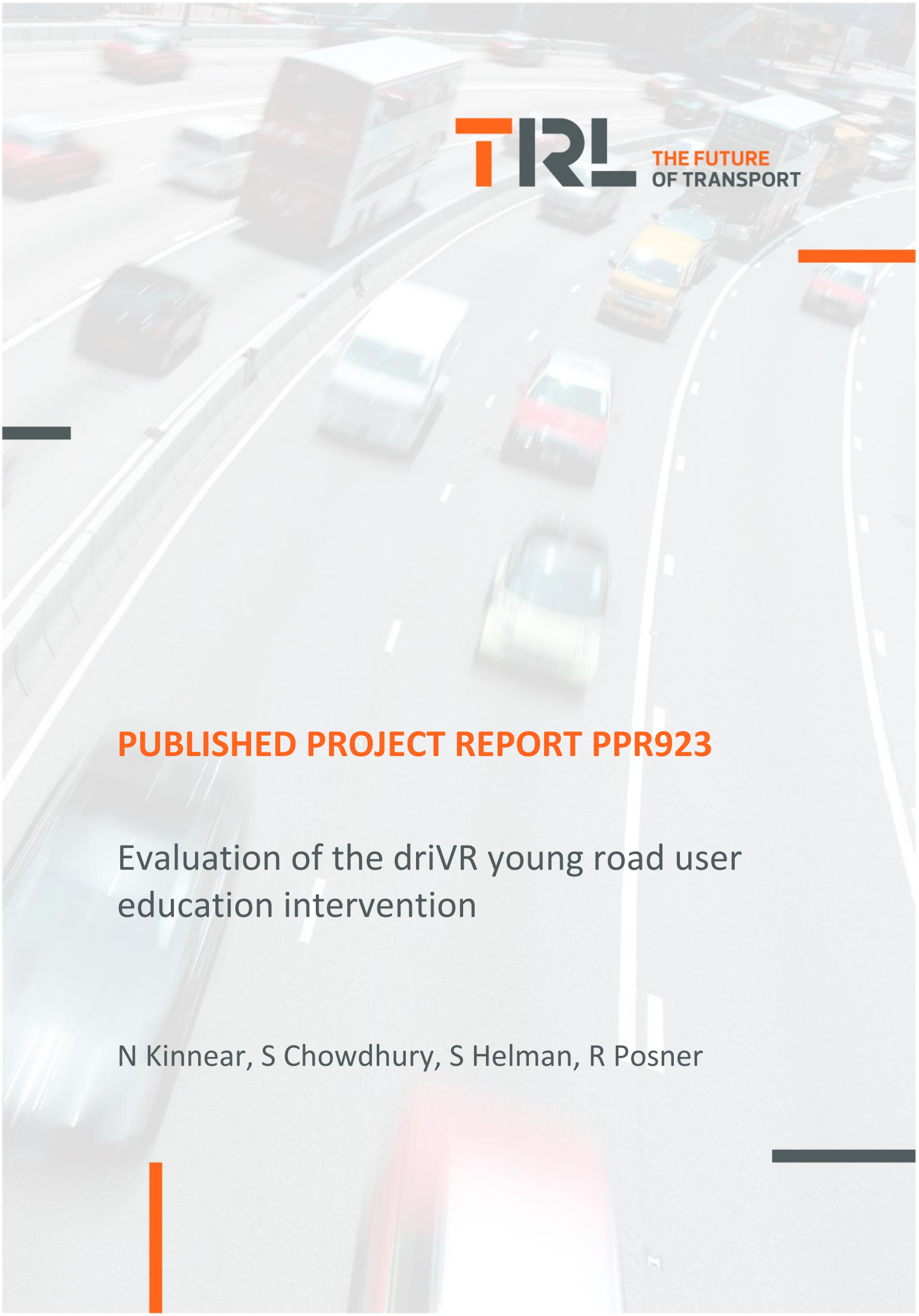

THE FUTURE OF TRANSPORT

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Evaluation of the driVR young road user education intervention

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Report details

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1	14/08/2019	Evaluation report for Safety Cameras Scotland, Police Scotland and Glasgow City Council	NK	SH
2	15/08/2019	Final report following client feedback	NK	SH

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Table of Contents

Executive Summary

driVR is an award-winning young road user intervention for S5-S6 pupils (aged 16-18 years old) developed by Safety Cameras Scotland, Police Scotland and Glasgow City Council. The resource utilises Virtual Reality (VR) to engage pupils with road safety messages. The learning intention was for the students to experience two VR films, to take part in group discussions and complete a workbook that led them to contemplate if they could make changes to behaviours that improve their safety when using the road. The 50-minute lesson plan created for driVR took into consideration behavioural change guidance and was designed with an aim to influence participants to make positive changes to their attitudes while in a vehicle or as a pedestrian or cyclist.

Funding for a pilot project to design and deliver driVR was obtained from Transport Scotland's Road Safety Framework Fund. TRL was funded to independently evaluate the intervention and proposed a quasi-experimental design (i.e. before and after data collection with intervention and comparison groups). Schools across Glasgow were selected to receive the intervention and matched schools were selected for the collection of comparison data. Data were collected 1-2 weeks before the intervention and 1-2 weeks after. A total of 215 pre-drivers completed the Time Point 1 questionnaire of which 75 were in the comparison group and 140 in the intervention group. A total of 183 pre-drivers completed the TP2 questionnaire of which 68 were in the comparison group and 115 were in the intervention group. A smaller matched-sample (i.e. same respondent at both time points) was used for the primary analysis (34 in the comparison group and 63 in the intervention group).

Results of the evaluation found that VR is an engaging and enjoyable tool for engaging with young people. It also found no evidence to suggest that the resource causes any harm. This should always be established prior to the roll out of any public health intervention.

The evaluation materials were designed to measure the themes and attitudes targeted directly by the intervention. The themes were self-awareness, empowerment to change, perceived legitimacy of authority and attitudes to targeted safety related behaviours. These themes were repeated for each road user type: pedestrian, cyclist and vehicle user (driver or passenger).

Evaluation of these attitudinal themes found no evidence that there were any attitudinal improvements as a result of receiving the driVR intervention. Pre-driver interventions have rarely demonstrated effectiveness, although a lack of quality evaluation has previously limited knowledge in this area. A number of reasons for this have been discussed previously (see McKenna, 2010) and include the 'dosage effect' (pupils' limited exposure to the resource), resource content limitations (e.g. assumed information deficits) and inconsistent delivery (e.g. variability across facilitators).

As a result of this, the following recommendations for the future development of driVR are made:

1. Taking into account the limited exposure pupils have to driVR, consider whether driVR can be extended, repeated or used to support other road safety messages that pupils will be exposed to throughout the year, thereby increasing the dosage.

2. Consider whether the content could be concentrated to focus on fewer key road safety messages, strengthening the dose to fewer focused attitudes and behaviours.
3. Future delivery of driVR should be conducted by fully trained individuals to ensure that the material is delivered as designed. A process evaluation should be conducted to ensure this is the case, along with a repeated impact evaluation (with a control or comparison group) to assess the effectiveness of the redesigned resource.

1 Introduction

1.1 Background

Based on national statistical publications (e.g. Reported Road Casualties Scotland 2018) and a significant body of literature (see Helman et al., 2010; Kinnear et al., 2013; McKenna, 2010; Pressley et al., 2016) young people, particularly young novice drivers, are a public health risk to themselves and other road users. As such, 'pre-drivers' have long been considered a group worthy of attention and intervention. Around two-thirds of Scotland's local authority areas run or support some form of pre-driver intervention, reaching approximately 20,000 young people annually (Kinnear, Pressley, Posner & Jenkins, 2018).

1.2 driVR

driVR is a 50-minute classroom intervention aimed at 16-18 year olds utilising virtual reality (VR) to encourage students to consider their attitudes towards road safety. Funding for a pilot project to design and deliver the intervention was obtained from Transport Scotland's Road Safety Framework Fund[1].

Safety Cameras Scotland had been using VR since 2016 during public engagement activities and identified that the use of this approach was engaging for 17-25 year olds, a traditionally hard to reach cohort. It was theorised that VR may be a useful method for engaging with young people to promote learning during a structured young road user lesson.

The broad objectives of the project were to create an education package that utilises VR to deliver road safety messages to young road users at a pre-driver stage. The material was developed to be engaging and informative with an aim to influence participants to make positive changes to their attitudes while in a vehicle or as a pedestrian or cyclist.

1.3 Evaluation

A review of pre-driver education interventions in Scotland identified that there is currently no robust evidence suggesting that pre-driver interventions are effective at improving road safety (Kinnear et al., 2018). Two of the reasons for this are that too few evaluations have been conducted, and that those conducted have been of inadequate quality (e.g. poor design). The lead agencies of driVR sought to address this by including evaluation from the beginning of the project which allowed the evaluation to utilise a robust quasi-experimental design (i.e. before and after data collection with intervention and comparison groups).

TRL was funded to independently evaluate the intervention and this report details the method (Section 2), results (Section 3) and discussion (Section 4) of the evaluation of driVR.

