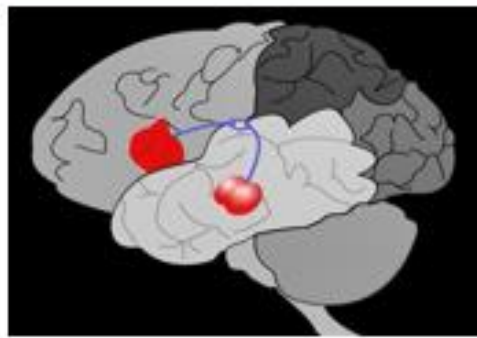


Promoting safe overtaking of horses and cyclists with mindfulness techniques



Making Roads Safer



Promoting safe overtaking of horses and cyclists with mindfulness techniques

**David Crundall, Editha van Loon
and Katherine Bailey**

Nottingham Trent University

Executive Summary

Introduction

1. Vulnerable road users (VRUs) include any road user who is not protected from injury by a metal shell, such as cyclists and horse riders. These road users have the greatest likelihood of being killed or seriously injured if they are involved in a collision.
2. Inappropriate overtaking is one of the key problems faced by cyclists and horse riders, which is typified by another vehicle approaching too quickly or too closely, and then passing without sufficient lateral clearance or at too high a speed. This can destabilise a bicycle and frighten a horse, increasing the possibility of injury to the VRU.
3. Drivers overtake too close and too fast for a number of reasons: They may not know what distances and speeds are safe to adopt when overtaking, they may be prompted by negative attitudes towards a particular group of VRUs, or they may be responding to in-the-moment emotions, such as frustration or anxiety.
4. When considering methods for overcoming these antecedents of inappropriate overtaking behaviour, mindfulness was considered as a possible aid. Mindfulness is a state of focus where one is grounded in the present moment, which allows you to be aware of your feelings, thoughts, and physical sensations. Emotions and thoughts that are not conducive to current goals (e.g., safely navigating from A to B) can then be put aside to allow one to focus on the task at hand.
5. Mindfulness has many potential benefits for drivers including the removal of distractions, increased focus, and emotional regulation. Researchers have demonstrated that mindfulness courses can have a positive impact on real measures of driving (reducing speeding and harsh accelerations).
6. A common medium to impart road safety interventions is through a road safety video. This is a short video clip that might be released through social media or used in TV road safety campaigns. The appeal of these videos is that they have the potential to reach a large audience for a relatively low cost. But can the benefits of mindfulness, which typically takes weeks to train, have beneficial effects in such a short time frame? This was the question of the current project.

Study 1: A survey of car drivers' emotions, attitudes and behaviours towards VRUs

7. To better understand the emotions, attitudes, and behaviours of car drivers towards our target VRUs (cyclists and horse riders) we undertook a large study of over 1000 drivers and asked them what they felt, thought, and how they behaved around VRUs.
8. Spotting horses in the road ahead was most likely to lead to feelings of surprise and happiness in our drivers, whereas the strongest emotions evoked by cyclists were reported to be frustration and anxiety.
9. Drivers' responses to our questions about their behaviours around VRUs produced two factors: *unsafe passing behaviours* and *aggressive behaviours*. All negative behaviours were reported

more frequently in regard to cyclists rather than horses. Drivers were also more likely to agree with negative statements about cyclists than horses.

10. Regression analyses demonstrated that *anger*, *contempt*, and *frustration* predicted aggressive and/or unsafe passing behaviours towards cyclists, and to a lesser extent towards horses.
11. Across a range of analyses, *anger* and *frustration* were perhaps the most important 'in-the-moment' (state-based) emotions to tackle, while an attitudinal factor we called *disdain* demonstrated that some prior attitudes towards these VRU groups might also influence inappropriate overtaking (trait-based).

Development of the videos

12. An expert focus group of mindfulness practitioners and stakeholders was convened to assess the data from study 1. The group confirmed the most important causes to focus upon, and provided advice on the techniques that could be used to improve driver behaviour.
13. The videos were then scripted, filmed and edited over a period of several months.
14. The topics were
 - a. The STOP technique – *Stop, Take a breath, Observe* why you are feeling this, and put negative thoughts aside and *Proceed*.
 - b. *Monitoring yourself for negative thoughts*
 - c. An explanation of in-groups, out-groups and stereotypes, culminating in the *Three Little Things* technique.
 - d. *Emotion labelling* – the act of verbalising your current emotion to bring it under control.

Study 2: Evaluating the videos

15. To evaluate the videos we recruited over 300 drivers who were matched in pairs based on frustration/anger towards, and exposure to, VRUs. Drivers within their pairs were then randomly allocated to an intervention group or a control group. The former were shown the four mindfulness videos, one per week via an online survey. The latter received a series of control videos delivered over the same time period (on the dangers of hands-free phones). Prior to (Week 1) and following the study (Week 6), respondents were asked about the emotions they feel when they see cyclists or horse riders in the road ahead, the attitudes they hold towards these groups, and the behaviours they engage in towards these VRUs.
16. We found attitudes towards cyclists improved after seeing the mindfulness videos. The control group showed no such improvement. While attitudes towards horses also appeared to improve relative to the control group, this was not statistically significant.
17. Regarding future intended passing behaviours, our intervention group reported a larger reduction in their intended speed for passing both cyclists and horse riders. They also showed a decrease in the behavioural factor of *unsafe passing behaviours* in regards to cyclists. A similar drop in regard to horse riders did not reach the threshold of significance.
18. In regard to emotions, our drivers reported an anticipated reduction in frustration when they next meet cyclists in the road ahead.

19. In a series of self-reflection questions, most of our intervention drivers agreed that their knowledge of how to pass cyclists/horses had improved (81% and 82%, respectively), that they will be in more control when overtaking them in the future (82% and 84%), and that they will use the mindfulness techniques when they next encounter these VRUs in the road (81% and 85%). Ninety-two percent of our intervention drivers agreed that the videos will improve the behaviour of some drivers.

Conclusions

20. The results suggest that the videos have had a positive effect on the attitudes and emotions (frustration) of drivers towards cyclists, and that their intended future overtaking speeds have decreased, along with a decrease in the unsafe passing behaviours factor identified in Study 1.
21. The effects on attitudes, emotions, and behaviours towards horse riders were less pronounced. Our drivers still, however, reported lower intended speeds for overtaking horse riders, and 73% believed that their attitudes towards horse riders had improved. One possibility underlying the weaker effects on attitudes towards horse riders is that our drivers already had relatively positive attitudes towards horses at baseline (Week 1), possibly resulting in a ceiling effect.
22. The study has also demonstrated an effective method for developing and evaluating a new road safety video. The initial survey identifies the causes of the problem. The expert focus group then helps select the potential solutions. The video scripts are written, storyboards are created, and filming and editing takes place. Then an evaluation is undertaken with a suitable control group and range of measures (in this case, attitudes, emotions, and past and future intended behaviours; including quantitative and qualitative data) to provide converging evidence.
23. Beyond the current project we aim to disseminate these videos through a range of partners. We recommend that a dedicated website could be set-up to act as the primary source of these videos, which could also include more in-depth training on mindfulness, and exercises to allow drivers to practice their new skills.

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1 Introduction

When collisions occur, drivers of cars, vans, and lorries are, to a certain extent, protected from injury due to being surrounded by a metal shell. Not only does the metal shell provide an impact layer between themselves and other road users or the environment, but safety features are also built in to the shell (e.g., A-frame airbags, front crumple zones, etc.). There is however a large segment of road users who do not have such protection, such as motorcyclists, cyclists, horse riders, e-scooter riders, mobility scooter users, and pedestrians. These vulnerable road users (VRUs) have the greatest likelihood of death or serious injury in the case of a collision.

In 2022, vulnerable road users accounted for 48% of fatalities. Motorcyclists and pedestrians were heavily represented, though there were also 91 cyclist fatalities and over 4000 serious injuries (DfT, 2023). Collisions with horses and riders are much less frequent due to the lower numbers on the roads, yet the British Horse Society still reported 68 horse deaths and 139 rider injuries in the same period (with over 3500 incidents reported to the BHS: an increase of 21% on the previous year; Hiscox and Baker, 2023). The current report focuses primarily on cyclists and horse riders.

One of the key instances that contribute to collisions involving cyclists and horse riders is inappropriate overtaking by another vehicle (Mackenzie et al., 2021; Pollard and Grewar, 2020). Cyclists and horse riders are very sensitive to the passing distance of other vehicles. Beck et al. (2021) asked cyclists to press a button while cycling on real roads if they felt threatened when being overtaken. Unsurprisingly, they pressed the button more often for closer passes. This sensitivity to closes passes was confirmed by a test-track study by Rasch et al., (2022) who found cyclists' perceived safety to be predicted by the lateral clearance of overtaking vehicles, and the speed at which they passed. In contrast, car drivers were more concerned about the proximity of oncoming vehicles. The cyclists' concerns can be understood in regard to changes in air pressure and suction that come with a close or fast overtake, which can easily destabilise a bicycle (Gromke and Ruck, 2021). For horse riders, the greater concern, beyond an actual collision, is how the horse will respond to a close pass. Horses can be unpredictable, even though most are well-trained and trust their handler. A close pass may cause the horse to become agitated and may cause it to bolt, possibly unseating and injuring the rider and/or the horse (see the Dead Slow Campaign by the British Horse Society; BHS, 2024).

In addition to death and serious injury, fears over safety issues can negatively impact on cyclists' and horse riders' willingness to use public roads. A perceived lack of safety was one of the key barriers to cycling noted in a recent systematic review (Pearson et al., 2023), with negative attitudes of non-cyclists towards cyclists frequently acknowledged in the qualitative data of the studies they reviewed. Similarly, Pollard and Furtado (2021) have found that safety concerns can prevent some riders from exercising their horses.

1.1 Why do car drivers overtake too close and too fast?

Crundall and van Loon (2023a) reviewed a number of reasons why drivers might overtake horses and cyclists at too high a speed and without sufficient lateral clearance. Lack of knowledge of what counts as a safe speed and a safe passing distance was identified as a cause, despite recent changes to the UK Highway Code that were supported by public awareness campaigns. They also noted that negative emotions, such as frustration and anger at being delayed by a VRU in the road ahead, can prompt risky overtaking manoeuvres (Stephens and Groeger, 2009, 2011; Chapman and Musselwhite, 2011). In the most extreme cases, this might result in road rage – aggressive and often confrontational behaviour typically borne out of anger (see Bjureber and Gross, 2021, for a more in-depth discussion on the definition of road rage). Such instances of road rage can be surprisingly common, with Love et al., (2022) finding more than a quarter of their Australian sample admitted to physical aggression, while more than half admitted to vehicular aggression (e.g., tailgating). Anger and aggression can be exacerbated if drivers hold pre-existing negative attitudes towards the other road user (Stephens et al, 2018), which can result in aggressive behaviours that disproportionately target VRUs (Poulos et al., 2019).

Negative attitudes towards cyclists have been found to predict passing distance, speed, and time-to-collision, with drivers who deny that cyclists are ‘legitimate road users’ tending to overtake at a higher maximum speed (Goddard et al, 2020). The argument against legitimacy is linked to in-group and out-group associations, with previous research indicating that drivers tend to perceive cyclists as an out-group (Horton, 2007; Basford et al., 2002). This tendency may be reinforced by a stronger attachment to the car as a preferred mode of transport (Fruhen et al, 2019). There is even evidence that drivers perceive cyclists who wear helmets or hi-vis vests to be ‘less human’ (Limb and Collyer 2023), and the extent to which drivers feel this way predicts aggressive behaviour towards them (Delbosc, et al., 2019).

The negative attitudes that some drivers hold may stem from genuinely risky behaviour witnessed in a small number of cyclists such as running red lights. Some cyclists report a positive attitude towards such violations (Cristea & Gheorghiu, 2016) because they allow them to maintain momentum and save physical energy (e.g., Cristea & Delhomme, 2016), and such actions may therefore be encouraged by peers (e.g., Curry, Mirman, Kallan, Winston, & Durbin, 2012; Vollrath, Meilinger, & Krager, 2002). However, if drivers view all cyclists as potential red-light runners then this reflects the application of a negative stereotype, which is easier to apply if the particular population of road users is seen as an out-group (e.g., Stewart and Raihani, 2023). For horse riders, drivers may apply the stereotype of wealthy and arrogant individuals who are engaging in a leisure pursuit at the expense of the driver (e.g., Chapman and Musselwhite, 2011). Holding negative stereotypes reduces the concern that one might otherwise have for these VRUs’ safety, resulting in careless passing at inappropriate times, or aggressive overtaking that is intended to convey displeasure.

1.2 How can we stop drivers overtaking too close and too fast?

Where risky overtaking is due to a driver’s lack of knowledge, then public education is required. There has been concern however that such public campaigns have been insufficient in the past to

encourage change (Crundall and van Loon, 2023a). Despite such concerns, educating car drivers through the provision of information would seem easier to achieve than persuading drivers to modify their negative attitudes and stereotypes. Nonetheless, there have been several attempts to improve attitudes towards VRUs in the past. For instance, some researchers have used road-safety videos to try to change drivers' attitudes through emotive content (e.g., Rogé et al., 2015), while others have provided drivers with a VRU perspective so they can experience the dangers for themselves (Shahar et al., 2011). Another video-based approach was to provide drivers with insight into the personal lives of VRUs (e.g., what job they do; Crundall and van Loon, 2023a) in an attempt to humanise them and increase empathy toward them. In the latter study, Crundall and van Loon (2023a) presented drivers with videos that provided insight into the lives of two horse riders and two cyclists. One video, for example, focused on Julie, an emergency worker for the fire service. It contained emotive information about her job and the stresses involved, before pivoting to show how she tries to cope with the pressures of the job by riding her horse (which, by necessity, includes riding on the road to travel from one bridleway to another). The results of this study were very positive, with car drivers demonstrating improved attitudes towards horse riders or cyclists (depending on which videos they saw) compared to a control group. They also recorded wider passing distances and slower passing speeds in an online test of future intended behaviours. Unfortunately, a follow-up study 16-months later found that all attitudes and future intended behaviours had reset back to baseline (Crundall and van Loon, 2023b). The authors acknowledged that it was perhaps overly optimistic to expect a short video to impact upon attitudes and behaviours nearly a year and a half later. A further problem with such video-based attempts is that, while negative attitudes might exacerbate a situation, it may be the emotions that one feels in the moment which trigger a maladaptive response (e.g., frustration due to delays, Chapman and Musselwhite, 2011).

Nonetheless, organisations with a road safety remit will continue to invest in road safety videos due to their relatively low cost and the possibility of reaching a wide audience. Thus it remains important for researchers to continue to investigate the best possible methods for conveying road safety messages in this short format. This is the intention of the current project.

Building on the findings of Crundall and van Loon (2023a, b) we suggest that video-based safety messaging should not be given as one-shot message. Instead the message must be repeated on a number of occasions, preferably with new content that addresses the same core safety issue in order to keep drivers engaged. Secondly, we argue that there needs to be some call to action. If a driver is prompted to engage in some form of activity between exposure to successive road-safety videos, this is likely to lead to a stronger memory trace for the information. Thirdly, while a focus on changing attitudes is important, we also recognise the need to deal with situation-specific emotions as they arise. Any solutions should therefore focus on both overarching attitudes and in-the-moment emotional cues to negative behaviour.

To this end we have chosen *mindfulness* as a core solution across a series of videos, providing techniques that will hopefully allow drivers to choose safer options when overtaking VRUs. The following section will briefly discuss the potential benefits of mindfulness for driving safety, before the current project is described in more detail.

1.3 The potential for mindfulness to improve driver safety

Mindfulness is a state of mind where one directs attention to awareness of the current moment. One acknowledges current emotions and thoughts in a non-judgemental way, and puts them to one side if they are getting in the way of the current experience (Miller et al., 1995). Benefits of mindfulness include the mitigation of external and internal distractions (such as rumination on negative experiences, or the desire to check one's mobile phone, e.g., Koppel et al., 2022), and perceptual clarity of one's current emotional states (Brown and Ryan, 2003). A wealth of academic evidence has demonstrated benefits of mindfulness in clinical and behavioural contexts (Bowen et al., 2007; Brotto et al., 2008; Kabat-Zinn, 1982; Koszycki et al., 2007; Ma & Teasdale, 2004; Shonin, et al., 2014a, 2014b; Symington & Symington, 2012; Van Gordon et al., 2016; Wanden-Berghe et al., 2011).

Regarding driving, researchers have argued that mindfulness could be an invaluable method for improving road safety (Kass et al., 2008), and several studies provide findings that could have important benefits for drivers, such as the mitigation of emotional interference (Ortner, et al., 2007) and a negative relationship between mindfulness and impulsivity (Peters et al., 2011). Other researchers have directly assessed mindfulness in relation to measures of driving safety: Koppel et al. (2018) found a negative link with self-reported driving violations; Terry and Terry (2015) found a link between trait mindfulness and a lower likelihood of phone-related near collisions; Albert et al., (2023) found mindfulness training to reduce mind wandering of drivers in a simulator.

In a large, multi-experiment mindfulness study, Crundall et al. (2019) found mindfulness training reduced reported anger of drivers in a 'road rage' test, improved speed control in a simulator, and reduced mind wandering across a series of laboratory tests. In a final study that involved collecting naturalistic data, mindfulness trained drivers were less likely to exceed 70 mph on dual carriageways and motorways, and had fewer instances of harsh acceleration. While this is a nascent research area, the results so far suggest that mindfulness could have positive influences on a range of problematic driving behaviours.

One issue however is the length of time required to impart mindfulness training. Crundall et al. (2019) started with a 12-hour training program and managed to reduce it to 4 hours. Others have reduced training even further, with Albert et al. (2023) limiting their training to 60 mins of pre-recorded instruction split into four 15-minute sessions. Unfortunately, we must reduce this even further to a more social-media friendly runtime of 3-4 minutes per video. Accordingly, we sought to distil core tenets of mindfulness into discrete techniques that could still provide a meaningful experience within the required time frame.

1.4 The current study

The current study was devised in three phases. First, we wanted to survey drivers to identify whether our suspected emotions (e.g., anger, frustration) were indeed responsible for risky overtaking behaviour. This required a large-scale survey of over 1000 participants.

Second, we planned to develop four training videos that would deliver mindfulness techniques and advice within our target 3-4 minute window. Through analysis of the survey data, combined with information scoured from the literature, and the assistance of road safety experts and mindfulness experts, we scripted, filmed and edited our videos.

The resultant videos were then sent out to drivers on a weekly basis across a month. Drivers' attitudes and reported behaviours were collected to inform our hypothesis that these videos would have a positive benefit on a range of driver safety measures.

2 Study 1: A survey of car drivers' emotions, attitudes and behaviours around horse riders and cyclists

2.1 Introduction

The literature suggests that cyclists and horse riders evoke certain emotions in car drivers such as frustration and anger. However, these studies tend to be small scale experiments (e.g., Stephens and Groeger, 2009), focus groups with small samples (e.g., Chapman and Musselwhite, 2011), or surveys with limited respondents (Oldmeadow et al., 2019, $N=273$). When seeking out attitudinal and emotive reports from drivers it is possible that certain sub-groups may be over-represented (e.g., cyclist-averse drivers might be less inclined to undertake a study which they may perceive to be supportive of cycling). Thus, larger samples are preferable to increase the chance of recruiting drivers with a variety of opinions.

