

Self-Explaining Roads & Forgiving Highways



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Forgiving or self-explaining roads, a concept largely popularised by the US, is aimed at forgiving mistakes made by drivers. While driving, forgiving roads envisage a road design that seeks to smoothly redirect motorists. The aim of self-explaining roads is to create a simple and clean road environment, rather than one which may be complex or ambiguous. A self-explaining road is used in various contexts associated with the demands and objective: to improve traffic conditions and enhancing safety. This article explores the concept of self-explaining roads, the rationale behind them, and drivers' expectations on how to instinctively behave when driving on them. It also looks at how the driver solves tasks on three different mental levels: Control, Guidance, and Navigation. The article ends with a conclusion.

Self-Explaining Roads & Forgiving Highways

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Introduction

Self-explaining roads is a concept that originated in the Netherlands and other parts of Europe. It envisages the creation of a roadway environment that would instinctively make drivers adjust and behave in tune with the design of the road. In other words, the road design would require driving behaviour to comply. It was also a concept largely popularized by the US, aimed at forgiving the mistakes made by drivers while driving. Forgiving Roads envisages a road design that seeks to smoothly redirect motorists.¹ As mentioned above, the concept of self-explaining and forgiving roads on which the driver is encouraged to naturally adopt behaviour consistent with the design and function originated in the Netherlands. The aim is that different classes of roads should be distinctive within each class; features such as width of carriageway, road markings, signage and use of street lighting would be consistent throughout the route. Drivers would perceive the type of road and “instinctively” know how to behave. The environment effectively provides a “label” for the particular type road and thus there would be less need for separate control devices, such as additional traffic signs to regulate traffic behaviour.² Forgiving Highways is a concept that designs roads “to forgive” mistakes committed by motorists on the roads. It seems to smoothly redirect vehicles that leave the road, and allow wide environment clear zones to bring vehicles to controlled stops if and when they leave the road. The idea that Forgiving Highways - which are wide and straighter – would reduce crashes on non-motorway roads took root during the 1966 National Highway Safety hearings in the US. Leading the way was a nationally recognized expert on road safety and design - Kenneth Stonex, who during his career at General Motors’ oversaw much of the research that created the basis for the Interstate Highway safety standards.³

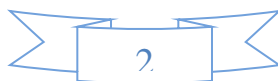
Self-Explaining Roads

The vision of The Self-Explaining and Forgiving Highways is a new way of thinking in planning and designing road infrastructure. Design of roads must focus on simplicity and cleanness instead of complexity and ambiguity.

¹ Bangalore Mirror. indiatimes.com

² European Commission. *Mobility & Transport. Road Safety.* ec.europa.eu

³ Gary Toth. August 2009. *Project for Public Spaces. Exiting the “Forgiving Highway” for the “Self-explaining road”.*



The aim of self-explaining roads is to create a simple and clean road environment, rather than one which may be complex or ambiguous. One author ⁴ described self-explaining roads as follows:

“Simple and unambiguous, clear and understandable, readable and recognizable traffic situations – easy to handle for road users- without too many distractions and overload and leaving no doubt about the reasonable speed level, the give way situation, location and movement of other road users around”.

One of the aims of self-explaining highways is to make the actions of road users more predictable. In order to achieve this, the design of self-explaining roads requires understanding between the fields of traffic psychology ⁵ and road engineering. ⁶ Such an approach uses simplicity and consistency of design to reduce driver stress and driver error. It is already used for the highest road classes e.g. motorways/freeways , but on low class roads consistency in design is often compromised by other objectives such as high access levels, variable alignment, mixed use and variable roadside development , which result in lack of consistency and lack of differentiation between road classes. These concepts are being developed further in current European projects to understand which design features modify driver behaviour to accord with the road function and result in speed choice consistent with the safe speed for that design and function. ⁷ The concept of the “Self-explaining” road is used in various contexts associated with the demands and objective: to improve traffic conditions and enhancing safety. But exactly what does that mean and how do we create self-explaining roads? ⁸

No Unexpected Surprises Occur

The road user’s expectations to the road and its continuation The experiences we as humans accumulate throughout life in terms of the surrounding world and how we adapt to the requirements we encounter are gathered in a bank of knowledge that we carry with us. We take advantage of this also when driving.