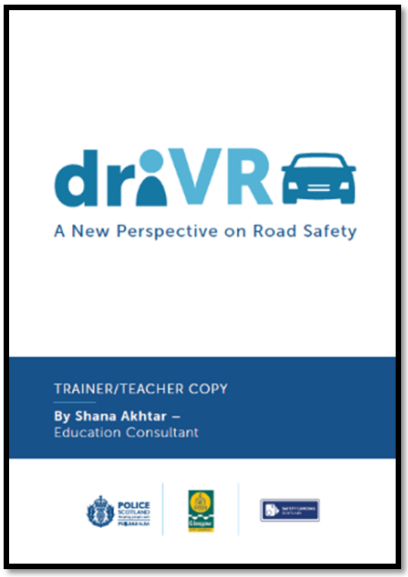
[1] Funding for the project was awarded to Safety Cameras Scotland, Police Scotland and Glasgow City Council. Other partners who helped to deliver this project include FirstCar who made the two VR films, Shana Akhtar (Education Consultant) and Avantis who supplied the VR equipment.

2 Method

2.1 Design

2.1.1 The driVR intervention

The lesson plan created for driVR took into consideration guidance on effective behavioural change techniques, such as that provided by Sullman (2017). For the age group being targeted, three specific behaviour change techniques were selected: provide information on consequences; prompt specific goal setting; plan social support or social change.



The learning intention was for the students to experience two VR films, to take part in group discussions and complete a workbook that led them to contemplate if they could make changes to behaviours that improve their safety when using the road.

At the end of the lesson the students were asked to set goals on what they can do to make themselves safer and were provided with promotional items (VR glasses) so that they could discuss and share the experience with friends and family. The workbooks that accompany the intervention tie in with Scotland's Curriculum for Excellence. There are two workbooks: one for the trainer/teacher and one for the students. The teacher/trainer workbook was designed to clearly set out the entire lesson plan. The student version was designed for the student to take away after the lesson.

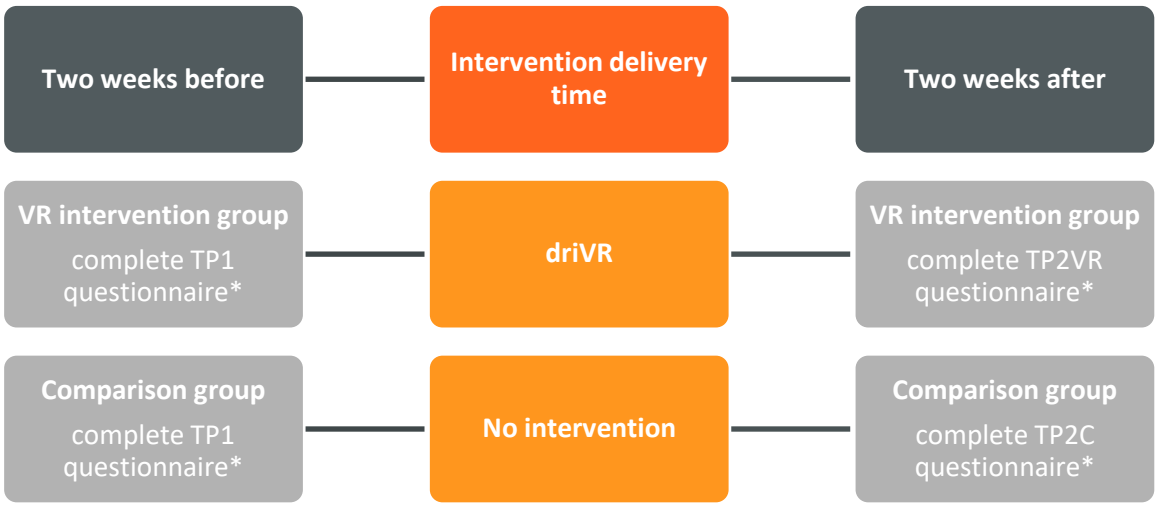
The VR films were approximately five minutes in total. The first shows a female pedestrian in her late teens who is using her phone while walking through an urban route. The second film puts the viewer in the front passenger seat of a Ford KA being driven by a young male, with another similarly aged male in the back of the car. The journey includes the driver on his phone, fatigued, speeding and almost hitting a cyclist. In the final minute of the second film the viewer comes to realise that the narratives are set in the same timeline and the car they are in will soon collide with the female pedestrian in the first film.

The two films end with the suggestion of a potential interaction, but do not explicitly show any collision between the female pedestrian and the car.

The VR content was presented using ClassVR from Avantis which allowed up to 32 students to individually view the films at the same time. Lessons were delivered by Road Safety Officers following training from the course developers and educational consultant.

2.1.2 *The evaluation*

A quasi-experimental design was used for evaluation of this intervention. This design is similar but not as stringent as a Randomised Control Trial (RCT), which is considered the best way of determining whether an intervention is effective or not. As shown in Figure 1, the design used requires that data are collected at two time points, before and after the intervention is delivered. It also requires that data are collected from pupils in schools that receive the intervention, and from pupils in schools that do not receive the intervention.



*see Materials for details of the questionnaires

Figure 1: Overview of study design

The driVR lessons were delivered from November 2018 to March 2019 to approximately 300 S5-S6 pupils (aged 16-18 years old) across four schools in Glasgow City. Based on the profile of the schools selected for the intervention, three comparison schools in Glasgow City were selected that were similar in size, location and academic status to those receiving the intervention.

Road Safety Officers (RSOs) for Glasgow City Council received an information pack and verbal briefing about the process for conducting the evaluation and were responsible for administering the questionnaires (see materials). Questionnaires were administered in-class 1-2 weeks before the intervention and approximately 1-2 weeks after the intervention. Participants in the comparison schools were administered questionnaires at similar time points but did not receive any intervention.

All pupils who took part in the evaluation were over 16 years old and required to provide consent. Ethics approval for conducting the evaluation was awarded by the TRL mini-ethics panel for the project.

2.2 Materials

The questionnaires were designed to be completed by pen and paper and take no more than five minutes for most pupils to complete. RSOs determined that completion by pen and paper was easier to administer than online questionnaires. Table 1 shows the versions of the questionnaires developed for the evaluation. The Time Point 1 (TP1) questionnaire was

the same for both intervention and comparison groups. The Time Point 2 (TP2) questionnaire replicated the TP1 questionnaire and was the same between groups except that the driVR intervention group questionnaire (TP2VR) had an additional section asking about the experience of using VR.

Table 1: Versions of the questionnaires

Group	Time Point 1 (Before)	Time Point 2 (After)
driVR intervention	Road User Questionnaire TP1	Road User Questionnaire TP2VR
Comparison		Road User Questionnaire TP2C

The TP1 and TP2 questionnaires were designed to measure responses to road user types, behaviours and safety-related themes that were directly related to the content and stated aims of the intervention. To represent the content of thee intervention, the questionnaires included items related to the road user types and behaviours summarised in Table 2.

Table 2: Road user types and road safety behaviours targeted by driVR content

Road user type	Road safety behaviours
Pedestrian	Distraction
	Crossing the road
Cyclist	Helmet wearing
	Safety clothing (conspicuity)
	Lane changing
Driver / passenger	Seatbelts
	Distraction
	Fatigue
	Speeding

The stated aims of the intervention were to produce attitudinal change through improving the following:

- Self-awareness
- Empowerment to change / goal setting
- Attitudes to targeted safety related behaviours
- Perceived legitimacy of authority / road laws / rules

The questionnaire was split into sections by road user type, with sets of questions designed as statements (e.g. “As a passenger, I would tell the driver to stop using their phone while driving”) that pupils were asked to rate on a 5-point Likert-type scale from 1 (Strongly disagree) to 5 (Strongly agree). The full list of questionnaire items coded by road user, aim and theme can be seen in Appendix A.

Additional information collected included gender of participant, frequency of cycling, driving situation and whether they had received any additional road safety education in the last 12 months. The TP2VR questionnaire had an additional section asking about the experience of using VR; whether it was enjoyable, engaging and caused any feeling of sickness.

3 Results

3.1 Sample

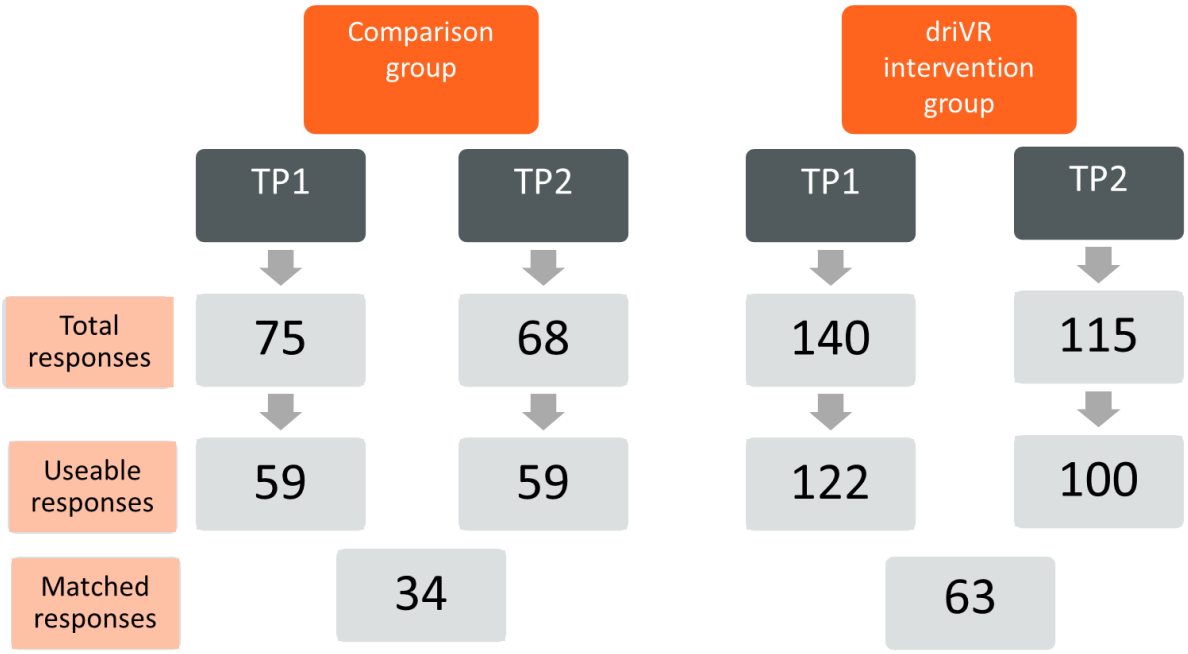


Figure 2: Overview of sample and data processing

A total of 215 pre-drivers completed the TP1 questionnaire of which 75 were in the comparison group and 140 in the intervention group. A total of 183 pre-drivers completed the TP2 questionnaire of which 68 were in the comparison group and 115 were in the intervention group.

