Chris Kennett Consulting Limited

Traffic Signal Engineering

Design, Perception and Driver Behaviour

JCT Symposium 2024

Written and presented by Chris Kennett FIHE and Ethan Baxter AppIHE

chris@chriskennett.consulting
ethan.baxter@chriskennett.consulting

03301 336 316

May I Have Your Attention

Why do drivers persistently use wrong lanes or run red lights when we (Traffic Signal and Highways Designers) have provided clear information? When we create designs, can we get the driver behaviour we want just by telling them what to do? Or is perception more important than information?

This paper looks into how junction design influences driver perception, and how that changes behaviour. Written applying decades of experience and a fresh pair of eyes, we explore how we might get drivers to react the way we want, just through our design choices.

This paper is NOT a critique on any particular junctions or designs (or designers), but we will look at examples which have and haven't worked. What we are trying to achieve is a better understanding of why a design feature works in one place – but seemingly not in another.

In writing this paper, we call on over 20 years of experience and opinion in traffic signal design and operation, with observations made by someone with less than two years of experience. This is not a research paper per se, and the selection of sites for examples is biased towards those with known problems, but the observations are genuine and reported factually. There is insufficient data here to formulate a theory, but we hope to apply work in other fields – specifically the psychology of perception – along with our experience and observations, in order to (hopefully) improve our designs.

Please Proceed

We Highways Designers tend to fall into two different types:

- "The *Guidance says that is how it should be done. They should just learn to drive*", or
- *"That's just how we do things round 'ere. People understand sooner or later."*

Experience proves that Designers being asked to deviate from what they have learnt (either from DMRB, or from their own local foibles) tends to make us itch, twitch and otherwise worry. But why do we find that some solutions work perfectly well on one site – but not at all on another?

There is a certain envy that some Traffic Engineers experience visiting a new City or place they are unfamiliar with and see a traffic control technique or layout working, and think "*it would never work at home*". Even worse is to see it work in practice, be convinced, introduce it… and find no one understands it or can use it. Perhaps early-start green arrows (of which there are at least two different kinds) would work in the South of England? We can blame some of this on drive unfamiliarity, after all most people don't really travel far.

We still have problems with driver behaviour at the most ubiquitous and oldest types of facility though. Why do some authorities find problems with indicative right turn arrows? In some cases almost all the injury accidents at a junction may be around one right turn.

Likewise, some junction and roundabout approaches just seem to attract accidents or complaints in ways that other do not.

Our instinctive approach is to check it meets standards (tick, yes). Fixed signage (tick, yes). Add more of everything? (tick again). Nothing seems to do the job and so on future schemes we insist on doubling up on lots of tall poles and fixed signs – perhaps even VMS or actuated signs to warn drivers – in fear of another site that drivers just don't seem to "get".

What is going on at these sites and where are we going wrong? Or are we going wrong? Perhaps we just need to think about what we are trying to achieve differently.

Read This Way

When we design a traffic signal site we might think we are taking conventions and standards, applying them as we've been taught; our design is a physical thing ready to be built. That is true at a superficial level, but we are planning to control traffic.

Planning is a form of design. "Traffic" consists of "people", regardless of whether they are driving, walking, riding etc. And control is no such thing – we cannot control people, only ask, guide, encourage or otherwise coerce.

So we are really designing a ***system to coerce strangers to do what we want***. If you put it in those terms to the public they may react….. negatively. And we see this in practice: road features and sites seen as gratuitous or unnecessary often get higher levels of non-compliance, generating complaints about the very nature and need for the site. The same is true of safety cameras, CCTV and speed limits.

One key aspect to getting people to willingly comply is acceptance – when people recognise the need (for a junction or crossing), they are much more obliging and cooperative. They tend to stop when they see a red signal.

Behaviour is driven by individual morals: drivers (in particular) are more likely to comply when they recognise the need, and therefore the legitimacy of the request. This behaviour is also learnt – from hours of driving lessons, touch screen tests, and being honked at (or worse) when they digress. Compliance breeds compliance by setting a social "norm", which recognises the need and then establishes good behaviour. Of course the opposite can be equally true.