A further issue with the research literature is that many cited studies are several years old. As the social climate changes, so attitudes change. Landmark events are particularly powerful in shifting collective attitudes. For instance, Hurricanes Irene and Sandy shifted political attitudes towards Green politicians, the global financial crisis of 2007-2008 increased conservatism in New Zealand, and the Obama Effect improved white Americans' attitudes towards black Americans (Albarracin and Shavitt, 2018). The most significant event of the last few years was the COVID pandemic, which led to an increase in cycling and positive attitudes associated towards cycling (Harford, 2022; Younes et al., 2023), but also a backlash against the segregation of road space for cyclists (e.g., Thorp, 2021).

Given the potential disruption of the pandemic on attitudes towards cyclists and horse riders, we wanted to gather a large sample to assess drivers' current attitudes towards VRUs, and whether there are specific emotions that relate to their self-reported passing behaviours. We therefore created a survey to assess the emotions, attitudes and behaviours of car drivers towards cyclists and horse riders, and sought to collect over 1000 responses.

2.2 Method

2.2.1 Participants

A total of 1006 car drivers took part in an online questionnaire (496 male, 504 female, 6 other), with an average age of 35.7 (ranging from 18 years to 50 years). Participants drove an average of 6921 miles a year ($SD = 8667$). Participants were recruited from the online paid participant panel Prolific. We recompensed respondents with £1.80 for an average time commitment of 12 minutes (reflecting an hourly rate of £9). Respondents were situated across all areas of the UK, other than London.

2.2.2 Design and Procedure

An online survey was prepared using Qualtrics survey software (Qualtrics.com). The survey consisted of 5 main blocks of questions (see Figure 1), starting with demographics to gauge the participants' age, gender, driving history, average miles driven, average hours per week driven, driving offences,

collision history, and how often they used or encountered various road users, including cyclists and horse riders.

The second block of questions presented the Deffenbacher Driving Anger Scale (Deffenbacher, Oetting, and Lynch, 1994). The 14-item short-form scale measures a driving anger trait that identifies those drivers who are most likely to suffer from intense anger while driving, and subsequently engage in aggressive driving behaviours (Deffenbacher, et al., 2016).

Questions in blocks 3 to 5 were specific to one of our targeted VRUs. First, we asked the questions in relation to cyclists. Then blocks 3 to 5 were repeated in relation to horse riders and then motorcyclists. While motorcyclists are not the primary focus of this study, their inclusion served to dilute the focus on the two target VRUs. Before each iteration of block 3, respondents were presented with an image of the VRU in question, from the perspective of a car driver following the VRU.

The third block focused on how strongly the VRUs evoke six emotions in our drivers: frustration, happiness, surprise, anger, contempt, and anxiety. These emotions were adapted from a set of emotional states widely regarded as universal and distinct (e.g., Ekman & Cordaro, 2011), with the following omissions and substitutions: 'Anxiety' replaced 'fear', 'sadness' was omitted, and 'frustration' was introduced as a category of emotion that is distinct from 'anger', due to its links to goal-blocking (e.g., Gonzalez-Gomez et al., 2020) which seems particularly apt for situations where one's progression might be impeded by VRUs. These questions required respondents to rate how often they feel these emotions when faced with cyclists, horse riders or motorcyclists in the road ahead. Responses were recorded on a 5-point scale ranging from 'never' to 'nearly always'. Following this, a free-text response box allowed respondents to explain why this type of VRU causes them to feel these emotions.

The fourth block used the same 5-point scale to assess how often the respondents engaged in risky or aggressive behaviour towards the VRUs, such as following behind them at one car's length or less, or sounding their horn. A free-text response box was also provided to allow our drivers to explain why they behave this way.

The fifth block of questions focused on attitudes towards VRUs. Each item was a statement to which drivers could provide their level of agreement on a 5-point scale from 'strongly disagree' to 'strongly agree'. To avoid social desirability bias, the statements were phrased from a third-person perspective: e.g., 'Drivers respond negatively to cyclists because... cyclists act arrogantly'. The questions and statements in blocks 4 and 5 were specific to each VRU (see Appendix A, Tables A1 and A2).

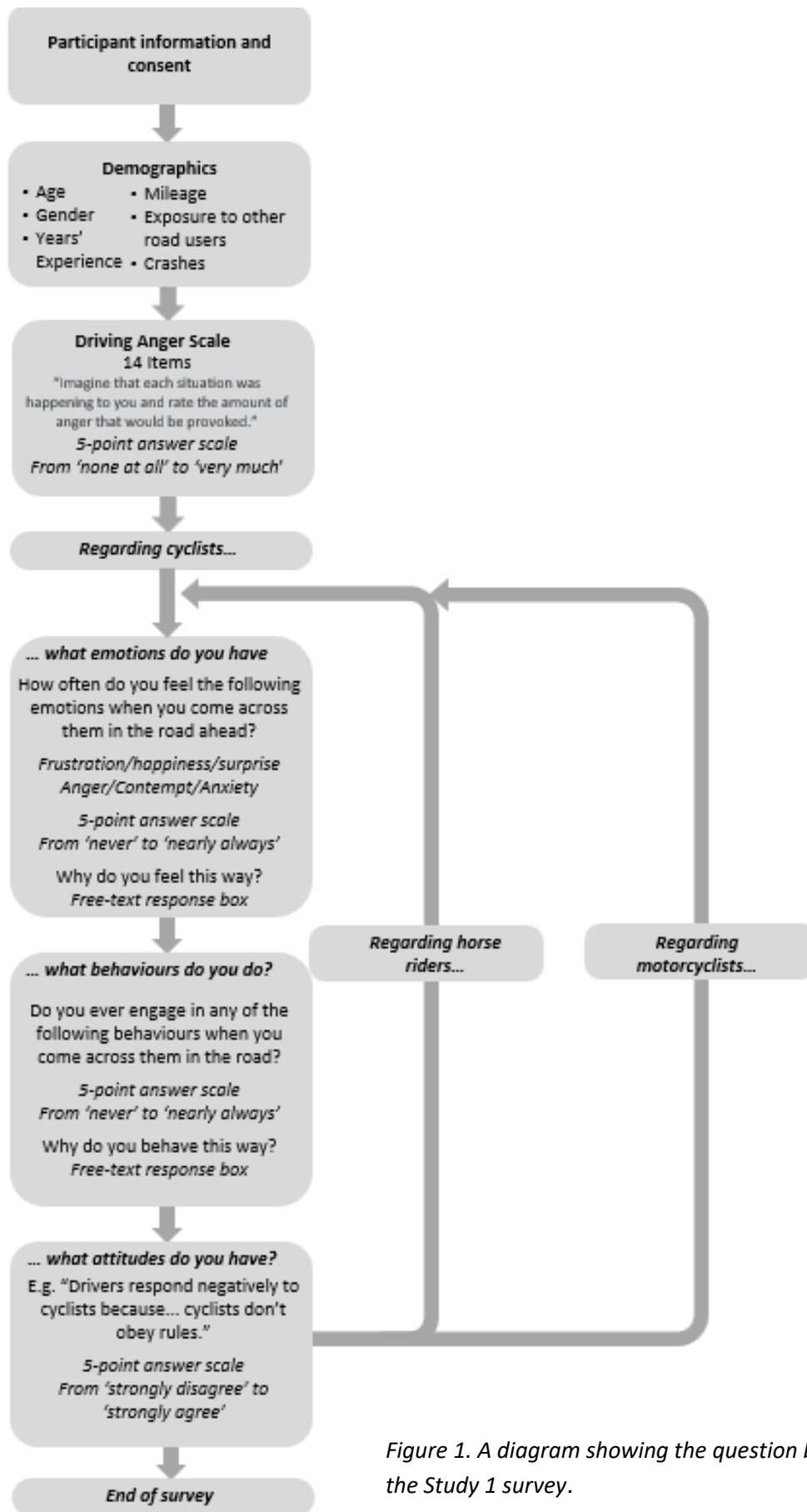


Figure 1. A diagram showing the question blocks in the Study 1 survey.

2.3 Results

2.3.1 Emotions evoked by Vulnerable Road Users

First, we looked at the strength of the emotions that drivers reported when encountering the different VRUs in the road ahead. Although our two target VRUs are cyclists and horse riders, emotions towards motorcycles were retained for this section as they were collected on the same scales. As the Likert scale data are ordinal in nature, we report the medians¹ as well as means (Table 1). The highest median responses were *happiness* and *surprise* upon encountering horses, and *frustration* and *anxiety* when encountering cyclists. The lowest median responses were *anger* and *contempt* for horses and riders, and *contempt* for motorcyclists.

Table 1. Median (and mean) ratings for self-reported emotions evoked when encountering vulnerable road users (1 = never, 2 = rarely, 3 = sometimes, 4 = often, 5 = nearly always).

	Frustration	Happiness	Surprise	Anger	Contempt	Anxiety
Cyclists	3 (3.0) ^a	2 (1.8)	2 (2.0)	2 (2.4)	2 (2.1)	3 (2.5)
Horses and riders	2 (1.9) ^a	3 (2.8)	3 (2.5)	1 (1.4)	1 (1.5)	2 (2.3)
Motorcyclists	2 (2.1)	2 (1.8)	2 (2.1)	2 (1.9)	1 (1.7)	2 (2.3)

Due to the ordinal nature of the data, Friedman tests (a non-parametric alternative to a repeated measure ANOVA) were conducted for each emotion across the three VRUs. All tests were significant (all $\chi^2_{(2)} > 35, p < .001$). Post-hoc Wilcoxon signed-rank tests were conducted to assess differences in the levels of the Friedman analyses (see Appendix B).

Even after Bonferroni correction for multiple comparisons (reducing the α level to control the probability of false positives with numerous tests) the results clearly show that cyclists evoke the most negative emotions compared to the other two VRUs (and lower happiness than horses). Horses produce the most happiness and the lowest negative emotions (with the exception of anxiety, which does not differ from anxiety evoked by motorcyclists). Regarding our two target VRUs for the current project, these results suggest we should focus on reducing frustration, anxiety, and possibly anger in regard to cyclists. For horses, the negative emotions of surprise and anxiety seem important, though the former is more of a failing of hazard perception and expectations rather than emotional regulation, and is less likely to be influenced by a mindfulness manipulation (Crundall et al., 2019). To provide a more concrete understanding of how many people respond in the extreme to the most pertinent of emotions, the percentage of responses in each category for anxiety, frustration, and anger are given in Figure 2. As can be seen in the figures 20% of respondents (N=204) reported

¹ Medians report the middle response of the ranked data set and are a more appropriate measure of central tendency for ordinal data.

feeling anxious around cyclists ‘often’ or ‘nearly always’, while 32% and 16% (Ns of 322 and 204) reported similar frequencies of frustration and anger towards cyclists, respectively. The least frequently reported negative emotion was anger towards horses and riders, with only 2% reporting that they ‘often’ or ‘nearly always’ felt this way. However, in absolute terms this refers to 24 drivers, which still remains a sizable minority with extreme views regarding this vulnerable group of road users.

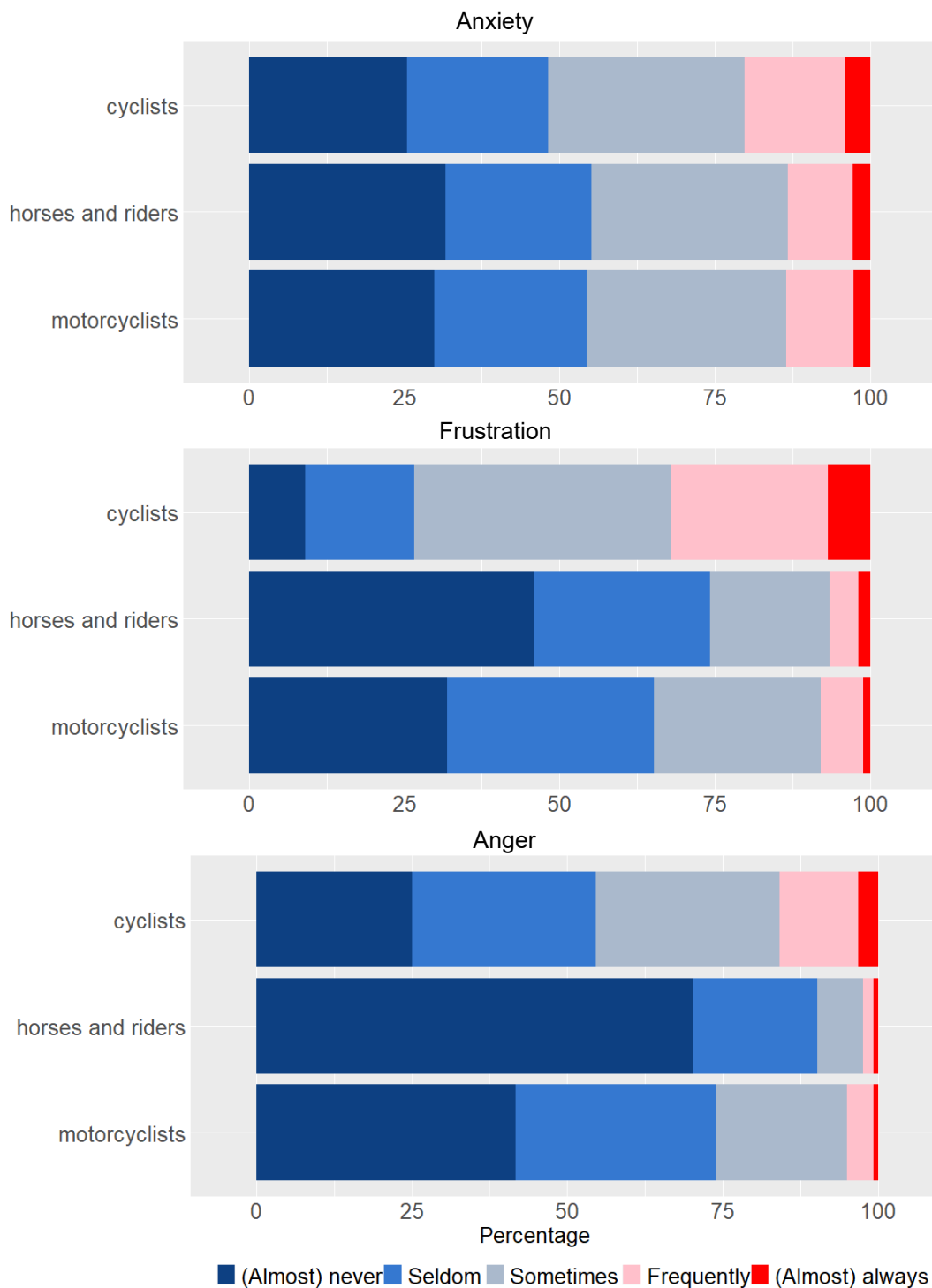


Figure 2. A breakdown of responses across the 5 frequency categories of emotional reactions to our three groups of VRUs for anxiety (top panel), frustration (middle panel), and anger (bottom panel).

2.3.2 Self-reported behaviour

Respondents were asked how frequently they engaged in 6 behaviours around each VRU. These items were chosen to potentially fit a two-factor structure, with 3 questions targeting behaviour that reflect *unsafe passing* (e.g., they may overtake at too high a speed because they are unaware of the dangers or the highway code), and 3 behaviours targeting *aggressive* behaviours (e.g., shouting at the VRU). While data were collected in regard to motorcyclists, many of the behaviour questions targeting cyclists and horse riders do not transfer well to motorcyclists (e.g., close following, overtaking at speed). Accordingly, the current section focuses solely on our two target VRUs (horses and riders, and cyclists).

A breakdown of participant responses to these questions can be viewed in Figure 3. As can be seen, the first three *unsafe passing* behaviours are reported more frequently than the latter three *aggressive* behaviours, though we still found, for instance, that 24% of respondents reported shouting or gesticulating at cyclists at least sometimes (from 'seldom' to 'almost always'), reflecting an *N* of 242. Though the number of drivers engaging in aggressive behaviours at the more frequent end of the spectrum is relatively low, the frequency of their offences suggests that a large number of VRUs could be directly affected by this small number of individuals (e.g., 2%, *N*=18, report 'frequently' or 'almost always' shouting at cyclists). Horses evoke fewer instances of negative behaviour, with an average of 97% of respondents saying they never engage in *aggressive* behaviours towards horses and riders.

To explore the different underlying dimensions that the items in the questionnaire may represent, the six behavioural items regarding cyclists were subjected to a factor analysis with oblimin rotation based on polychoric correlations (for ordinal data)². To determine the suitability of the data for factor analysis, a Kaiser-Meyer-Olkin test was performed, showing an overall measure of sampling adequacy (MSA) of 0.8, which is adequate. Eigen values suggested two factors could be extracted following our *a priori* assumptions, with three items loading on *unsafe passing* behaviours and three loading on *aggressive* behaviours. A similar analysis of behaviours towards horses and riders (MSA 0.68) suggested three factors, with three items loading on *unsafe passing* behaviours and two items loading on *aggressive behaviours* (see Table 2). The item 'Shouting or gesticulating at the rider' was the only item to load highly on a third factor. This single item was therefore excluded from all subsequent analyses.

Following the factor analyses, the items for each factor for each VRU were averaged to create mean scores for unsafe passing and aggressive behaviours towards cyclists and horses and riders. These factor scores provided the criterion variables for subsequent regression analyses (see section 2.3.5).

2.3.3 Attitudes towards VRUs

Drivers were asked to agree or disagree with a series of statements about why drivers may behave negatively towards VRUs. The intention behind these statements was to access drivers' attitudes

² Factor analysis is a method that groups questionnaire items into meaningful categories, simplifying further analyses.

Table 2. Factor loadings for behaviours towards cyclists (6) and towards horses and riders (5).