A data cleaning process was undertaken in order to ensure that the dataset was suitable for analysis. This included, for example, removing responses that were less than 50% complete. This resulted in a total of 181 responses in the TP1 survey and 159 responses in the TP2 survey. Of these, there were 34 matched responses in the comparison group (i.e. participants who had completed both TP1 and TP2 questionnaires and could be identified at both time points) and 63 in the driVR intervention group.

3.1.1 Matched response sample

All participants in the matched-response sample were aged between 16-18 years. Of the 97 matched-response participants, 36 were male and 58 were female. A majority of the matched-participants (85) did not cycle. For driving status, 36% were not old enough to drive, 35% were 17 years of age but did not have a licence, and 18% were learning to drive but had not passed their theory test. Twelve participants in the comparison group (one-third) reported having previously had some form of road safety education in their school in the last 12 months; none of the intervention group had.

The data analyses presented in the following sections are based on the matched sample, although additional checks using the unmatched data were also conducted and this is noted where appropriate.

Table 3 presents the breakdown of matched responses by school.

Table 3: Matched responses by school

Group	School	Number of participants
Comparison group	A	8
	B	9
	C	17
	Total	**34**
driVR intervention group	D	31
	E	10
	F	16
	G	6
	Total	**63**

Around 50% of the responses were from school C for the comparison group and school D for the intervention group.

3.2 Factor analysis and statistical tests

All the questions relating to the four overarching themes (self-awareness, empowerment to change, perceived legitimacy of authority and attitudes to targeted safety related behaviours) were repeated in both TP1 and TP2, enabling comparison of how learner driver attitudes change over time. This section presents these comparisons using the matched-sample of 97 participants who completed both the TP1 and TP2 questionnaires.

Descriptive plots of the four themes by road user type from TP1 to TP2, for both groups, can be seen in Appendix B. For pedestrians these show small improvements for all themes from TP1 to TP2 for the intervention group, although the comparison group also show improvement over this time for self-awareness and perceived legitimacy of authority. Attitudes to safety related behaviours were rated highest and perceived legitimacy of authority was rated the lowest by both groups at both time points.

For items related to cycling, all themes except perceived legitimacy of authority were rated highly (by both groups at both time points). The low rating to perceived legitimacy of authority may be related to most of the sample not being regular cyclists.[2]

[2] Removing these items from the statistical tests did not have an effect on the analysis presented in the following sections.

Results to the various driver/passenger plots (seatbelts, distraction, fatigue, speeding and peer-pressure) suggest occasional improvements over time but few obvious differences between the comparison and driVR intervention groups. Of note was that perceived legitimacy of authority to distraction was highest across the driving related behaviours, suggesting that there is already an awareness of the associated risk and that the authorities have a right to target it.

A type of factor analysis called Principal Components Analysis (PCA) was run on this set of questionnaire items. PCA, often referred to as factor analysis, is used to reduce many related variables into smaller linear combinations of variables, reflecting the same underlying information. The main advantage of using this approach for this study is that it helps to reduce Type 1 errors[3] arising from multiple comparisons.

Each item was measured on a 5-point Likert-type scale from 'Strongly disagree' to 'Strongly agree'. Items were reversed where required in order to ensure that all items were worded in a positive direction, where high scores indicate higher self-awareness, for instance.

In order to ensure that the results were comparable between the TP1 and TP2 questions, the coefficients for the factor scores created using the TP1 questions were applied to the data collected from TP2. This process ensures that the results are presented on the same scales and any differences found can be attributed to a change over time (i.e. two weeks after intervention for the intervention group).

Prior to performing any factor analysis, a Bartlett's test of sphericity and Kaiser-Meyer-Olkin (KMO) tests were conducted in order to ensure that factor analysis is suitable for the data. For each theme, the KMO value was greater than 0.6 and the Bartlett's test was significant, indicating that factor analysis was appropriate for the data.

Statistical tests were conducted to test for differences between groups (comparison and intervention) and over time (TP1 and TP2). The results along with the p-value have been presented below. If statistically significant, the effect size[4] has also been presented using partial eta-square values[5].

3.2.1 Self-awareness

The questionnaire included 14 items that measured self-awareness of the participant as a driver/passenger, pedestrian or cyclist. A one factor solution was identified with all fourteen items positively loading onto the factor, explaining around 25% of the variance. Reliability analysis was conducted to verify the internal consistency of the items in the factor. The Cronbach alpha coefficient was 0.74 indicating a good internal consistency.

[3] A Type 1 error is when an effect is reported when in reality there isn't one. This can happen when multiple items are tested, increasing the chance of finding a result to one of them by chance alone.

[4] Effect size is simply a measure of the size of the difference between two groups or the association between two variables.

[5] Traditionally, partial eta-squared values of 0.01, 0.06 and 0.14 represent small, medium and large effect sizes.

A mixed between-within analysis of variance (ANOVA) was conducted to investigate whether there were significant differences in the mean factor scores for self-awareness over time and between the intervention and comparison group.

There was no significant effect (p=0.583) of the factor score between TP1 and TP2, suggesting that there was no change in participants' self-awareness. In addition, there was no significant difference between the two comparison groups (p=0.221) and the interaction term was not significant (p=0.069, partial eta-square=0.03), which suggests that there were no differences in measures related to self-awareness between the intervention and comparison groups.

3.2.2 Empowerment to change/ goal settings

The questionnaire included 14 items that measured empowerment to change when thinking as a driver/passenger, pedestrian or cyclist. A one factor solution was identified with all items positively loading onto the factor and explaining around 29% of the variance. Reliability analysis showed that the Cronbach alpha coefficient was 0.785, indicating a good internal consistency of the items in the factor.

A mixed between-within analysis of variance (ANOVA) was conducted to investigate whether there were significant differences in the mean factor scores for empowerment to change over time and between the two comparison groups. Analysis showed that there was no significant difference over time (p=0.79) and between the two groups (p=0.49) and the interaction was not significant (p=0.39). This suggests that there was no change in participants' attitude towards goal settings between the intervention and comparison group and over time.

3.2.3 Perceived legitimacy of authority

The questionnaire included 10 items that measured perceived legitimacy of authority when thinking as a driver/passenger, pedestrian or cyclist. A one factor solution was identified with all items positively loading onto the factor, explaining 28% of the variance. However, reliability analysis showed that the item 'Pedestrians who are not paying attention and cause an accident should be punished' did not improve the internal consistency of the scale and should be analysed separately. The Cronbach alpha coefficient after removing this item was 0.62 showing an acceptable internal consistency[6].

A mixed between-within analysis of variance (ANOVA) was conducted to investigate whether there were significant differences in the mean factor scores for perceived legitimacy of authority over time and between the two comparison groups. Analysis showed that there was no significant difference over time (p=0.98) and between the two groups (p=0.72) and the interaction was not significant (p=0.93). This suggests that there was no

[6] Cronbach's alpha is a good measure of internal consistency of the latent variable, and acceptable values are normally above .70 (Nunnally, 1978). However, values near.60 is acceptable, especially if the factor has only a few items (4-9) (Hair, et al., 2006).

change in participants' attitude towards legitimacy of authority between the intervention and comparison group and over time.

A Mann Whitney U test was conducted to investigate for differences in the item 'Pedestrians who are not paying attention and cause an accident should be punished' between the control and intervention group. Results showed there was no significant difference between the two groups (p=0.558) at TP2.

3.2.4 Attitudes to targeted safety related behaviour

The questionnaire included 13 items that measured perceived attitudes to targeted safety related behaviour when thinking as a driver/passenger, pedestrian or cyclist. A one factor solution was identified with all items positively loading onto the factor and explaining 26% of the variance. The Cronbach alpha coefficient was 0.69 showing acceptable internal consistency.

A mixed between-within analysis of variance (ANOVA) was conducted to investigate whether there were significant differences in the mean factor scores for attitudes to targeted safety related behaviour over time and between the two comparison groups. Results showed there was no significant differences over time (p=0.53), between groups (p=0.06, partial eta-square=0.03) and the interaction was not significant (p=0.0501, partial eta-square=0.04)[7].

