers to develop insights into these cultural and contextual influences, providing objective metrics that can be used as measures of change.

Within a population – Behaviour change is primarily concerned with finding influences that work at a population level, not just for an individual.

Reliable mechanisms for change – The evaluated impact of behaviour change programmes ought to show that when a behaviour change intervention is delivered in a consistent way, it produces a reliable and repeatable outcome in terms of changed behaviour.

Sustaining or Changing – It is not all about change! As we are seeing at present, some people are doing things that we would want to encourage, support, and maintain. We want to be protective of that, whilst recognising that there are behaviours that are neither in the interests of the individuals or the population.

For social benefit – These behavioural effects might be experienced by other road users, the health and social care system, the lives of families and friends or the economy. The interest of behaviour change is that the welfare of society is improved through these programmes.

There is a common misconception that behavioural science focuses solely on changing individual behaviour, when it can serve our need to influence the behaviour of the entire system. In some parts of the system, the reliable mechanisms of change may involve greater regulation, standards or control, whereas communications approaches or social support might have validity in others. As we assess which problems require specific solutions, it is crucial to determine whether a behavioural approach is truly the best fit for addressing the challenges at hand. Understanding this distinction can guide us toward more effective and systemic interventions.

Changing Behaviour in Road Safety; Understanding the Context

Road Safety has long been heralded as a great example of behaviour change and successful social marketing (French et al., 2009). Through years of policy development, dramatic changes have been observed in drink drive related collisions and average vehicle speeds. However, even as the UK moves steadily towards the adoption of the Safe System to Road Safety, serious questions have been asked about the validity of behavioural approaches in delivering additional significant safety benefits as part of a systematic approach (Kinnear et al., 2018). Behavioural approaches could include a range of approaches such as improving capability, reducing overconfidence, providing people with more knowledge and many more.

While behavioural approaches in road safety inherently require a holistic view, many practitioners fall back on a limited toolkit, believing that a select few methods will effectively change behaviour. These

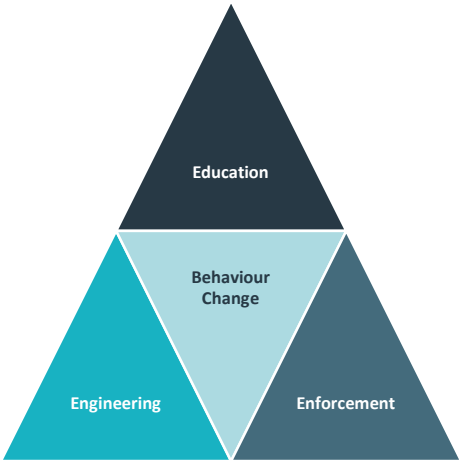

Figure 10 – The 3E's in Road Safety

often centre around the well-known "3E's", introduced to the road safety sector in 1923 through a presentation by the director of the Kansas City Safety Council, who used a triangle to illustrate them with each side of the demonstrating one of the 3Es (Damon, 1958) as shown in Figure 10.

More recently, discussions within the sector have expanded this to the 5E's, with the additions of Evaluation and Engagement (Helman, 2024) and Groeger's 7E's (Groeger, 2011). The *7Es* expand on the traditional 3Es by incorporating additional elements: *Exposure*, which examines the patterns of risk an individual may face, and *Examination of Competence and Fitness*, emphasising the often-overlooked need for assessing fitness to drive. The final two Es highlight the importance of a rapid *Emergency Response* and *Evaluation*, the latter aligning with Helman's "5 Es" to stress the critical role of assessing intervention effectiveness. Together, all these Es provide a more comprehensive framework for road safety.

Education is often seen as a cornerstone of behaviour change in the road safety sector (Christmas et al., 2017; Davies, n.d.). While it has a crucial role to play, it is not a one size fits all solution. As (McKenna, 2010) highlights:

> *"The great danger that education programmes face is that they are treated as a magic bullet that satisfies a number of goals."*

In road safety, the challenges we aim to address are often complex, multifaceted and deeply interwoven with human behaviour. According to the Cynefin framework (Clark, 2018; Snowden, 2011), complex problems demand a willingness to experiment, try different methods, and adapt as new insights emerge. But should we abandon our well-established methods altogether? Certainly not.