This much is obvious and can easily be seen in practice – when is a driver mostly likely to ignore a red light? Answer: when the driver in front has done so already. Just watch a queue at a set of temporary lights stuck on all-red. Once the first driver goes, the social convention is already broken, so the next driver does not feel bound by it.

We can accept that most drivers are instinctively trying to *behave correctly*. What explains the phenomenon of particular sites, approaches, or just one specific manoeuvre which, despite being designed at or above standards, people get *wrong*?

This is where the second type of Highway Designer offers their opinion. A slight tweak to a road marking, a phase delay added, or a different type of hood fitted, because "that's how WE do it…" and the problem *might* go away.

Do Concentrate

A slight digression – how much attention do you pay while driving, or while waiting at a pedestrian crossing for the lights to change?

There have been many research projects and papers that have shown the wide differences in situational awareness between drivers at all levels of experience. This situational awareness has an impact on the persons "perception factors", or how they perceive the moving world around them as they travel. For our purposes, the fact that people have different levels of awareness of the situation they are in is not the point, as we are not in a position to affect their awareness. However this raises a new aspect to consider – *perception*.

Perception is how we instinctively interpret and understand our surroundings. We use our perception all the time at a sub-conscious level to inform our actions – our behaviour. Working at a sub-conscious level, our perception informs our reflexes faster than our conscious mind can process.

Driving (for example) is difficult to learn initially, because we have to process every situation at a conscious level, often with someone talking next to us giving instructions. As we learn we build our ability to perceive the vehicle and our surroundings without really thinking about them. Our speed of response improves to the point where our responses are automatic. To demonstrate this to yourself (drivers) try sitting in the passenger seat of a fast car and pay attention to how often you push against the floor with your brake-foot.

Young children can often (counterintuitively) be seen to be use pedestrian crossings most-correctly. They have not yet established the experience to allow them to stand chatting to each other before instinctively walking into traffic when they hear the beep-beep of a reversing van or shop alarm.

For people to be able to respond instinctively, they must see the traffic signals and sub-consciously build a model of the part of the junction they are travelling through in their own mind. This must be near-instant, so no time to read text on road signs (reading is a slow process), or compare with other junctions. It is well established that we actually see relatively little of what we are looking at anyway – we absorb some of the details and our memory (or imagination) fills in the rest *[Tong, Pearson & Clifford, 2008, 'Mind's Eye' Influences Visual Perception, Science Daily]* . Our driver's perception of the traffic signals is formed in a blink.

We also ignore things that don't fit with what we are expecting to see or experience. For a very real example of this, just search the internet for "Selective Attention Test" and count how many times the players in white pass the ball. The so-called test doesn't work for everybody – you are paying more attention because you have searched for it and expect something to happen. But the fact it exists, and unsuspecting persons miss the Gorilla in the video, shows how powerful this trait to ignore things we don't expect can be.

This perception can be expected to play a role in driver behaviour. If they want to drive correctly, and they perceive the junction or crossing as we intend, they should respond and behave as we wish they would. Assuming the willingness to comply remains the same – if

the driver (or cyclists, or pedestrian) perceives the road in a way other than we intended, their behaviour may well reflect that difference.

Let us get back to design now. Our design meets standards and guidance. It is drawn in accordance with TSRGD, DMRB and Chapter 6, but how will drivers perceive it? The difference between an ideal design and the built world is stark. Guidance such as Manual for Streets (both publications), are firm on the idea that the design of the street should reflect how people are expected to use it. This is closer to what we have discussed so far, but is often seen simply as a relaxation in standards, rather than the conceptual approach it is meant to represent.

We draw, review and audit our designs on 2D plans and unless spending millions on “digital twins” and “visualisations”, we don’t see them in the same way that a driver will: from just above ground level, moving fast towards. Even with modern design aids, we don’t consider the driver’s short time to absorb and contextualise the world around them. We also don’t generally consider their lack of technical knowledge. Because we know the difference between an indicative right turn and a separately signalled right turn, we expect they will recognise it instantly too.

So how do our (subtle) design choices influence driver perception? Can we recognise and predict the effect of these differences? And if so, can we use those differences to get the behaviour we would like?

What Do You See?

Ethan toured a number of sites to specifically look at how drivers react to different features at right turns, while Chris investigated several known cases involving drivers reacting unexpectedly or inappropriately to signals.