3.3 Virtual reality

The driVR group was asked three questions regarding their interaction with VR. Participants were asked to rate the following questions on a 5-point Likert scale from 'strongly disagree' to 'strongly agree':

- I enjoyed using virtual reality as part of this lesson (Enjoy VR)
- Watching the films using a virtual reality headset was more engaging than if I had watched them on a standard TV screen (Engaging)
- Watching the films using the virtual reality headset made me feel sick (VR sickness)

Figure 3 shows the responses for these items.

[7] This interaction could be termed as approaching significance. However, there has been debate in the social sciences, and in other fields such as medicine, for the correct protocol for dealing with such results. The general consensus is that significance levels should be respected.

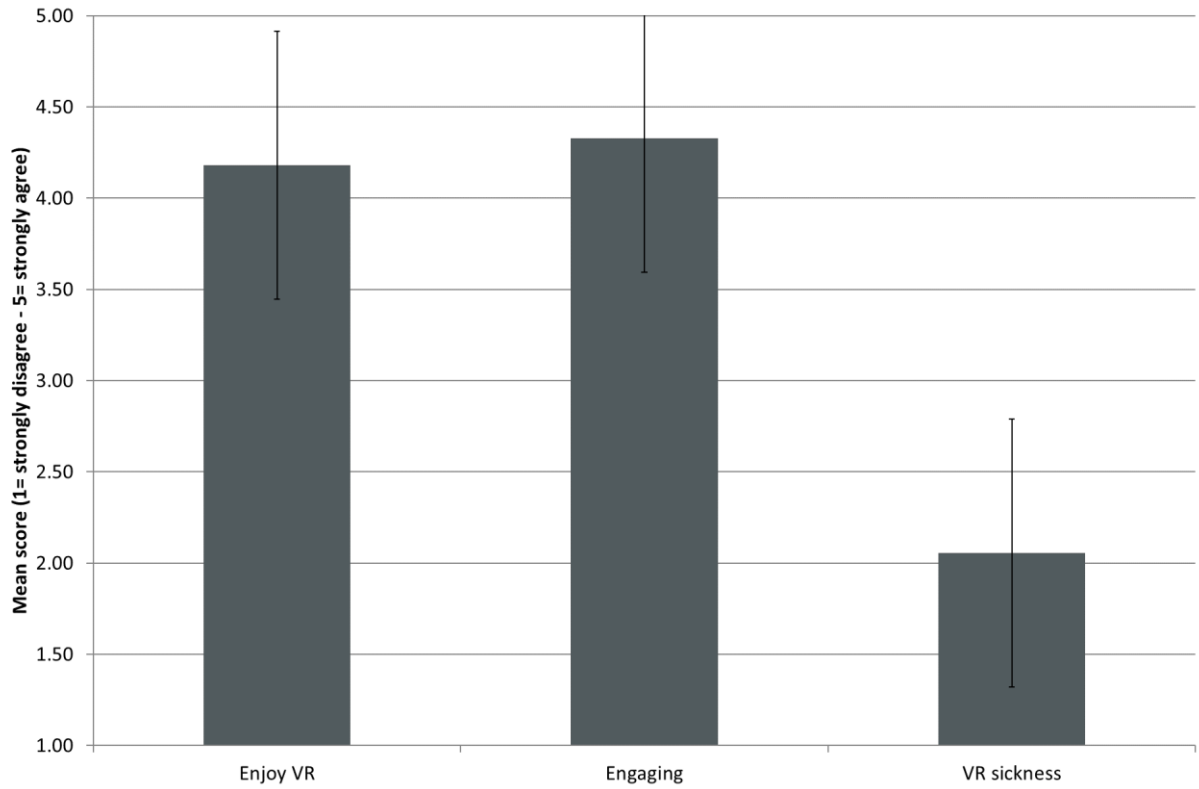


Figure 3: Responses to VR related questions with error bars (standard deviation)

Overall, the mean score for enjoying and engaging with VR was just over 4 suggesting that participants were more likely to agree with the items stated above. At the same time, participants were more likely to disagree with the statement around VR sickness (mean score=2.1).

4 Discussion

This report details an evaluation of a new young road user intervention. The driVR in-school intervention was designed in line with best practice behaviour change principles with input from an independent educational consultant. The lesson plan was developed around promoting attitudinal change to targeted safety related themes and behaviours from the perspective of a pedestrian, cyclist and driver or passenger. Virtual reality technology was used to enhance the learning experience and sought to provide greater engagement with the lesson's core content. It was hypothesised that this greater engagement would enhance the likelihood that young people would engage with the core road safety messages and improve their attitudes. The evaluation found that those who experienced the intervention rated VR as both engaging and enjoyable.

Evaluation is a critical part of the development of any intervention that aims to improve safety. Previous research for Transport Scotland identified a knowledge gap on the effectiveness of pre-driver interventions in Scotland. This knowledge gap is largely the result of a lack of evaluation to establish effectiveness, or where evaluation has been conducted, it is not to a required standard to allow formal conclusions to be drawn.

Best practice approaches recommend that evaluation is considered at the point of intervention design. This has several benefits including enabling the aims of the intervention to be clearly established, for materials to be designed around these aims, and for baseline data to be collected prior to the intervention being implemented. It also allows for the consideration and planning of a strong evaluation design involving either a control or comparison group, which allows for the data collected to be compared with data from a group who did not receive the intervention.

Previous international research has demonstrated the potential for young driver interventions (and other public health interventions) to cause harm by unintentionally impacting negatively on attitudes and behaviours (often these are the same attitudes and behaviours that are being targeted to improve) (e.g. Brinkman et al., 2016; Glendon et al., 2014; Poulter & McKenna, 2010). As a result, best practice (and a moral duty) requires that all interventions with the public, and particularly young people, are evaluated to at least establish that they are not causing harm. As there were no attitudes that were negatively impacted by the driVR intervention, it can be concluded that there is no evidence that the driVR intervention causes harm. The use of a comparison group provides greater confidence in this assertion.

While the intervention was not found to cause harm, the results do not provide any support that the intervention positively impacts attitudes targeted in its design. The intervention targeted safety related attitudes and behaviours relating to pedestrians, cyclists, car drivers and passengers (specifically seatbelts, peer pressure, speeding, distraction, fatigue). None of the behaviour change themes (self-awareness, empowerment to change, perceived legitimacy of authority and attitudes to targeted safety related behaviours) measured across these road user types were found to change following experience of the intervention. Again, use of a comparison group in the design provides confidence in these results.

The reason for not finding any statistically significant difference following the intervention is not immediately clear and could be the result of several factors. It should be noted that pre-

driver education interventions do not commonly result in attitudinal or behavioural change (see Helman et al., 2010; Kinnear et al., 2013; 2018). The overarching reasons for this have been discussed previously (see McKenna, 2010) and relate to such things as the level of influence a short-term course is likely to have on young people, the applicability of the content and the inconsistency of delivery.

There are many daily influences on a young person (parents, peers, significant others, media etc.) and these are more likely to dominate the development of attitudes than a one-off one-hour, or even one-day, classroom intervention. This is known as the 'dosage' effect; the amount of time a recipient is exposed to an intervention. In simple terms, it is like giving a sick patient a drug that is ineffective because either the strength of the drug is not sufficient, or it is not taken for long enough. It is possible that the driVR intervention was not strong enough as a one-off short intervention and may require being part of an ongoing engagement programme, with core messages repeated and supported by additional materials and engagement with the pupils.

It is possible that the content of the resource was not suitable for enacting attitudinal change. For example, where the content relied on the presentation of information, it assumes that there is an information deficit that needs to be corrected. It is possible that pupils were already aware of known risks and the intervention content that was being provided, which may explain why there was no difference between the intervention and comparison groups. However, the intervention was designed around established behaviour change techniques and in line with current Scottish curriculum guidelines by an educational consultant. The design of the intervention was clearly well thought through but could be reappraised following the results of the evaluation. One area for focus might be to reduce the number of areas covered by the intervention. Given the limited dosage, it may be appropriate for the intervention to strengthen its focus in fewer areas. The areas chosen for focus could be informed by the analysis in the current study as well as further work with the target audience (e.g. process evaluation).

A further area for consideration is the implementation and delivery of the resource. driVR was presented by several Road Safety Officers (RSOs) across the schools. The RSOs were briefed on the purpose and delivery of the lessons but this may not have been sufficient to result in consistent presentation of the materials between RSOs, or as originally designed. Due to the sample size, it was not possible to test or control for the effect of RSO or school on the data. It is recommended that any future evaluation of the driVR resource looks to control for presentation of the material as intended by the use of fully trained facilitators.

Finally, all research has limitations, particularly when conducted in the real world. An example of this was the resultant matched-sample size in the intervention group from delivery of the resource to over 300 pupils. The sample was sufficient for overall testing of effectiveness but further exploration to assess the impact by school, for example, was not possible. A further limitation is that the effect of the intervention was only measured against factors that the content was designed for. The evaluation materials were designed against this and may not have measured any additional peripheral impact (positive or negative) that the intervention had. For example, it may be that participation on driVR, in combination with other road safety messages, helps to reinforce road safety culture more generally. While the 'perceived legitimacy of authority' theme was designed to potentially

capture such reinforcement, it is possible that the effect is more subtle and can only be measured over time.

4.1 Conclusion

The driVR intervention was designed with the intention of improving road safety for a high-risk group of road users. The innovative use of VR and the informed approach to design resulted in driVR being the recipient of a Young Driver Road Safety Award at the Young Driver Focus 2019 conference. This independent evaluation has found that first and foremost, the intervention does no measurable harm. However, it does not demonstrate any meaningful change in attitudes towards road safety.