⁴Herrstedt, L. *Making our roads safer – a vision for the future safe environment*. First Annual European Energy and Transport Conference. Barcelona. October 2001.

⁵ Traffic psychology is a discipline of psychology that studies the relationship between psychological processes and the behaviour of road users. Additionally, social and cognitive applications of psychology are used, such as enforcement, road safety education campaigns and also therapeutic and rehabilitation programmes.

⁶ RoSPA. rospa.com

⁷ European Commission. *Mobility & Transport. Road Safety*. ec.europa.eu

⁸ Lene Herrstedt, M.s C. Ph D. 12 March 2014. *The basis for self-explaining roads*. PDFS. semanticscholar.org

Based on previous experience from similar roads and traffic environments we build up certain expectations about how to drive on the current road and which requirements it will pose on us. Before driving on a road for the first time, we have certain expectations as to how this looks. If the road is a national highway we expect the road standard to be relatively high. However, if the road is a minor road in a rural area, we expect it to be narrow and winding. We have a natural curiosity about how the road looks the very first time we drive on it. But after a few kilometres we have built up an expectation of how the continued road will look. The natural expectation is that the road will continue as it began. However, if the road worsens, we prepare ourselves to meet an even worse standard along the way. If the driver's perception and expectations of the road design and functionality do not correspond with the physical design and function, the driver may encounter difficulties. In a situation where prompt action is required, problems often occur because there is not enough time to take proper actions. Very often this will lead to human error, which in turn can cause critical situations such as lack of reaction, longer reaction times, sudden and unexpected manoeuvres, etc. When a driver has regularly driven on the same road and has become accustomed to it, he has even stronger expectations of the appearance of the road when driving it the next time. If the road has been reconstructed since the driver's last visit, the design of the road may not correspond to his expectations. The driver will then immediately start to reorient himself and base his knowledge on the immediate visual impression. The challenge for the driver is then, that he will need sufficient time to act in a new unexpected way, if required by the reconstructed road. Changes in the road environment pose increased demands on the driver. The road leading up to the change should therefore be constructed such that the driver will gradually lose recognition and thereby consciously begin to reorient in the new road environment. When the road and the traffic conditions are in line with our expectations, no unexpected surprises occur. We then naturally have a high level of preparedness for the incidents and situations that we expect ahead. Correct expectations with respect to road design are therefore an important prerequisite for a well-adapted and safe driving environment.⁹

The Concept of Self-Explaining Roads

- The Self-Explaining Road refers to a road which is designed in such way that road users immediately perceive how to drive on this

⁹ Herrstedt, L. *Making our roads safer – a vision for the future safe environment*. First Annual European Energy and Transport Conference. Barcelona. October 2001.

- Road user behaviour is mainly determined by the driver's expectations to and perception of the road and the current traffic situation. Consequently, the road must be designed to meet driver expectations.
- This means that the road must have a clear and recognizable standardized design.
- The Self-Explaining Road must make it easy for the road user to go right and difficult to go wrong.
- The idiom of the Self-Explaining Road should make symbolic information dispensable.

Symbolic information (road signs and markings) will primarily confirm the natural information expressed by the road design and must never be in conflict with this natural information. Today the self-explaining road is a long-term design goal for all road designs. Creating the self-explaining road requires continued development towards standardized; consistent and easily recognizable "design characteristics" for different types of roads and road sections of various functions. In this process it is very important that use of symbolic information always supplement and confirm the natural information of the road design without being in conflict. Recognition in the immediate holistic perception of the road and the traffic environment is a fundamental prerequisite to enable precise and accurate driver expectations of the road, both in terms of road design and traffic situations. The Explanatory Model is a tool for use in the development process towards realizing the Self Explaining Road.