Awareness of what you are approaching

Junction 8 of the A1139 is a roundabout between two A-class roads, forming part of a high speed dual carriageway ring-road system. The roundabout itself is entirely at-grade but due to its four lane approaches, is signal controlled. The junction has had a long history of accidents, particularly on one approach. Drivers have been known to approach the roundabout far too fast and hit the centre of the roundabout.

Figure 1. Photo - Peterborough Telegraph, photo Terry-Harris

It seems as though drivers don't know it is there, which might be a visibility problem. But the site is fitted with three tall poles and a mast arm, with seven heads in total. The centre of the roundabout is raised, has chevron signs and trees. It seems really easy to see.

Following a fatal accident in 2019, an effort was made to understand why these crashes were happening. Rather than change the traffic signals, an old barrier railing on the offside of the road was replaced and moved to bring it closer to the carriageway, making the railing follow the offside kerb line in an arc, rather than going across the central reservation in a straight line.

Figure 2. A1139 Junction 8 before (left) and after (right), Google Street View

The theory was that drivers were seeing the lights shine off the barrier rail in the dark and were subconsciously following it. Even though the traffic signals were visible, they just weren't looking at them and would drive through the gap between railing and signals, or hit the offside primary pole.

The accident data is difficult to compare because of Covid, but the total number of injury accidents at the roundabout since the change has reduced from 32 over four years before,

to 18 in the four years since. Of those, the number of serious or fatal accidents has reduced from 7, to 1. Accident data for 2020 (the year the barrier was changed, and affected by COVID) has been left out.

Large roundabouts and gyratories in the area have been designed slightly different since, with this in mind. They now use fewer tall poles and mast arms, but use additional secondary heads on standard height poles. The surrounding features are also considered to make sure they don't mislead drivers, so the barrier rails will follow the kerb or have chevron boards on the radius, in the drivers eye. It is difficult to judge these using numbers as the sites are so different, but the accident numbers don't stand out in the local statistics and they don't have the same reputation for bad accidents with the public.

Figure 3. A47 Junction 20, designed with signals and clues to road alignment in the driver's line of sight, Google Street View

Controlling right turns

Views Common

A junction in Huntingdon was built to create a new access onto an existing road. The junction is close to a hospital and directly outside the Police Headquarters. One of the approaches was built with the right turn (to the hospital) as a give-way right turn.

After the site was commissioned there were crashes almost immediately. The site generated many complaints, as well as the attention of the police, hospital and local councillors. Damaged car parts could normally be found in the road or by the side of it. Changes were made to try to create the impression of a give way right turn, by adding lane markings and an arrow in the middle of the junction, but there was no noticeable improvement.

Figure 4. Views Common Rd, earliest (left) to latest (right), photo R Ling

The accidents were only stopped when the signal heads and stage sequence was changed, to fully separately signal the right turn so that drivers didn't need to give way.

To start with it was difficult to see why adding the white lines didn't work. But looking across the junction, the oncoming traffic is not in the driver's eye line because the junction is so big. The lane lines which were added bend towards the exit (because the junction is so big), so the effect is to create a fast lane through the right turn, rather than a centre line to cross. Finally, the offside primary and closely associated secondary catch the driver's attention and look a lot like a fully signalled right turn.

Westfield Road, Lime Kiln Close

The layout of this site it looks quite similar to another site I (Ethan) visited but had completely different results. Similar to the A10, London Road junction I'll talk about in a moment, this site features lots of white lining after the stop line creating what looks like two lanes to drive through to.

Figure 5. Westfield Road Approach, vehicle waiting (left) and natural track path (right), image Google.

Now despite this, drivers were very hesitant to pull over the stopline and the whole time I was on site only 2 drivers over shot the stopline on a red and on green nobody ever pulled further over the stopline that 1.5 car lengths and many drivers would sit at the stopline to wait for the arrow (6 drivers) or a gap (3 drivers) to appear. Now I think the answer to why I saw such different results lies within the junction geometry, as shown below there is no real benefit from driving much further than half a cars length over the stop line. The drivers are looking at their exit and therefore don't overshoot as not only does it not give them an advantage it actually puts them at a disadvantage.

