Article:
Day, M., Norman, P., Poulter, D. et al. (2 more authors) (2023) The adoption and application of Intelligent Speed Assistance by private motorists: user and non-user perspectives. Transportation Research Part F: Traffic Psychology and Behaviour, 99. pp. 262-273. ISSN 1369-8478

https://doi.org/10.1016/j.trf.2023.10.016

Transportation Research Part F: Psychology and Behaviour 99 (2023) 262–273

Contents lists available at ScienceDirect

Transportation Research Part F: Psychology and Behaviour

journal homepage: www.elsevier.com/locate/trf

The adoption and application of Intelligent Speed Assistance by private motorists: User and non-user perspectives

Marianne Day [a,*], Paul Norman [a], Damian Poulter [b], Özgün Özkan [b], Richard Rowe [a]

[a] Department of Psychology, University of Sheffield, UK
[b] School of Human Sciences & Institute for Lifecourse Development, University of Greenwich, UK

ARTICLE INFO

Keywords:
Intelligent Speed Assistance
Driver behaviour
Speeding
Road safety
Crash reduction

ABSTRACT

Intelligent Speed Assistance (ISA) is an in-car system that can help drivers to avoid speeding and therefore reduce crash frequency and severity. ISA systems that intervene to reduce vehicle speeds are increasingly available in new cars. Their efficacy in crash reduction will depend on the extent to which they are adopted and used by motorists. Increasing ISA use is therefore a promising new target for behaviour-change interventions seeking to reduce crash involvement. To provide context for intervention development, this study explored the beliefs and attitudes of 20 car drivers who have intervening ISA systems and 20 that do not. Thematic analysis of interview scripts generated five superordinate themes across both sets of drivers relating to: (1) safety, (2) driver control, (3) choice and enforcement, (4) driver identity and behaviour, and (5) enabling roll-out. ISA acceptability was generally high as long as driver choice around turning off and overriding the system was maintained. Drivers described a number of information needs relating to ISA: increased general awareness of ISA, provision of system-specific information for new ISA drivers and reassurances around non-ISA driver concerns (e.g., the responsiveness of the override and the speed control process). Many drivers indicated that ISA adoption would be facilitated by emphasising personal benefits (e.g., protecting driver licences, reduced insurance premiums, improved fuel efficiency, more relaxed driving) as well as safety advantages.

1. Introduction

Road traffic crashes (RTCs) are the eighth most common cause of death globally, with approximately 1.3 M annual fatalities, costing most countries 3% of their Gross Domestic Product (World Health Organisation, 2018). Reducing RTCs is one of the United Nations' Sustainable Development Good Health and Wellbeing Goals (UN General Assembly, 2015). Speeding increases RTC risk (Aarts & van Schagen, 2006); for example, in the UK 25% of fatal RTCs in 2021 involved exceeding the speed limit or travelling too fast for conditions (Department for Transport, 2021), with speeding implicated in 26% of the 9,748 US RTC fatalities in 2019 (National Center for Statistics and Analysis, 2021).

The role of speeding in increasing crash risk can be understood through Reason's (1990) Generic Error Modelling System (GEMS) that classifies dangerous human behaviours into deliberate violations of accepted safety practices and various types of error. Errors may be sub-classified as slips of action, where one action is intended but another is performed, lapses, where an action is

* Corresponding author at: Department of Psychology, University of Sheffield, 1 Vicar Lane, Sheffield S1 2LT, UK.
E-mail addresses: marianne.r.day@sheffield.ac.uk (M. Day), p.norman@sheffield.ac.uk (P. Norman), D.R.Poulter@greenwich.ac.uk (D. Poulter), O.Ozkan@greenwich.ac.uk (Ö. Özkan), r.rowe@sheffield.ac.uk (R. Rowe).

https://doi.org/10.1016/j.trf.2023.10.016
Received 5 April 2023; Received in revised form 25 August 2023; Accepted 15 October 2023

unintentionally omitted, and mistakes, where action plans are executed as intended but the plan is unsafe in the given situation. Speeding has most often been treated as a deliberate violation, for example taking a prominent role in the violations scale of the influential Driver Behaviour Questionnaire (Reason et al., 1990). Driving violations have been shown to relate to self-reported crash involvement in a large body of research (see De Winter et al., 2015 for a review). However, it is possible for speeding to also result from driver error (Truelove et al., 2022; Salmon et al., 2019). For example, drivers may inadvertently accelerate beyond the speed limit (a slip), may unintentionally fail to reduce speed when entering an area with a lower speed limit (a lapse), or speed unintentionally when they incorrectly believe that the speed limit is higher than it is (a mistake).

Driver-assistance systems such as Intelligent Speed Assistance (ISA) can reduce the public health burden of RTCs by reducing speeding. Advisory or warning ISA systems inform the driver when the limit is exceeded, leaving the driver to decide whether to reduce speed or not. This system has been shown to increase compliance with speed limits (Payre & Diels, 2023; Lehtonen et al., 2020) and may help to reducing speeding resulting from slips, lapses, and mistakes. In contrast, intervening ISA systems automatically reduce engine fuel transmission until the vehicle returns to the speed limit. Therefore, they have the potential to reduce speeding that results from violations as well as from errors. Trials of intervening ISAs across high-income countries generally find that they substantially reduce speeding (Carsten, 2012). For example, Lai and Carsten (2012) found a large effect at the more extreme end of the speeding distribution; in 70 mph limits the 85th percentile was approximately 80 mph before and after an ISA trial period, but close to 70 mph during the ISA trial. Lai et al. (2012) estimated that the universal adoption of intervening ISA could reduce serious road traffic injuries by up to 29%, versus 12% with intervening ISA that could be used at the drivers' discretion and 3% with advisory only ISA. Given the substantial safety potential of intervening ISA, this version of ISA is the focus of our current research.

Several factors may contribute to driver engagement with intervening ISA. First, an ISA system must be fitted to their vehicles. ISA availability depends on local road safety policy and manufacturers' decisions regarding fitting ISA systems. For example, the European Union has legislated that all new vehicles will feature ISA (either advisory or intervening) from 2024 (European Transport Safety Council, 2020). Independent from legislation, many manufacturers offer ISA systems, either as standard or optional modifications. As such, ISA-enabled vehicles are likely to become increasingly common in many countries, but drivers can still choose to buy cars without ISA including via the used car market.

Currently available ISA systems can be switched off entirely or temporarily overridden, usually via existing mechanisms such as pressing hard on the accelerator. One rationale for temporary override is that there may be occasional emergency situations where breaking the speed limit is perceived as the safest option such as during an overtake manoeuvre or to avoid a road hazard. However, continuously overriding ISA might reduce the effectiveness of the system. Field trial evidence indicates that drivers use the override more often than just in emergencies, with Lai and Carsten (2012) finding that ISA was overridden 16% of the time in 70 mph limits, 13% of the time in 20 mph limits and 2–8% of the time in other limits.