The strength of the Safe System lies in its holistic, systemic approach. The issue arises when we become overly reliant on certain elements—education, enforcement, and engineering - at the expense of exploring a broader range of behavioural approaches. This complexity may seem overwhelming, especially when considering the wide range of factors that shape behaviour. However, we can utilise the power of theories of change to provide us with a framework of understanding behaviour. These frameworks help us navigate the intricate web of influences by mapping out potential causal pathways in specific contexts, offering clarity amidst the complexity. If we are to make lasting progress, we must strike a balance, embracing new strategies while refining the tools we already have.

Flirting with Behavioural Science

As a sector, we have made significant strides in incorporating behavioural approaches to drive change. By no means the sum total of the published literature, the following represent a few publications that we have highlighted to reflect challenges to the sector, guidance for the sector or examples of innovative approaches that have adopted a more rigorous approach to intervention design:

- Education in Road Safety: are we getting it right? (McKenna, 2010)
- Meta-analysis of the effect of road safety campaigns on accidents (Ro et al., 2011)
- The Impact of threat appeals on risky driving behaviours (Carey, 2014)
- Behaviour Change Symposium (Campsall, 2016)
- Development of a communication approach to tackle younger driver safety on rural roads (Christmas et al., 2016)
- A review of interventions which seek to increase the safety of young and novice drivers (Pressley et al., 2017)
- Paving the Way, putting behaviour change at the heart of a safe system (Christmas et al., 2017)
- Young driver safety: behaviour change techniques (Sullman, 2017)

- Using Behaviour Change Techniques: Guidance for the road safety community (Fylan, 2017)
- Effectiveness of UK road safety behaviour change interventions (Fosdick, 2019)
- RideFree - Refreshing our approach to motorcycle safety (Fosdick et al., 2019)
- Creating a cultural maturity model to assess Safe System readiness within road safety organisations (Fosdick et al., 2024b)
- Empowering young drivers with road safety education (Box, 2023)

Despite this body of work, a survey and focus groups conducted by Agilysis, commissioned by the RAC Foundation in 2019, revealed that there is still a long way to go. Of the 87 responses gathered from 78 organisations, the average percentage of interventions designed using behaviour change theories was just 32% (Fosdick, 2019). The largest group of respondents, labelled '*Believe in Yourself*', were practitioners who applied behaviour change theories to less than 50% of their interventions, and evaluated less than half of those. Although the sample size is small and may not fully represent the entire sector, it offers a useful snapshot of where the sector stood pre pandemic. The sector requires a more consistent and evidence-based application of behavioural science to drive sustainable change.

One tool which can help practitioners and policy makers in their understanding of a behavioural problem and which interventions could be adopted to help solve it is the Double Diamond (Design Council, 2003). Agilysis have further developed it to provide road safety specific pointers (Agilysis, 2017).

It comprises of four streamlined stages: Discover, Define, Develop, and Deliver as illustrated in Figure 11.