Harston

When I was at the A10, London Road junction in Harston, one of the things I noticed more here than any of the other sites id have been to was the speed of approaching vehicles in the right turn lane especially compared to the ahead lane. Drivers were hitting the brakes late, and they were hitting them hard. And even despite this harsh breaking it was not enough to stop a fair number of drivers overshooting the stopline.

Figure 6. Approach to Harston Junction, Google (left), and a vehicle stopped having overshot the stop line, (right).

As shown here you can see there is a lot of white lining past the stopline including lane markings through the ped crossing, which I think is a partial cause for this heavy breaking. With the extended lane making having no proper gap from start to end and the hatching almost acting like a stop line, the secondary heads act as a false primary.

Hartford Road

While I was out at the Hartford Road, Desborough road junction in Huntingdon I saw the most varied results I got from one junction. I had all manner of combinations of what people thought was right.

The junction has a right turn “box” painted in the middle, to encourage drivers to pull forward and give way. I saw 3 separate drivers pull into the right turn box on a full green but wait for the arrow to come up before making their turn and I even saw 2 drivers cross the stop line on a red but then sit stationary on full green until the arrow was shown, despite there being multiple opportunities for them to make the turn. This made me wonder if perhaps the box was being perceived as the stop line.

Figure 7. Driver stopped in right turn "box", instead of at stop line.

Thinking back to what’s already been said by both Chris and I, I think where drivers stop is generally more down to the geometry of the junction that determines if people will overshoot.

How drivers recognise whether they need to stop, or give way, or go, depends on what the junction looks like. If the junction has lots of white lining in the middle and far side secondary signals, drivers are more likely to treat it like a give way. Big junctions with no white lines to cross and closely associated secondaries, drivers are more likely to see as full signalled, and they might not give way.

But junctions with unusual markings can mislead drivers as to where to stop, or even if they should stop or give way.

Secondary signals and internal stop lines

A final phenomena we looked at was raised recently on site by a member of public. At one site, several people commented about how drivers frequently stopped in the middle of the junction. It was quite easy to see what drivers were reacting to – the secondary signal for the main road – but why do they stop at it. Secondary signals are very common, so this should not catch drivers by surprise. Many signal engineers have seen something similar at certain sites – and it happens at them repeatedly, so this is the junction being perceived wrongly, rather than individual drivers making the same mistake over again.

Figure 8. Learner driver stopped at secondary signal

The common design features on sites where this is misunderstood are that there is a crossing over the exit, to an island with a secondary signal close by, and often tall poles on either side of the crossing (even if they don't all have signal heads). Some drivers perceive a separate crossing – an internal stop line. We can't blame drivers for responding this way when white lining is so often worn or not replaced.

Figure 9. Exit of a junction at which drivers used to stop at the secondary - until it was moved. Google

At this site in Wisbech, the secondary signal had to be moved from the island to the right, before drivers from the side road would ignore it. There may be some conscious thought or confusion at these sites, but once those features are taken away – by moving the secondary signal and reducing the height of the poles, it no longer looks like a crossing. Once that is the case, drivers react as we want them to – without them needing to think.

Thinking as We Go

Many studies have looked at driver perception speed, distraction, and the effect of concentration on perception. It is widely understood that most accidents are the result of driver error, with it being shown [*Dingus et al, 2016, Driver crash risk factors and prevalence evaluation using naturalistic driving data, Proceedings of the National Academy of Science*] that 90% of 'critical incidents' are attributable to drivers. Distraction and lack of concentration correlate strongly with driver performance in specific measured tasks, but there is little outward sign of this lack of concentration: drivers are simply acting automatically in response to their perceived surroundings [*Qu et al, 2015, The relationship between mind wandering and dangerous driving among Chinese drivers, Safety Science*]. But that perception is narrowed and reduced – contextual information is missed.

Other studies unrelated to driving have looked at the impact of limiting visual and other sensory stimulus to people. Altering a person's sensory environment through the reduction or application of full body stimulus has been showed to change how people experience time itself. [*Glicksohn et al, 2017, Time Perception and the Experience of Time When Immersed in and Altered Sensory Environment, Frontiers – Human Neuroscience*]. As before, this chimes with our real-world experience; sitting in a non-moving queue of traffic seems to take forever, while cruising on a motorway for the same period can flash past, with little memory of the journey.