The availability of an override option may make ISA more suitable for reducing speeding in error rather than speeding through violation. The extent to which override options are available is again contingent upon national transport policy and manufacturer decisions. For example, ISA systems could be on by default at the start of each journey or could require the user to actively switch the system on. There are also different potential approaches that could deter overriding behaviour. For example, overriding ISA systems that allow deliberate speeding violations in non-emergency situations could be discouraged by concurrent warning sounds when the override is used or by telematic-linked insurance discounts.

Drivers' perspectives will be key to the adoption and use of ISA in terms of governing individual behaviour, public acceptance of ISA policy decisions and influencing car manufacturers' commercial approaches. The perspectives of drivers who do and do not currently use ISA are important. Drivers who currently use ISA can describe their reasons for using ISA and their experiences around its use which may indicate how ISA will be received and help identify the most publicly acceptable forms of ISA. At present, there is a lack of research exploring how ISA is being used by drivers in real world situations. The perspectives of drivers who do not currently use ISA are also important in determining ISA uptake, particularly in the early stages of ISA roll-out when most drivers are part of this group. Non-ISA drivers' views will therefore inform policy decisions and manufacturers' approaches to ISA availability as well as determining their individual choices on when to adopt ISA. Understanding these perspectives will also inform efforts to promote the adoption of ISA to maximise its potential safety benefits.

To date, most research addressing drivers' perspectives on ISA has involved driving simulations (e.g., Carsten et al., 2020) and on-road trials (e.g., Vlassenroot et al., 2007). These studies generally show ISA acceptance is high (Carsten, 2012); for example, Vlassenroot et al. (2007) reported that most participants felt more comfortable driving with ISA enabled than without it. While undoubtedly valuable, it is possible that driving in simulations and trial studies is not fully representative of the real-world experience of driving with ISA. It is also possible that the samples who volunteer for these studies are biased. For example, one study reported great difficulty in recruiting volunteers to trial ISA even when offering a 30% insurance premium reduction in return for participation (Lahrmann et al., 2012). Therefore, additional methodologies are required to gain a full picture of drivers' perspectives on ISA.

Driver beliefs and attitudes towards ISA and how they might use it, have rarely been addressed in the literature. Beliefs regarding overriding ISA have been explored previously in a study focusing predominantly on drivers who did not have ISA systems fitted (Rowe et al., 2021). Guided by the Theory of Planned Behaviour (Azjen, 1991), this study found that attitudes were the strongest correlate of overriding intentions and that attitudes were independently related to two sets of behavioural beliefs. One set included beliefs about overriding providing the safest course of action to reduce crash risk. The other set included beliefs about wanting to be able to reach destinations more quickly and enjoying driving fast. These beliefs may be important contributors to intentions to use ISA where fitted. However, this study did not explore why drivers held these beliefs or the extent to which their beliefs were specific to ISA rather than relating to speeding in general. This study also only addressed overriding ISA rather than the other issues involved in ISA including purchasing a vehicle fitted with ISA and turning the system on.

Research addressing the uptake of driving technology in general may provide some pointers to the extent to which ISA technology will be accepted. Stiegemeier et al. (2022) surveyed drivers on the acceptance of in-vehicle technology such as adaptive cruise control and lane-keeping assist, although they did not include ISA. They highlighted some general issues around adoption of technology by drivers. For example, reasons for non-use of in-car technology included perceptions that systems were not needed or were only relevant in specific contexts. Other barriers included distrust that the system would work effectively, perceived loss of driver control, perceived complexity, and lack of knowledge about system functions. It is possible that these issues will also be reflected in drivers' views on ISA adoption.

The present paper reports a qualitative interview study that sought to deepen understanding of driver perspectives on intervening ISA systems. Given the paucity of research exploring the views of users and non-users, we sampled a group of drivers who regularly drive a car fitted with an intervening ISA system to ascertain their perspectives on real-life ISA usage as well as a group of drivers who did not have ISA enabled cars. The perspectives of both groups of drivers on barriers and facilitators to ISA adoption and use were explored.

Table 1
Details of participants. ISA denotes ISA drivers, N denotes Non-ISA drivers matched to ISA drivers on sex, driving experience (years since licensure, miles driven per week).

Study ID	Age	Sex	Years since license	Mileage per week	Make and model of car	Year of manufacture	ISA system (if known)	Advisory system
ISA Drivers								
ISA1	41	Male	24	110	BMW 530d	2020	Speed limit assist	Yes
ISA2	34	Male	16	300	Vauxhall Combo	2020	Intelligent Speed Limiter	Yes
ISA3	54	Male	35	600	Jaguar XF	2018	Adaptive Speed Limiter	Yes
ISA4	44	Male	26	100	Tesla Model 3	2021	Autopilot Driver Assist	Yes
ISA5	34	Male	18	200	Volvo XC60	2020	Intellisafe assist	Yes
ISA6	55	Female	36	200	Jaguar Ipace	2021	Adaptive speed Limiter	Yes
ISA7	34	Female	17	100	Jaguar Ipace	2019	Adaptive Speed Limiter	Yes
ISA8	28	Female	3	200	Mercedes a220d	2021	Speed Limit Assist	Yes
ISA9	39	Male	22	200	Hyundai Kona	2021	Intelligent Speed Limit Assist	Yes
ISA10	27	Male	11	450	Ford Smax	2020	Intelligent Speed Assistance	Yes
ISA11	21	Female	3	10	Honda Jazz	2019	Intelligent Speed Limiter	Yes
ISA12	33	Male	1	20	Mercedes A180	2016	Active Speed Limit Assist	Yes
ISA13	63	Male	44	50	Mercedes Benz 220e	2016	Active Speed Limit Assist	Yes
ISA14	49	Male	30	200	(Audi Rs6)/Mercedes C63	2020	Active Speed Limit Assist	Yes
ISA15	77	Male	60	200	Kia Sportage	2019	Intelligent Speed Limit Assist	Yes
ISA16	44	Male	12	150	MG ZS EV	2021	Advanced Driver Assistance System	Yes
ISA17	67	Male	50	250	Mercedes E class	2018	Active Speed Limit Assist	Yes
ISA18	64	Male	45	200	Ford Focus Active	2020	Intelligent Speed Assist	Yes
ISA19	24	Male	3	250	Mercedes AMG A200	2019	Active speed limit assist	Yes
ISA20	40	Male	16	10	Peugeot 3008	2019	Intelligent Speed Adaption	Yes
Matched Non-ISA Drivers								
N1	42	Male	20	150	Hyundai ix35	2013		No
N2	44	Male	19	250	Suzuki GSXF	2008		No
N3	51	Male	32	300	Vauxhall Corsa	2018		No
N4	48	Male	20	80	Volkswagen Tiguan	2016		Yes
N5	43	Male	17	200	Skoda Fabia	2013		No
N6	51	Female	30	240	Mazda 3	2019		Yes
N7	32	Female	15	150	Ford Fiesta	2016		No
N8	32	Female	7	240	Smart Fortwo	2013		No
N9	42	Male	25	300	Kia Ceed	2018		No
N10	26	Male	9	400	Volkswagen Golf	2017		No
N11	25	Female	2	30	Nissan Note	2014		Yes
N12	30	Male	5	10	Mercedes Benz CLA Class	2016		Yes
N13	62	Male	45	50	Skoda Citigo	2012		No
N14	47	Male	30	500	Land Rover Discovery Sport	2016		No
N15	71	Male	54	150	Fiat Panda	2020		Yes
N16	30	Male	13	200	Skoda Citigo	2014		No
N17	65	Male	48	250	Volvo XC40	2021		Yes
N18	61	Male	42	100	Seat Ibiza	2015		Yes
N19	56	Male	5	150	Volkswagen Tiguan	2018		Yes
N20	29	Male	11	40	Honda Civic	2009		Yes