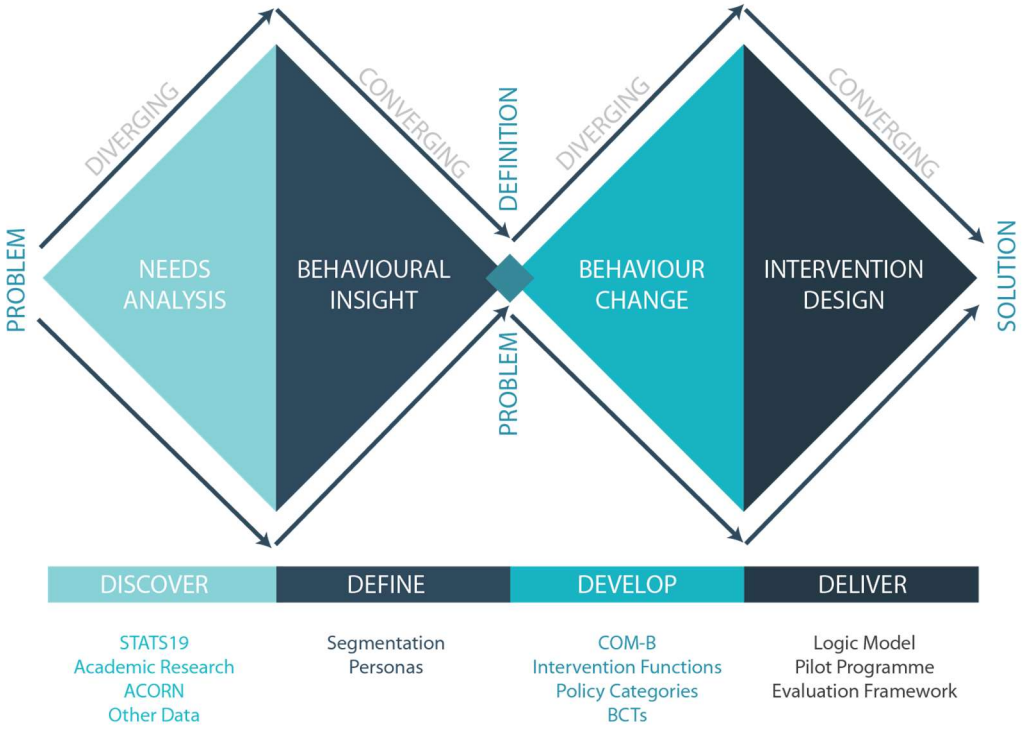

Figure 11 - Double Diamond Framework 2017 (developed from Design Council concept)

“If you try and take a cat apart to see how it works, the first thing you have on your hands is a non-working cat.”

Douglas Adams

Discover

Much like all challenges we seek to address, the first step in developing an intervention is to identify the behaviour you want to change. At this stage, it is crucial to wear your "*experimenter hat*", as what initially appears to be a problematic behaviour could, in fact, be an enabler. For example, if a child's behaviour is seen as being inattentive or disruptive in school, it initially appears problematic. Without knowing the underlying reason, it could be attributed to conditions like ADHD or Dyslexia, leading to interventions focused on these problems. However, this problematic behaviour can enable a deeper exploration of possible causes, such as undiagnosed vision problems. Once identified, providing the child with glasses could dramatically improve attention and engagement in class.

As some behavioural scientists suggest, identifying the problem can often be more challenging than finding the solution. At this stage, the purpose is to 'go wide' and collate all of the information you can about what the problem might be – who is involved in, where, when, with whom, and in what context. The key points at this stage are: 1) make no assumptions about what is causing the problem and 2) don't start to think about potential solutions.

Depending on your problem area, it is best to start with understanding what is already out there in terms of research. In the world of road safety, we should start with our official source of collision data: STATS19. This data should then be augmented with other data sources to bring clarity. In-depth fatal collisions can provide rich, detailed insight after specialist investigations. Socio-demographic data can be linked to information about those engaging in the behaviour to provide understanding of the context in which the behaviour occurs. You can use a variety of other methods of data collection to discover more about the behaviour(s). One approach is using self-reported surveys with validated scales to measure key behavioural factors such as perceived risk, ability, confidence and more. These scales provide insight into the psychological dimensions of behaviour. Other methods of uncovering related behaviours can be found through varying the approach to data collection or research methodologies; simulators, naturalistic driving or observation studies can enrich our data, while conducting interviews or focus groups with diverse questions can uncover underlying influences.

For instance, if you are trying to improve cycling within a five-mile radius in a particular area, if we intuitively assume that providing knowledge will increase cycling uptake, we might potentially overlook root causes that are less obvious. For instance, it could simply be that people are not motivated to cycle because of a steep incline. In this case, the root cause would be the topography of the area and knowledge would not lead to a change in the behaviour.

Another, pertinent aspect to consider is how far you should dissect a problem. In other words, is it worth considering a broader systems approach to the same? (Rentoul, 2019):

> *"If you try and take a cat apart to see how it works, the first thing you have on your hands is a non-working cat." Douglas Adams*

Sometimes, addressing the behaviour on its own might not yield the results you are looking for. In such cases, a systems thinking approach can help you analyse the problem as part of a larger, interconnected framework. For example, improving seatbelt compliance requires more than a single intervention. It demands a combination of strategies: ensuring knowledge about seatbelt safety, using reminders, and enforcing compliance, among other factors. This systems-level thinking helps ensure that you're addressing the full complexity of the problem, not just one piece of it.

Once you start delving into the problem, it could end up creating more questions and requiring more evidence to be explored! Bringing together stakeholders and experts at this phase will help with

interpretation of data and research, which may also lead to further questioning but will also start to generate insights.

The key element of the Discover phase is striking a balance: keeping insights focused enough to uncover deeper problems but broad enough to capture surrounding factors.

