Methods to evaluate international SER treatments; preparations for a workshop

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Executive summary

This report has been prepared as part of the SPACE project (Speed Adaptation Control by Self-Explaining Roads). SPACE is a project funded by the ERA-NET Roads research programme ‘Safety at the Heart of Road Design’. The programme comprises five projects that aim to explore the concepts of ‘forgiving roads’ and ‘self-explaining roads’, and to provide practical tools and guidance for road authorities for use in their efforts to improve road safety. This report presents the evaluation method of SER treatments used in the preparation of the workshops held in the frame of the SPACE project. This report also discusses the experience gained and the comments made by organizers and participants of the workshops. The report conclusions put the use of this type of evaluation method of SER treatments in perspective to the method using a driving simulator.

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1 Global context

"ERA-NET ROAD – Coordination and Implementation of Road Research in Europe" was a Coordination Action funded by the 6th Framework Programme of the EC. The partners in ERA-NET ROAD (ENR) were the United Kingdom, Finland, The Netherlands, Sweden, Germany, Norway, Switzerland, Austria, Poland, Slovenia and Denmark (www.road-era.net). Within the framework of ENR this joint research project was initiated. The funding National Road Administrations (NRA) in this joint research project are from Austria, Belgium (Flanders), Denmark, Finland, Germany, Hungary, Ireland, Norway, Slovenia, Sweden, the Netherlands and the United Kingdom.

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Improving road infrastructure safety can be achieved by making roads forgiving and self-explaining. Self-explaining roads reduce crash likelihood and forgiving roads mitigate crash severity.

The aim of SPACE is to identify ‘self-explaining’ treatments that lead to the adoption of speeds that are safe and appropriate to conditions. SPACE will identify treatments that offer the greatest potential for speed reduction through a traditional literature review: international expert panel review, expert workshops and driving simulator experiments.

Figure 1 below illustrates the work packages that will lead to guidance on how to improve the safety of the road network.

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**Figure 1: The SPACE project Work Packages**

- WPs 1 & 2: Literature and expert review
  - Classification and vocabulary
  - Literature review
  - Identification of self-explaining treatments
  - Selection of promising treatments

- WP 3: Expert workshop
  - Simple evaluation of treatments using expert workshops

- WP 4: Driving simulator
  - Testing of promising treatments in the driving simulator

- WP 5: Dissemination and exploitation
  - Reporting on the findings of SPACE

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2 Scope

SPACE evaluates ways to assess SERS. One possible procedure, Figure 1, has been suggested by the SPACE team and will be tested. This report describes the procedures and preparations to set up a workshop. The workshops will use images, both video and pictures as a source to trigger the discussions. A detailed schedule is also developed to make the conditions as equal as possible at the different workshops. One problem is the lack of European standards on detailed road design including markings and signs, countries do even use both left and right hand driving. Those differences have not been prioritized.

3 Evaluation method at expert workshops

The second step in SPACE (WP 3 in Figure 1) is to evaluate and assess self-explaining solutions selected from the previous conducted State of the Art (see Deliverable 1 of the SPACE project). Initially the evaluation and assessment was planned to be done using one international workshop. However, for various reasons, this plan was changed to include several separate workshops that were organised in the participants’ countries. It was realized that, in practise it is not possible to gather experts and stakeholders from many countries to one occasion with a maintainable budget. After discussions, within the consortia it was decided to carry on using local workshops using as equal conditions as possible. The organisation of several local workshops had its advantages: it was easier to conduct more in-depth investigations especially since workshop participants had a common first language and the method was more cost effective than to gather people from Europe at one central venue. This was especially true for the planned SPACE workshop where experts were to be invited. Deliverable 3 discusses the outcome on SER treatments from the workshops.

This report refers to two different aspects of the evaluation method used at the SPACE workshops: the use of the evaluation method to stimulate expert/road authority discussions and the usefulness of the method in relation to testing the effectiveness of treatments.

The main tools in the workshops were the use of photograical pictures, video material and computer screens to display scenarios. This report describes and specifies how photographs and video clips were collected. A common agenda questionnaire was developed to assure that the workshops were as equal as possible in all countries.

The workshops were also used to evaluate the ‘simple’ evaluation methodology (using photographs and video material) itself. The principle to use a common material to assess and discuss possible solutions was a success. In the “SPACE case” it was very informative to elicit the views of the participants concerning the self-explaining solutions identified in the first two Work Packages. These views included academic and theoretical positioning to practical aspects concerning the implementation of solutions.

In the “SPACE case” it was a challenge to find adequate scenes to be filmed containing the solutions of interest to the SPACE project. In a future evaluation exercise it would be interesting to use a mixture of real videos and animations of possible solutions. That would mean that variables could be controlled adequately and new innovative solutions could be tested.