2. Method

2.1. Participants

A purposive sample of 20 UK drivers with an intervening ISA system and 20 UK drivers without an intervening ISA system (8 female, 32 male), between the ages of 21 to 77 (M_{ISA} = 43.6 years, SD = 15.5; $M_{Non\text{-}ISA}$ = 44.4 years, SD = 13.9) was recruited through the Prolific online research platform (https://www.prolific.co). Screening filters were applied which limited study presentation to UK residents who held a full driving licence, drove regularly (at least once per month) and were fluent in English. Potential participants completed a screening survey which recorded their driving experience (years since licensure, weekly mileage), their make and model of car and whether they had an intervening ISA system. Drivers with only advisory ISA systems were not included in the ISA sample. In the Non-ISA group, nine drivers had a device in the car which informed them if they exceeded the speed limit (e.g., phone app, in-vehicle speed advisory system). Non-ISA drivers were matched to the ISA drivers on sex, years since licensure and weekly mileage. We screened 750 drivers to recruit the targeted sample. Table 1 shows the sample details including the driver's vehicle make, model, manufacture year and name of ISA system. Driving experience ranged from 1 to 60 years (M_{ISA} = 23.6 years, SD = 17.0; $M_{Non\text{-}ISA}$ = 22.5 years SD = 15.4) and weekly mileage from 10 to 600 miles (M_{ISA} = 190 miles, SD = 143.9; $M_{Non\text{-}ISA}$ = 189.5 miles, SD = 126.4). Mann-Whitney U-tests and Fisher exact probability tests indicated that there we no significant differences between the two groups in terms of age, sex, driving experience and weekly mileage. Of the 20 ISA drivers, six (30%) drove with the system switched on all the time, 11 (55%) had ISA switched on for particular journeys and three (15%) did not use ISA at all. Participants gave informed consent via the Prolific platform. The study procedures were approved by the Research Ethics Committee of the Department of Psychology, University of Sheffield (reference number: 044723) and were pre-registered on the Open Science Framework (https://osf.io/zk2j8).

2.2. Data collection

On-line interviews were conducted March-April 2022 by MRD via Google Meets. Both groups of drivers were briefed about the specifications of ISA to be discussed. ISA drivers were asked to think about the system they had in their vehicle and how they used it, while Non-ISA drivers were asked for their impressions of the described ISA system and how they believed they would use it. The interview was semi-structured around seven topics (summarised in Table 2). The full schedule is included in Supplementary Materials. The schedule covered participants' behaviour and beliefs around the specifications of the ISA system, how they would feel about variations in ISA system functionality (e.g., making it harder to turn off or override), their opinions regarding the introduction and implementation of ISA systems in UK vehicles and how this introduction could be facilitated. While the interviewees were asked all scheduled questions, the order varied according to the conversation and participants were able to elaborate on areas of interest to them. Interviews lasted 19–43 min (M_{ISA} = 30.5 min, SD = 5.4; $M_{Non\text{-}ISA}$ = 29.8 min, SD = 7.0) and were audio-recorded via Google Meet. Transcripts were generated automatically using otter.ai and were manually checked and edited for veracity.

2.3. Data analysis

Interview data were analysed using thematic analysis to transform the data into codes and themes following Joffe (2012) and as used in a previous driving behaviour study (Day et al., 2018). A realist approach was taken to coding and analysing the data in that the driver's expressed perspectives on ISA were taken to be a true reflection of their beliefs (Brooks et al., 2015). A hybrid method, as described in Fereday and Muir-Cochrane (2008), was adopted to generate both deductive and inductive codes. The interview questions and probes meant that codes such as positive and negative evaluations of ISA and attitudes around ISA roll-out were automatically present in the data. Other, more interpretative codes were derived during analysis.

The verbatim transcripts were initially coded into beliefs and attitudes towards ISA and other aspects of driving by adding notes to the transcripts where they occurred. These notes were then classified into codes and summarised into a coding frame which provided a template to analyse the remaining transcripts (Brooks et al., 2015). The initial coding frame was developed from a sample of 10

Table 2
Summary of interview topics.

ISA Drivers	Non-ISA Drivers
Could you tell me about the ISA system in your car?	
Could you describe how you use your ISA system and what you think about it?	How do you think you would use an ISA system and what would you think about it?
How did you feel about getting a car with ISA fitted? Have your feelings towards ISA changed through having the system?	How would you feel if you were getting a car with ISA fitted?
How would you feel about changes/options to your ISA system?	How would you feel about changes/options to the ISA system?
Do you think ISA should be rolled out nationally? For example, should it be compulsory for all new cars and/or old cars?	Do you think ISA should be rolled out nationally? For example, should it be compulsory for all new cars and/or old cars?
What do you think would make the roll out of ISA more or less successful with drivers? And how could ISA be used to maximise safety benefits?	What do you think would make the roll out of ISA more or less successful with drivers? And how could ISA be used to maximise safety benefits?
Have you used any advisory speed systems in your car (e.g., warning systems fitted in the car, SatNav or smartphone systems)?	Have you used any advisory speed systems in your car (e.g., warning systems fitted in the car, SatNav or smartphone systems)?

transcripts and modified as it was applied to the remaining 30 transcripts. Data saturation was achieved once all the data was codable under the final coding frame and no new codes were emerging from subsequent transcripts (Guest et al., 2006). The final coding frame (see Supplementary materials) was developed from this iterative process. As well as *a priori* codes (e.g., positive and negative attitudes towards ISA), the frame included codes derived from the data, related to driver choice and enforcement, driver control and driver identity. Transcripts were coded against the final coding frame using NVivo 12 (QSR international, 2018) by MRD. This final coding frame was then organised into a thematic structure with superordinate themes and subthemes which reflected patterns of meaning and structure across the data.

To test the consistency and validity of the coding frame a sample of 10% of the transcripts was independently coded by a second coder (DP). These codes were compared against the initial coding frame to check that codes were applied consistently and that the frame adequately covered all the data. Any areas of disagreement around coding were resolved through discussion. The analytic project files were shared with the research team and the coding frames and final thematic structure were agreed with the research team. Discussions allowed consensus-building and the introduction of different perspectives to provide a wider understanding of the themes and conclusions.