It seems as though the more information our driver is being subject to, while not having to put much conscious thought in, the more they rely on subconscious autopilot. But this means when they arrive at a decision point requiring active thought and effort they may have already missed many of the visual ques and context.

Our drivers are potentially arriving at our junction 'waking up' from a period of diminished perception, forming a near-immediate model of what they are expected to do and how to behave. To build this model fast enough, they are taking the briefest visual clues and filling in the rest of the junction from memory or imagination. Even if there is something that doesn't quite fit with this model, their mind just 'retcons' this in later, without worrying the driver too much – their model is already complete, and their autopilot is ready to respond.

Seeing The Light

Use what drivers see to tell a story

As we see in the case studies looking at road layout approaching large roundabouts and interchanges, visibility alone is not enough.

We tend to think that drivers will follow the road, and the signals just need to convey a stop / go message. Many designers and safety auditors express their opinion that this stop / go message needs to be seen far in advance of the signals – over the tops of lorries or other large vehicles. Of course if those vehicles don't move, if they slow down or stop, the signal is irrelevant, the driver cannot proceed.

We know from experience that good forward visibility is important, but it goes beyond allowing drivers enough time to respond to a red.

The signals themselves form part of the overall contextual information to the driver. Regardless of the current state, the lit signal head immediately conveys an instinctive meaning – a junction is coming up. If this is in the narrow eyeline of a driver early, even if it is seen between gaps in other vehicles, the message should be received. As the driver approaches, the arrangement of signal heads (as the most visible and prominent feature) helps to build the subconscious model along with signs, rails and kerbs.

This is updated as the driver travels towards the site, but each new piece of information provided needs to build that consistent model – anything not fitting or outside of the driver's narrow field of perception is more likely to be lost or ignored.

As the driver finally arrives at the junction they may well 'wake up', but their perception of the junction is already formed. Tall poles or mast arms are likely to be out of their sight line, with the driver concentrating on what is immediately in front of them and the hazards they perceive.

Considering this, mast arms and tall poles play only a very limited role in achieving driver compliance. Much more important is placing signal heads relevant to the driver close to their natural field of view both initially and throughout their approach, up to the stop line. Accepting that many drivers will be acting instinctively, by our deliberate placement of simple messages into their natural sight line we can convey our message and meaning, forming a more accurate model of the junction in their mind.

This is even / especially true of the geometry of the junction. Multiple signals in front and to the right of the drivers give an immediate impression of a curving or changing road. This forms a consistent world-model for the driver as they approach the junction, with all the signage, barriers and kerbs adding to that impression.

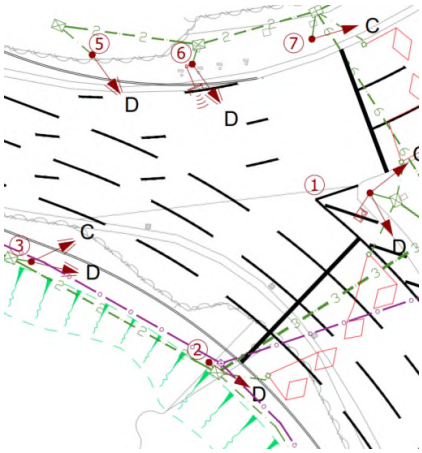

Figure 10. Multiple secondary signals are placed on the roundabout in the approaching drivers' line of site, on the outside of the bend. In this case, no tall poles or mast arms are necessary.

If this is true, the opposite should be true – that a different arrangement of signal heads and other street furniture should give different driver behaviour – and we see this in the examples mentioned earlier. In the case where most of the signal heads are out of the driver's immediate line of site to the nearside, and where the barrier rails and other furniture align unusually (but not wrongly), we see people make mistakes with potentially fatal consequences.

Figure 11. A1139 Junction 8, driver's centre of focus misses most of the signals (left) and the street furniture creates a misleading gap (right)

These mistakes can be put down to driver carelessness and lack of attention – and that is certainly true. All the clues and necessary visibility are there for them to drive safely, and most people do. But if we want to achieve better compliance and avoid these types of accidents entirely though, we need to understand how the design allows this to happen when drivers don't pay enough attention.