Define

Once we have a brief background knowledge of the ecosystem in which the target group and the behaviour operates, the defining phase helps us in converging and defining the problem(s). The definition of the behaviour should ideally answer some pertinent questions such as:

- What is the exact behaviour?
- Where does the behaviour occur?
- What is the target group for the behaviour or who is involved in performing the behaviour?

Consider the seatbelt example mentioned above and assume our objective is increasing seatbelt use among backseat passengers. To achieve this, it is important to first identify the enablers and barriers. Enablers might include clear communication about the safety benefits of wearing a seatbelt and/or the implementation of in-car reminders. On the other hand, barriers could stem from a lack of awareness about the risks of not wearing a seatbelt in the back seat, or the belief that it is unnecessary. Of course, we want to increase seatbelt wearing per se but if we do not understand that there is a knowledge gap about the need to wear a seatbelt in the back seat or that the reason there is a belief it is unnecessary is because of social norms, we will not be treating the problem effectively.

At the end of this phase, we can fully define the problem. Rather than starting with a general problem of high numbers of young people being killed or seriously injured in collisions, we can use the Discover and Define phases to determine that the target audience are young male car passengers and that the behaviour we want to change is non-seatbelt wearing when in a car with other young males. We can link seatbelt wearing rates to severity risk through extensive research studies so by targeting this specific problem, we can have some confidence that we can achieve our overall goals of reducing their likelihood of death or serious injury.

Develop

In this stage, we move towards designing a behavioural intervention that aligns with the defined behaviour(s) and target group(s). This marks the transition into the second diamond of the Double Diamond approach, which focuses on developing and evaluating the intervention. The "Develop" phase emphasises exploring a wide range of possible interventions before narrowing down the most effective ones. Just as in the "Discover" phase, this stage requires a mindset of experimentation to understand what truly works for the identified problem. Again, ‘go wide’ and put all potential interventions on the table and don’t jump to the familiar, quickest, or easiest.

As practitioners, we often default to familiar behaviour change theories such as the Theory of Planned Behaviour, Stages of Change, COM-B, the Prototype Willingness Model. This tendency may be due to limited exposure to the full spectrum of available theories; a tendency to build on prior research; a lack of motivation to explore further; or the time constraints that make it difficult to delve into other frameworks. An excellent resource for broadening our understanding of behaviour change theories is *The ABC of Behaviour Change Theories* by (Michie et al., 2014), which provides a comprehensive guide to diverse models.

There is also a perception whether following through with a behaviour change theory would guarantee change in the behaviour. The previous stages have helped us to define the behavioural

problem and understood our target groups; behaviour change is now contingent on choosing the right behavioural theory so that the levers used to create change are the right ones.

So, why is it still recommended to utilise a theory? Theories offer us a structured understanding of specific behaviours. They provide a roadmap, guiding us through the pathways of behaviour change by highlighting key constructs that need attention (Michie & Johnston, 2012). Given the complexity of behaviour change, which involves numerous influencing factors, the use of theory can help mitigate cognitive overload. It offers clarity, enabling us to visualise how change might unfold.

It is equally important to incorporate Behaviour Change Techniques (BCTs)—the "*active ingredients*" of an intervention (Michie et al., 2014). BCTs are the observable, actionable elements within an intervention, including techniques like providing feedback on behaviour, restructuring the physical environment, and more. There are several key benefits to using BCTs:

- **Broader range of techniques**: They expand our toolkit, moving beyond traditional methods like the 5Es to include a wider variety of techniques that can be adapted to different contexts.
- **Consistency and comparability**: Standardising the language and coding of techniques provides consistency across interventions, making it easier to evaluate and compare what works across different contexts.

Ultimately, integrating behaviour change theories and BCTs provides a framework that not only simplifies the complexity of behaviour but also enhances the effectiveness of interventions. By doing so, we can create more precise, measurable, and impactful interventions for driving lasting behavioural change.

Traditionally, behaviour change models were designed with the aim of incorporating BCTs from the outset. However, this practice has been neglected in the field of behavioural science. Few practitioners in our sector consistently use BCTs, and even fewer evaluate their effectiveness. This raises an important question: do we, as a sector, need to undergo our own behaviour change? Should we reflect on what would help us adopt these practices more effectively?

We often rely on intuition when designing behavioural interventions, yet the interventions we believe to be most effective sometimes fail to deliver. A significant recent study, widely discussed in the behavioural science community, addresses this very issue: *Which determinants are the most effective to target when designing and selecting behaviour change interventions?* (Albarracin et al., 2024).