In the SPACE project the next step will be to use the driving simulator to assess some self-explaining treatments. If possible a video will be made from the driving simulator scenario that could be used to demonstrate the use of real videos and animations.
4 Evaluation method of SER treatments in action

Several experiments have used photographic material to evaluate the speed choice of drivers. These experiments have been described in the literature [2, 3, 4, 5, 6]. Following the project’s scope, the “simple evaluation method” used in the SPACE project is based on video material. Alternative methods make use of driver simulators (a technique that is also envisaged in the SPACE project) or investigations in real world settings (visiting existing sites). All these methods have their advantages and drawbacks and these are discussed extensively in the literature.

In the SPACE project we opted for a “simple evaluation method” almost exclusively based on video material in order to be able to present a rather large number of SER treatments to the experts at the SPACE workshops and to select a few SER treatments that are considered worth investigating in further depth. The driver simulator experiment in the SPACE project will only focus on a few selected SER treatments but allows a rigorous examination of driver behaviour and is a fully controlled – simulated – environment.

4.1 Camera configuration in vehicle

It was considered that, taking into account the objectives of the SPACE project, the images should be captured from the driver’s or rider’s point of view. It was also determined that the images needed to show the road and also the near road side, while also ensuring that the view was not obstructed by any part of the car itself (such as the central mirror).

Some experiments were conducted at the BRRC for the SPACE project, installing a camera at different positions in different vehicles and shooting some short movies with each configuration. From these experiments BRRC concluded that the best position of the camera seemed to be the position right next to the driver (that is, on the left from the driver when the vehicles drive on the right side of the road as in continental Europe). In this case the camera could easily be fixed on the window of the driver’s door. Another good position is about 20 cm to the right of the right hand shoulder of the driver (again for a continental European car configuration). In that case the camera could easily be fixed on the seat of the driver.

Figure 1: A camera configuration next to the driver seat
Standard camera systems exist that can be bought on the market. Many of these systems use cameras on top of the vehicle. Most of these systems allow repositioning of the cameras. In the SPACE project we envisaged the possibility of using a camera on the roof of the vehicle right on top of the driver. This could be a good approximation of the view of a lorry driver. In practice, the movies used in the SPACE project were all made with a camera inside the vehicle in order to give a ‘car driver’s eye’ view of the road.

The type of camera must have appropriate technical specifications to allow an adequate ‘field of vision’. A camera with 1920 x 1080 pixels was considered to give a more than sufficient resolution for the purpose of the evaluation method used at the workshops of the SPACE project.

In order to determine the optimal view angle for the camera, we considered the visual field of a human pair of eyes:

- Without head movements the visual field of a human eye is 70°, and with head movements the visual field is 120° (see [1])
- The visual field does depend on traveled speed: the horizontal angle gets smaller at higher speeds (see Figure 3).
- Outside this range and up to 190° the vision of a human eye is not sharp but can still observe.

From this we may conclude that it is recommended to use a camera with view angle of at least 70° (35° to the left, 35° to the right of the central axis) in order to make an accurate simulation of the view area of the driver. The view angle should not exceed 120°.

An alternative could comprise a camera with a lens and view angle of more than 120°, combined with a ring that filters at the border of the camera lens. Doing so, the images would be blurred at the edges in a similar manner to that of a human eye.

Since the scope of the SPACE project does not comprise the development of optimal camera equipment, the movies used at the SPACE workshops were made with a camera that was already in possession of the BRRC before the start of the SPACE project. This camera has a viewing angle somewhat smaller than the angle considered as optimal.

We considered that the use of a somewhat less optimal camera configuration would not
significantly deteriorate the quality of the images for a test of the evaluation method at the SPACE workshops. Indeed, the method aims at the evaluation of SER treatments for speed adaption and it seems reasonable to assume that for the driver to adapt his/her speed these treatments must be visible from a somewhat further distance. The wider viewing angle is thus not needed for the treatments to be filmed.

4.2 Making of the movies

Movies were filmed with a camera installed in a car (as described above). Each of these movies covered several kilometres of road. SER treatments only appeared occasionally along the roads filmed and so it was necessary to edit the movies and select only stretches of interest. In this way a total of 38 short film sequences were produced. All movies focused on SER treatments for curves or transitions.

The sequences were then grouped together by theme (curves or transitions as per the SPACE Deliverable 1 report). A movie play list was composed, this one is available in the deliverable 3. At the workshops the sequences were shown grouped together in small groups of 2 to 5 sequences.

4.3 Presentation at workshops

During the second part of the workshop (afternoon session), a simple evaluation method was used. Workshop participants were asked to take a look at scenarios and to evaluate their own behaviour, should they encounter these scenarios in a real world situation. This constituted a version of what we refer to as the "simple evaluation method". In order to have a uniform evaluation method at all workshops, an evaluation form was developed to allow the participant (or a group of participants) to fill in his/her/their thoughts and opinions, this one is available in the deliverable 3.

In one movie or in one set of pictures presented to the audience, a certain number of treatments were presented. The viewer was asked to mark (by checking a box next to the description given on the form) each type of treatment he/she encountered in the movie. This addresses the first question:

- What treatments were presented in the viewed material?