Forgiving Roads

Forgiving roads, a concept largely popularised by the US, is aimed at forgiving the mistakes made by drivers. While driving, forgiving roads envisage a road design that seeks to smoothly redirect motorists. The experiences we as humans accumulate throughout life in terms of the surrounding world and how we adapt to the requirements we encounter are gathered in a bank of knowledge that we carry with us. We take advantage of this also when driving. Based on previous experience from similar roads and traffic environments we build up certain expectations about how to drive on the current road and which requirements it will pose for us. Even before driving on a road for the first time, we have certain expectations as to how it should look. If the road is a national highway we expect the road standard to be relatively high. If the road is a minor road in a rural area, we expect it to be narrow and winding. We have a natural curiosity about how the road looks the very first time we drive on it. But after a few kilometres we built up an expectation of how the continued road will look.

The natural expectation is that the road will continue as it began. The road leading up to the change should therefore be constructed such that the driver will gradually lose recognition and thereby consciously begin to reorient in the new road environment. When the road and the traffic conditions are in line with our expectations, no unexpected surprises occur. We then naturally have a high level of preparedness for the incidents and situations that we are expecting ahead. Correct expectations with respect to road design are therefore an important prerequisite for a well-adapted and safe driving.

Control, Guidance & Navigation

Driving a car involves three main tasks and is a learned skill. For experienced drivers, driving is primarily an automated action (or is it?) which they perform without having to think too deeply about it. Therefore, they can think about other things while driving although they should concentrate fully on the task at hand. Through his immediate holistic perception of the road environment – a driver chooses speed and position in such way that a comfortable safety margin can be maintained. The driver achieves this by driving in such way that his perceived safety margin in front of the car is longer than his perceived shortest stopping distance. The driver controls this by continuously adapting his driving speed. The perceived safety margin of the driver is subjective. At the same time a true (objective) but unknown safety margin exists. The driver can lose control when he/she overestimates the objective (true) safety margin. To ensure compliance between perceived and true safety margin, the driver must be sufficiently experienced. The driver solves tasks on three different mental levels: Control, Guidance, and Navigation. The control task is the most important one as this must be performed continuously during driving. It is performed more or less automatically whereby the driver automatically adjusts speed and position to maintain a comfortable perceived safety margin. As long as the driver needs to perform control tasks only, he has reserves of mental capacity to think of other things, talk to passengers or listen to the radio. The mental reserve capacity also means he has “a wide range of awareness” or a large functional field of vision enabling him to register what is happening along the road in a relatively long and broad sector in front of the car. The guidance task requires more capacity of the driver. When performing various manoeuvres such as lane changing or overtaking, the driver must make perceptual assessments in order to consciously decide whether a respective manoeuvre can be performed safely in traffic. Overcoming this task requires a high degree of focus and the driver’s entire mental capacity. The functional field of vision is reduced and consequently the driver is at risk of overlooking traffic incidents which he/she would typically register during automated driving.