Whilst the findings around individual determinants commonly agree about what might be most effective in terms of behavioural interventions (and indeed what might not work!) this doesn't mean that we can shortcut the process of intervention design. If we have a particular behavioural diagnosis, consideration of the influences (e.g. COM-B), identification of appropriate intervention functions and classification or behaviour change techniques – these still need validating experimentally for efficacy and confounding effects. Careful consideration also needs to be given to whether interventions are aimed at the individual or population level; much of the current evidence on behaviour change interventions is focused on individuals, rather than the population (Hagger & Weed, 2019).

Yet, the broader question is whether population-level interventions might be more impactful. Research by (Swinburn et al., 2011) highlights a framework for tackling obesity that emphasises systemic and environmental drivers as key factors for behavioural change (Figure 12). These drivers, often influenced by policy interventions, have the potential for large-scale impact but are difficult to implement due to their reliance on national government action. This might explain why many practitioners gravitate towards individual-level interventions where we can exert more direct control.

As in any science-based discipline, behavioural science relies on building knowledge from prior research and using that foundation to design interventions. However, our current literature tends to focus on a limited range of interventions and theories. This skews the evidence base, meaning we need to be mindful of how we conduct research and evaluate future interventions. The pathways we choose now shape the future of behavioural change in our sector, and we must ensure we are advancing practices that are both evidence-based and effective.

What can we do as a sector to systematically drive behaviour change?

Harry Rutter from the London School of Hygiene and Tropical Medicine makes an insightful point in a video on reducing obesity levels. He suggests that we might be asking the wrong questions when it comes to our interventions.

Typically, when designing behavioural interventions, we ask:

- Who needs to perform the behaviour?
- What does the target group need to do differently to achieve the desired outcome?
- When do they need to do it?
- Where do they need to do it?
- How often do they need to do it?
- With whom do they need to do it?
- Which intervention would lead to behaviour change?

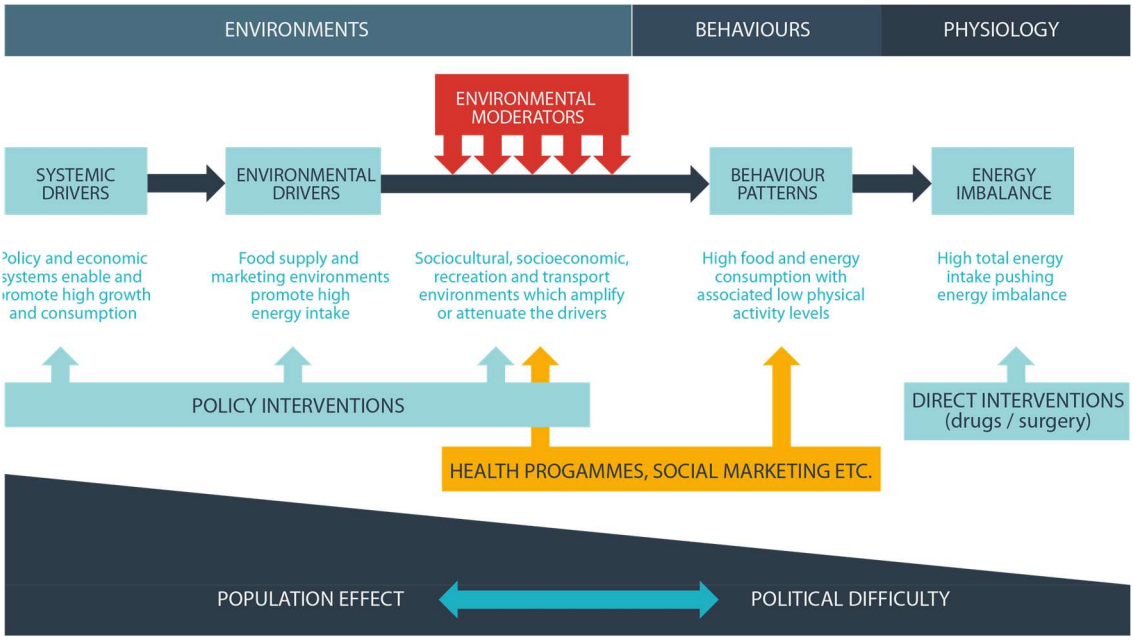

Figure 12 - Systemic Framework showcasing population and individual effects. (Taken from Swinburn et al., 2011)

While these are valid and necessary questions, Rutter argues that we need to shift our focus from identifying a single intervention to understanding how that intervention fits within a broader system. Instead of focusing solely on "what will change behaviour," we should be asking "how does this intervention integrate into a larger system of interventions?"