Item	Factor 1 Unsafe Passing	Factor 2 Aggressive Behaviours
<i>Behaviours towards cyclists</i>		
- Overtaking at or above the speed limit	0.475	
- Following behind at one car's length or less	0.665	
- Overtaking with a passing distance of <2m	0.902	
- Sounding the car horn		0.908
- Shouting or gesticulating at the cyclist		0.881
- Revving your engine while behind the cyclist		0.655
<i>Behaviours towards horses and riders</i>		
- Overtake at over 20mph	0.540	
- Following behind at one car's length or less	0.659	
- Overtaking with a passing distance of <1.5m	0.803	
- Sounding the car horn		0.747
- Revving your engine while behind the horse and rider		0.959

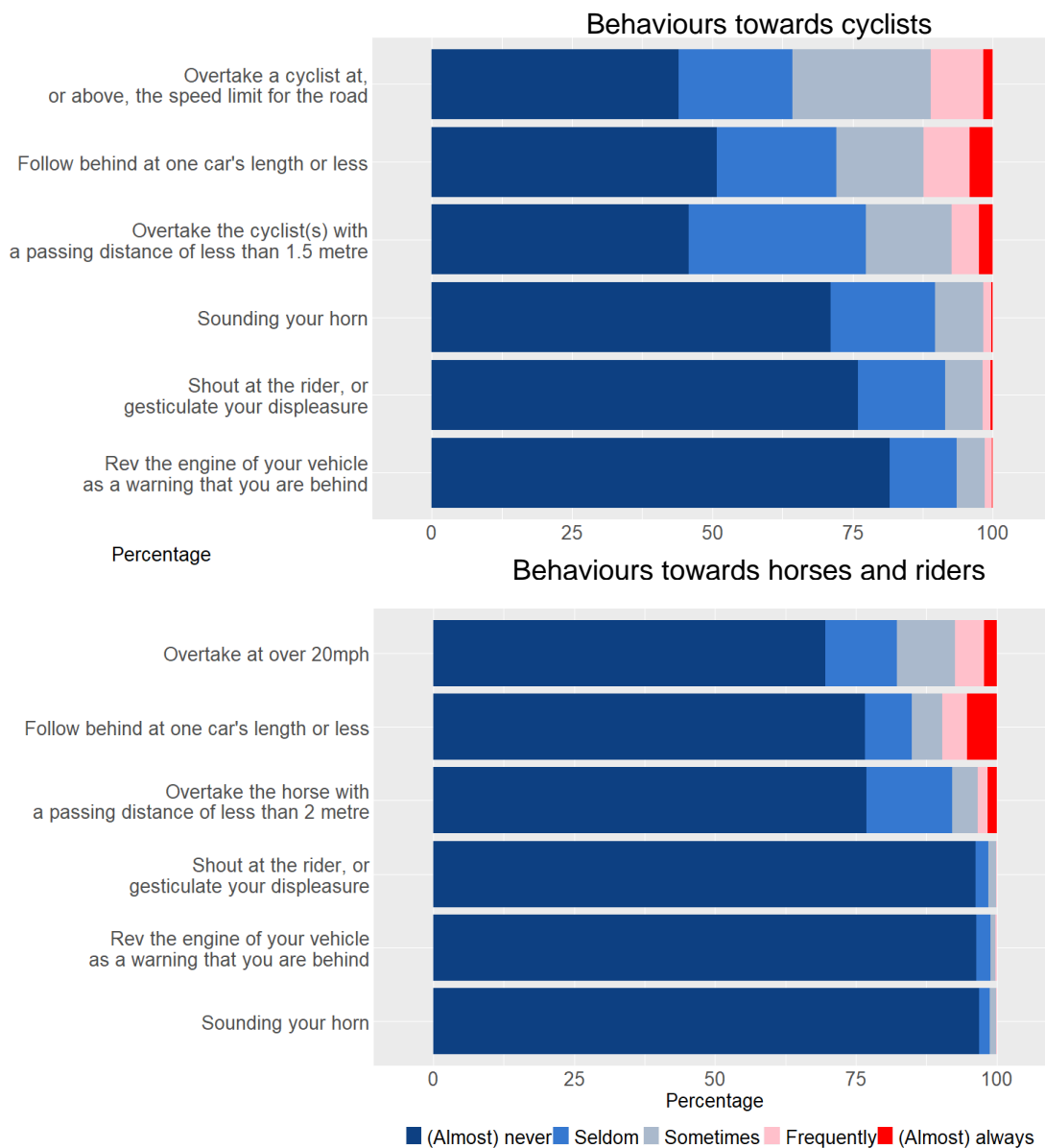


Figure 3. Self-reported behaviour when encountering cyclists (top panel) and horses and riders (bottom panel).

towards our VRUs in a non-challenging manner. As with self-reported behaviours, we only report the results for our target VRUs (see Figure 4).

Regarding cyclists, the statement that received the most agreement was that drivers might be held up by cyclists while in a rush. The next three statements that received the most agreement focused on the unpredictability of cyclists, their unexpected appearances, and their perceived willingness to disobey road rules.

Regarding horses, the possibility of drivers being held up while in a rush again received the greatest levels of agreement, followed by the possibility that drivers may be stressed about something else, and use the horse and rider as an outlet for that emotion. Concerns over dung and the perception of a leisure pursuit causing drivers to be delayed received considerable agreement also.

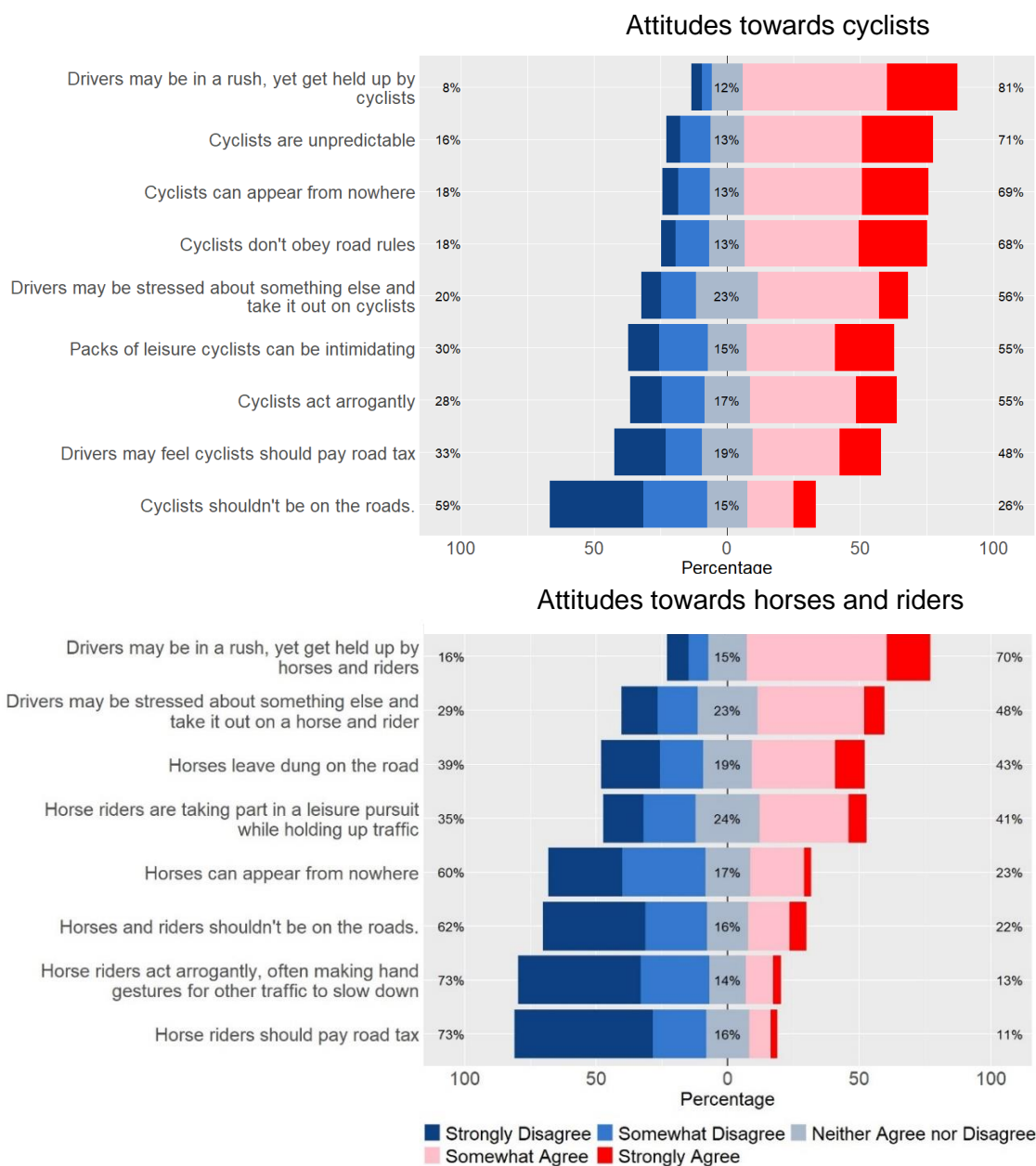


Figure 4. Levels of agreement with statements that might explain why drivers feel negatively towards cyclists (top panel) and horses and riders (bottom panel).

These statements were subjected to factor analyses with oblimin rotation based on polychoric correlations. The analysis for the negative feelings towards cyclists (MSA 0.85) suggested that three factors could be extracted. One factor contained items reflecting *disdain*: beliefs that cyclists act arrogantly, do not obey the road rules, should pay road tax, or not be on the road at all. A second factor included items we have categorised as *fear*: cyclists being unpredictable, cyclists appearing from nowhere, and packs of cyclist being intimidating. Two items loaded on the third factor: ‘Drivers may be in a rush...’ and ‘Drivers may be stressed...’ acknowledge that the driver might be to blame for negative thoughts towards the VRUs, rather than the cyclists themselves, and this factor is accordingly named *ownership* (i.e., the drivers *own* the responsibility for the negative emotion). The factor analysis for the negative feelings towards horses and riders resulted in two factors (MSA 0.82). The *ownership* factor was made up of the same items as for the cyclists (‘Drivers may be in a rush...’ and ‘Drivers may be stressed...’), and the remaining six items loaded to a factor expressing *disdain* (see Table 3). Recoded responses on the Likert scales of these items were averaged to create mean factor scores for *fear*, *disdain* and *ownership* that could be used as predictors in subsequent regression analyses (see section 2.3.5).

Table 3. Factor loadings for reasons for negative feelings and behaviour towards cyclists and horses and riders

Item	Factor 1 Disdain	Factor 2 Fear	Factor 3 Ownership
<i>Cyclists</i>			
- Cyclists act arrogantly	0.784		
- Cyclists shouldn't be on the roads	0.522		
- Cyclists don't obey road rules	0.495		
- Drivers may feel cyclists should pay road tax	0.727		
- Cyclists are unpredictable		0.909	
- Packs of leisure cyclists can be intimidating		0.455	
- Cyclists can appear from nowhere		0.659	
- Drivers may be in a rush, yet get held up by cyclists			0.404
- Drivers may be stressed about something else and take it out on cyclists			0.603
<i>Horses and riders</i>			
- Horse riders act arrogantly, often making hand gestures for other traffic to slow down	0.577		
- Horses leave dung on the road	0.446		
- Horses can appear from nowhere	0.444		
- Horse riders are taking part in a leisure pursuit while holding up traffic	0.541		
- Horse riders should pay road tax	0.852		
- Horses and riders shouldn't be on the roads	0.736		
- Drivers may be in a rush, yet get held up by horses and riders			0.883
- Drivers may be stressed about something else and take it out on a horse and rider			0.586

2.3.4 Analysis of drivers' free-text responses

Respondents were given the opportunity to provide written comments on why the target VRUs evoke their self-reported emotions and behaviours. A thematic analysis was carried out on the free-response data from the online survey. Responses to why they felt certain emotions and why they behaved in certain ways tended to overlap considerably, and therefore we report these together.

Many drivers reported positive feelings towards cyclists and horses and riders, and said that they behaved appropriately around them. Often such drivers reported empathy for these VRUs due to being a rider or cyclist themselves, or having friends or family members who engage in the pastime. Horses were particularly linked to positive emotions, with many drivers describing them as a joy to see on the roads. Other drivers reported less charitable emotions towards cyclists and horses, but insisted that these feelings did impact on their driving safety. Many drivers however reported a range of negative emotions and rationales to explain poor behaviour. We have grouped these into six themes.

Anxiety

Many respondents reported feeling anxiety around our VRUs. Anxiety was evoked by their unexpected appearance in the road ahead, and our drivers' awareness of their vulnerability coupled with the fear of consequences should they make the wrong decision, or should the cyclist or horse do something unpredictable:

"They make me anxious because they are so vulnerable with little to protect them should they be involved in an accident"

"[Cyclists] can be unpredictable e.g., if they swerve to go round a pothole..."

"I am anxious the horse will freak out when I go past them."

"With horses you never know how they will react."

An additional source of anxiety was the presence of traffic behind the driver. Respondents were concerned that they would be perceived to be holding up the traffic (i.e., part of the problem) and that this could lead to other drivers responding angrily:

"I would feel anxious about having to overtake, especially if there were other cars behind me that would feel more confident overtaking at times where I wouldn't feel safe to do so."

"I have felt pressured by motorists behind me to overtake the cyclist quickly."

"...I am happy to wait and pass safely but my anxiety is raised by cars behind me getting frustrated or pushy."

"...often drivers behind start getting up close to you to make you overtake them."

“I have only followed a horse that closely because I have been tailgated myself...”

Frustration

Frustration was a popular emotional response to the appearance of VRUs, primarily due to the difficulty to overtake them, and the perception that they are holding up traffic, especially during rush hour or when the driver was under time pressure:

“...when I’ve been stuck behind them for a long time and it’s a narrow road”

“I get annoyed that they are slowing down the traffic.”

“I am often in a rush and with time deadlines to get somewhere so the hold up of staying behind a cyclist holds me up far too long.”

These feelings are likely to develop the longer one must follow a VRU. Every opportunity to overtake which is rejected by the driver due to the risk involved is likely to add to the frustration, and the feeling of being ‘stuck’, with the concomitant possibility that this will increase the likelihood of the driver taking the next opportunity to overtake, regardless of the risk:

“...cyclists often slow traffic and there is no good point to overtake them so you end up stuck behind them.”

Frustration was perhaps greater towards cyclists due to their more frequent appearance, the times of day that they may ride (especially commuters), and the types of roads they travel on. Drivers were particularly frustrated by speed discrepancies between cyclists and other traffic on the fastest roads:

“It can be frustrating when ... I’m being slowed down to below 20mph on national speed limit roads, where it is safe for me as a car driver to go faster.”

“...cyclists riding on a 60mph road is frustrating.”

One significant subtheme under *frustration* (which applies primarily to cyclists) is road position. Many drivers commented on the frustration of cyclists maintaining a middle-of-the-lane position, rather than moving over to the left. There was a perception that this position was adopted to purposefully hinder the driver behind and prevent overtaking:

“The way they edge into the middle of the road to prevent you from passing with a safe distance....”

“Commuting cyclists... ride in the middle of the road making it hard to pass.”

“Cyclists are very rude and ride in the middle of the road so that you can’t overtake”

To a much lesser extent, similar attitudes were raised about horse riders:

“They are so slow that it tends to annoy me, especially if the riders clearly don’t care they are holding you up.”

Riding side-by-side, or in large groups, was also a cause of frustration. This was seen as disrespectful to other road users, and was often seen as purposefully designed to slow traffic flow:

“...how they act annoys me. Especially when they ride side by side and take up the whole left side.”

“Recreational cyclists are so annoying and when they ride side by side by side and sometimes do not allow you to pass!”

“Cyclists need to ride in single file and be respectful...”

“Recreational expert cyclists often ride deliberately next to each other to slow other [road] users down.”

“...some cyclists in groups act like they can take up the whole road and have a long conversation while cycling instead of trying to be in a single file.”

Once again, while cyclists took the brunt of these complaints, horses and riders were not immune:

“[Horse riders] often ride side by side on narrow roads, that is annoying...”

“The [horse] riders have been riding two abreast meaning I could not give them the proper amount of space.”

These drivers are unlikely to be aware of the Highway Code rules 53 (horses) and 66 (cyclists) that allow, and in the case of cyclists – encourages, riding two abreast. This prevents cars from trying to squeeze past them in the face of oncoming vehicles, and is recommended by British Cycling and the British Horse Society (especially when riding with an inexperienced horse or rider).

Disdain

This theme refers to a range of emotions from contempt through to anger. A number of sub-themes were identified.

Entitlement refers to the perception that some riders and cyclists believe that they have more rights to the road than other road users. The recent inclusion of the Hierarchy of Road Users in the Highway Code does indeed give priority to riders and cyclists, and it is likely that many of our drivers were not aware of this. The comments however go beyond the priorities afforded VRUs by the Hierarchy of Road Users. Indeed, there is a clear *in-group/out-group* distinction in many comments

(juxtaposed against the empathic comments referenced earlier), and some of our drivers responded fervently regarding VRUs' perceived arrogance:

"The commuting cyclist often acts quite entitled and above other road users."

"Recreational sport cyclists – they are the most entitled..."

"...they are selfish and dangerous and think they own the road at times."

"...Lycra warriors that think they own the road."

"[Cyclists] are arrogant arseholes".

"Many of the [horse] riders are stuck up and think they own the road."

"[Horse riders] have the air of people who believe that they are superior to car drivers, and are usually very arrogant people"

Our respondents also reported that some VRUs could be *aggressive*, or at least drivers might fear an aggressive response.

"I don't like to antagonise cyclists, especially sporty cyclists as they generally seem more aggressive than other cyclists."

"They either cycle dangerously so you nearly hit them, swear at you, or act like you're not going to crush them if they suddenly slow in front of you."

"...I never knew if the [horse] rider is going to be aggressive about the situation."

A *failure to respect road rules* also featured heavily in this theme, though only in regard to cyclists. Respondents commented on cyclists' willingness to go through red lights, to switch to pavements to avoid traffic lights, weaving in and out of traffic, and a lack of bike lights at night. Though not rules *per se*, drivers also commented on the lack of helmets and high-vis clothing on some cyclists. Disgruntlement at cyclists using the roads when cycle paths are present also featured frequently in the comments.

The environment

When considering reasons for why they might sometimes overtake VRUs too closely, the available road width was often cited. Rural roads were viewed as a particular problem, with narrow lanes and limited passing places given as reasons for close passing. In addition to narrow lanes, high hedgerows and tight bends reduce visibility, limiting the opportunities to overtake:

"...the roads are sometimes too narrow to have enough space to overtake them with bigger distance."

“On rural roads where I live you often cannot give 1.5m space, as the lane isn’t wide enough to do so.”

“It’s not the cyclists, it’s the fact the roads aren’t wide enough to leave enough gap.”

“Overtaking distances are just not practical within UK urban areas, where cars are parked alongside the kerb”

“It’s sometimes difficult to overtake such as on windy country roads”

Speed justification

Many drivers acknowledged that they tend to drive at, or even over, the speed limit when overtaking cyclists (less so for horses and riders, though drivers still admitted to overtaking horses quickly in some instances). Some drivers did not seek a justification for this beyond their own frustration (“Sometimes I overtake the cyclist, even if that means breaking the speed limit, because I don’t like to stay behind a cyclist...”).

Speed was seen as complementary to safety by some drivers (“It is about getting past them quickly yet safely...”). Most speed justifications were related to minimising the amount of time spent in proximity to the cyclist, and minimising the time spent in the oncoming lane, therefore limiting the chance of conflict with oncoming traffic:

“I want to ensure I spend as little time as possible overtaking so it is as safe as possible.”

“...to get past them quickly so I can then be safe around corners.”

“...on some occasions I have had to speed up quickly to overtake them when the oncoming lane is clear.”

“I have overtaken at speed, occasionally to reduce the time it takes to get around the cyclist.”

“I want to get past them fast enough to not cause me to be in danger (as I’m driving on the wrong side of the road) and I want to get our interaction over with quickly.”

For some drivers however, their choice to increase speed related more to the anxiety they feel during the manoeuvre:

“I often need to speed up to get past them quickly due to anxiety when driving next to them.”

“Desperation to get in front of them – once I have done this they are no longer a hazard to me.”

To change behaviour

Regarding the more confrontational behaviours that our drivers reported carrying out, while some drivers admitted behaving out of anger or frustration (“Venting frustration at poor riding and lack of

awareness”, “...they deserve to be honked at if they are in the way especially when they know you are coming and they don’t move”), most justifications focused on trying to increase awareness of the VRU to their presence, or to change their current behaviour:

“When they are in groups and I cannot pass I may sound my horn to get them to go into single file”

“Sounding my horn has only ever been done in situations where the cyclist has acted in a manner that could have caused an accident to draw their attention to their poor decision making.”

“Sounding the horn tends to be when the rider appears unaware of traffic behind and is obstructing onward progress due to lane positioning and/or speed”

“When there is a cycle path and it’s not being used we always shout ‘use the cycle path, psychopath!’”

“I come across riders wearing headphones... so a beep of the horn is necessary to make them aware of your presence.”

“If a cyclist is unaware of my presence, I wouldn’t ever sound horn but sometimes drop gear to slightly rev.”

All of these comments were made in reference to cyclists. None of our drivers tried to justify the use of the horn or revving the engine around horses, and several respondents clearly denounced such behaviour.