3. Results

The analysis generated five superordinate themes across ISA and Non-ISA drivers: (1) Safety implications, (2) Technology and driver control, (3) Choice and enforcement, (4) Driver identity and behaviour, and (5) Enabling roll-out. In addition, a number of subthemes were also identified (see Table 3). The following determiners were used to indicate the extent to which specific themes and beliefs were mentioned by participants: few (<25%), some (≥25%), many (≥50%) and most (≥75%). Quotes are prefixed 'ISA' when from ISA drivers and 'N' from Non-ISA drivers.

3.1. Safety

Most of the ISA and Non-ISA drivers thought that there would be safety benefits of ISA being used in UK vehicles, through speed reduction. They believed this could reduce the number and severity of crashes and reduce incidents involving vulnerable road users (e.g., pedestrians, cyclists). Only a few drivers did not think ISA would have any positive safety benefits, suggesting that speed was less important in crash involvement than other issues such as tailgating, lack of attention or aggressive driving.

While recognising these potential safety benefits, most Non-ISA drivers and many ISA drivers had negative safety concerns about ISA which had (or would) put them off using it. A few Non-ISA drivers worried their car would slow suddenly without any indication to other drivers.

> especially motorway driving because you're probably going to be in that 65 to 70 zone. And if you are on the outside lane going for it and you suddenly start to slow down, it just needs a big BMW or a high-performance vehicle coming close at the back of you… he's going to be into you and …… you know, the consequences could be devastating. *(N15)*

Some Non-ISA drivers worried that the override would not be responsive enough for overtaking or hazard avoidance:

> *If a lorry is coming into your lane, for example, and you need to get away erm… you're going to have that delay. And that delay could… could…… could be a matter of life and death. (N14)*

A few ISA drivers who had limited experience of using their ISA system shared these concerns.

Most of the Non-ISA drivers and many of the ISA drivers said that the role of ISA in reducing the risk of getting a speeding penalty was an equal or greater motivation for using the system relative to safety benefits. A few drivers said they used (or would use) ISA on all journeys but many said that they used (or would use) it on specific journeys only. Many suggested they would use it on urban and motorway driving for safety benefits and in variable speed zones or on unfamiliar journeys to avoid speeding penalties.

3.2. Driver control

3.2.1. Negatives of reduced driver control

Most Non-ISA drivers and some ISA drivers had concerns around reducing driver control. These drivers believed that the car would

Table 3
Thematic structure showing superordinate themes and subthemes.

Superordinate theme	Subtheme	Subtheme divisions
Safety		
Driver control	2.1.Negatives of reduced driver control	
	2.2.Positives of reduced driver control	
Choice and enforcement	3.1.Autonomy	3.2.1.Mandating fitment
	3.2.Enforcement	3.2.2.Mandating use
Driver identity and behaviour	4.1.Competence	
	4.2.Other drivers	
Enabling roll-out		

not understand the context of the road as well as a human and would not take other factors into account (e.g., weather conditions, road conditions and potential hazards). Driver judgement was seen as a skill and around a quarter of drivers from both groups suggested that using ISA could de-skill drivers, reduce their focus on the road and lead to complacency or over-reliance on automation.

> *because it… sharpens your awareness and keeps you focused on the road. Sometimes when technology takes over a role for you, especially people who drive long distances…… they could start daydreaming and that kind of thing so…. I think you've got to… still have that focus haven't you… (N6)*

Some Non-ISA drivers and ISA drivers had concerns that ISA would not (or did not) accurately read speed limit signs, especially when damaged or dirty, or for temporary speed limits and overhead motorway gantries:

> *It isn't always completely accurate. It can miss them. It can read ones that it shouldn't read… they can be off on a different lane and it'll read those… and all of a sudden, I'll be slowing down… when I don't need to… And I've found that it can read them on the back of lorries as well… and all of a sudden, I'm slowing from 70 down to 50, which is a bit disconcerting. (ISA17)*

Many drivers in both groups thought the override function was important in maintaining driver control over the vehicle and was important for public acceptability. These drivers thought that the override was necessary for when the ISA system was inaccurate or for hazard avoidance (e.g., to avoid obstructions in the road, emergency vehicles, vulnerable road users and other people's hazardous driving):

> *occasionally we've all done it… Somebody pulls out on you or… you have a lapse of concentration and perhaps pull out on somebody else or something like that… And you just sort of… think to yourself, oh, my goodness, I've got to get out of this… really quickly. If you couldn't do that, then no, I would hate it… because that really would be… taking away your control. (N13)*

They also thought the override was important to be able to overtake other road users safely:

> *if you're overtaking a group of cyclists or a slow-moving vehicle, you might want to get above the speed limit and complete that manoeuvre as fast as possible, because that's the safest way of doing it. (N1)*

A few drivers from both groups thought the override function could maintain good traffic flow, allowing them to keep up with other cars and preventing the system feeling too restrictive if they were in a rush.

3.2.2. Positives of reduced driver control

Only a few drivers in both groups believed that technology was preferable to human judgement. Nonetheless, most drivers in both groups thought ISA would reduce speeding through inattention, especially on roads with variable speed limits (e.g., motorways and urban areas) or in unfamiliar areas. These drivers often identified this as the main benefit of ISA for the majority of drivers who only speed unintentionally.

> *it's probably most beneficial to the people… that genuinely aren't aware. And then once their car starts slowing down, they're suddenly something like, Oh wow, I didn't realise we'd move from a 40 to a 30 or whatever… (N11)*

Some drivers in both groups stated that allowing the ISA system to control speed would make driving a more relaxing experience. Speed was then '*one less thing to worry about' (ISA4),* meaning that attention could be directed to other aspects of driving including navigation and hazard perception.

> *you wouldn't be looking at the speedo, for example. You would just be able to concentrate on… the hazards around you… things like, are there pedestrians that are likely to run out or… other various things… (N4)*

3.3. Choice and enforcement

3.3.1. Autonomy

A few Non-ISA drivers disagreed with ISA on the principle that it would infringe on the 'spirit of freedom' (N2) represented by driving. Many drivers from both groups thought that ISA could feel '*naggy*' (ISA16) or restrictive and disliked the idea of *'a machine telling you what you should do'* (ISA15) or having '*a mind of its own' (N8)*. Around a quarter of drivers from both groups justified their own speeding in situations such as driving on quiet and clear roads, with no hazards, during the night and where they thought speed limits were conservative. They wanted to retain the choice to drive faster in those situations and did not want an ISA system to interfere with this.

> *I only speed when it's safe to speed, if that makes sense. And that sounds ridiculous… but I can see a long, straight country, road… I can see there's no junctions… and there's no farmer's gates… I can hurtle down there. On a motorway… dry day… not many cars, I can hurtle there… through a town I wouldn't speed… so therefore I don't need assistance to tell me so… (ISA5)*

Many drivers in both groups thought driver choice was important for ISA acceptability and wanted a system which could easily be turned on and off. Six ISA drivers had ISA switched on all the time, while 11 turned it on for specific journeys and three had turned it off completely. Some Non-ISA drivers wanted the option to turn ISA off because they did not know whether they would have confidence in using it or whether it would be annoying. A few drivers from both groups said they would turn ISA off when in a rush or driving for enjoyment.