Historically, pre-driver interventions are notorious for a lack of supportive evidence for improving safety although much of this is due to a lack of evaluation in the first place. The designers of driVR deserve credit for including evaluation at the initial design phase of the project. Independent evaluation allows for informed decisions to be made with regard to further development, implementation and re-evaluation.

As discussed, there are a number of factors that could have affected the effectiveness of the resource. In considering these, the following recommendations for the future development of driVR are made:

1. Taking into account the limited exposure pupils have to driVR, consider whether driVR can be extended, repeated or used to support other road safety messages that pupils will be exposed to throughout the year, thereby increasing the dosage.
2. Consider whether the content could be concentrated to focus on fewer key road safety messages, strengthening the dose to fewer focused attitudes and behaviours.
3. Future delivery of driVR should be conducted by fully trained individuals to ensure that the material is delivered as designed. A process evaluation should be conducted to ensure this is the case, along with a repeated impact evaluation (with a control or comparison group) to assess the effectiveness of the redesigned resource.

References

Brinkman SA, Johnson SE, Codde JP, Hart MB, Straton JA, Mittinty MN and Silburn SR (2016). Efficacy of infant simulator programmes to prevent teenage pregnancy: a school-based cluster randomised controlled trial in Western Australia. *The Lancet*, 388(10057), 2264-2271

Glendon IA, McNally B, Jarvis A, Chalmers SL and Salisbury RL (2014). Evaluating a novice driver and pre-driver road safety intervention. *Accident Analysis and Prevention*, 64(3), 100-110

Hair J, Black W, Babin B, Anderson R, and Tatham R (2006). *Multivariate Data Analysis* (6th ed.). New Jersey: Pearson Educational, Inc.

Helman S, Grayson GB and Parkes AM (2010). *How Can We Produce Safer New Drivers? A review of the effects of experience, training and limiting exposure on the collision risk of new drivers* (INS005). Crowthorne: Transport Research Laboratory https://trl.co.uk/reports/INS005

Kinnear N, Lloyd L, Helman S, Husband P, Scoons J, Jones S, Stradling S, McKenna FP and Broughton J (2013). *Novice Drivers. Evidence Review and Evaluation: Pre-driving education and training, graduated driver licensing, and the New Drivers Act* (PPR673). Crowthorne: Transport Research Laboratory https://trl.co.uk/reports/PPR673

Kinnear N, Pressley A, Posner R and Jenkins R (2018). *Review and assessment of pre-driver interventions in Scotland* (PPR838). Crowthorne: Transport Research Laboratory https://www.transport.gov.scot/media/41989/pre-driver-review-and-assessment-trl-final-report.pdf

McKenna FP (2010). *The Public Health Benefits of Road Safety Education for Teenagers*. Think piece for Road Safety Scotland. Edinburgh: Transport Scotland

Nunnally JC (1978). *Psychometric theory* (2nd ed.). New York: McGraw-Hill

Poulter DR and McKenna FP (2010). Evaluating the effectiveness of a road safety education intervention for pre-drivers: An application of the theory of planned behaviour. *British Journal of Educational Psychology*, 80, 163-181

Pressley A, Fernández-Medina K, Helman S, McKenna FP, Stradling S and Husband P (2016). *A Review of Interventions Which Seek to Increase the Safety of Young and Novice Drivers* (PPR781). Crowthorne: Transport Research Laboratory

Sullman M (2017). *Young Driver Safety: A review of behaviour change techniques for future interventions*. London: RAC Foundation

Appendix A Questionnaire design: Intervention aims, items and themes

Pedestrian

Intervention aim	Positively influence attitudes
Content	Looking at phone rather than surroundings
	Loud music obscuring traffic noise
	Not looking when crossing
	Not using pedestrian crossings
	Crossing with view obscured
Theme	Self-awareness (SA)
	Empowerment to change/goal setting (EC)
	Perceived legitimacy of authority /road laws /rules (PLA)
	Attitudes to targeted safety related behaviours (ATB)

Theme code		Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
SA	I always choose a safe place to cross the road	☐	☐	☐	☐	☐
SA	I often use my phone (e.g. to text, check social media, play games) when walking alongside roads	☐	☐	☐	☐	☐
EC	I am trying not to use my phone as much when walking alongside the road	☐	☐	☐	☐	☐
EC	I turn my music down so I can hear the traffic when walking alongside the road	☐	☐	☐	☐	☐
PLA	Pedestrians who are not paying attention and cause an accident should be punished	☐	☐	☐	☐	☐
PLA	If a car hits a pedestrian, it is always the car driver's fault	☐	☐	☐	☐	☐
ATB	Using a mobile phone whist walking (e.g. to text, check social media, play games) doesn't impact a person's ability to spot hazards	☐	☐	☐	☐	☐
ATB	Listening to music through headphones whilst walking doesn't impact a person's ability to spot hazards	☐	☐	☐	☐	☐

Cyclist

Intervention aim	Positively influence attitudes
Content	No helmet
	No high vis
	Changed lanes without looking
	Changed lanes without signalling
Themes	Self-awareness (SA)
	Empowerment to change/goal setting (EC)
	Perceived legitimacy of authority /road laws /rules (PLA)
	Attitudes to targeted safety related behaviours (ATB)

Theme code		Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
SA	It is easy for drivers to see cyclists on the road	☐	☐	☐	☐	☐
SA	If I was cycling on the road I would always check behind me before changing lane	☐	☐	☐	☐	☐
SA	If I was cycling on the road I would always make clear arm signals before changing lane or turning	☐	☐	☐	☐	☐
EC	When cycling, it is important to make yourself visible to other road users by wearing bright clothing and using lights	☐	☐	☐	☐	☐
EC	I would always wear a helmet when cycling on the road	☐	☐	☐	☐	☐
PLA	There should be a law that cyclists always have to wear a helmet	☐	☐	☐	☐	☐
PLA	If a car hits a cyclist, it is always the car driver's fault	☐	☐	☐	☐	☐
ATB	Wearing a helmet when cycling doesn't make you any safer	☐	☐	☐	☐	☐
ATB	Cyclists shouldn't be allowed on the road	☐	☐	☐	☐	☐

Driver / passenger

Intervention aim	Positively influence attitudes
Content	No seatbelt
	Not checking mirrors/blind spot
	Driver fatigue
	Driving at speed inappropriate for conditions
	Mobile phone use
	Passenger distraction
	Failure to notice signs
	Loud music
Themes	Self-awareness (SA)
	Empowerment to change/goal setting (EC)
	Perceived legitimacy of authority /road laws /rules (PLA)
	Attitudes to targeted safety related behaviours (ATB)

Theme code	**Seatbelts**	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
SA	I always wear my seat belt when driving or as a FRONT-seat passenger in a car	☐	☐	☐	☐	☐
SA	I often need to be reminded to put my seat belt on when I am a REAR-seat passenger in a car	☐	☐	☐	☐	☐
EC	Whenever I get in the car (as a driver or passenger) I make sure everyone is wearing their seatbelt	☐	☐	☐	☐	☐
PLA	I think the police should target drivers and passengers who do not wear seat belts	☐	☐	☐	☐	☐
ATB	It is a driver's responsibility to ensure that all passengers in their vehicles are wearing seatbelts	☐	☐	☐	☐	☐
ATB	I don't see the need to wear a seat belt when a car has an airbag	☐	☐	☐	☐	☐

Theme code	**Distraction**	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
SA	I do/would use my mobile phone when driving	☐	☐	☐	☐	☐
SA	I enjoy listening to loud music in the car	☐	☐	☐	☐	☐
EC	If I was driving, I would put my phone on silent or put it out of reach so that I do not use it	☐	☐	☐	☐	☐
EC	As a passenger, I would tell the driver to stop using their phone while driving	☐	☐	☐	☐	☐
EC	As a driver or passenger, I would turn the music down if I thought it was too loud	☐	☐	☐	☐	☐
PLA	Harsher penalties should be introduced for drivers who use their mobile phone when driving	☐	☐	☐	☐	☐
ATB	Some people can drive safely even when they are using their mobile phone at the same time	☐	☐	☐	☐	☐
ATB	I enjoy playing loud music in the car with my friends	☐	☐	☐	☐	☐

Theme code	**Fatigue**	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
SA	I do/would drive to meet friends even if I felt tired	☐	☐	☐	☐	☐
EC	If I was driving, I would stop and take a break if I was feeling tired	☐	☐	☐	☐	☐
EC	As a passenger, I would tell the driver to stop driving if I saw that they were tired	☐	☐	☐	☐	☐
PLA	Harsher penalties should be introduced for drivers who fall asleep while driving	☐	☐	☐	☐	☐
ATB	Some people can drive safely even if they are feeling tired	☐	☐	☐	☐	☐

Theme code	**Speeding**	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
SA	I am confident that as a driver I will know exactly how fast I can drive and still drive safely	☐	☐	☐	☐	☐
SA	When I am in a car as a passenger, I feel uncomfortable if the driver drives fast	☐	☐	☐	☐	☐
EC	As a passenger, I would tell the driver to slow down if I thought they were driving too fast	☐	☐	☐	☐	☐
EC	I do/would not exceed the speed limit when driving	☐	☐	☐	☐	☐
PLA	Even drivers who are just over the speed limit deserve to be punished	☐	☐	☐	☐	☐
PLA	I would favour stricter enforcement of the speed limit	☐	☐	☐	☐	☐
ATB	Driving fast and having a bit of fun with your friends in the car is just part of being young	☐	☐	☐	☐	☐
ATB	Even driving slightly faster than the speed limit makes you more likely to have an accident	☐	☐	☐	☐	☐