2.3.5 Predictors of emotions and behaviour

How important are drivers’ emotional responses to VRUs in influencing subsequent behaviour toward cyclists and horse riders? The factor analyses of our behavioural questions allowed us to average across the items to produce two interval scale scores for *unsafe passing* and *aggressive* behaviours. Linear regressions were carried out to establish whether emotions, attitudes, or demographics could predict the two types of behaviours that drivers report in relation to both cyclists and horse riders. Demographic predictors included age, gender, annual mileage, exposure to the relevant VRU, cycling/riding experience. The Deffenbacher Anger Scale score was also included, along with our attitudinal factors and participants’ self-reported emotions (see Table 4).

All of the regression models were significant, though the most variance that was accounted for was 26%. The pattern of significance with the individual predictors supported many accepted relationships in this domain. For example, age was a negative predictor of unsafe passing behaviours and females were less likely to engage in aggressive behaviours. Both of these factors are well known to relate to risk-taking in drivers, with older drivers and female drivers taking fewer risks and being less aggressive (e.g., Rhodes and Pivik, 2011).

Table 4. T-values for significant predictors for aggressive and unsafe passing behaviour towards cyclists and horses and riders.

	Cyclists		Horse and Rider	
	Aggressive	Unsafe passing	Aggressive	Unsafe passing
Age		-4.05***		
Gender	-3.01**			
Annual mileage	2.21*	2.05*		
Exposure	-2.54*		-2.62**	-2.73**
Cycling/riding experience	3.35***			
DAS score	4.65***	3.05**		2.79**
Attitudinal Disdain	4.95***			2.50*
Attitudinal Fear	-2.28*			
Attitudinal Ownership			-3.37***	
Anger	4.41***		4.59***	
Contempt	2.32 **	2.58*		2.90**
Anxiety		-1.98*		
Surprise				
Happiness				
Frustration		3.04**		
<i>F</i> (15,989)	23.62***	15.68***		
<i>F</i> (14, 990)			9.16***	8.91***
<i>R</i> ²	0.26	0.19	0.11	0.11
<i>R</i> ² _{adjusted}	0.25	0.18	0.10	0.10

Note: *<.05, **<.01, ***<.001

The relationship of mileage and exposure to VRUs with aggressive and unsafe passing behaviours was interesting. Greater mileage predicted more aggressive and unsafe passing behaviours, whereas exposure to VRUs as a driver led to a decrease in aggressive behaviours. While exposure to a sub-population is generally considered to attenuate negative attitudes toward that group, general mileage does not necessarily confer such advantages. Indeed, several studies have shown that increased mileage is linked to increased aggression (e.g., Sullman et al., 2002; Perepjolkina and Renge, 2011). We interpret this in the following way: Drivers who do a lot of mileage are likely to view driving as a core part of their identity, which may therefore be more susceptible to threat when they feel as if they are being held up.

Many of the other predictors are entirely expected. DAS, disdain, anger and contempt all positively predict aggressive behaviours towards cyclists, though only anger predicts aggressive behaviours towards horse riders. Frustration increases the likelihood of inappropriate passing behaviour towards cyclists, though anxiety decreases such rash actions. One surprising result however was that experience of riding bicycles predicts aggressive behaviours towards other cyclists. In-group bias would predict that drivers who also cycle should have greater empathy for other cyclists. One interpretation of the positive relationship between cycling experience and aggressive behaviours towards cyclists is that our driver-cyclists are punishing other cyclists for not living-up to their own high expectations of cycling behaviour. This aberrant finding is worthy of future research.

2.4 Discussion

Study 1 provided a rich dataset to help us understand car drivers' emotions, attitudes and behaviours when faced with VRUs in the road ahead. Though motorcyclists were included in the initial survey, the primary intention of their inclusion was to dilute the focus of the study away from cyclists and horses and riders. For this reason, we do not consider results pertaining to motorcyclists here.

One obvious finding from the analyses of reported emotions is the clear divide between horses and cyclists, with the latter evoking much greater frequencies of negative emotion than the former (and cyclists also generated fewer instances of happiness in our drivers than horses).

The most frequent emotions prompted by cyclists were frustration and anxiety. This was mirrored in the analysis of free-text responses, where drivers often reported both emotions. Frustration tends to be caused by the slowing of traffic and perceived delays, which is exacerbated by the position that riders take on the road. Many drivers were frustrated by cyclists riding too far out from the curb, or cycling two abreast. There are however very good reasons for cyclists (and horse riders) to adopt these positions, which are supported by the Highway Code. For instance, riding in a more central position in the lane forces drivers to plan an overtaking manoeuvre, and consider the environment and oncoming traffic. If a cyclist is riding close to the curb however, drivers may not even class this as an overtaking manoeuvre, and may be more willing to squeeze between the cyclist and oncoming traffic. Riding two-abreast is also often misconstrued. This reduces the amount of time that a driver is in the oncoming lane during an overtake. If cyclists are instead strung out in a single-file line this requires the driver to spend more time in the oncoming lane risking a head-on collision. In response to this, drivers may therefore maintain a closer position to the cyclists when passing to minimise their perceived risk of conflict with on-coming traffic (though without consideration of the danger they place the cyclists in).

Free-text responses to anxiety around cyclists suggested this emotion was evoked by the vulnerability of cyclists (and the associated fear that it is very easy to injure a cyclist), and the perceived unpredictability of these VRUs.

The most frequently reported emotion regarding horses in the road was happiness followed by surprise. It is understandable that surprise features highly as this class of VRU is the least frequent on UK roads. Fortunately, any video-based intervention that involves horses will make drivers more aware of their potential presence on the road and may reduce future instances of surprise. Closely following surprise was anxiety. Once again, horse riders' vulnerability and possible unpredictability were given as potential reasons.

One interesting facet of anxiety relating to horses and cyclists was the pressure that drivers felt from traffic behind them. It is possible that some of our respondents perceived pressure from behind that was not intended by following drivers, and this is especially likely when one is unsure of how to behave in a specific situation. By providing drivers with guidance on how to behave from a (hopefully) perceived source of authority, this should lessen the conflict they feel between the urge

to overtake and the need to wait for a safe opportunity. Increased knowledge will provide them with the confidence to behave in a safe manner whatever pressure is perceived from behind.

The regression analyses supported the importance of our emotions in predicting negative behaviours towards VRUs. *Frustration* is a particular concern. The frustration-aggression hypothesis argues that frustration (the blocking of goals, in this case progression down the road) is an important precursor to aggression (Dollard et al., 1939). Early theorists did not consider *why* frustration might cause aggression, though more recent researchers have explored a range of causal links. For instance, Kruglanski et al. (2023) believe that for frustration to lead to aggression it must (1) reflect an insult or some form of humiliation (such as the misperception that the VRU is intentionally holding them up), and (2) the opportunity to use aggression as a method of restoring one's self-worth must be salient in the situation (such as the presence of a weapon, which in this case can be considered the car that one is driving).

The regression analyses linked frustration to *unsafe passing* behaviours in regard to cyclists, while anger was a significant predictor for *aggressive* behaviours towards both cyclists and horse riders. General anger, as measured by the DAS scale, predicted inappropriate passing behaviours, suggesting that lack of knowledge is not the only reason why drivers score high on the *unsafe passing* behaviour factor. The DAS score was also a predictor for *aggressive* behaviours towards cyclists, as was attitudinal disdain. If we think of the emotions as reflecting a state-based response to VRUs and attitudes reflecting more of a trait-based response, then it appears that both cues to *aggression* and *unsafe passing* behaviours need to be tackled in any video-based intervention.

3 Developing the intervention

The evidence from study 1 suggested that *frustration* and *anger* might be the key emotional levers to pull in order to improve drivers' behaviours around cyclists and horse riders, while attempting to change *attitudinal disdain* that our drivers report for VRUs could have wider benefit. The qualitative evidence also provided a wealth of data on why drivers might feel these emotions and undertake these behaviours.

An expert focus group was convened to discuss the results of study 1 and to identify methods that could be used in brief videos to provide drivers with the means to prevent negative emotions from building up or transferring into on-road behaviours. The focus group included two clinical psychologists working in the field of mindfulness, a road safety coach leading on mindfulness training for drivers, an academic who also delivers mindfulness training, and two representatives from the British Horse Society with responsibility for safety and research, respectively.

The group identified four key techniques distilled from the mindfulness literature that could address our primary concerns of driver frustration and anxiety. Scripts were built around these techniques to create four standalone videos. The introduction to each video was similar, with advice on how to overtake horses and cyclists, before a technique was introduced to help combat negative emotions in such situations, while also making a persuasive case for a change in attitudinal disdain using a variety of behaviour change techniques. All filming was completed with the advice and support of the British Horse Society, and was undertaken on roads in Nottinghamshire with the knowledge of both the police and local authorities. The following sections will detail the introductory script (common to all four videos) and the content specific to the four videos with screen shots included.

3.1 The introduction to the videos

In discussion with the expert focus group, it was decided that the videos should always start with instructions on how to safely overtake our VRUs, with each mindfulness technique subsequently introduced to help drivers follow this guidance. We acknowledged the possibility that drivers might be exposed to all four videos, thus the first video provides the most detailed explanation of when and how to overtake (2 mins), with later videos containing a concatenated version of the advice (50 secs). This ensured that any driver who watches one of the videos at random will get the advice on how to pass horses and cyclists, while those drivers who watch all four videos in order will get a more complete description of how to overtake, but would hopefully not feel that subsequent videos were too repetitive. Screen shots in Figure 5 show the narrative behind the introduction.

First, we defined what a vulnerable road user is and then showed clips of what might happen if drivers overtake VRUs in an inappropriate manner. This involved showing a clip where a cyclist is knocked off by a car and horses are distressed by a passing vehicle. These two shots were taken from existing videos shot on behalf of the BHS.

The video then references the Highway Code and reminds drivers of the rules for overtaking, before showing three situations where one should definitely not overtake (a blind bend, a humpback bridge, the brow of a hill). Two examples of safe overtaking are then provided with clear reference

to distance and speed required. This allows viewers to calibrate their understanding of overtaking distances and speed, and provides a concrete example for potential behavioural modelling.

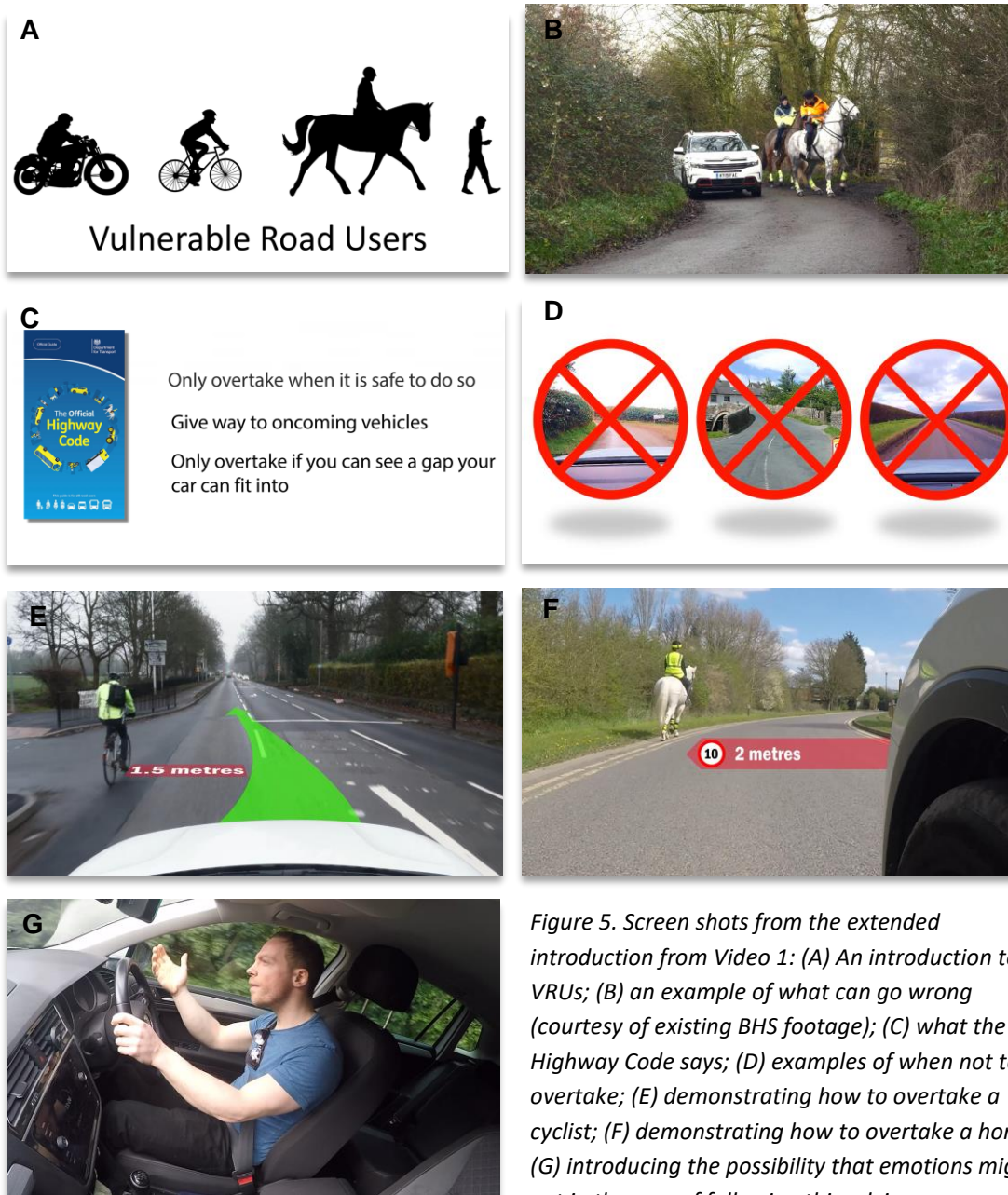


Figure 5. Screen shots from the extended introduction from Video 1: (A) An introduction to VRUs; (B) an example of what can go wrong (courtesy of existing BHS footage); (C) what the Highway Code says; (D) examples of when not to overtake; (E) demonstrating how to overtake a cyclist; (F) demonstrating how to overtake a horse; (G) introducing the possibility that emotions might get in the way of following this advice.

Finally, we acknowledge that there are a range of reasons why drivers do not follow this guidance, focusing on negative emotions. This is also the first opportunity to introduce viewers to our angry driver, who demonstrates a range of emotions and how to overcome them in the subsequent videos.

This extended introduction lasted two minutes and included the following behavioural change techniques (BCTs) taken from Fylan (2017):

- Instructions on how to perform the behaviour are given early in each video (4.1)³
- The correct passing behaviour is also demonstrated (6.1)
- Drivers are exposed to our VRUs through these videos (which is probably more important for horses given the high level of surprise noted in Study 1) (7.7)
- Information about antecedents is given (i.e., how negative emotions can encourage inappropriate passing) (4.2)
- Information about consequences (5.1) is provided by showing the negative outcomes from passing too closely or at too high a speed
- Drawing attention to the discrepancies between current behaviour (assuming that the viewers may occasionally have negative emotions in similar situations) and drivers' goals (which is to get to the end of their journey safely) (1.6)
- Use of Road Safety Trust and BHS logos at the start of each video provides evidence that the information provided comes from a credible source (9.1)

The three subsequent videos included a reduced introduction that included only the examples of how to overtake a cyclist and horse rider correctly before introducing the problem of negative emotions.

3.2 The STOP technique

As Kabat-Zinn noted, "If you want the future to be different, the only leverage you have is to inhabit the present moment fully..." (Kabat-Zinn, 2021, p786). The STOP technique is an easy method to achieve this state of mind. It is a micro-exercise in reconnecting with one's physical state, and recognising how your current feelings might influence your behaviour. The STOP acronym references a brief 4-stage process:

1. Stop – This does not mean 'stop driving', but rather to stop the current train of thoughts (or lack of thoughts) and provide a pause in the causal chain of thoughts and actions. This gives an opportunity to assess if you are happy with your response to a current situation.
2. Take a breath – Some authors suggest this should be 'take three deep breaths' though our expert focus group pointed out the problem of espousing deep breathing exercises to drivers who could have health issues related to breathing (e.g., asthma). Accordingly, we have simplified this stage, merely urging drivers to 'take a breath'. This should induce relaxation and allows one to connect with the physical state.
3. Observe – What is going on around you? Traditional stop methods encourage spreading attention to all sounds, sights, and sensations, from nearby birdsong to the feeling of your hands on the steering wheel. Here we also include the observation of how external and internal events are impacting on our state of mind.
4. Proceed – Once you have identified and put away any negative thoughts or emotions, you can continue with your current task, hopefully in a better frame of mind.

This technique has been used in a variety of studies to combat stress and anxiety, and improve mental well-being in a range of populations from university medical students to pregnant first-time mothers (Anggorowati et al., 2019; Levin et al., 2022; Phang et al., 2014). For the current purpose,

³ Numbers in parentheses refer to the number of the BCT in Fylan's (2017) 93-item taxonomy.

we focused the STOP stages on stopping negative emotions from controlling one’s behaviour, encouraging the driver to identify what is causing their negative emotions, and asking them to consider whether the emotions are justified (typically, they are not). Our expert focus group thought that this technique could be particularly useful for mitigating anger and frustration. Screen shots from this segment of video 1 can be seen in Figure 6.



Figure 6. Screen shots from the STOP technique (Video 1): (A) An introduction to acronym; (B) an example of performing the stop technique while driving; (C) extension of the stop technique to pre-driving (before you leave the driveway).

This video content included the following behavioural change techniques (BCTs):

- We are encouraging the self-monitoring of behaviour (2.3)
- Instructions on how to perform the STOP technique are provided (4.1)
- We are training drivers to pick up on biofeedback (2.6)
- We demonstrate the behaviour and link it to safe driving (6.1)
- We prompt practice of the technique in a different context. As well as practicing STOP while driving, we demonstrate how it can be beneficial to try this technique before you leave the driveway (8.1)

3.3 Spotting negative emotions

William James (1884) argued that emotions are reliably related to certain physiological responses (e.g., frowns and anger tend to be concomitant). This is often referred to as *autonomic specificity*, and while there has been over 100 years of debate on this topic, the evidence tends to support this model (Friedman, 2010). A more contentious claim of James (1884) is that the autonomic somatic response is the precursor to emotion: One sees a bear in the woods, the body produces adrenaline, you run away, you interpret your bodily changes as fear. The Somatic Marker Hypothesis (e.g., Damasio, 1994) argues a similar case, with bodily changes providing information that can subsequently influence decision-making. This in turn shares arguments with the facial feedback hypothesis which suggests that faking facial emotions can amplify or initiate that emotion (e.g.,

Coles et al., 2022; Kraft and Pressman, 2012), or attenuate current emotions with a facial expression of the opposite valence (e.g., Söderkvist et al., 2017). Mindfulness espouses the benefits of getting in touch with one’s current body state, providing an opportunity to reflect upon whether current states are conducive to one’s goals. Thus, by recognising the autonomic specific patterns that arise with a build-up of negative emotions, this gives the mindful driver an opportunity to consciously change those body states (e.g., relax the shoulders, unclench the hands on the steering wheel), with a potential concomitant attenuation of the negative emotion. Put simply, this video starts by telling drivers to watch out for the bodily signs of frustration and anger, and then to counteract them.

Following this the video asks drivers to consider why they have negative thoughts. It describes the negativity bias (that humans have an evolutionary tendency to perceive the negative in a situation; e.g., Vaish et al., 2008), and then offers example scenarios to help reframe situations in a more positive (and realistic) light (e.g., Wolf et al., 2016). Screen shots from this video can be seen in Figure 7.