But if I'm driving at the weekend or going to a mate's or whatever I will… I won't use any of the assistance stuff and I'll just… enjoy the drive. (ISA5)

Many Non-ISA drivers and some ISA drivers believed that options to turn off or override ISA would reduce its safety benefits, because drivers who were most likely to speed would be less likely to use the system effectively. Therefore, the optionality in the system was seen as both a necessity and a limitation.

if I knew someone had it… that was speeding on purpose and I knew they could override it, I'd kind of feel a bit like, Oh, well, it's a bit of a useless system then, because they're not actually stopping anyone. (N11)

Some ISA drivers and a few Non-ISA drivers preferred a system which could not be turned off or where this was made difficult but did not think this would be generally acceptable. A few drivers from both groups suggested that reducing the number of opportunities or time period where the override could be used would be a compromise to including it in the system.

So it would be a good idea to have some sort of limits on how long you could… press it for. So you could only like… 30 s or a minute or whatever, but… I would want some sort of system where you couldn't just… override it continually for the whole journey. That wouldn't… seem to make much sense. (N18)

3.3.2. Enforcement

3.3.2.1. Mandating fitment. Most drivers from both groups were generally favourable towards fitting ISA to new vehicles because of the potential safety benefits, as long as optionality was included in the system due to the concerns they had around ISA. Only a few drivers from both groups did not think ISA should be fitted, citing the cost implications, disbelief in ISA safety benefits and the belief that fitting ISA would eventually lead to mandatory use.

3.3.2.2. Mandating use. Most drivers from both groups were not in favour of regulation around ISA use or anything which reduced the driver's ability to override or turn the system off. A few drivers suggested that if it could be demonstrated that ISA was accurate and that there was evidence of a positive impact on road safety that this would support mandating its use.

if it had been rolled out and embedded and it was being used a lot… if there was… tangible statistics that said, since this has been used on certain roads, there have been… I don't know… 10 per percent less accidents in the last six months or whatever it might be. (N5)

However, most drivers who were positive towards a roll-out of ISA thought that people should be encouraged to use it rather than being mandated to use it, as enforcement would increase resistance.

Think persuasion is more important because… if you don't persuade people then… rebellion kicks in and… people want to break into the system and change it (ISA20)

3.4. Driver identity and behaviour

3.4.1. Competence

Most Non-ISA drivers and many ISA drivers expressed the belief that ISA would be more useful for less skilled drivers (e.g., newly qualified drivers) or habitual speeders. Some of these drivers suggested that inexperienced drivers could be incentivised to use ISA through insurance benefits and that habitual speeders could be mandated to use ISA or offered an ISA system as an alternative to speeding penalties. While many drivers admitted to sometimes speeding through inattention, they also distinguished this speeding behaviour from bad and aggressive drivers who choose to speed deliberately and thought it was these other drivers who posed a risk on the road.

I'm guessing the road traffic accidents that happen because people are purposefully speeding compared to the ones that are… really genuinely accidentally speeding… I think there's probably a big difference between the two… like little old Sally, who's off on her road… driving and she's like at 35 miles per hour instead of 30 and she genuinely didn't realise, I don't think she's the one that's causing… a danger to society… it's going to be someone that's going at 60… down a 30. (N11)

In comparison, some drivers thought that because they were a competent and confident driver they did not need to use ISA.

most men like to think they're probably better than they are and kind of think…….. I don't want a bloody system on, I want to drive myself […] so and again, for me and someone that feels reasonably confident driving, I don't really feel like I need or want driver aids to be honest. (ISA14)

3.4.2. Other drivers

Some drivers from both groups felt there were issues around using ISA where many cars on the road did not have it, especially with low public awareness of ISA. They worried that other drivers might be annoyed at ISA-fitted cars slowing to the speed limit and that this could lead to road rage incidents and rear shunt collisions.

> *…you're going to have people coming up behind you that might not recognise that you are slowing down and they might be like, well what on earth is he slowing down for you know… (ISA15)*

A few also thought that they might be at a disadvantage on the road compared to other drivers who were not being limited by an ISA system.

> it has to be the same for everyone…… you know, if the rules are absolutely the same for everyone, then I'm absolutely happy you know, with this sort of technology…. if it's just me, then I feel a bit more uncomfortable. *(N19)*

3.5. Enabling roll-out

Most drivers in both groups stated they would be happy to buy a car with ISA as long as they had the ability to turn it off and override it. Most drivers from both groups said that having an ISA system had not been (or would not be) a priority when buying their car and they would not pay extra for ISA. Since driving with the system, around half of the ISA drivers would now look for the system to be included in their future purchases. However, because ISA had not been a motivation in their car purchase, drivers had not asked for, or received, information about it at the time of purchase. Some drivers in both groups had concerns about the complexity of ISA which reduced their confidence in using it effectively.

> *I just want a car that's going to get me from A to B… this car does more than I can possibly begin to use. So, I don't believe that I'm using the system correctly. (ISA6)*

Some non-ISA drivers and many ISA drivers suggested a need for more public awareness about ISA which would increase motivation to purchase an ISA-enabled car and would reduce any potential resistance around its use.

> *I mean, it's a good idea if it's… installed in new cars, but I think they also need to inform the populace what they are doing… because there's no point if it's on all cars and people who have these cars don't know how to use them, don't have any idea about it. (ISA12)*

Most non-ISA drivers and ISA drivers stated that adequate information needed to be provided at the point of sale, in different formats (e.g., car manuals, pamphlets, verbal explanations, and demonstrations), for drivers to understand how to use their ISA system. Some of the Non-ISA drivers thought it was important to address their specific concerns, such as the slowing process and responsiveness of the override, through demonstrations at the point of sale. Many ISA drivers had sought information about the functionality of their cars from other drivers, social media, and YouTube videos. A few ISA drivers suggested that feedback from drivers who had found the ISA system useful and non-intrusive might be helpful in encouraging others to trial the system.

> *Have people speak in these videos that have experienced it… or have thought, I didn't want to implement this because I wanted to go faster on the roads. But now it's been implemented I actually don't mind it… have people encourage them to give it a shot and try it. (ISA11)*

Some drivers stated the importance of emphasising safety benefits to encourage ISA use. However, safety messages were also seen as too abstract to motivate the majority of drivers to use ISA. Demonstrating the effectiveness of ISA through statistics was described as helpful by around half of the drivers, both to underpin safety messages and to convince people to use it. Most drivers thought that emphasising personal, material benefits would be a better motivation. Examples included improved fuel efficiency (particularly in relation to rising fuel costs at the time of the interviews), reduced insurance premiums, reduced chances of receiving a speeding penalty and more relaxed driving.