Just Wait a Moment

Build distinctiveness and familiarity

(How) Can we use this concept of design-perception-behaviour to explain why we get inconsistent behaviour at right turns of all kinds? Large cities don't seem to suffer from the same inconsistencies – perhaps because urban regions tend to be more closely homogenised. The frequent signals and give-way turns in a large city become part of the autonomous routine for drivers. Or perhaps in these cities, speeds are just so much lower, the consequences are reduced and they don't get reported.

Small cities and parochial towns throughout the country do see difficulty with this inconsistent behaviour. Perhaps the lack of consistent and repetitive junctions plays a part. Or inconsistent design standards in authorities with few signalled junctions. These parts of the country often have fewer resources to control designs and enforce standards, compared to their urban colleagues. This results in a much wider range of design features and styles compared to areas with strict design standards. In the examples presented, we see sites in a relatively small geographic area, each with minor variations trying to address different problems.

A typical site with no markings in front of the stop line makes drivers feel (perhaps) instinctively vulnerable. The lack of markings makes the stop line the focus point in front of them at which they stop, reinforced if the approach has closely associated secondary signals. This has the feel and impression of a full-signalled right turn, and so the driver waits for an arrow, refusing to move forward or turn in gaps.

Alternatively, if far enough away and the junction is large enough that they don't feel vulnerable, the drivers don't perceive any immediate hazard from oncoming traffic. The impression – the perception – is of an unopposed movement, from which they can freely turn. The danger of the oncoming traffic is simply outside of their zone of perception until too late.

Painting a box-marking, lane lines or a give way marking seems an obvious solution, but if it doesn't fit with the driver's expectation, it may be automatically ignored or worse – misread. Transverse lines across the road in the drivers line of sight does create a focus point, but is easily misread by our subconscious as a stop line. As a result, drivers happily run up to it past the red, unaware that they are doing anything wrong.

Lane-line markings can just reinforce the feel of being in an unopposed lane if not used carefully, giving the driver a sense of right of way. And give-way markings in a junction are so unusual they just get filtered out – the driver just doesn't see them, as they don't fit the internal picture.

Providing lane lines, transverse lines and arrows to form focal points after the stop line may be very effective – but if used on a fully signalled right turn, we may find drivers instinctively pull forward and give way. The turn is so familiar as a give-way right turn, drivers don't register the red in front or next to them, as that (to them) is the abnormality, filtered out of their consciousness.

Figure 12. A non-typical opposed right turn with continuing problems, Google

In all these cases, there is no easy solution. This way of thinking suggests treating every give-way right turn the same, with strict design standards and a clear and uniform set of markings. Fully signalled right turns, unopposed, should be kept clear of any markings beyond the stopline which could become a point of focus. It seems unlikely that most authorities could apply this across their existing sites, but making clear and consistent distinctions between places where drivers are expected to give way, and where they are not seems sensible.

And regardless of whether this can be achieved or not, an awareness of how drivers are likely to perceive and therefore react to different designs when turning must be essential in identifying and assessing the risks in the design.

Don't Stop Now

Avoid misleading appearances

The tendency for drivers to stop at secondary signals is a well-known phenomenon, which shows the intention of most drivers to obey the rules as they perceive them. The mistake being made is easy to spot and to understand, where it occurs. More difficult to understand is why individual sites will be treated consistently by drivers (i.e. many people stop, or no one stops at the secondary), but the same drivers will get other sites right. A driver insistently stopping at one secondary every time, will happily pass through other similar sites without stopping.

This would seem to relate to the first impression that the site creates – a secondary signal, next to a crossing point, perhaps tall poles around it, all give the immediate perception of a crossing separate to the junction. Even when other elements of the design – no stop line, no secondary head – don't fit, those don't get recognised as they don't fit the mental picture already formed.

Once the perception of it being somewhere to stop is formed, it is hard to shake. Even when explained or pointed out, their memory of the site has already been filled in and they may even 'remember' other details such as a stopline, which they insist used to be there.