Figure 7. Screen shots from the ‘Spotting negative emotions’ (Video 2): (A) A demonstration of how negative emotions can build up over time using the Angerometer; (B) an example of the negative physical signs that might accompany negative thoughts, followed by advice on how to reduce them; (C) an explanation of the negativity bias in evolutionary terms; and (D) message reframing is achieved by juxtaposing the driver’s and cyclist’s thoughts about the same situation.

This video content included the following behavioural change techniques (BCTs):

- We are encouraging the self-monitoring of behaviour (2.3)
- We are training drivers to pick up on biofeedback (2.6)
- The video prompts drivers to re-attribute their anger and frustration (4.3)
- By juxtaposing drivers’ and VRUs’ thoughts in the same situation we are prompting drivers to reframe such situations (13.2)

3.4 In-groups, out-groups, and stereotypes (The Three Little Things technique)

Psychologists make a distinction between in-groups and out-groups. In-groups consist of individuals with whom we identify for some reason (friends and family, co-workers, fans of the same football team, people who driver the same car as us). These do not have to be people we know *per se*, but their perceived attributes overlap with our self-perceived social identify (Hogg et al., 2004). We apply positive stereotypes to people who fall within our in-group. Out-groups are formed of people who feel fundamentally different to ourselves, and are typically associated with negative stereotypes and perceived threat. Hoekstra et al. (2018) found that out-group bias was displayed between car drivers and cyclists, with generalisations of negative behaviour in both directions. This can lead to perceptual biases where actions undertaken by a member of the out-group are seen as threatening (e.g., thinking that a VRU is deliberately trying to block them from passing).

The video explains the difference between in-groups and out-groups, and challenges drivers' social identity boundaries through a number of methods. First, we demonstrate the embarrassment of incorrectly allocating a friend to an out-group, and the concomitant realisation that externalised anger is unjustified. Second, we demonstrate the situational specificity of out-group definitions, pointing out that cyclists and horse riders might be considered part of the in-group in other contexts. Finally, we provide a technique to humanise the VRU. Adapted from grounding techniques in mindfulness training, we ask drivers to guess three things about the rider or cyclist ahead, such as what job they have, what music they like, and what restaurant they would choose for a night out. This technique is designed to make drivers realise that the VRU ahead is a real person who is likely to share many preferences and traits with ourselves.

This video content included the following behavioural change techniques (BCTs):

- Instructions on how to perform the Three Little Things technique are provided (4.1)
- The video prompts drivers to re-attribute their anger and frustration (4.3)
- Social and emotional consequences are made apparent (e.g., embarrassment due to miscategorising a road user into the out-group) (5.3, 5.6), and viewers experience these consequences vicariously through our lead character (16.3)
- The potential for future social embarrassment can provoke anticipated regret (5.5)
- A demonstration of the Three Little Things technique in practice is given (6.1)
- By defining and challenging out-group categorisation we are seeking to restructure the social environment (12.2)

Screen shots from this video can be seen in Figure 8.

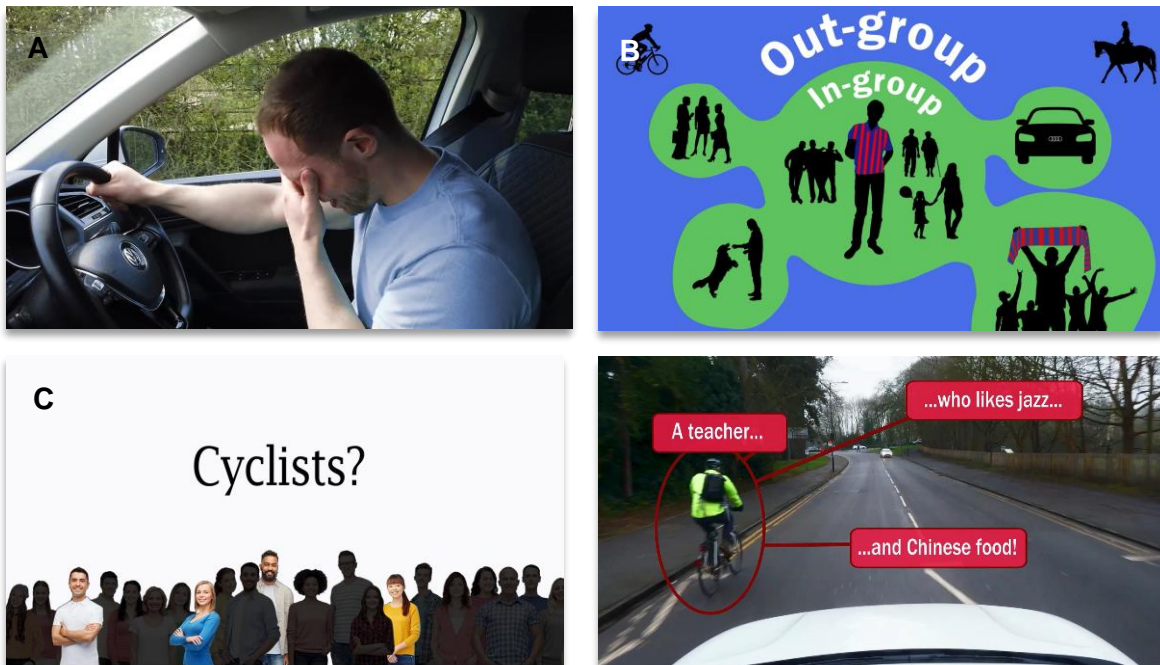


Figure 8. Screen shots from the ‘Three Little Things’ video (Video 3): (A) Our driver is embarrassed after raging at a rider whom he then recognises as a friend, demonstrating the fickleness of out-group attribution; (B) in-groups and out-groups are explained in further detail; (C) out-groups are shown to be context specific (we subsequently find out they all belong to our live-music in-group as we realise they are standing next to each other at a live concert); and (D) in-group adoption is promoted through the Three Little Things technique.

3.5 Emotion labelling

Putting emotions into words is often used in talking therapies and may reflect one of the benefits of keeping a diary (or *journaling*; Kow et al., 2024). This process has been distilled into a practice called *affect labelling* (which we have simplified for inclusion in Video 4 to *emotion labelling*). Studies have demonstrated that vocalising one’s negative emotion can reduce negative physiological markers (e.g., heart rate) and self-reported anxiety in a variety of populations including arachnophobes (Kircanski et al., 2012), glossophobes (Niles et al., 2015), and aerophobes (Azoum et al., 2018). There is also evidence that affect labelling can have similar impacts on the physiological markers of anger (Kassam and Mendes, 2013). It is believed to achieve these effects by reducing activity in the amygdala, while increasing frontal lobe activity (e.g., Hariri et al., 2000). Video 4 was designed to demonstrate how to label your emotion while driving, and provide a scientific explanation for why this may help them reduce their anxiety, frustration, or anger. Screen shots can be viewed in Figure 9.

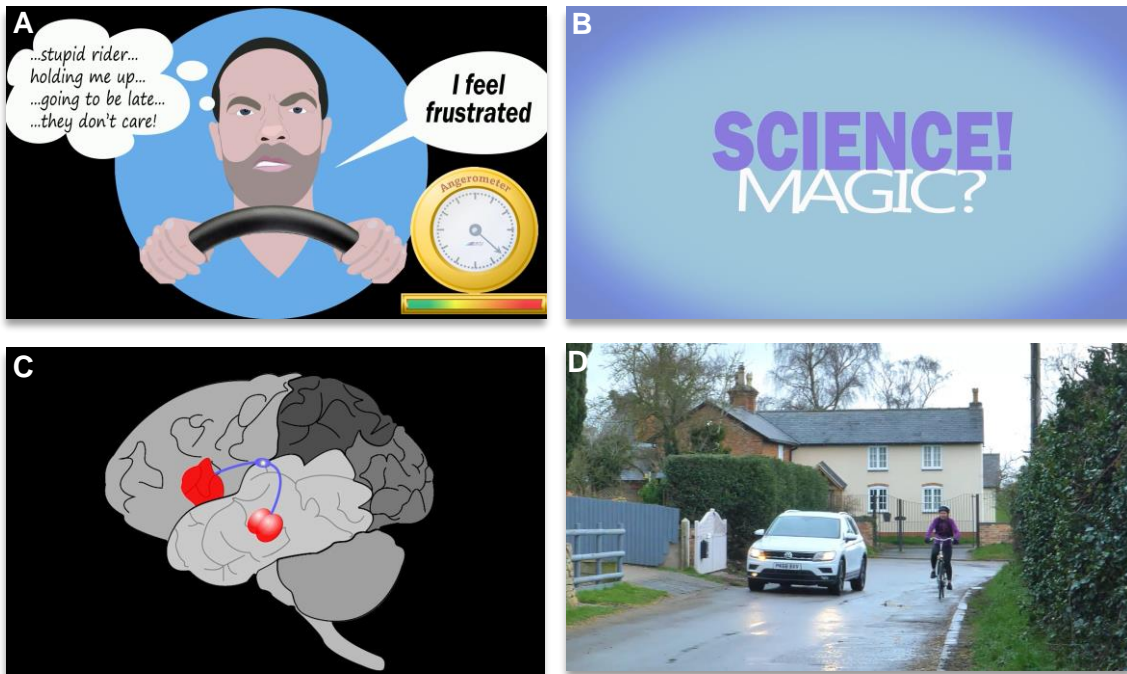


Figure 9. Screen shots from the 'Emotional Labelling' video (Video 4): (A) We explain the concept of emotional labelling; (B) we acknowledge that it sounds a bit wacky, but promise to explain the science; (C) brain animations show how verbalisation can reduce amygdala activity; and (D) we demonstrate emotional labelling in practice resulting in a safe overtake.

This video content included the following behavioural change techniques (BCTs):

- Instructions on how to perform the Emotion Labelling are provided (4.1) and a demonstration is given (6.1)
- The technique requires self-monitoring of behaviour (2.4)
- The video provides scientific evidence supporting the credibility of the technique (9.1)
- We acknowledge that verbalising an emotion might make the driver feel a little silly and then contrast this feeling against the anger or frustration that may have been felt, creating incompatible emotions (13.3)

4 Study 2: Evaluating the videos

4.1 Introduction

It is important to assess the effectiveness of road safety resources (e.g., Fosdick, 2019). While it may be disheartening to find out that a particular intervention did not work, this provides valuable information for those developers and researchers who follow. If an intervention does demonstrate an effect however, this evidence is useful to convince others to adopt or extend that particular approach (e.g., moving from a local intervention to a national roll-out).

To evaluate the impact of the mindfulness videos on drivers' attitudes and intended behaviours, we adopted a longitudinal design with participants assigned to either an intervention or control group. Participants in the intervention group were shown the mindful driving videos over a period of four weeks (Weeks 2 to 5 of the study), with the control group shown a series of four road safety videos once a week addressing a completely different topic: the dangers of handsfree mobile phone use. In Week 1 and Week 6 of the study we collected data on attitudes and behaviour towards both horse riders, and cyclists. We also asked participants for feedback on the content of the videos and the mindfulness techniques that were introduced in them.

We hypothesised that, over the course of 6 weeks, drivers' attitudes and intended behaviour towards horse riders and cyclists would be positively influenced by watching the mindfulness videos.

4.2 Method

4.2.1 Participants

Of those drivers who completed the initial survey, 455 were invited to take part in the evaluation of the videos. The respondents in Study 1 were ranked based on the sum of their reported frustration and anger with horse riders and cyclists, followed by their exposure to those vulnerable road users, and their reported annual mileage. Only participants reporting at least an annual mileage of 1000 miles were included. The ranking was done to try and ensure that participants in the intervention study had sufficient exposure to these VRUs and experienced at least some level of negative emotions toward them. Participants were compensated for their time for each survey at a minimum rate of £9 per hour. If participants made it to the end of the study (Week 6) they received an extra £1 bonus.

Of the 455 invited drivers, a total of 323 drivers completed all six weeks, with 154 drivers in the intervention group (mean age of 37.3; 75 male) and 169 drivers in the control group (mean age of 37.6; 83 male). The average general driving experience of all drivers was 16.4 years since passing their driving test (full car license), with intervention drivers passing 16.3 years ago, and control drivers passing 16.5 years ago. Annual mileage and time of last collision was also recorded. Average demographics for both groups are reported in Table 5.

Table 5. Demographics of the intervention and control groups

	Intervention Group	Control Group	Comparison
Number of participants	154	169	
Number of males	75	83	$\chi^2 = 0.01, p = .94$
Age	37.3	37.6	$t = -.027, p = .98$
Experience since passing test (years)	16.3	16.5	$t = -.203, p = .84$
Annual mileage	7848	7274	$t = 1.02, p = .31$
Number of participants with a collision in last 3 years	15	13	$\chi^2 = 0.43, p = .51$

4.2.2 Design and Procedure

The design was a longitudinal study, with half of the participants allocated to an intervention condition (who would be shown the mindfulness videos), while the other half were allocated to a control condition. Allocation was done by first yoking participants (matching them into pairs based on levels of frustration/anger with and exposure to VRUs), and then randomly allocating each participant in a pair to the experimental or control group. This allowed us to ensure that the groups were balanced. Participants received a link to six online surveys created on the Qualtrics ([Qualtrics.com](https://www.qualtrics.com)) platform. Subsequent surveys would become available one week after completion of the previous survey. An overview of the study can be seen in Figure 10. The survey in Week 1 contained questions about demographics, driving history in the past month, and their experiences with, and attitudes towards, vulnerable road users. In Weeks 2 to 5, participants were presented with a road safety video about mindful driving or the dangers of hands-free phone use, depending on which group they were in. Following each video, respondents had the opportunity to leave written feedback. Week 6 asked the same questions as in Week 1 plus three additional blocks of questions. In the first additional block, participants were asked to rate (on a 7-point Likert scale) how likely they were to use the mindfulness techniques from each of the four videos before or during their driving. The second additional block contained questions about VRU attitudes and knowledge and the third block asked for their explicit thoughts on the road safety videos.

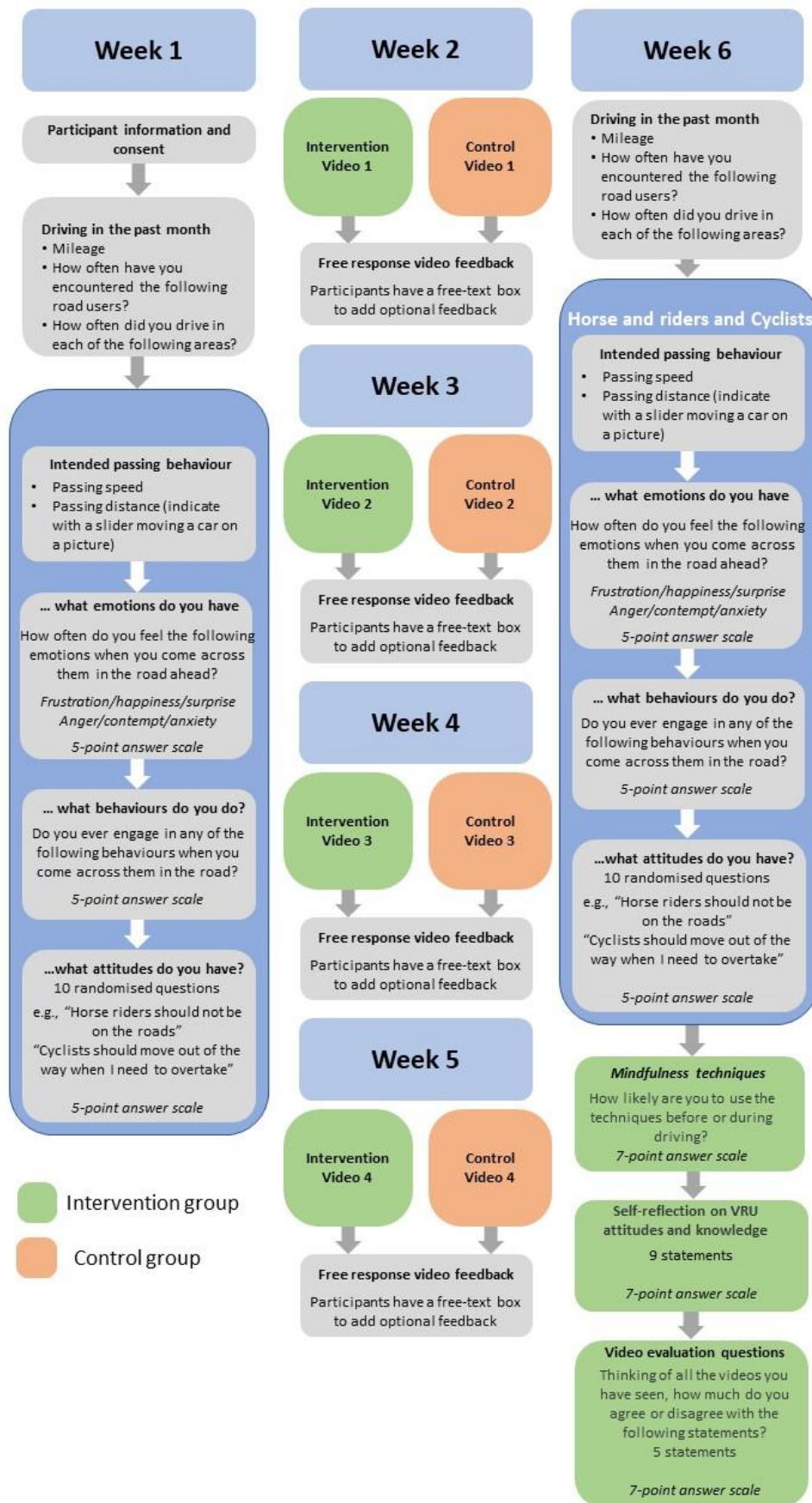


Figure 10. An overview of Study 2.

4.2.2 Materials

The first block of questions asked respondents how many miles they had driven in the past month, how often they had encountered a range of road users while driving a car (including horse riders and cyclists), and how frequently they drove in different areas (urban, suburban, rural, and motorway) in the past month.

Respondents were then given the *intended passing behaviour* question block. This contained four questions taken from Crundall and van Loon (2023a). Respondents were presented with an image containing either a horse rider or a cyclist, viewed from behind on a rural road (see Figure 11). A white car was placed next to the horse or cyclist. Respondents were first asked “Assuming that it is safe to overtake, what do you think the minimum distance should be between the horse and the overtaking car?” Underneath the picture, respondents were given a 7-point sliding scale. As they moved the scale to the left, the car would get closer to the horse or cyclist, while moving the slider to the right move the car further away. The second question asked at what speed they would overtake the horse/cyclist. For this they were provided with a sliding scale from 0mph to 50mph. It should be noted that the image clearly shows a 40 mph restriction is in place on this road.



Figure 11. Participants were presented with a picture of a car overtaking a horse and rider, and a cyclist. A slider allowed participants to both move the car to the left or right in the image to reflect their chosen passing distance, and to select a passing speed of up to 50 mph.

Following this, respondents were given the *emotions* block regarding horses and riders. In Week 1 the questions were phrased as, “Have you felt any of the following emotions when you have come across a horse and rider in the road ahead?”. In Week 6 the questions were phrased as “How often do you think you will feel the following emotions when you come across a horse and rider in the road ahead in the future?”. The emotions that required a response were the same as those used in Study 1: frustration, happiness, surprise, anger, contempt and anxiety. Our drivers responded on a 5-point scale from ‘never’ to ‘nearly always’.

The *behaviours* block was then presented with similar questions to those used in Study 1. Respondents were asked how often they *had* engaged in negative behaviours towards horses and riders (Week 1) and how often they would be *likely to do so* in the future (Week 6) (see Table 1, Section 2.2.2). Response scales to *behaviour* items were identical to those for *emotion* items. The

emotion block and *behaviour* block were then presented a second time, though in regard to cyclists rather than horses.