> *I think kind of like pointing out the benefits quite clearly to people… you know, this can help you with your driving licence and avoiding fines, because I think then… people see it impacting them more personally, whereas, most people think I'm never going to have an accident… until it happens. (ISA1)*

A few drivers suggested that emphasising driver choice and control over the ISA system would encourage use. As well as being able to turn the system off and override it, some drivers also suggested other aspects of adaptability would make the system more useful. This included having a small allowance above the speed limit (to be able to keep up with traffic flow) and being able to set the ISA system according to journey/road types. Around half of the drivers in both groups said that they preferred the intervening ISA to an advisory system or wanted to be able to choose between the two versions for particular journeys. However, some preferred the greater perceived driver control in the advisory system. Many drivers thought an advisory system was helpful in encouraging drivers to drive slower and a few suggested that advisory ISA could be a useful intermediate step towards intervening ISA.

4. Discussion

This study explored UK drivers' perspectives on the introduction and use of intervening ISA. A strength of the study is that in addition to drivers who had not driven with ISA, we sampled drivers who use ISA in everyday driving, complimenting existing data from field-trials and simulation studies. Drivers were also able to relate ISA to their other driving behaviours and were able to raise issues which were important to them. This exploratory approach is informative as ISA technology has not been extensively studied. As expected, drivers discussed ISA use in relation to speeding. In the terms of the GEMS framework (Reason, 1990) they discussed both intentional speeding, resulting from deliberate violation, and unintentional speeding, resulting from errors.

Most drivers acknowledged that speed was a major contributor to road crashes and that reducing speeds could impact this. On this basis they identified potential safety benefits from using ISA. However, the sample did raise concerns about ISA, and even drivers who accepted potential safety benefits wanted to see evidence of its contribution to reducing road crashes before fully accepting enforcement around ISA.

Furthermore, many participants expressed concerns that ISA could pose safety risks. The idea that it is sometimes necessary to speed to escape from a dangerous situation or to overtake safely was commonly expressed. The majority reported that the override option was necessary for ISA to be a safe system and that ISA would be unacceptable without it. This matched the results of Rowe et al. (2021) who found a set of beliefs amongst drivers without ISA regarding overriding ISA being a safe course of action that could improve response in an emergency and reduce crash risk.

The present study indicates that these beliefs generalise beyond overriding to other aspects of ISA adoption. The richer interview data available here illuminates the nature of the concerns more precisely. Some concerns were related to how the system would slow cars down and the responsiveness of overriding. There were also concerns regarding driving a vehicle restricted by ISA on roads where other drivers were not similarly restricted. Vlassenroot et al. (2010) highlighted equity as a factor in the acceptability of ISA, with drivers more likely to accept ISA if a larger proportion of vehicles were fitted with it. In particular, participants believed that driving with ISA enabled could lead to road rage or rear end shunts due to the slower speeds of ISA vehicles or that ISA-enabled vehicles may be less able to negotiate busy traffic. ISA drivers in the current study generally reported that they had not faced such difficulties, although some reported perceiving pressure from other drivers to drive faster than the speed limit and reported using the override to allow them to keep up with traffic. Jamson (2006) also demonstrated that drivers were less likely to adhere to an advisory ISA where they were trying to "keep up with" other traffic in a field trial.

ISA safety concerns were also raised by drivers who had negative attitudes towards general automation in driving, particularly in terms of the dangers of reduced driver control. However, none of the ISA drivers reported difficulties around loss of focus or de-skilling. They often made the counterargument that ISA had freed up attention for other aspects of driving, such as hazard avoidance, and that this had made driving more relaxing.

Rowe et al. (2021) identified a set of beliefs about overriding ISA held by non– ISA drivers that were related to wanting to reach destinations quicker and enjoying driving fast. These beliefs seem conceptually related to driving stemming from deliberate violations although that has not been empirically tested. Similar beliefs were expressed in this study; drivers mentioned not allowing ISA to control their speed when they were in a rush, to make progress on the road or when responding to an emergency. This interview study allowed more exploration of the context of these beliefs, showing that they were often part of a perception that slightly exceeding the speed limit is a normal part of driving. As suggested in Vlassenroot et al. (2010), the extent to which speeding is seen as a problem and drivers' personal and social norms around speeding will impact on how acceptable ISA is and how likely they are to engage with the system. In the current study, around a quarter of drivers thought it was safe to speed in certain situations such as on open roads, with no hazards or at quiet times of the day. In these situations, drivers relied on their own judgements of 'safe' speeds rather than the speed limits. Most participants recognised they occasionally broke the speed limit and did not see slightly exceeding the speed limit as dangerous. These results indicate that the beliefs underlying decisions to violate speed limits in vehicles that are not fitted with ISA (e.g., Elliott et al., 2005) may also underlie decisions on how ISA is used. Drivers who are more prone to violate speed limits and therefore are most at risk of crash may also be less likely to engage with ISA when it is available in their vehicles. This issue has also been highlighted in a trial of ISA, where drivers who reported enjoying speeding were less likely to use ISA (Jamson, 2006). Arguments have been made around the possibility of using more restrictive ISA systems (less ability to override or turn off) as these would be more effective. However, the acceptability of these systems is generally seen as low, with additional issues around equity and misuse (van der Pas et al., 2014).

In the current study, many drivers reported that they were safe and skilful drivers and that they believed other drivers who purposefully speed cause traffic danger. This often meant that they did not see ISA as personally relevant, although they conceded that they sometimes exceeded the speed limit in error. Instead, ISA was viewed as a means of supporting inexperienced and more hazardous drivers. Stiegemeier et al. (2022) and Vlassenroot et al. (2010) both reported that an important motivator for using in-car technology was the drivers' perceived usefulness of the system and the potential to enhance their driving. Therefore, if drivers do not see the relevance of ISA to their own driving they are less likely to use it. Interventions may therefore need to highlight the usefulness of ISA for inadvertent, or non-intentional, speeding (e.g., when not aware of the speed limit on a particular road).

As noted above, feeling in control of their vehicle was important to many drivers and this extended to wanting to be in control of ISA too. The options to override and switch off ISA were important to the ISA and Non-ISA drivers. Stiegemeier et al. (2022) also highlighted the importance of trust in the adoption of in-car technology. Our participants emphasised that they needed to trust that ISA would reliably and accurately support them in controlling their speed. ISA drivers often reported that their systems were inaccurate in identifying the current speed limits. Some participants with ISA-enabled vehicles had lost confidence in ISA because of this and permanently turned their systems off. The tendency to stop using ISA as a result of errors has also been demonstrated in a trial (Warner & Aberg, 2008) and is likely to also relate to the perceived usefulness of the system, as highlighted by Vlassenroot et al. (2010).

In addition, a number of trials have suggested that speed compliance resulting from ISA use may reduce over time (e.g., Warner & Aberg, 2008; van der Pas et al., 2014). This highlights the importance of exploring real world use of ISA, as well as looking at its initial acceptability.