Theme code	**Peer pressure**	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
SA	When I am in a car as a passenger I like to encourage the driver to speed up	☐	☐	☐	☐	☐
SA	When I am in a car with friends, we often turn the music up	☐	☐	☐	☐	☐
EC	When I am a passenger in a car I try to avoid distracting the driver	☐	☐	☐	☐	☐
EC	If I was driving and my friends were encouraging me to go faster, I would just ignore them	☐	☐	☐	☐	☐
PLA	There should be restrictions on new drivers carrying same-age passengers just after passing the driving test	☐	☐	☐	☐	☐

ATB	It's ok for passengers to encourage a driver to speed up and take a few risks if they are late for something important	☐	☐	☐	☐	☐
ATB	Drivers should avoid taking risks when driving, even if their passengers are encouraging them to	☐	☐	☐	☐	☐

Appendix B Descriptive plots

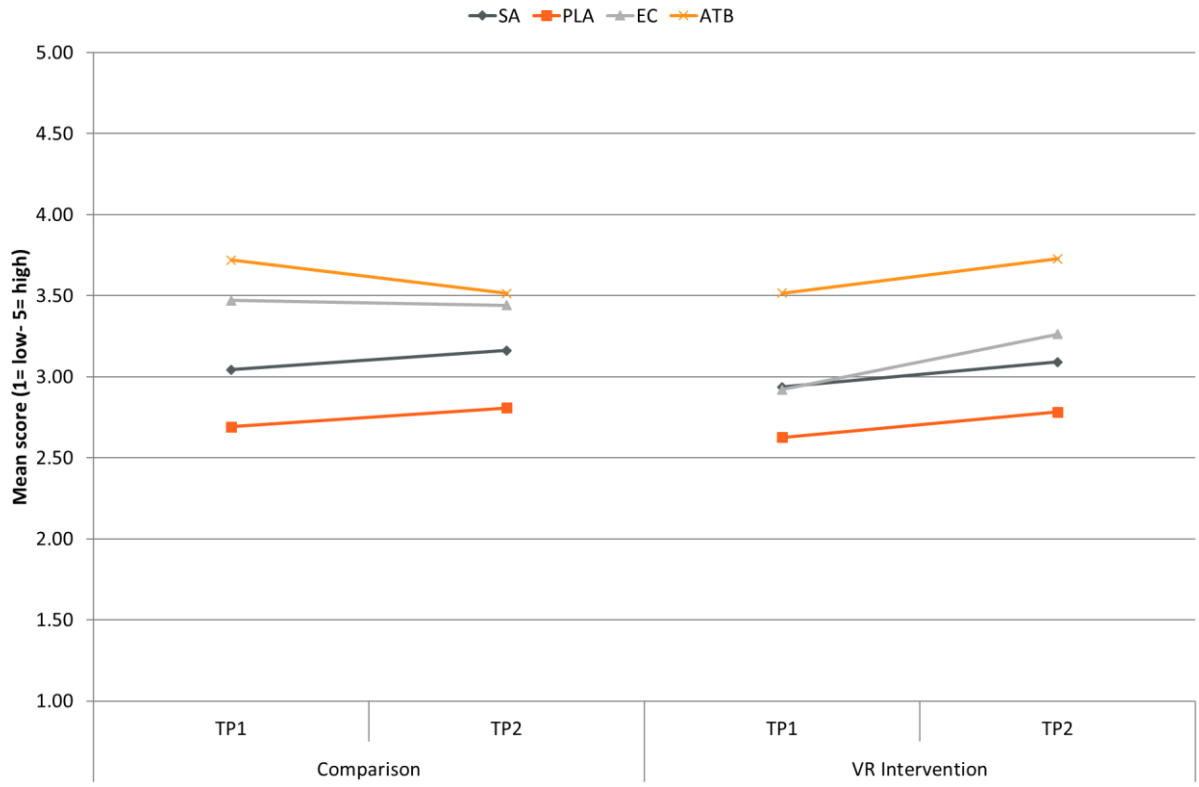
As noted in section 2.2, there were four overarching themes in the course materials and evaluation questionnaires:

1. Self-awareness
2. Empowerment to change / goal setting
3. Attitudes to targeted safety related behaviours
4. Perceived legitimacy of authority / road laws / rules

The following figures compare these themes between TP1 and TP2 for the comparison and intervention groups. The analysis has been separated by road user group (pedestrian, cyclists and driver). Due to a greater focus on being a driver or passenger in the intervention, the driver/passenger group has been split by the five behaviours of interest: seatbelts, distraction, fatigue, speeding and peer-pressure.

Each item was measured on a 5-point Likert scale from (1) 'Strongly disagree' to (5) 'Strongly agree'. However, items were reversed where required in order to ensure that all items were worded in a positive direction, where high scores indicate higher self-awareness, for instance.

This section allows for a visualisation of the responses over time for each group by theme. Any visual changes do not represent meaningful statistical change (see section 3.2).



SA= Self-awareness; PLA= Perceived legitimacy of authority; EC= Empowerment to change; ATB: Attitudes to targeted safety related behaviours