The *attitudes* block contained ten statements to which respondents had to agree or disagree. These were intended to query their attitudes towards both horse riders and cyclists (five statements each; Table 6). Each statement required a response on a five-point scale ranging from ‘strongly disagree’ to ‘strongly agree’. These differed from those in Study 1 and were taken from the 10-items used by Crundall and van Loon (2023a). This was intended to allow a cross-study comparison. There was no difference in the item phrasing between Week 1 and Week 6 for the attitude items.

All participants then received a 12-item *mobile phone* block, in reference to the control videos that half of the respondents watched in the control condition.

Table 6. Statements given to respondents to gauge explicit attitudes to horse riders and cyclists.

Statements	Scoring
1. Most horse riders behave responsibly when on the road	Positively scored
2. Horse riders should not be on the roads	Reverse scored
3. Car drivers should take extra care when passing cyclists	Positively scored
4. Most cyclists behave responsibly when on the road	Positively scored
5. Horse riders should move out of the way when I need to overtake	Reverse scored
6. Cyclists should not be on the roads	Reverse scored
7. Cyclists are similar people to me	Positively scored
8. Horse riders are similar people to me	Positively scored
9. Cyclists should move out of the way when I need to overtake	Reverse scored
10. Car drivers should take extra care when passing horses	Positively scored

The Week 6 survey also contained a number of question blocks that did not appear in the Week 1 survey. A *self-reflection* block presented respondents with 9 items regarding their own perception of whether their knowledge, safety, and intentions improved by the end of the study (see Table 7). Responses were collected on a 7-point scale ranging from ‘strongly disagree’ to ‘strongly agree’. This block was only presented to respondents in the intervention condition. In addition to one item asking how likely they would be to use the techniques in the videos, a follow-up question asked them to rate their likely use of each technique separately to help us identify the most acceptable techniques.

The final block of items in Week 6 was presented to all participants. Five items asked respondents to rate their agreement with statements about the videos, regarding how professional, informative, persuasive, interesting, and effective in improving driver behaviour they thought they were.

4.2.3 Road Safety Videos

As described in section 3, the four intervention videos each addressed different mindfulness techniques to deal with anger, frustration and anxiety when encountering vulnerable road users. The explanation of each technique was preceded by a brief introduction of the current rules in the highway code regarding the safe overtaking of horse riders and cyclists.

To provide control participants in this study with a similar series of road safety videos (but having nothing to do with VRUs), we provided them with a series of myth-busting videos about the safety (or lack thereof) of using handsfree mobile phones when driving. Each video provides a rationale that van drivers often rely on for why they use hands-free phones even when their company specifically forbids it. The videos then provide evidence and argument to show that these rationales do not hold up. A short description of each video can be found in Table 8. For more details on the nature of the control videos, please see Crundall et al., (2024) where they are described in more detail.

Table 7. Self-reflection questions for the intervention group in Week 6 (7-point Likert scale from strongly disagree to strongly agree)

Statements
1. My attitudes toward horse rider safety have improved.
2. My attitudes toward cyclist safety have improved.
3. My knowledge of how to safely pass horses has increased
4. My knowledge of how to safely pass cyclists has increased.
5. I feel I will be more in control when I overtake horses in the future.
6. I feel I will be more in control when I overtake cyclists in the future.
7. I will make use of the techniques I have learned when overtaking horses in the future.
8. I will make use of the techniques I have learned when overtaking cyclists in the future
9. My interest in mindfulness in general has increased and I may look into this further.

Table 8. The intervention and distracter videos that were distributed in Weeks 2 to 5 of the study.

Video	Week of delivery	Title/Story	Duration (s)
Intervention Video 1	2	The STOP technique	285
Intervention Video 2	3	Monitoring for negative thoughts/emotions	249
Intervention Video 3	4	The Three Little Things technique	244
Intervention Video 4	5	Emotion labelling	207
Control Video 1	2	Myth 1: Hands-free is legal so it must be safe.	150
Control Video 2	3	Myth 2: Driving is 'dead' time...	133
Control Video 3	4	Myth 3: Hands on the wheel, eyes on the road	109
Control Video 4	5	Myth 4: It's no different to talking to a passenger	142

4.3 Results

4.3.1 Understanding respondents' exposure to vulnerable road users

To ensure that any post-intervention group differences in attitudes, experienced emotions, and (intended) behaviour cannot be attributed to differences in exposure to vulnerable road users, we compared mileage, exposure to cyclists and horses and riders, and the time spent driving in different

areas for the two groups in the last month (before Week 6). Mann Whitney comparisons showed that there was no difference between the groups for those measures, suggesting that the matching of the groups had been successful (see Appendix C, Table C1)

4.3.2 Explicit attitudes towards VRUs

Participants were asked to rate their agreement with ten statements that probed specific attitudes to horse riders and cyclists (e.g., “cyclists should move out of the way when I need to overtake”). Participants recorded their agreement on a 5-point scale from ‘strongly disagree’ to ‘strongly agree’. Following Crundall and Van Loon (2023a), we combined rating of positive attitudes towards horses and riders, and towards cyclists. To combine ratings from individual items, we first recoded the categorial responses as integers (e.g., “Strongly disagree” = 1, “Somewhat disagree” =2, etc.). We then reversed the scale on 4 items (e.g., “horse riders should not be on the roads”) to ensure that higher scores always reflect more positive attitudes. The ratings were summed to create the combined positive attitude score towards cyclists and horse riders (with a maximum positive attitude of 25). The five items concerning horse riders had Cronbach’s alphas of 0.623 and 0.681 (before and after the intervention, respectively) and the five items related to cyclists gave alphas of 0.753 and 0.781 (before and after the intervention).

A 2x2 Analysis of Variance (ANOVA) was conducted on this combined positive attitude towards cyclists. This compared the pre-intervention combined attitude to the post-intervention attitudes across the intervention and control group. The results revealed a significant difference between the pre- and post-intervention attitude towards cyclists, $F_{(1,321)} = 5.81, p < .05, \eta_p^2 = .018$, showing that attitudes towards cyclists improved during the study. A significant interaction between pre- and post-intervention and intervention vs. control group was also found ($F_{(1,321)} = 4.41, p < .05, \eta_p^2 = .014$). This demonstrated that the improvement in positive attitude was greater for those participants who saw the mindfulness videos, than for the group who saw the control videos (Figure 12).

A similar pattern of results was found for the combined attitude towards horse riders, though the increase in positive attitudes towards horse riders after having watched the videos failed to reach significance, $F_{(1,321)} = 3.34, p = .07, \eta_p^2 = .010$, and there was no interaction.

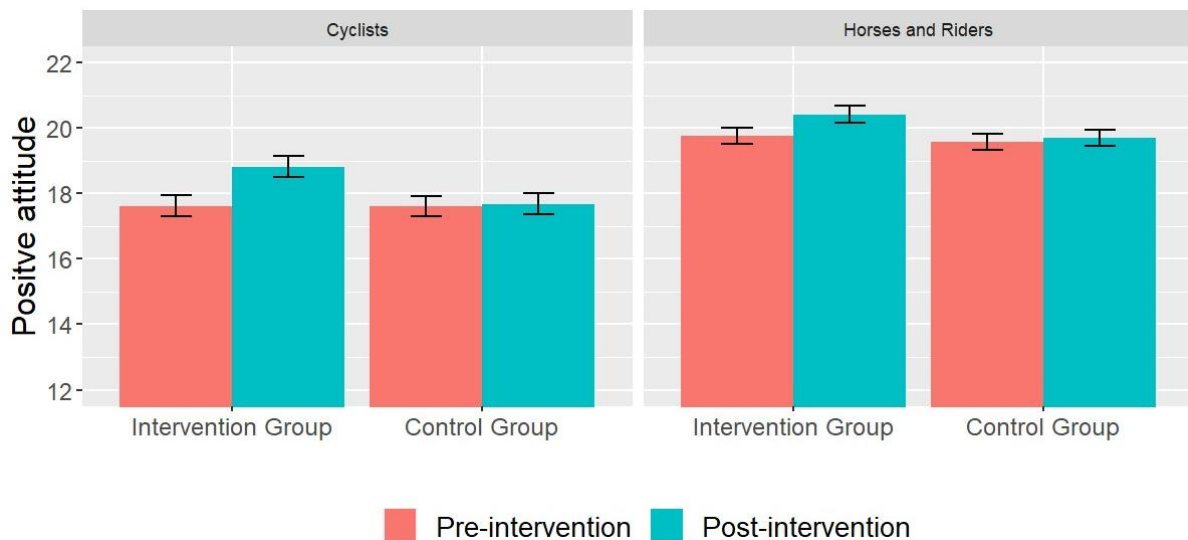


Figure 12. The combined positive attitude of participants to cyclists (left panel) and horses and riders (right), with standard error bars.

4.3.3 Passing behaviours

Respondents were asked two questions about their intended passing behaviour when overtaking a horse and rider and a cyclist. The first question asked respondents to select a distance between a car and the VRU to reflect the minimum lateral distance gap that they would leave. This was measured on a 7-point scale, where respondents were able to move a car on screen to a suitable distance from the vulnerable road user. The second question asked them to pick a speed at which they would overtake either the horse or cyclist (an interval scale from 0-50 mph). These questions were asked before and after the intervention or control videos were presented to respondents, in Week 1 and 6.

A 2x2 Analysis of Variance (ANOVA) showed that the intended minimum gap when overtaking a cyclist increased after having watched the videos, $F_{(1,321)} = 7.32, p < .001, \eta_p^2 = .022$, but this was the case for both the intervention and control group, as indicated by the lack of interaction. The same was found for the intended minimum gap when overtaking horse riders. Participants opted for a larger gap, $F_{(1,323)} = 8.89, p < .001, \eta_p^2 = .027$, but there was no interaction (Figure 13).

When looking at the selected speed for overtaking cyclists (Figure 14), participants chose lower speeds after having watched the videos, $F_{(1,321)} = 35.84, p < .001, \eta_p^2 = .010$, and this was more the case for the participants that had seen the mindfulness videos than the control videos, as shown by a significant interaction, $F_{(1,321)} = 4.25, p < .05, \eta_p^2 = .013$. Likewise, the selected overtaking speed for horses and riders decreased after the intervention, $F_{(1,321)} = 14.70, p < .001, \eta_p^2 = .044$, and again there was a significant interaction, $F_{(1,31)} = 4.26, p < .05, \eta_p^2 = .013$, suggesting that the intervention group showed a greater reduction in passing speed.

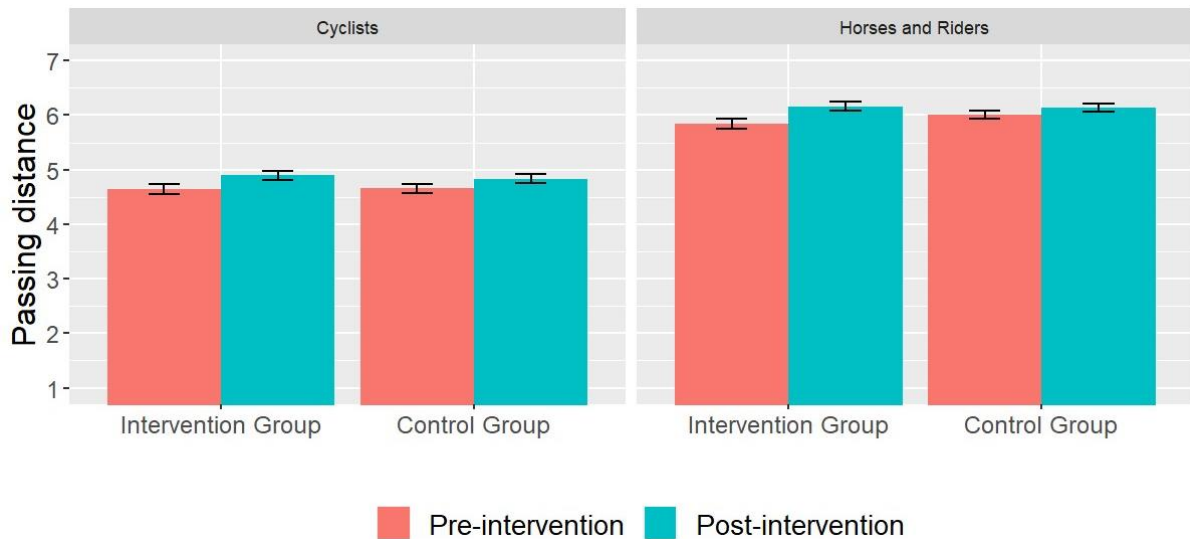


Figure 13. The minimum passing distance that respondents think is safe to overtake cyclists (left) and to overtake horses and riders (right) according to participant group (intervention vs. control) and comparing responses before and after the intervention. With standard error bars.

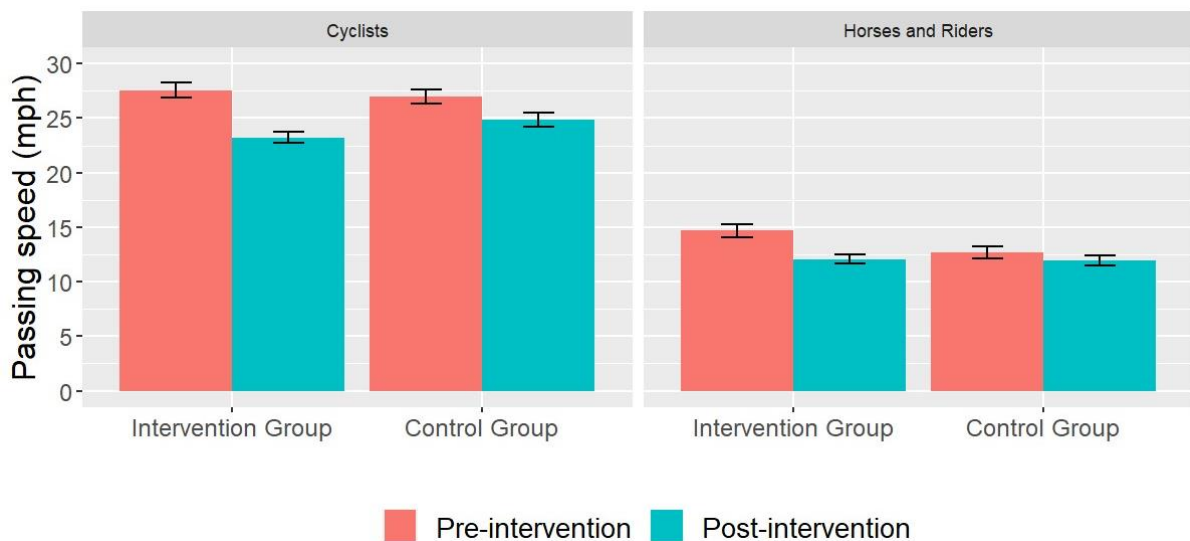


Figure 14. Respondents' chosen passing speed for overtaking cyclists (left) and horses and riders (right) according to participant group (intervention vs. control) and comparing responses before and after the intervention. With standard error bars.

4.3.4 Evoked emotions by Vulnerable Road Users

A series of individual 2x2 Repeated Measures ANOVAs (following data transformation using the Aligned Rank Transform procedure, Wobbrock et al, 2011) were performed to analyse changes in evoked emotions by VRUs. We found participants expected to feel fewer negative emotions towards VRUs (frustration, anger and contempt towards cyclists, and contempt towards horses and riders) in the future after having watched the videos. However, only frustration towards cyclists showed a significant interaction ($p < .01$). Three other interactions approached significance ($p < .10$). The medians, means and results of the analyses can be seen in Appendix C, Table C2) The distribution of responses across the reported emotion scales are shown in Figure 15.

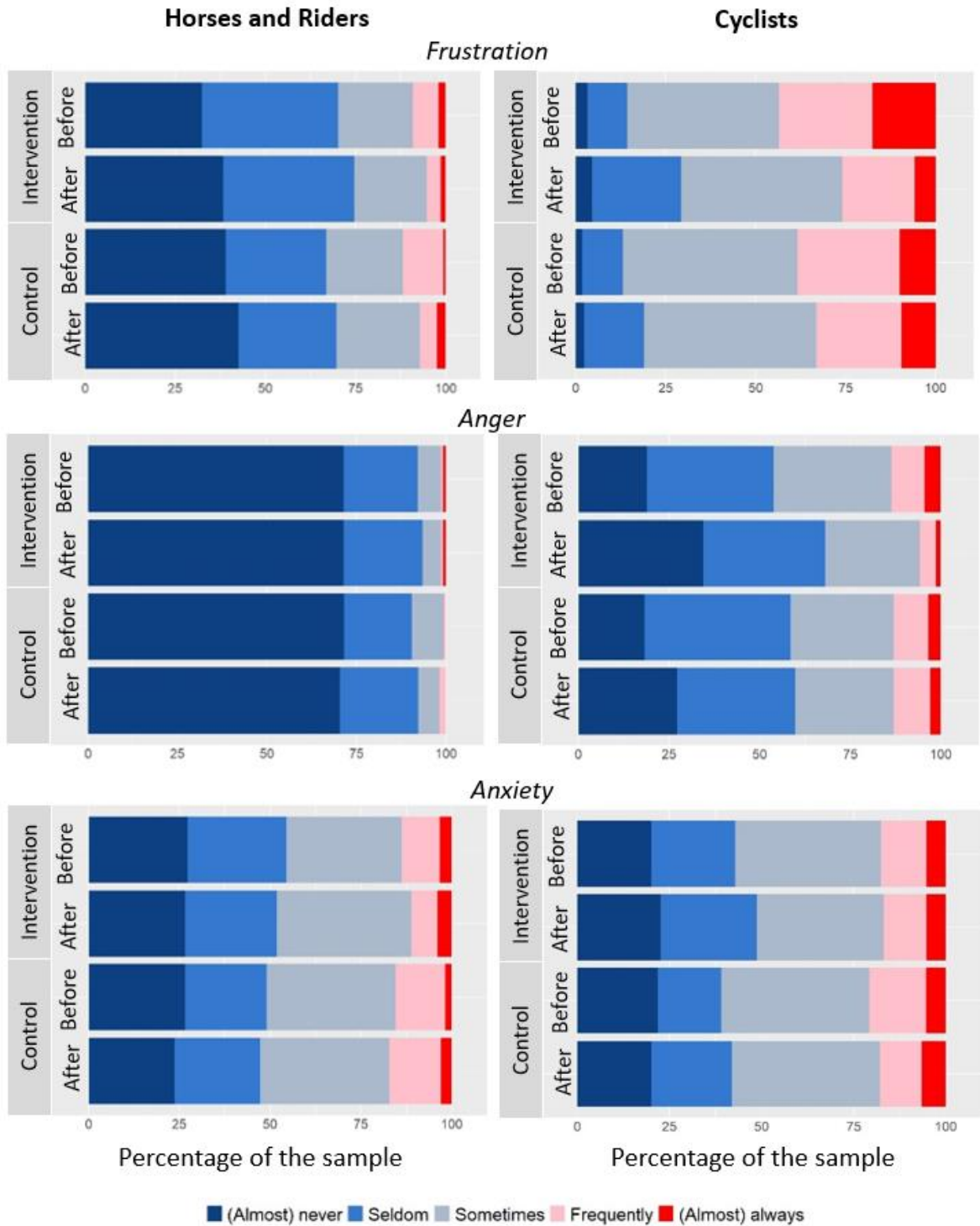


Figure 15. Levels of self-reported emotions towards horses and riders (left column) and cyclists (right column), before and after seeing either the intervention videos or the control videos.