4.1. Implications for introducing ISA

The interview data provides useful evidence on how ISA might be introduced to maximise its safety potential. Our results

highlighted a lack of knowledge about ISA. Both groups had little awareness of ISA, either before the study, or before buying a car with ISA fitted. This meant that drivers were not generally motivated to buy a vehicle with ISA and did not request or receive adequate information about ISA when purchasing their vehicle. Some had also bought their cars second-hand and therefore received no information beyond the car manual. This suggests a dual need for information. First, information regarding awareness of ISA benefits, plans for regulation, and information which addresses ISA functionality concerns (i.e., the vehicle slowing process, the responsiveness of the override, perceived reductions in driver control). Drivers suggested that this could increase motivation to buy a car with ISA fitted and to use the system effectively. They also suggested that general information could be spread through safety campaigns or advertising. Second, information is also required about how to use specific ISA systems. Some Non-ISA drivers worried ISA would be too complex to use, either for themselves or for other drivers. A few ISA drivers had not used their system because of this or were not sure they were using it correctly. Stiegmeier et al. (2022) noted that in-car technology complexity was a barrier in that drivers may not take the time to learn how to use a system they perceive as too complicated. The car manual was not generally seen as sufficient to provide information about ISA and drivers suggested that information could be provided for drivers in different formats (e.g., printed materials, online videos, through the car's interface/computer, driver forums).

Both ISA and Non-ISA drivers believed that some new ISA drivers' concerns could be allayed by learning from experienced ISA drivers, for example through testimonials in ISA promotional material. Another suggestion was to allow drivers to experience the system in a controlled environment (e.g., on a test drive). These methods may be particularly effective in reducing worries around hazard avoidance and overtaking as we found that these were predominantly concerns of Non-ISA drivers rather than ISA drivers.

More problematic were intentions to override the system to allow deliberate violation of the speed limit. Drivers talked about overriding ISA if they were in a rush, enjoyed driving faster or wanted to resist the car telling them what to do. The beliefs underlying deliberate speeding in general, such as that some speeding is safe, may additionally need to be addressed in materials designed to encourage ISA use. One approach may be to focus on ISA's potential to prevent speeding penalties and therefore protect driving licences as this was often identified as a major benefit by both groups of drivers. Financial benefits have previously been identified as important incentives in trials of ISA (Warner & Aberg, 2008). In this context, emphasising that ISA can reduce speeding resulting from errors may also be helpful, as recognised by most participants. Although they did not believe it was particularly dangerous, preventing speeding penalties resulting from this sort of speeding may be seen as an important function of ISA for many drivers.

4.2. Limitations and further research

There were some limitations to this study which must be considered when interpreting our results. Our sample of 40 drivers may not generalise to other ISA or Non-ISA drivers. However, the sample size was sufficient to achieve data saturation and exceeds other recommendations for qualitative interview studies (Dworkin, 2012; Guest et al., 2006). The results from our exploratory interview study also fit well with sources of quantitative data (e.g., Rowe et al., 2021) and provide new leads on understanding driver perspectives on ISA. Further research will be needed to test the extent to which the beliefs and concerns identified in this study are quantitatively related to drivers' intentions, uptake, and use of ISA, using models such as the Theory of Planned Behaviour (Ajzen,1991). Additional theoretical approaches are also likely to be useful. For example, Social Cognitive Theory has been used to explore the acceptance and adoption of automated vehicles, as well as the use of media messaging to increase trust and intentions around their use (Lee, Baig & Li, 2022). The technology acceptance model (Davis, Bagozzi & Warshaw, 1989) which explores the acceptance of technology around perceived usefulness and perceived ease of use could also be applied to ISA technology.

Intervening ISA systems are still uncommon in UK motoring, as indicated by the high number of drivers that we needed to screen before recruiting a sufficient number of ISA drivers for the current study. It is likely that owning an ISA-enabled vehicle is associated with other characteristics that may influence views on social issues, including differences in income class groups. In order to minimise background differences between ISA and Non-ISA drivers we matched the samples on a number of key demographic variables. We also note that many themes identified in the current study were present in both ISA and Non-ISA drivers. However, continuing research will be valuable as the views of the ISA-driving population may change over time as larger proportions of motorists start driving ISA-enabled vehicles.

5. Conclusions

This study suggests high acceptability for fitting intervening ISA systems into UK vehicles with the proviso that systems allow driver choice and control. Optional functionality (i.e., the ability to turn ISA off and override it) may be necessary for drivers to see ISA as an aid to driving rather than a means of control. Drivers emphasised the importance of persuasion and increasing awareness of ISA to improve uptake and effective ISA use. Our analysis suggests a number of ways that drivers could be supported to adopt and use ISA effectively, including providing the initial motivation to choose a car with ISA fitted, and providing adequate system-specific information for the driver to use their ISA system. It may also be important to address how to re-engage drivers with ISA if they have lost trust in the system. The importance of using relevant messaging around personal and material benefits, in addition to emphasising safety benefits, was highlighted by drivers. Addressing specific concerns which drivers have in relation to ISA and changing perceptions around the relevance of ISA to skilled driving, may also be effective targets for intervention.

CRediT authorship contribution statement

Marianne Day: Methodology, Formal analysis, Investigation, Writing – original draft. **Paul Norman:** Conceptualization,

Methodology, Writing – review & editing, Funding acquisition. **Damian Poulter:** Conceptualization, Methodology, Writing – review & editing, Funding acquisition. **Özgün Özkan:** Writing – review & editing. **Richard Rowe:** Conceptualization, Methodology, Writing – review & editing, Funding acquisition.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Acknowledgements

This work was supported by a Road Safety Trust Grant, RST_235_8_21, awarded to RR, DP and PN.

Funder: The Road Safety Trust. The funder was not involved with the design or running of the interview study. A copy of this manuscript was made available for comment to the funder before submission.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.trf.2023.10.016.

References

Aarts, L., & van Schagen, I. (2006). Driving speed and the risk of road crashes: A review. *Accident Analysis and Prevention, 38*(2), 215–224.

Azjen, I. (1991). The theory of planned behaviour. *Organizational Behaviour and Human Decision Processes, 50*, 179–211.

Brooks, J., McCluskey, S., Turley, E., & King, N. (2015). The utility of template analysis in qualitative psychology research. *Qualitative Research in Psychology, 12*(2), 202–222. https://doi.org/10.1080/14780887.2014.955224

Carsten, O. (2012). Is intelligent speed adaptation ready for deployment? *Accident Analysis & Prevention, 48*, 1–3. https://doi.org/10.1016/j.aap.2012.05.012

Carsten, O., Ezenwa, A., Tomlison, A., & Horrobin, A. (2020). *ISA Interface Study*. Retrieved from Institute for Transport Studies, University of Leeds: https://environment.leeds.ac.uk/download/downloads/id/5102/isa_interface_study_accessible.pdf.

de Winter, J. C. F., Dodou, D., & Stanton, N. A. (2015). A quarter of a century of the DBQ: Some supplementary notes on its validity with regard to accidents. *Ergonomics, 58*(10), 1745–1769. https://doi.org/10.1080/00140139.2015.1030460

Davis, F., Bagozzi, R., & Warshaw, P. (1989). User acceptance of computer technology: A comparison of two theoretical models. *Management Science, 35*(8), 982–1003.