Even worse, once a driver stops at the secondary, the other drivers passing through are exposed to the same design and now the impression of another driver stopping there. This just serves to reinforce the perception of being somewhere to stop. There is likely to be a lot of doubt in any driver who is paying attention, but the mistake becomes self-replicating – helped by a herd instinct to assume everyone else knows something we don't, so follow them!

How do we break this trend or avoid it through our design? Simply being aware of this in our design should work. Be careful in placing the position of any secondary heads, placing them away from crossings or on the offside of the junction exit. Avoiding tall poles around crossings on exits should also help to break the illusion of a separate crossing.

Almost There

We (as an industry and as individuals) frequently reach for technical answers to problems around accidents, and blame drivers for their poor behaviour and digressions. The answers we often reach for are to provide *more* or *different*. If that doesn't work, or clearly isn't the answer, we tend to provide *information* to drivers, as though they have time to read and consider our signs. These approaches are not necessarily wrong but may miss the point.

We are seeking to encourage people to behave in a specific way through our designs, and we should understand and appreciate that point specifically. Our design needs to lead people to do what we want, which means it needs to be clear. Not only clear on a drawing when we (traffic nerds) look at it, but instinctively when people drive or walk through the finished product.

The people using our product are doing so semi-automatically, often tired or bored. They do not know the technical rules around signalled junction design and many may struggle to remember the Highway Code. We rely on their instinctive learnt behaviour to be able to react in time, so we should not blame them when in a split-second they interpret our designs differently to how we intended. We are the professionals who should take human nature and perception into account when we design junctions and crossings.

So what can we learn and put into practice?

Teaching Opportunities are Rare

We must stop expecting to solve problems by throwing more information at people, whether it is more signal heads, warning signs, VMS or lengthy text signs. All these things have their place in delivering information, but all are fallible. None of them seem capable of overcoming our initial perception that we form in the first blink of an eye.

In fact throwing more information at drivers may just result in them ignoring more and relying on their instincts and intuition to overcome the visual clutter.

If we put critical information outside of the drivers' immediate area of focus, we can expect it to also be ignored. This is fine for non-critical information, such as route guidance, but we can't expect a driver to instinctively react to something if they need to move their head to look for it.

And if we throw together different elements, borrow from different design techniques, styles or regions, drivers do not simply get confused – they actively ignore the bits that don't fit and imagine things that do. Their first impressions are critical when moving at speed, and it is unlikely they will change quickly enough to impact on their behaviour.

Conventional is Understandable

Our behaviour seems linked to our perception – which is formed very fast and based on a few key points that we see. The rest is filled in from memory and our own expectations.

Logically, we should be able to exploit this by using conventions explicitly to trigger the desired response. These conventions are laid down in the most basic standards that we follow (TSRGD, DMRB etc). We should not treat these as rigid – far from it. Instead we should ask ourselves what are the core principles that drivers would recognise? How can we

apply those standards and guidance in our specific circumstance without changing the appearance?

An arrow past the stop line provides a focal point in the driver's line of sight, which may encourage them to pull forward if they see a green – even if that green was only for the ahead movement. A lane marking between opposing traffic flows provides a demarcation line. But other lines across the road – such as a cycle symbol or second stop line – may change the point of focus and their perception of how they should behave.

Stub poles may help break an illusion of a stand-alone pedestrian crossing, but placing a secondary signal may still be difficult. The Designer needs to weigh up the need to keep the signals in the focussed eye-line of the driver, while avoiding creating an impression of a separate crossing.

On wide approaches, around bends or on sites with unusual geometry, we need to work hard to ensure drivers understand the layout instinctively. We can design the approach to lead the driver to the correct conclusion but simply adding more signals in the wrong places, outside of their eye-line, is not enough. Instead, we need to design the approach to convey the meaning we want, without any effort on the part of the driver. Creating a line of signals can be effective, starting in the driver's eye line from furthest away and leading them towards where we want them to look. This approach to design needs to take everything into account though – white lining, kerbing, barriers and signage all need to reflect the same in order to help the driver build a consistent model – instead of an illusion.

The more our site looks like something recognisable to most drivers, the more likely they are to treat it in the same way. This is not the end of unique sites or clever techniques.

We need to perform the magician's trick: only let them see what we want them to see.