Then, for each treatment identified by the viewer (or group of viewers), a separate form is to be filled out, answering following questions:

- Which type of treatment is discussed?
- What are the advantages and disadvantages of the treatment?
- Is this treatment self-explaining and efficient in speed adaptation?
- Are they aware of some places where this particular treatment has been (successfully) implemented?

The following approach was used during the workshops:

- Give the participants the opportunity to visualise the list of treatments under investigation (on a blackboard, on a sheet distributed to them),
- Divide the participants in small groups of 4 persons,
- Show one of the movies or set of pictures once,
- Let the groups discuss what they saw, addressing the following questions:
  - What treatments where presented in the viewed material?
  - What are the advantages and disadvantages of those treatments?
  - Are these treatments self-explaining and efficient for speed adaptation?
o Are they aware of some places where these treatments have been (successfully) implemented?

- While they discuss, show the same movie or set of pictures in continuous loop,
- Repeat with the next movie or set of pictures,
- When all visual material is shown, one person of each group reports on the group’s findings, confronting the views of all the groups,
- From the confronted reports it is then deduced which treatments are judged promising, but with a doubt in the experts minds as to their effectiveness.

It was important to strictly keep to the time schedule since all available visual material had to be shown. The discussions in the groups were limited to a fixed amount of time of about 10 minutes at the most. The number of movies or sets of pictures that were shown was limited to 5 or 6.

The groups were provided with forms where they could fill in their answers. These forms were filled in by the reporter of the group and they were collected by the SPACE partner who organised the workshop. Based on these, the final report on the workshop outcome was written up (see also Deliverable 3 of the SPACE project, on the workshops).

4.4 Comments on the method

At the end of each workshop, the participants were asked to comment on the “simple evaluation method” as they had experienced it.

Belgium:
The scenarios presented by showing movies did indeed elicit discussion on the practical aspects of different treatments. Therefore the evaluation method was considered very useful as a tool for the workshop. Some films, showing a combination of treatments, were however difficult to evaluate. It is important to use simple questions.

However the method used seemed more appropriate to pre-select the most interesting treatments, as it is less well adapted to address the question of the effectiveness of different treatments.

If a simple evaluation were to be used for experimental purposes, it would be important to obtain otherwise comparable pictures for controlled comparisons. Other possibilities are to use still pictures generated from simulation software or to use full driving simulators. Can participants accurately report the impact of treatments on their driving behaviour? Experts will have different views than the general driving public.

Czech Republic:
Also at this workshop the movie sequences formed a good basis for triggering discussions about SER treatments.

Austria:
The video sequences were considered to be too short. It was not possible to see how the road was organized before and after the treatment shown on the sequence.

Another remark that should also be taken into account is the effect of the treatments over time, particularly when relying on particularly novel or surprising treatments. It may be important to test whether treatments are effective over time and after many encounters with the same treatment.

Ireland:
Participants felt that the treatments presented in the movie sequences should be tested for performance both in the night-time and the day time. The sequences were all filmed during day-time.

**Sweden:**

Even though the videos mainly showed urban SER solutions they were good triggers to start a discussion on SER treatments, as long as the discussion was controlled to cover the situation type. It was suggested that for the purpose of the workshop more examples could have been collected and shown such as 2+1 roads and main road roundabout.

## 5 Conclusions

The “simple evaluation method” as it was used at the SPACE workshops in different European countries triggered very interesting discussions on SERs among the participants. From that we can conclude that the use of video sequences showing examples of SER treatments can be useful in eliciting the view of experts and road authorities, or used as material for workshops or training sessions.

The “simple evaluation method” may not be very effective for experimentation purposes in order to determine the effectiveness of different SER treatments. Other issues also make the method (as used in the workshop) imperfect:

- It would be preferable to present the same situation under different circumstances (night/day, dry weather/rain,).
- The movie sequence must show the situation over long enough distance before and after the SER treatment under evaluation – this makes it more difficult to control for other variables that might influence the behaviour under investigation.
- It is difficult to study the longer term effects of a treatment on behaviour using this methodology.

The collection of interesting material from real world implementations of SER treatments has been rather challenging. An additional tool that could be of use in future use of video material is that of animation: by adding objects in an artificial way to a movie in order to show different (combinations of) SER treatments at a particular existing site, the different approaches can be evaluated and compared.

The simplicity of the “simple evaluation method“ makes it difficult to study all aspects of user behaviour with respect to SER methods in an equally rigorous way as might have been envisaged. The driver simulator studies are without any doubt a very useful method for scientifically well-founded research and for that purpose cannot easily be replaced by a simpler method.

The experience in the SPACE project shows that the “simple evaluation method“ can play a role in a preparatory phase, preceding a driver simulator study. The participants in the workshops generally agree that the “simple evaluation method“ can also have its place for particular “project level“ studies or in training sessions.

It has been difficult to find a consensus of what a SER is. From [7], it can be seen that most SERs can be found in rural areas and transition sections. Therefore many of the images are from those situations. Anyway it has been shown that this was efficient to trigger fruitful discussions and an efficient method for conceptual purposes. The next step will be to look on a possible procedure to assess more individual SER treatments. This will be done in WP4 of the SPACE project.
Sources