4.3.5 Self-reported behaviour towards VRUs

With regards to self-reported behaviour (past behaviour for Week 1 and future behaviour for Week 6), we calculated the average scores for unsafe passing and aggressive behaviours towards cyclists and horses and riders as defined in section 2.3.2. We performed 2x2 Repeated Measures ANOVAs (following data transformation using the Aligned Rank Transform procedure, Wobbrock et al, 2011) for each behaviour, apart from aggressive behaviour towards horses and riders. As 98% of scores in this category were '1' responses ('(Almost) Never') and the data were therefore extremely skewed with many tied values, this analysis was not appropriate.

An overall main effect for pre vs post was found for unsafe passing behaviour towards horses and riders. This was mainly driven by the intervention group, who reported reduced future unsafe passing behaviour, whereas the control group did not. The interaction approached significance ($p < .10$). A similar pre vs post main effect was found for unsafe passing behaviour towards cyclists. Self-reported future unsafe passing behaviour was reduced in the intervention group, but not in the control group. This was confirmed by a significant interaction and a main effect of group (see Table 9). No significant differences between the groups or over time were found for aggressive behaviour towards cyclists.

Table 9. Self-reported past and intended behaviours in Week 1 and Week 6 (pre vs. post) respectively for the intervention group (Int) and control group (Con). F values for the two main effects and the interaction are also given.

	Intervention Group		Control Group		Main Effect 1	Main Effect 2	Interaction
	Pre	Post	Pre	Post	Int. vs Con	Pre vs. Post	
<i>Horse and Rider</i>							
Unsafe passing behaviour	1.48	1.36	1.39	1.44	0.39	7.86**	3.11'
Aggressive behaviour	1.02	1.04	1.00	1.02	NA ¹	NA ¹	NA ¹
<i>Cyclist</i>							
Unsafe passing behaviour	1.49	1.37	1.36	1.38	4.18*	6.80**	5.21*
Aggressive behaviour	1.67	1.57	1.62	1.64	0.01	1.46	1.52

Note: ' $<.10$, * $<.05$, ** $<.01$, *** $<.001$

¹As the vast majority (98%) of responses in this category consisted of '1's ('(Almost) Never'), requirements to perform an ART-ANOVA were not met.

4.3.6 Participants' Self-reflection

In Week 6, intervention participants were asked to reflect on what they had taken from the videos over the previous 4 weeks. Participants' responses are shown in Figure 16. Eight-five percent of respondents agreed to varying degrees that they would make use of the techniques when overtaking horses in the future. This level of agreement dipped slightly when considering cyclists, with only 81% agreeing to use the techniques, though this still represented a substantial portion of the sample. Respondents were also in agreement that their knowledge of how to safely overtake horses and cyclists had increased (82% and 81%, respectively), and that they would be more in control when

passing horses (84%) and cyclists (82%) in the future. Even the item that the fewest of our drivers agreed with showed that 68% thought they may look into mindfulness further following the study.

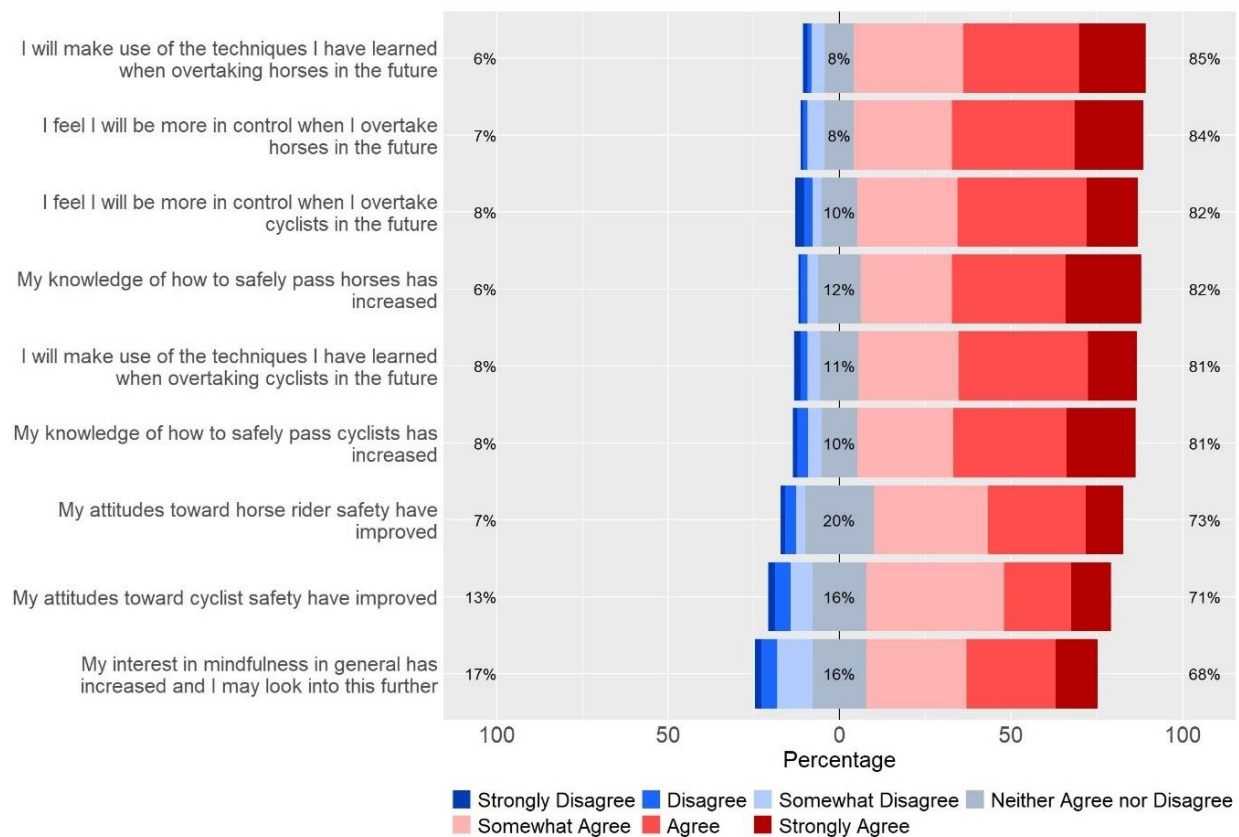


Figure 16. Drivers' agreement with belief statements regarding their knowledge, attitude and perceived future behaviour towards cyclists and horses and riders. Numbers reflect the percentage of the sample who disagreed, were ambivalent, or agreed with the statements (from left to right).

Respondents were also asked how likely they were to use the individual techniques (Figure 17). The technique of spotting negative emotions (76%) was considered most likely to be employed, followed by the 'STOP' technique (69%), the 'Three little things' technique (50%) and emotional labelling (49%).

4.3.7 Video evaluation

At the end of the study, all respondents were asked five questions regarding the videos themselves. The responses given by participants who saw the mindfulness videos can be viewed in Figure 18. Ninety-seven percent agree to some degree that the videos were informative, 87% thought they were interesting, and 94% agreed that they looked professional. Ninety-two percent agreed that the videos will improve some drivers' behaviour, while 85% agreed that they were persuasive.

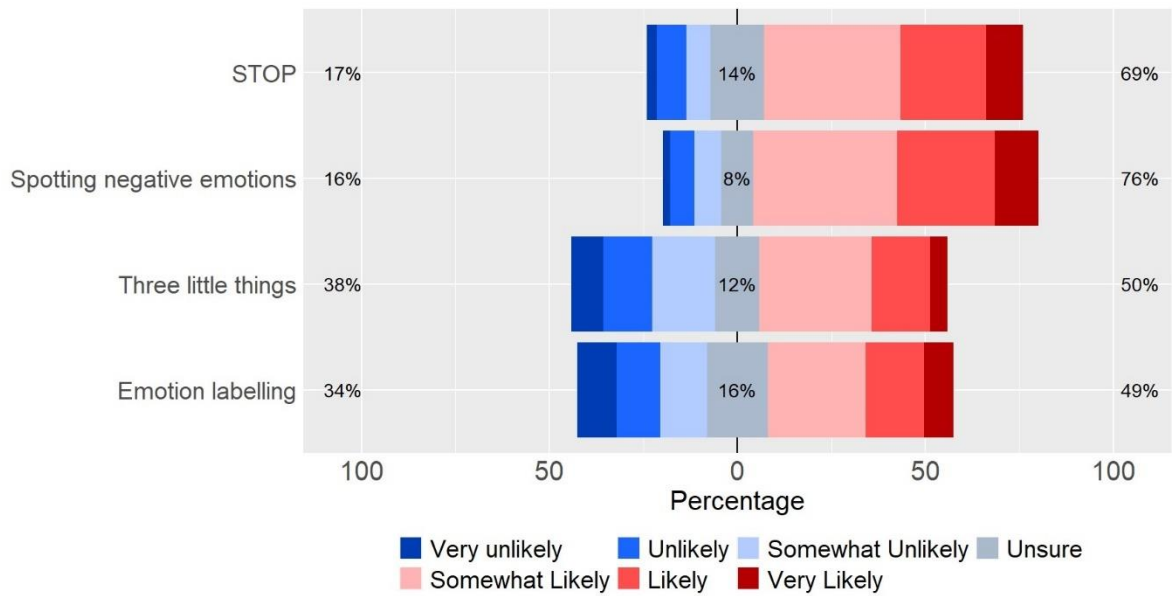


Figure 17. Drivers' likelihood to use the mindfulness techniques introduced in the four videos before or during driving.

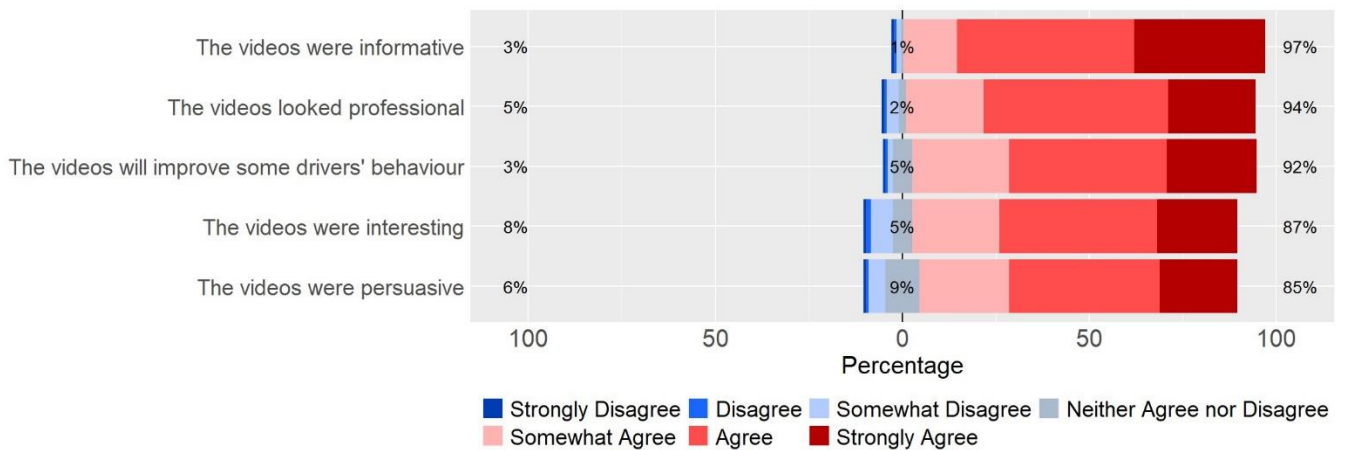


Figure 18. Drivers' agreement with belief statements regarding the series of videos. Numbers reflect the percentage of the sample who disagreed, were ambivalent, or agreed with the statements (from left to right).

In addition to these items, respondents had the opportunity to provide written feedback on each video (Weeks 2-5) or provide more collective feedback in Week 6. Many respondents responded positively towards the videos, with some reporting their intention to use them, while others reported positive outcomes from already using them:

“It does an excellent job on not only explaining the trigger points of aggressive driving but also how to combat and resolve these issues. The thought processes and sound logic help the video to be clear and concise on the actual dangers that driving can

entail. I feel the information given was not too overwhelming and well thought out and easy to absorb."

"The video helped you think more about why you may get frustrated and would help you gain more control of your emotions while driving."

"It portrayed mindful driving very well and is pertinent to today's society where everything is 100 miles an hour. Saying it's ok to stop and think about why you are behaving in this manner is powerful. A powerful video that is so true of many road users."

"It was a useful video which helped me to pinpoint some ways that I have let my emotions take hold of me when driving, and provided an easy solution for how to control them in the future."

"Actually might use this technique whilst driving and outside of driving to help reset."

"The videos have been very good. I drive on a lot of country lanes and sometimes feel anxious and pressured by the cars behind me to overtake. I have been using these strategies for the last couple of weeks and it has helped me to care less about what they might think."

The format of the videos also found favour, with positive comments reflecting the longitudinal nature of the delivery, simple explanations of the concepts, and the use of concrete examples.

"I really enjoyed the videos and also enjoyed doing them bit by bit and not all at once. It helped keep them in my head from the last week and remember the last rule I was given and think about it again."

"Everything was explained well and easy to understand."

"It discusses and explains things in very simple and easy to understand terms and uses very good examples."

The use of scientific explanations and evidence was particularly well received. Respondents noted that this increased their interest in the videos, and the likelihood that drivers may try the techniques. The scientific approach also left respondents feeling that they had been informed rather than 'preached to' about road safety.

"Loved the psychology behind why we get annoyed."

"Was interesting to find out about the psychological reasons why we as humans think of the negative aspects of a situation."

"I enjoyed the educational aspect about the brain, and the link-up between that and the suggested technique."

"It's good to bring science into it. With this approach people will feel less like they are being told off and more like they are being informed."

“I think the technique demonstrated in the video was made especially persuasive because the psychological/neurological reasoning behind it was explained in plain terms as well.”

“I like that the science behind the theory was explained. I don’t personally think this technique would work for me but because the science was explained I’m more likely to try it.”

“I think this is a really rational approach and think the scientific framing would really help it land with the majority of viewers.”

There was some concern however that the drivers who really need to change their behaviour around VRUs would be unlikely to engage with the material, and even if they did, the videos might be insufficient to change deep-seated attitudes and behaviours. Indeed, some of our respondents may have fallen into an ‘entrenched attitude’ category:

“Thought the video was good. But unfortunately people who don’t think horses should be on the road won’t change their behaviours.”

“I can imagine the kind of people who get angry at horses really not being the sort of person who would take any notice of these videos, unless they were obliged to as part of a reprimand/awareness course.”

“I don’t think the people who get a lot of road rage are going to be onboard with ‘mindfulness’”

“I could see the point but regardless I still find cyclists a menace.”

“The issue is that I am genuinely annoyed by cyclists, not that I have some other issue that is upsetting me. I’m normally quite happy to be travelling to work or wherever else I’m headed. If I were to stop take a breath and observe my surroundings the issue is that the bike is probably still there.”

This is a point acknowledged by Crundall et al., (2019) who found that any positive effects of mindfulness were dependent on participants’ engagement with the mindfulness training. This suggests that someone who holds disparaging views about mindfulness is unlikely to benefit as much as someone who approaches these videos with an open and curious mind, and as the respondents noted, there is a good chance road rage and closed-mindedness are comorbidities.

The latter comment is particularly interesting, as it suggests that at least one of our respondents did not understand the rationale behind the techniques. Taking a breath will not make cyclists disappear, but it can stop you from making an immediate rash overtaking action, and encourage you to wait for a safe overtaking opportunity.

Some drivers also thought the videos were too long. The average length was 246 seconds (just over 4 minutes) which is slightly over our intended time of 3-4 minutes, and this was noted in some of the comments:

“It was an interesting video to watch. But to hold attention I think it could have been a bit shorter.”

“Very long, it would not be beneficial for those with a short attention span.”

“It was informative but quite long and so busy people may not watch the video until the end. You should have a short version and a long version.”

There is, of course, a trade-off between the amount of information we want to put across, the simplicity with which we need to explain it, and the amount of time that a viewer is willing to give up to watch the whole video. In the current project it is impossible to know whether the length of the videos would have indeed stopped many drivers from engaging as all of them were receiving recompense for taking part in the study. This argues for monitoring of uptake in a dissemination phase.

Beyond the length of the videos, many respondents offered helpful advice and opinions on how to improve our road safety video messaging:

“There should be a video made to those ‘vulnerable’ people about considering other road users.”

“I would have liked more advice about how to overtake in certain situations - and acknowledgement that sometimes road conditions just don't allow you to overtake for a very long time - this is what makes me more frustrated and anxious, rather than allowing the obstacle more room when I pass...”

“I'm a relatively cautious driver, so when cars behind me start behaving as if I should have taken an earlier opportunity to pass the obstacle that makes me anxious - how about some tips on how to deal with that.”

“Perhaps some pictures of injuries sustained from horses being spooked and coming through a windscreen might influence some people's behaviour.”

“I felt that the videos were largely aimed at male drivers and so I didn't really feel much affinity with what I was being shown... I've never been as furious as the person in the video was. I imagine far fewer women react like that than men.”

“...could use different actors/surroundings so you don't feel like you've watched it before.”

Many suggestions that we received were sensible and actionable, while others might be less appropriate (e.g., graphic pictures of injuries). It is true that gender diversity was not apparent in our clips, though this was primarily dictated by budget. Several comments discussed alternative situations that our drivers wanted help on (e.g., how to deal with cars behind you, what to look for as an ideal overtaking spot). It would be possible to extend the range of videos to include these other scenarios, which would also provide an opportunity to film with other drivers to increase diversity and representation.

Our drivers also offered advice on how these videos should be distributed:

“It should be shown on tv or social media more.”

“I feel like it should be a video that is played to drivers at courses for speeding for example or when they are taking their theory test.”

“it was a great video and should be made part of the driving course preparation if it isn't already.”

“Should be broadcast on public TV.”

“These videos would be great for tv adverts or driving school.”

4.4 Discussion

Study 2 set out to assess whether our mindfulness videos would improve drivers' attitudes and emotions towards cyclists and horse riders, and whether it would change our drivers' future behaviour. In regards to driver attitudes, for Study 2 we employed the same attitude items that were used by Crundall and van Loon (2023a) to allow comparison between the studies. The results demonstrated an improvement in attitudes towards cyclists following the mindfulness videos. While attitudes towards horse riders followed the same pattern, the difference was not sufficient to produce a significant interaction.

While Crundall and van Loon (2023a) used different videos to evoke attitude change (they used empathy-inducing videos based on the personal lives of horse riders and cyclists), it is interesting to note that the pattern of results regarding attitudes to cyclists is very similar between the two studies (Figure 19). The magnitude of improvement is almost identical though our drivers started with, and finished with, lower positive attitudes overall. Regarding attitudes towards horse riders, the patterns between the two studies are again similar, though without the significant interaction in the current study.