Day, M. R., Thompson, A. R., Poulter, D. R., Stride, C. B., & Rowe, R. (2018). Why do drivers become safer over the first three months of driving? A longitudinal qualitative study. *Accident Analysis & Prevention, 117*, 225–231. https://doi.org/10.1016/j.aap.2018.04.007

Department for Transport. (2021). Factors contributing to collisions and casualties (RAS07). Retrieved from https://www.gov.uk/government/statistical-data-sets/reported-road-accidents-vehicles-and-casualties-tables-for-great-britain#factors-contributing-to-collisions-and-casualties-ras07.

Dworkin, S. L. (2012). Sample size policy for qualitative studies using in-depth interviews. (2012). *Archives of Sexual Behaviour, 41*, 1319–1320. https://doi.org/10.1007/s10508-012-0016-6

Elliott, M. A., Armitage, C. J., & Baughan, C. J. (2005). Exploring the beliefs underpinning drivers' intentions to comply with speed limits. *Transportation Research Part F-Traffic Psychology and Behaviour, 8*(6), 459–479.

European Transport Safety Council. (2020). Intelligent Speed Assistance (ISA). Retrieved from https://etsc.eu/intelligent-speed-assistance-isa/.

Fereday, J., & Muir-Cochrane, E. (2008). Demonstrating rigor using thematic analysis: A hybrid approach of inductive and deductive coding and theme development. *International Journal of Qualitative Methods, 5*, 80–92. https://doi.org/10.1177/160940690600500107

Guest, G., Bunce, A., & Johnson, L. (2006). How many interviews are enough? An experiment with data saturation and variability. *SAGE J., 18*, 59–82. https://doi.org/10.1177/1525822X05279903

Jamson, S. (2006). Would those who need ISA, use it? Investigating the relationship between drivers' speed choice and their use of a voluntary ISA system. *Transportation Research Part F: Traffic Psychology and Behaviour, 9*(3), 195–206. https://doi.org/10.1016/j.trf.2005.11.002

Joffe, H. (2012). *Thematic analysis. Qualitative research methods in mental health and psychotherapy: A guide for students and practitioners* (pp. 209–223).

Lahrmann, H., Agerholm, N., Tradisauskas, N., Berthelsen, K. K., & Harms, L. (2012). Pay as You Speed, ISA with incentives for not speeding: Results and interpretation of speed data. *Accident Analysis & Prevention, 48*, 17–28. https://doi.org/10.1016/j.aap.2011.03.015

Lai, F., & Carsten, O. (2012). What benefit does Intelligent Speed Adaptation deliver: A close examination of its effect on vehicle speeds. *Accident Analysis & Prevention, 48*, 4–9. https://doi.org/10.1016/j.aap.2010.01.002

Lai, F., Carsten, O., & Tate, F. (2012). How much benefit does Intelligent Speed Adaptation deliver: An analysis of its potential contribution to safety and environment. *Accident Analysis & Prevention, 48*, 63–72. https://doi.org/10.1016/j.aap.2011.04.011

Lee, J., Baig, F., & Li, X. (2022). Media influence, trust, and the public adoption of automated vehicles. *IEEE Intelligent Transportation Systems Magazine, 14*(6), 174–187. https://doi.org/10.1109/MITS.2021.3082404

Lehtonen, E., Malhotra, N., Starkey, N. J., et al. (2020). Speedometer monitoring when driving with a speed warning system. *European Transport Research Review., 11*, 16. https://doi.org/10.1186/s12544-020-00408-8

National Center for Statistics and Analysis. (2021). Speeding 2021 data (DOT HS 813 194). Retrieved from National Highway Traffic Safety Administration: https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/813194.

Payre, W., & Diels, C. (2023). Driving behaviour and usability: Should in-vehicle speed limit warnings be paired with overhead gantry? *Future Transportation, 3*(1), 1–22. https://doi.org/10.3390/futuretransp3010001

QSR International Pty Ltd. (2018) NVivo (Version 12), https://www.qsrinternational.com/nvivo-qualitative-data-analysis-software/home.

Reason, J. T. (1990). Human Error. *Cambridge University Press*. https://doi.org/10.1017/cbo9781139062367

Reason, J. T., Manstead, A., Stradling, S., Baxter, J., & Campbell, K. (1990). Errors and violations on the roads - a real distinction. *Ergonomics, 33*(10–11), 1315–1332. https://doi.org/10.1080/00140139008925335

Rowe, R., Maurice-Smith, M., Mahmood, M., Shuja, A., & Gibson, D. (2021). Understanding intentions to override intelligent speed assistance prior to widespread availability: An application of the theory of planned behaviour. *Accident Analysis & Prevention, 151*, Article 105975. https://doi.org/10.1016/j.aap.2021.105975

Salmon, P. M., Read, G. J., Beanland, V., Thompson, J., Filtness, A. J., Hulme, A., et al. (2019). Bad behaviour or societal failure? Perceptions of the factors contributing to drivers' engagement in the fatal five driving behaviours. *Applied Ergonomics, 74*, 162–171.

Stiegemeier, D., Bringeland, S., Kraus, J., Baumann, M. (2022). "Do I really need it?": An explorative study of acceptance and usage of in-vehicle technology. *Transportation Research Part F: Psychology and Behaviour, 84, 65-82.* https://doi.org/10.1016/j.trf.2021.11.011.

Truelove, V., Watson-Brown, N., Mills, L., Freeman, J., & Davey, J. (2022). It's not a hard and fast rule: A qualitative investigation into factors influencing speeding among young drivers. *Journal of Safety Research*, *81*, 36-44. (78).

UN General Assembly. (2015). Transforming our world: The 2030 Agenda for Sustainable Development accessed 17 January 2023 https://www.refworld.org/docid/57b6e3e44.html.

Van der Pas, J., Kessels, J., Vlassenroot, S., & Van Wee, B. (2014). The pros and cons of intelligent speed adaptation as a restrictive measure for serious speed offenders. *Transportation Research Part A: Policy and Practice, 67*, 158–174.

Vlassenroot, S., Broekx, S., Mol, J. D., Panis, L. I., Brijs, T., & Wets, G. (2007). Driving with intelligent speed adaptation: Final results of the Belgian ISA-trial. *Transportation Research Part A: Policy and Practice, 41*(3), 267–279. https://doi.org/10.1016/j.tra.2006.05.009

Vlassenroot, S., Brookhuis, K., Marchau, V., & Witlox, F. (2010). Towards defining a unified concept for the acceptability of intelligent transport systems (ITS): A conceptual analysis based on the case of intelligent speed adaptation (ISA). *Transportation Research Part A: Policy and Practice, 13*(3), 164–178. https://doi.org/10.1016/j.trf.2010.02.001

Warner, H., & Aberg, L. (2008). The long-term effects of an ISA speed warning device on drivers' speeding behaviour. *Transportation Research Part A: Policy and Practice, 11*(2), 96–107. https://doi.org/10.1016/j.trf.2007.08.002

World Health Organisation. (2018). *Global status report on road safety 2018*. Retrieved from https://www.who.int/publications/i/item/9789241565684.