Figure 4: Pedestrian

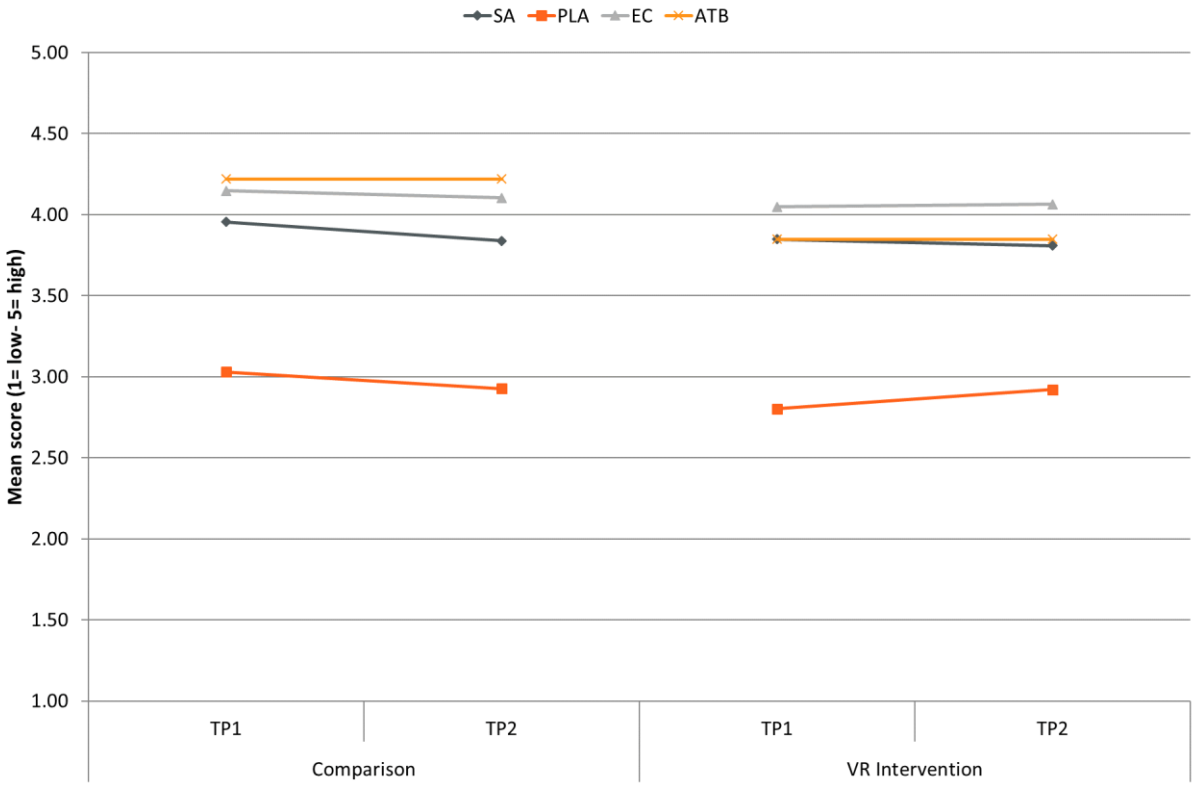


Figure 5: Cyclist

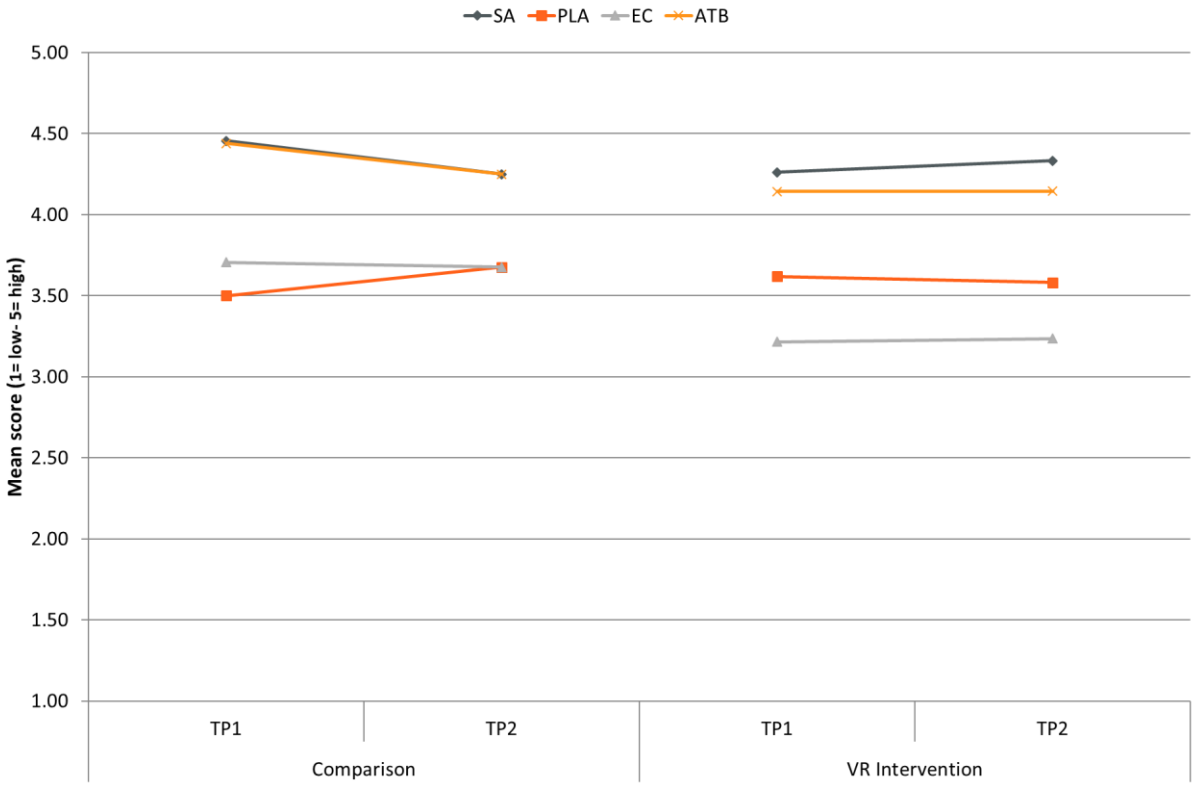


Figure 6: Seatbelt

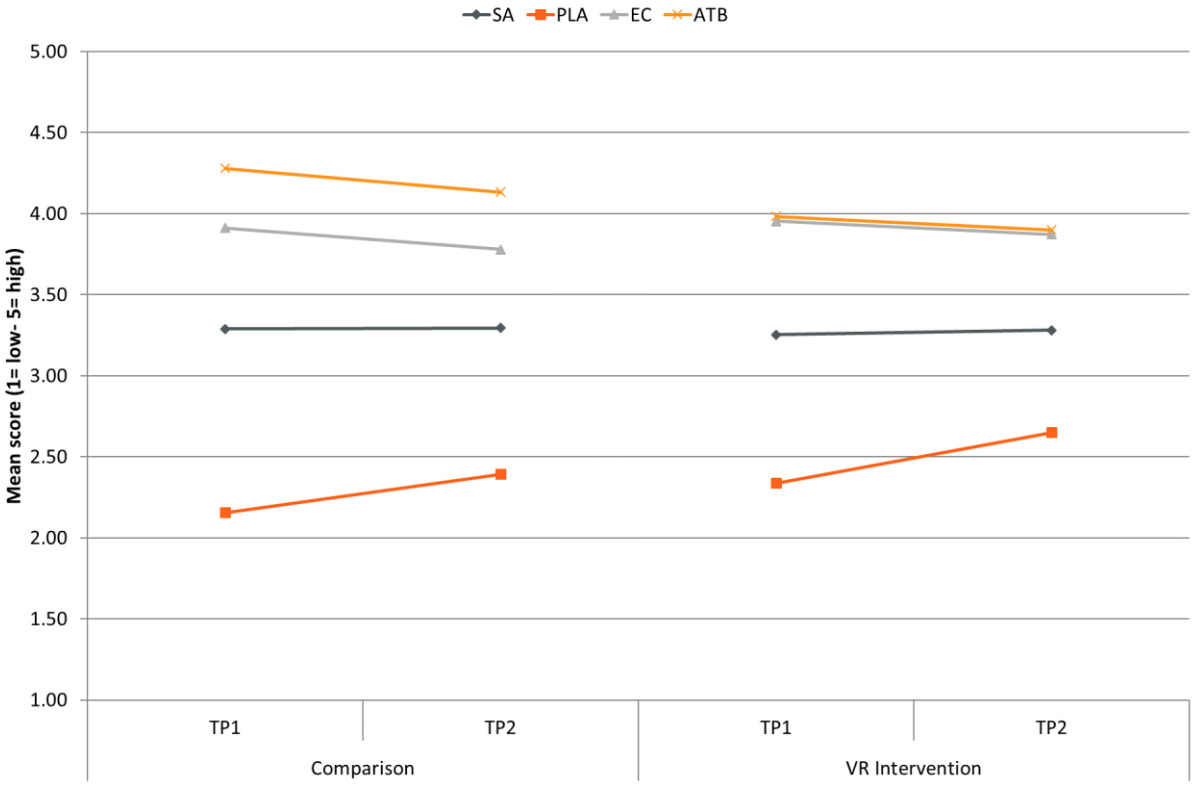


Figure 7: Peer pressure

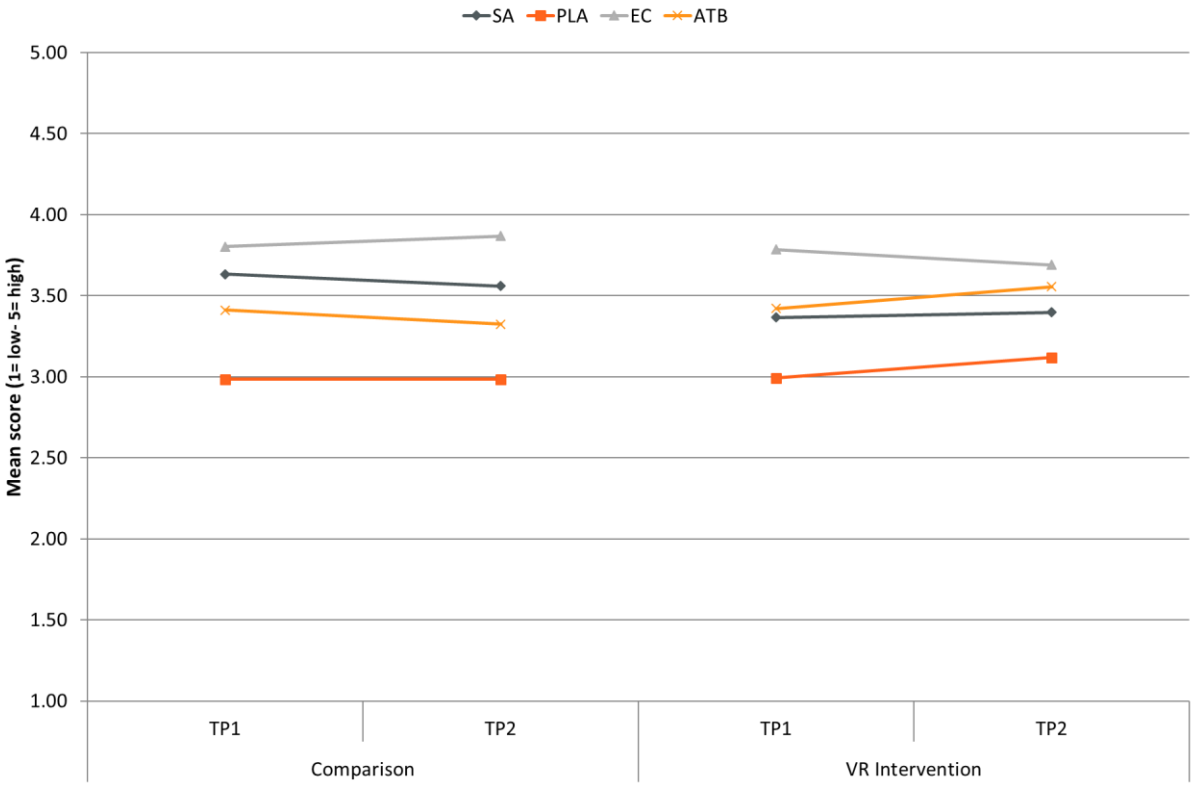


Figure 8: Speeding

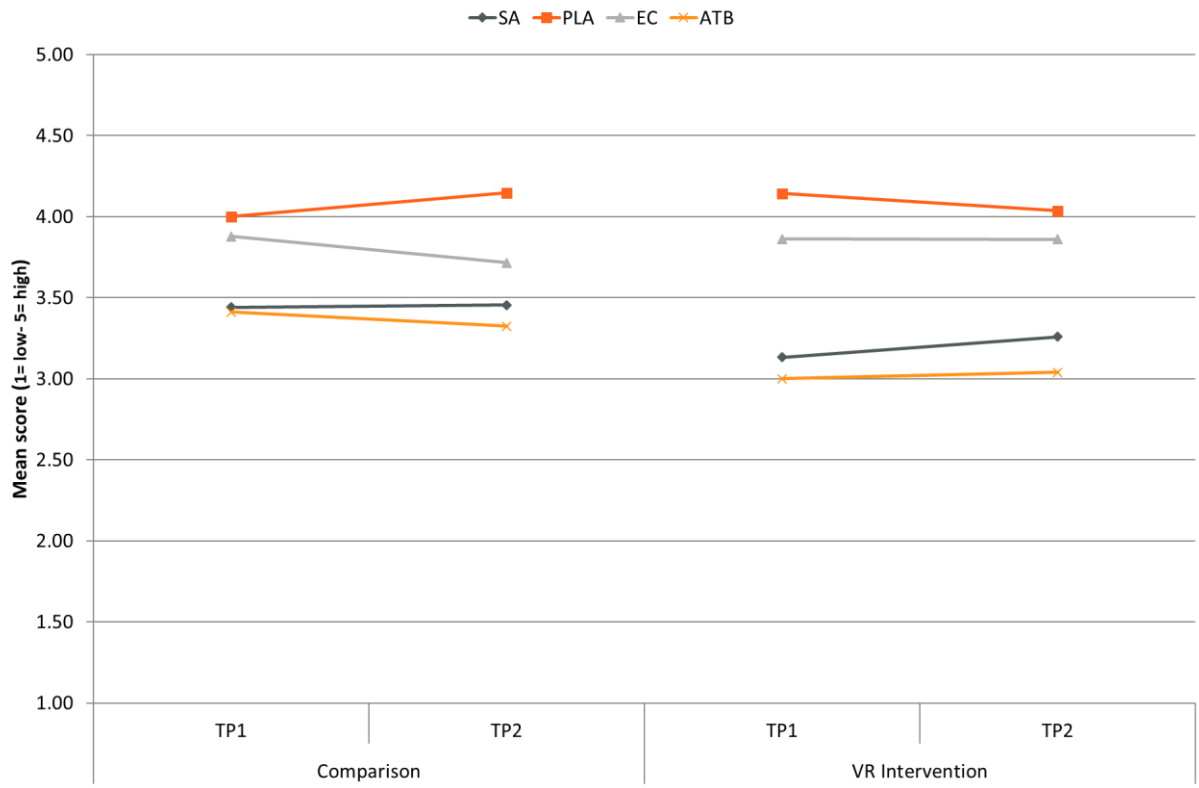


Figure 9: Distraction

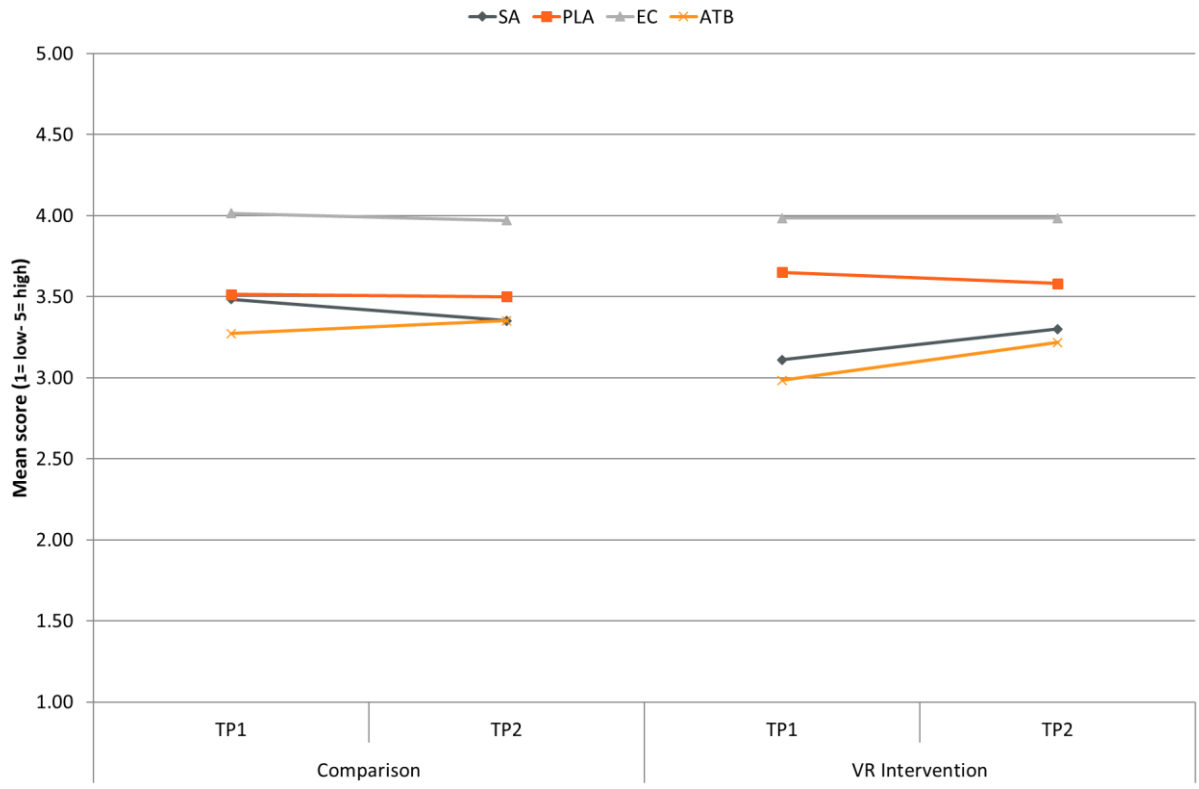


Figure 10: Fatigue

Figure 11 presents the results averaged across the three road user groups for the four overarching themes.

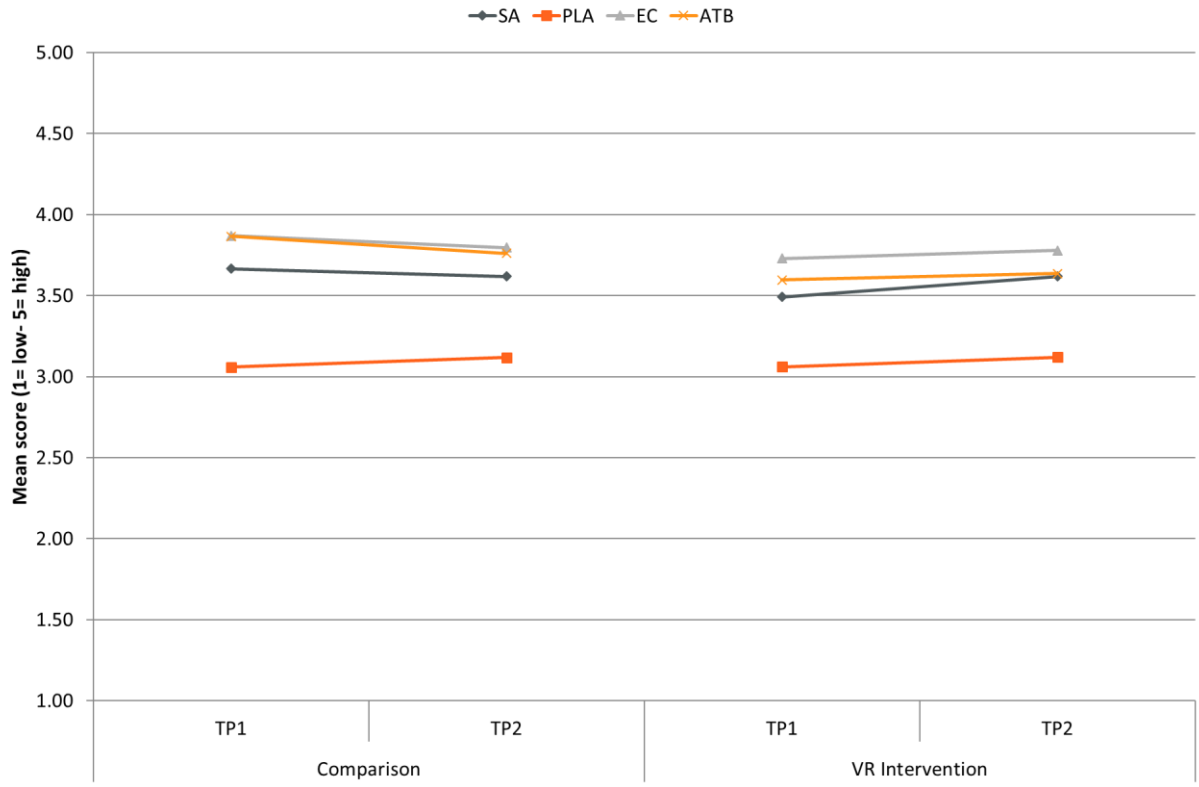


Figure 11: Overall (all road user categories)

Evaluation of the driVR young road user education intervention

driVR is an intervention which uses virtual reality, groups discussions and a workbook to engage young people (16-18 years old) with road safety messages. It was designed to improve self-awareness, empowerment to change, attitudes to targeted safety-related behaviours, and perceived legitimacy of road laws. An evaluation with a quasi-experimental design was used to measure the effectiveness of the intervention. All participants completed self-report surveys measuring the outcome variables, both before and after the intervention (with comparison group participants having a similar delay between surveys, but no intervention). No evidence was found of the intervention changing any of the intended outcomes. Importantly, the evaluation will enable the providers of the intervention to consider several improvements, including testing higher dosages, focusing on fewer safety messages and topics, and considering a process evaluation to check the fidelity with which the intervention is being delivered.

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