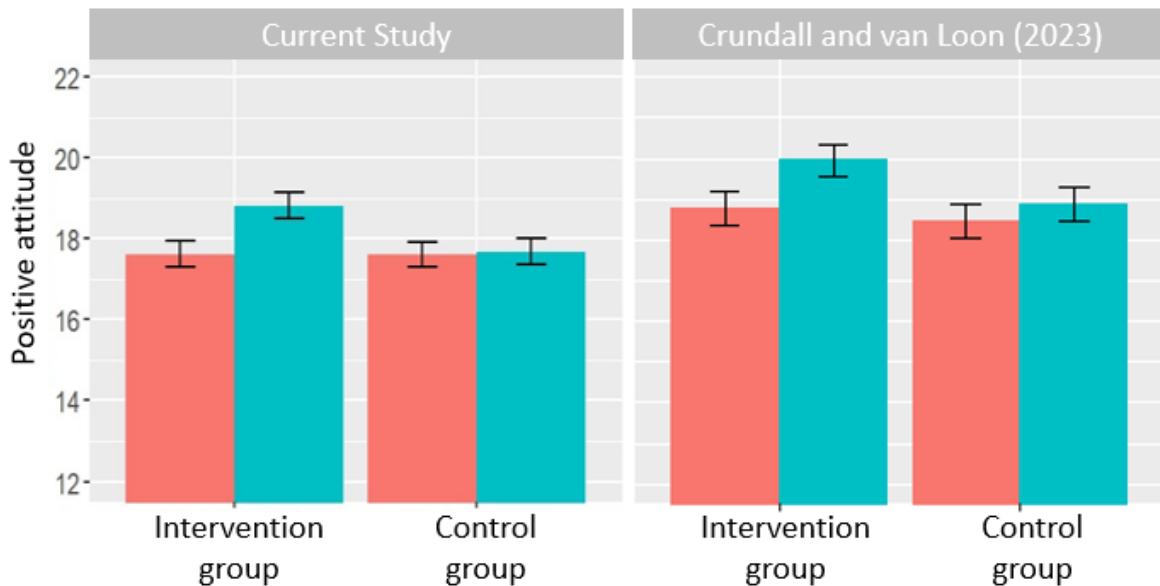
It should be noted however that Crundall and van Loon (2023a) measured participants' attitudes immediately after they had viewed their intervention videos. In the current study, attitudes were measured at least one week after respondents had seen the last of the four videos. Thus is it a possibility that an improvement in horse rider attitudes might have been more salient if measured earlier. Even if this were the case, the disappearance of the attitudinal improvement within the space of a week would limit the chances of this impacting on safe behaviour.

The reported emotions experienced when encountering VRUs (Week 1) or anticipating encountering them in the future (Week 6) also showed a benefit for cyclists, with an interaction revealing that our intervention group believed they would be less likely to feel frustration when they encounter cyclists in the future.

Beyond attitudes and emotions, we were also interested to see whether the videos would change future behaviours. This was measured in a number of ways. First, we reported the results of the overtaking task, where respondents were required to position a car at an appropriate lateral distance when overtaking a horse and a cyclist, and select an appropriate speed. The training did not have an effect on our measure of lateral distance, though there were clear interactions on speed choice, with drivers in our intervention group reporting slower overtaking speeds for both cyclists and horse riders, compared to the control group. It is possible that choosing an overtaking speed in the study is easier to do in accordance with your intentions, as it is just a matter of moving a point on a continuous scale to their desired speed. If you want to pass the horse at 30 mph, you simply

move the pointer to 30 mph on the scale. With the passing distance however, the movement of the vehicle (closer or further away from the VRU) was more discrete and did not give a numerical estimate. In other words, drivers could provide an exact figure for the speed question that fits with the rules of overtaking, but they had to make a visual estimation of the passing distance. This provides avenues for future research for refining and further developing this novel overtaking task.

Attitudes towards cyclists



Attitudes towards horses and riders

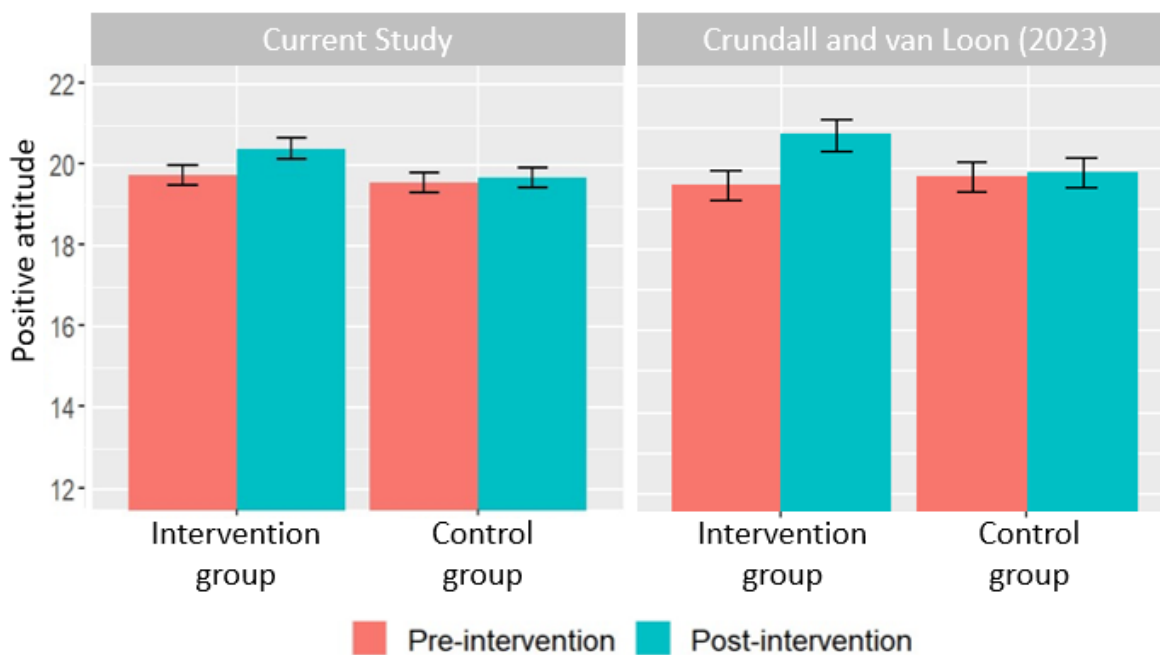


Figure 19. Drivers' agreement with belief statements regarding the series of videos. Numbers reflect the percentage of the sample who disagreed, were ambivalent, or agreed with the statements (from left to right).

Another measure of future behaviour was recorded in our two-factor behaviour items that we used in Study 1. The primary effect of note was that the intervention group reported lower likelihood of engaging in unsafe passing behaviours towards cyclists (too close when following, too close when passing, too fast when passing) compared to the control group, suggesting that the videos have changed intentions for future passing behaviours. There were no effects on aggressive behaviours towards cyclists (and it was impossible to analyse the effect on aggressive behaviours towards horses because nearly all respondents had answered 'almost never'). There was a trend towards safer passing behaviours for horses, but the interaction did not reach the threshold of significance.

A third indication of future behaviour is found in the self-reflection data (4.3.6), where 85% and 81% agreed (to varying degrees) that they would use our mindfulness techniques when they encounter horses and cyclists, respectively, on the roads in the future. This is supported by the qualitative feedback, with many respondents reporting the intention to use these techniques, or that they have already done so and noticed benefits.

Overall, the findings suggest that our videos have had a significant impact on emotions (frustration), attitudes, and future passing behaviours, at least towards cyclists, and our respondents are planning to make use of the techniques in the future. The effects are much less pronounced in relation to horses, possibly due to a ceiling effect caused by the relatively safe responses that drivers gave regarding horses on many of the baseline measures (pre-intervention). It is heartening to note however that our drivers feel that their attitudes towards horse riders have improved, that they will feel more in control when overtaking horses in future, and that they will make use of our techniques to assist them.

5 General Discussion

This project contained three phases of research. First, we conducted a large survey of drivers to gauge their emotions, attitudes, and behaviours in regards to horse riders and cyclists. Using these data we identified that targeting the emotions of *frustration* and *anger* was a priority, though *attitudinal disdain* was also a significant predictor of aggressive behaviours towards cyclists and unsafe passing behaviours towards horse riders.

Scripts were then developed to provide basic knowledge on how to pass VRUs (targeting *unsafe passing behaviours* that might be due to lack of knowledge), and general persuasive arguments to reframe one's relationship with VRUs (targeting *attitudinal disdain*), with mindfulness techniques providing immediate tools to combat in-the-moment emotions (primarily *frustration* and *anger*).

Four scripts were developed with expert assistance, and were then filmed and edited into the final four videos. Each video was designed so that it could be watched alone, though the primary reason for creating four videos was to ensure we have more opportunities to engage with drivers on a core topic, using different content to retain engagement. Thus we recommend that the videos are provided to drivers in the given order where possible.

The evaluation of the videos demonstrated clear improvements in anticipated emotions (lower frustration), attitudes, future intended passing speeds, and overall unsafe passing behaviours in regard to cyclists. The pattern was less emphatic for horses, with several of the analyses failing to reach the threshold of significance, though a reduction in future intended passing speeds was still found for our intervention group. Qualitative data supported the drivers' belief that these videos would be of great benefit, and they thought that their knowledge, attitudes, and level of control when overtaking had improved. Furthermore, the majority of our drivers thought that they might use the recommended techniques in practice, with qualitative evidence suggesting that several drivers would extend the use of these techniques outside of driving.

Overall, the results suggest that the videos may produce road safety benefits. However, at the moment we only have indications of drivers' future intentions to be safe. While these data are a great starting point, we would ideally follow-up with these participants to see whether their intentions blossomed into actual behaviours. It would be of great interest to check in with these drivers in 6 months to ask whether they have used any of these techniques while actually driving, and whether they recognise any improvements in their safety around VRUs.

One limitation of this video-based approach was noted in the respondents' feedback: They were concerned that the worst offenders on the road would not get to see these videos, and if they did, they would not engage with the mindfulness techniques. Unfortunately, we have to agree. Our previous research suggested that mindfulness benefits were, at least partially, dependent on being open to engagement (Crundall et al., 2019). Some drivers will have highly entrenched negative attitudes, often concomitant with high levels of risk-taking, and extreme levels of over-confidence. As Kruger and Dunning (1999) wrote, "Those with limited knowledge in a domain suffer a dual burden: Not only do they reach mistaken conclusions and make regrettable errors, but their incompetence robs them of the ability to realize it," p1132. Several studies have demonstrated how

relevant this quote is to road safety (e.g., Martinussen et al., 2018), with the least-safe drivers often having the most inflated view of their skills, which makes them less likely to take on board road safety advice. Beyond this minority of extreme drivers however, there are many people who would class themselves as rational thoughtful drivers, who still overtake inappropriately due to a lack of knowledge, sudden frustration, or a particular dislike for an out-group of road users. All of these drivers were represented in the free-text feedback that drivers gave in Study 1 and Study 2. These are the drivers whom we hope to target with these videos. While their transgressions are fewer and less severe than those of extreme risk-takers, there are enough of these drivers on the road to make targeting them a worthwhile endeavour.

Our respondents also gave good advice on potential dissemination going forward. While TV advertising is outside our scope, other media routes are more realistic. Social media was a popular suggestion, while others identified a range of captive audiences such as learner drivers via driving schools, offenders via retraining courses, and even patients sitting in doctors' waiting rooms.

If these videos are shown in sequential order to captive audiences (e.g., learner drivers, fleet drivers, etc.) then we recommend spreading the videos across a 4-week period. Ideally, we would also provide access to online resources to support our drivers in exploring and using these techniques, such as online exercises. Online resources could also include more in-depth introductions to mindfulness for those who are interested to know more.

Beyond the dissemination of the current videos, our drivers have asked for more content. Respondents felt that two key topics were missed out: general anxiety around VRUs, and the pressure that drivers feel from traffic behind. Both of these were noted in the initial survey, but did not make it into the final cut when creating the topic list for our four videos. It would be possible to develop further videos that look at other problems with overtaking VRUs, and this would give us an opportunity to bring in a different driver to provide diversity and prevent some viewers from thinking that the videos are not aimed at them.

Finally, we argue that one advance we have made is to provide a protocol for developing road safety videos. First, we surveyed the target population to ensure that we understood the causes of the target aberrant behaviour. Second, we gathered a group of experts from relevant fields (mindfulness practitioners and industry stakeholders) to debate the best solutions. Coupled with a review of the published literature, this gave us the four concepts that were then worked into scripts and storyboards. Filming and editing followed to create the final videos. Finally, we evaluated the videos, and iterated where necessary based on comments and feedback (e.g., changing typos in on-screen text). Evaluation is a cornerstone of the process. It must be built in to the development from the start, and should record a number of measures (both quantitative and qualitative) to provide converging evidence.

In conclusion, our four videos have changed the attitudes, anticipated emotions, and intended behaviours towards cyclists, and to a lesser extent, towards horse riders. Drivers report planning to use the techniques in real life, and some have already reported benefits. The discrepancy in our effects between cyclists and horses probably reflects the more positive emotions and behaviours that most drivers report in regard to horses, but this does not diminish the experience of the 3500+

riders who reported dangerous and aggressive behaviours to the BHS in 2022. If our videos can reach and speak to just a portion of these drivers, then we have the opportunity to prevent a collision.

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Appendix A : Survey questions about negative behaviour and emotions towards Vulnerable Road Users

Table A1. Questions about self-reported behaviour towards VRUs. Responses are recorded on a 5-point Likert scale from never to always.

Statements
<i>Have you ever done any of the following behaviours when you have come across a cyclist in the road ahead?</i>
<ol style="list-style-type: none">1. Sound your horn?2. Follow behind at one car's length or less?3. Shout at the cyclist or gesticulate your displeasure?4. Overtake the cyclist with a passing distance of less than 1.5m (5ft)?5. Rev the engine of your vehicle as a warning that you are behind?6. Overtake the cyclist at, or above, the speed limit for the road?
<i>Have you ever done any of the following behaviours when you have come across a horse and rider in the road ahead?</i>
<ol style="list-style-type: none">1. Sound your horn?2. Follow behind at one car's length or less?3. Overtake at over 20mph?4. Shout at the rider, or gesticulate your displeasure?5. Overtake the horse with a passing distance of less than 2m (6.5ft)?6. Rev the engine of your vehicle as a warning that you are behind?
<i>Have you ever done any of the following behaviours when you have come across a motorcyclist in the road ahead?</i>
<ol style="list-style-type: none">1. Sound your horn?2. Follow behind at one car's length or less?3. Pull out from a side road in front of an approaching motorcycle such that they have to slow down?4. Shout at the motorcyclist or gesticulate your displeasure?5. Close the gap between you and traffic in the next lane to prevent a rider from filtering past you?6. Speed up to prevent a motorcycle from overtaking you?7. Accelerate quickly from traffic lights to race a motorcycle?

Table A2. Questions about reasons for negative feelings and behaviour towards VRUs. Responses are recorded 5-point Likert scale from never to always)

Statements
<i>Drivers respond negatively to horses and riders because...</i>
1. Horse riders act arrogantly, often making hand gestures for other traffic to slow down
2. Horses leave dung on the road
3. Drivers may be in a rush, yet get held up by horses and riders
4. Drivers may be stressed about something else and take it out on a horse and rider
5. Horses can appear from nowhere
6. Horse riders are taking part in a leisure pursuit while holding up traffic
7. Horse riders should pay road tax
8. Horses and riders shouldn't be on the roads
<i>Drivers respond negatively to cyclists because...</i>
1. Cyclists act arrogantly
2. Drivers may be stressed about something else and take it out on cyclists
3. Cyclists shouldn't be on the roads.
4. Drivers may feel cyclists should pay road tax
5. Cyclists are unpredictable
6. Cyclists don't obey road rules
7. Packs of leisure cyclists can be intimidating
8. Cyclists can appear from nowhere
<i>Drivers respond negatively to motorcyclists because...</i>
1. Motorcyclists act arrogantly
2. Drivers may be in a rush, yet get held up by motorcyclists
3. Drivers may be stressed about something else and take it out on motorcyclists
4. Motorcyclists can appear from nowhere
5. Motorcyclists ride too fast
6. Motorcyclists overtake dangerously

Appendix B: Study 1 Evoked emotions by Vulnerable Road Users

Table B1. Omnibus and post-hoc comparisons across the three VRU groups for each emotion.

Emotion	Friedman (χ^2)	<i>p</i>	Cyclist vs. horse (z)	<i>p</i>	Horse vs. motorcyclist (z)	<i>p</i>	Cyclist vs. motorcyclist (z)	<i>p</i>
Frustration	659.06	<.001	-21.14	<.001	-5.90	<.001	-19.17	<.001
Happiness	589.11	<.001	-18.89	<.001	-19.00	<.001	-0.13	.90
Surprise	162.21	<.001	-12.80	<.001	-8.11	<.001	-4.87	<.001
Anger	606.48	<.001	-20.41	<.001	-13.24	<.001	-12.37	<.001
Contempt	293.76	<.001	-14.62	<.001	-7.99	<.001	-10.45	<.001
Anxiety	35.67	<.001	-6.02	<.001	-.54	.59	-5.17	<.001

Appendix C: Study 2 Driving behaviour and evoked emotions by Vulnerable Road Users

Table C1. Driving behaviour in the last month before Week 6. Miles driven and medians (means) for exposure to vulnerable road users and frequency of driving in different areas (1=never, 2 = seldom, 3 = sometimes, 4 = frequently, 5 = always).

	Intervention	Control	Comparison
Mileage in last month	537	451	$z = -1.38, p = .17$
Exposure to Cyclists	4 (3.7)	4 (3.8)	$z = 1.62, p = .11$
Exposure to Horse and Rider	2 (1.9)	2 (1.8)	$z = -.58, p = .56$
Urban driving	4 (4.2)	4 (4.1)	$z = -.45, p = .65$
Suburban driving	4 (4.4)	5 (4.4)	$z = .82, p = .41$
Rural driving	3 (3.2)	3 (3.0)	$z = -1.04, p = .30$
Motorway driving	3 (2.8)	3 (2.7)	$z = -.73, p = .47$

Table C2. Medians (and means) for self-reported emotions in Week 1 and Week 6 (pre vs. post) for the intervention group and control group. F values for the two main effects ME1 and ME2 (Intervention group vs control group and pre vs post, respectively) and the interaction are also given.

	Intervention Group		Control Group		Main Effect 1	Main Effect 2	Interaction
	Pre	Post	Pre	Post	Int. vs Con	Pre vs. Post	
<i>Horse and Rider</i>							
Frustration	2 (2.1)	2 (1.9)	2 (2.1)	2 (2.0)	0.14	3.86'	0.01
Happiness	3 (2.8)	3 (2.7)	3 (2.8)	3 (2.8)	0.39	1.28	0.06
Surprise	3 (2.7)	3 (2.8)	3 (2.7)	3 (2.8)	0.61	3.32'	0.01
Anger	1 (1.4)	1 (1.4)	1 (1.4)	1 (1.4)	0.03	0.35	0.23
Contempt	1 (1.6)	1 (1.5)	1 (1.5)	1 (1.5)	2.17	4.52*	3.58'
Anxiety	2 (2.4)	2 (2.4)	3 (2.4)	3 (2.5)	1.41	0.13	0.04
<i>Cyclist</i>							
Frustration	3 (3.4)	3 (3.0)	3 (3.3)	3 (3.2)	0.55	23.60***	7.01**
Happiness	2 (1.7)	2 (1.8)	2 (1.6)	2 (1.7)	0.78	5.97*	1.43
Surprise	2 (2.1)	2 (2.1)	2 (2.2)	2 (2.1)	0.22	0.19	1.16
Anger	2 (2.5)	2 (2.0)	2 (2.4)	2 (2.3)	0.84	12.10***	3.30'
Contempt	2 (2.3)	2 (1.9)	2 (2.2)	2 (2.1)	0.10	6.99**	3.30'
Anxiety	3 (2.6)	3 (2.5)	3 (2.7)	3 (2.6)	1.04	1.83	0.34

Note: ' < .10, * < .05, ** < .01, *** < .001