The navigation task is the most complex and the only task out of the three which may be characterized as problem solving. As such, the task requires both understanding of symbols and logical thinking. Reading and understanding of road signs, guidance signs and road markings as well as planning a journey from A to B are navigation tasks. If the driver doesn't know the way he will have to use road guidance signs whilst simultaneously orienting in the road system to determine "Where am I?" and "Which direction should I choose?" The choice of direction will be based on previous experiences and use of the symbolic information conveyed on road guidance signs, road maps and GPS. The navigation task requires the driver's full attention and takes up his entire mental capacity. Road signs will only be read when the driver has an immediate need for information. The driver needs to - at least briefly - operate in navigation mode in order to perceive and utilize the information on a road sign or road guidance sign. If the driver continues in automated mode (control task) or performs a demanding manoeuvre (in guidance mode) he is likely to miss the road sign and hence the information. At automated driving the driver strives to maintain full control of the vehicle and he unconsciously registers from a long distance what is happening on the road ahead of the car. As soon as the driver observes a deviation from a distance, his curiosity and need for information are aroused. The driver will then "slide" into guidance mode enabling him to make an assessment of the situation. If he does not fully understand the situation, he begins functioning at navigation level by reading road signs etc. to collect information. When a driver is using a road for the first time he is curious about the appearance of the road. He will be attentive and careful. He will need time to identify possible dangerous passages and will therefore need timely information from road signs, i.e. a warning about a dangerous bend, series of dangerous corners, hump-backed bridge etc. The warning sign(s) must contribute to creating the proper expectations in the driver thus avoiding surprises. However, when driving on a road he knows very well, the driver will know how to drive.¹⁰

Conclusion

The concept of Self-explaining roads concept originated in the Netherlands and other parts of Europe. It envisages the creation of a roadway environment that would instinctively make drivers adjust and behave in tune with the design of the road.

¹⁰ Herrstedt, L. *Making our roads safer – a vision for the future safe environment*. First Annual European Energy and Transport Conference. Barcelona. October 2001.

In other words, the road design would require driving behaviour to comply. It was also a concept largely popularized by the US, aimed at forgiving the mistakes made by drivers while driving. Forgiving Roads envisages a road design that seeks to smoothly redirect motorists. One of the aims of self-explaining highways is to make the actions of road users more predictable. In order to achieve this, the design of self-explaining roads requires understanding between the fields of traffic psychology and road engineering. Such an approach uses simplicity and consistency of design to reduce driver stress and driver error. It is already used for the highest road classes e.g. motorways/freeways, but on low class roads consistency in design is often compromised by other objectives such as high access levels, variable alignment, mixed use and variable roadside development , which result in lack of consistency and lack of differentiation between road classes. Before driving on a road for the first time, we have certain expectations as to how this looks. If the road is a national highway we expect the road standard to be relatively high. However, if the road is a minor road in a rural area, we expect it to be narrow and winding. We have a natural curiosity about how the road looks the very first time we drive on it. But after a few kilometres we have built up an expectation of how the continued road will look. The natural expectation is that the road will continue as it began. However, if the road worsens, we prepare ourselves to meet an even worse standard along the way. One of the aims of self-explaining highways is to make the actions of road users more predictable. In order to achieve this, the design of self-explaining roads requires understanding between the fields of traffic psychology and road engineering. ¹¹ Such an approach uses simplicity and consistency of design to reduce driver stress and driver error. It is already used for the highest road classes e.g. motorways/freeways , but on low class roads consistency in design is often compromised by other objectives such as high access levels, variable alignment, mixed use and variable roadside development, which result in lack of consistency and lack of differentiation between road classes. These concepts are being developed further in current European projects to understand which design features modify driver behaviour to accord with the road function and result in speed choice consistent with the safe speed for that design and function. Changes in the road environment pose increased demands on the driver. The road leading up to the change should therefore be constructed such that the driver will gradually lose recognition and thereby consciously begin to reorient in the new road environment. When the road and the traffic conditions are in line with our expectations, no unexpected surprises occur. We then naturally have a high level of preparedness for the incidents and situations that we expect ahead.

¹¹ RoSPA. rospa.com

Correct expectations with respect to road design are therefore an important prerequisite for a well-adapted and safe driving environment. Finally, Self-Explaining Roads and Forgiving Highways is an asset to the average driver however, at the end of the day it's up to the individual driver to have sufficient knowledge, skills and attitude to deal with any road type he faces. The driving task is a complex skill that requires constant concentration, observation and anticipation. Pre-existing knowledge from previous journeys and the expectation of various road layouts will be a distinct advantage in dealing with any type of road the motorist may encounter on his travels.