This systemic thinking should extend beyond the initial discovery and definition stages; it needs to be applied when designing the intervention itself. Marketing provides a powerful example of systemic behaviour change. For instance, when you visit a retail store, the entire experience is carefully orchestrated to encourage you to buy. From the product displays at the entrance, to the strategic layout of trendy clothes, to the lighting in fitting rooms, and even the small items placed near the tills,

the entire process is designed to influence us to buy a product. Although the ethics of such techniques can be debated, the marketing industry has long mastered systemic thinking, well before behavioural science formalised it.

As practitioners, we should look more closely at the environments around us. Many systems are already operating in a way that influences behaviour on a large scale. By observing these environments, we can take inspiration and begin applying systemic thinking to drive behaviour change at a population level. If we want to create long-lasting change, we need to think beyond individual interventions and see the bigger picture; how everything connects and works together as part of a wider system.

Deliver

This is the final stage of intervention design, where the focus shifts to converging on the final intervention plan and establishing a robust evaluation framework. At this stage, it is often beneficial to conduct a pilot before fully rolling out the intervention. As road safety practitioners, we understand that human error is inevitable, and piloting allows us to identify and address any unforeseen issues, improving the intervention's effectiveness.

One powerful tool at this stage is utilising a logic model, that maps out the potential chain of causation and helps anticipate factors that could impact the delivery of the intervention. By visually aligning inputs, activities, outputs, and outcomes with our clearly defined aims and objectives, we can understand how each component connects and contributes to the desired change.

To define the behaviour we want to change, it is helpful to frame it using the SMART criteria: Specific, Measurable, Achievable, Relevant, and Time-bound. For instance, instead of a vague goal, "encourage more backseat passengers to wear seatbelts," we can create a more focused objective:

SMART Goal: "Increase the rate of seatbelt use among backseat passengers from 40% to 55% within six months."

Setting a SMART goal does more than just sharpen our focus, it transforms a broad aim into a measurable target. This helps in providing a clear mechanism to track the success of the intervention. If we are able to measure the impact, we will know whether our strategy is effective, allowing us to adjust and improve it over time.

This reflective process raises an important question: how often do we, in our attempts to change behaviour, set clear, measurable goals? By being intentional and precise, we increase our chances of success and give ourselves the tools to evaluate whether our efforts truly make a difference.

Once an intervention is implemented, the next critical step is evaluation. Ideally, the evaluation framework will have been established beforehand to ensure clear metrics for measuring effectiveness are based around the SMART objectives described above. When using a systems approach, a key question arises: should we evaluate each intervention individually, or assess the entire system of interventions as a whole?

Traditional evaluation methods, tend to focus on isolating the impact of individual interventions to determine the effect size of each intervention individually. This approach has its merits, as it enables us to assess the effectiveness of each intervention and focus on deploying only the most impactful ones in the future. However, systemic interventions are built on the understanding that change occurs within a network of interdependent factors. This may call for a broader evaluation strategy that

considers the overall impact of the interconnected interventions, rather than treating each one in isolation to offer deeper insights into how these elements work together to foster sustained behaviour change.

Though this process may seem resource-intensive in terms of both time and funding, it is important to weigh this against the potential waste of resources if interventions fail to achieve meaningful change (or worse, creates unintended negative consequences). In the end, investing in thorough design and evaluation ensures that the interventions we implement are effective, and ultimately, contribute to safer, more sustainable outcomes.

Recommendations Reappraised

In considering whether this whitepaper should propose some recommendations, we explored a range of advice emerging from the literature and sectoral engagement over the last decade. Taken together, they provide us with a fairly comprehensive 'To Do' list that would represent progress:

- **A national framework for evidence and repository for access –** following the deprecation of the Road Safety Observatory, there is no place where evidence of interventions is regularly reviewed and syntheses to inform practice are published.
  (Behaviour Change Symposium, 2016)
- **A national framework of professional standards –** the language of 'road safe profession' has been used for many years, but the lack of an agreed competency framework with training requirements remains a glaring omission.
  (Road Safety Education Forum, 2022)
- **Standardised approaches for intervention design and creation of licensed products –** for many years we have discussed the idea of consolidating the approach of designing behavioural interventions or indeed working collaboratively to develop a suite of approved products. These actions would save significant cost, time and effort, whilst improving outcomes.
  (Behaviour Change Symposium, 2016)
- **Raise standards & skills across the sector –** in line with the need for a national framework of professional standards (raised above) the sector would benefit from a wider range of interventions (mentoring, coaching, expert clinics, webinars, symposia etc.) aimed at improving professional practice.
  (Paving the Way, 2017)
- **Take stock of current interventions –** many interventions continue without rigorous evaluation or routine monitoring, often in competition with other publicly funded programmes. National and regional stocktakes to review, rationalise and refocus effort would improve overall capacity and outcomes.
  (Effectiveness of UK road safety behaviour change interventions, 2019)
- **Collaborative design approaches between academics & practitioners –** whilst this has been arguably improved through Road Safety Trust funded projects, unhealthy gaps between theory and practice remain unaddressed.
  (Effectiveness of UK road safety behaviour change interventions, 2019)
- **A review of current design guides to encompass the Safe System approach –** from appraisal and risk assessment to specific infrastructure specification, the Safe System is not codified in our manuals for practitioners which is a discreet area of behaviour change in itself
  (Safe System and Local Partnerships, 2022)

Beyond these recommendations already made, there are a number of steps that the authors propose would help us to develop a more mature consideration of the role of behavioural science in our application of the Safe System.

- **Mapping behaviour across the Safe System** – as highlighted earlier in this White Paper, the challenges of behaviour are across the Safe System, from leaders who lack understanding to organisations with immature culture, from human-centred design to the perverse incentives

that some standards or guidance can induce. Navigating the system and mapping out these flows and dependencies is a first step in beginning to address them.

- **Interdisciplinary dialogue** – engineers understanding the behavioural outcome of design, enforcement authorities understanding how enforcement complements other system responses, we have highlighted the need for disciplines to come together and recognise that the behaviour we get is the outcome of the system we have designed. Until we change our approach, we will continue to get the same results.
- **Developing Corporate Culture** – while we may talk about safety being everyone's number one priority, the reality is that our decision-making and investment priorities convey a different narrative. Working on the culture (and associated behaviours) that underpin our ambitions to eradicate death and serious injury needs to be taken seriously.
- **Work out the scale of the innovation gap**. We already have a range of known interventions that, if applied consistently across the network, would deliver improvements but will not lead to an ultimate Safe System. We therefore need to evaluate and enumerate the scale of the gap that will have to be addressed through innovation.
- **A Safe System Playbook** - more than a manual, we need to develop a way of identifying fragile system performance, performing a behavioural diagnosis, cataloguing potential responses, piloting and testing countermeasures and building the evidence for scale-up response.

Where Next?

Finally, as we stand on the cusp of a new national road safety strategy, and burgeoning ambition across the country to embrace a vision for eradicating zero death and serious injury by 2050, there is clearly still some significant work to progress, that will help us in embracing the behavioural components of a Safe System for the country.

- **A grown-up conversation about the levels of personal freedom that can be enjoyed in a safe mobility system.** There is a danger of 'cakeism'[1] with our current approach to Safe System, that we can get there with mild tweaks and incremental improvements that will be publicly palatable. Without giving serious consideration to interventions such as reducing traffic volumes, segregation, prioritisation of vulnerable modes, enhanced vehicle safety regulation, management of speed and more rigorous training and monitoring of road users, we will not make meaningful progress.
- **Increasing accountability for the operation of the system.** At present the continued willingness to point to the behaviour of road users along with the profusion of agencies and organisations involved in operating the road network and the lack of a rigorous accountability framework disincentivises institutions from intervening as they must. Defining the governance and accountability arrangements more clearly, will make it easier to ensure that obligations are robustly discharged and system operators do not enjoy the freedom to evade responsibility.
- **Capacity building to address the needs of the system.** Over the last decade or more, our approach to Safe System has been overly theoretical and strategic, but the vision alone will not deliver a changed set of our poor system outcomes in terms of lives cut short or dramatically altered through road traffic injury; we need capacity. This means a strategic need to consider the skills, tools and standards required to deliver the system imagined in the forthcoming strategy.

[1] *Cakeism* is the idea that it's possible to have or do two good things at the same time when it is impossible to simultaneously resolve the demands or effects of both.

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