Evaluating the effectiveness of brief anti-speeding messages disseminated within warning notices to driving offenders

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ABSTRACT

Road safety messaging represents a long-standing strategy in efforts to reduce speeding, a behaviour which accounts for an estimated 30 % of all road crashes on Australian roads. This study aimed to further examine the effectiveness of such a strategy via the use of a novel message medium that included anti-speeding messaging disseminated to speeding offenders via warning notices issued by a Start Government Transport agency. Informed by the Step approach to Message Design and Testing (SatMDT), survey content was devised to compare the effectiveness of the messages across various outcome measures including intentions to stay within the posted speed limit. A total of 219 speeding offenders completed the online survey. Overall, the results found some positive responses regarding Intervention condition participants' responses to the anti-speeding messaging featured within the warning notices. Among some of the key findings were that the Intervention condition participants reported relatively low levels of message rejection. Additionally, females responded more favourably to both messages than males. Collectively, the findings suggest that there is no harm in including such messages within warning notices providing such messages are concept-tested prior to use. Overall, the findings suggest this approach may represent a low-cost option for targeted message delivery.

Introduction

Considered as one of the 'fatal five', speeding accounts for an estimated 30 % of all road crashes on Australian roads (Budget Direct, 2020; Queensland Police Service, 2014)). Between 2016 and 2017, Australians reportedly paid $1.1B in speeding fines (Are Media, 2017), with speed-related fatalities and hospitalised casualties costing the Australian State of Queensland an estimated $3.2B annually (Queensland Government, 2021). Overall, such statistics highlight the pervasiveness of speeding on Australian roads and the need to identify effective anti-speeding interventions.

In addition to long-standing, traditional enforcement-based approaches (e.g., speed cameras) road safety advertising campaigns have been implemented to help combat speeding (see Tay, 2005). For many decades, road safety advertising campaigns in Australia have constituted a significant portion of the government's yearly expenditure on road safety initiatives (Donovan et al., 1999; Lewis et al., 2009). Typically, anti-speeding advertising has highlighted the consequences of speeding in efforts to raise public awareness of the risks and ultimately motivate changes in attitudes and behaviour. Common to all these approaches is

the focus on some type of threat as an aversive consequence whether that threat is physical (e.g., crash and harm to self/others), financial (e.g., demerit points and monetary fines) or social (e.g., threat of embarrassment or being disapproved of by others) (Lewis et al., 2017b).

Representing the first *meta*-analytical investigation of Australian road safety campaigns in 1992, Elliott provided support for road safety advertising as an intervention. Findings revealed an average 6 % improvement in outcomes (e.g., attitude change, knowledge, behaviour) as measured via pre- versus post-exposure measures. Elliott (1993) reported that greater change was achieved in awareness-raising and attitudinal type measures as opposed to actual behaviour change. Consistent with this conclusion, contention has long existed as to the extent to which road safety advertising campaigns may in and of themselves influence behaviour change and, ultimately, contribute to reductions in crashes (Donovan et al., 1999).

In 2004, Vaa et al. reported an 8.9 % reduction in the number of road crashes while a road safety campaign was in market, as well as a 14.8 % reduction in the after-exposure period of the campaign. However, Vaa et al. also reported that advertising campaigns alone (i.e., without an accompanying measure, such as police enforcement) did not have a

significant effect on road crashes. Similarly, Delhomme et al., (1999) found an 8.5 % reduction in crashes when a road safety advertising campaign was implemented in conjunction with traffic enforcement. In 2005, Tay evaluated the combined effectiveness of enforcement initiatives and anti-speeding as well as anti-drink driving advertising campaigns launched in the Australian State of Victoria. Regarding speeding, Tay found that the anti-speeding campaign significantly reduced young male drivers' involvement in serious crashes when combined with enforcement. In contrast, in relation to drink driving, Tay also found significant and independent effects of the anti-drink driving advertising campaign and enforcement initiatives on young male drivers' crash involvement. Tay's (2005) findings highlighted the complexities associated with understanding the effects of advertising and how it may differ depending on the risky behaviour being addressed. Overall, however, such findings support the role that advertising can play as a road safety intervention. Even over two decades ago, Donovan and colleagues (1999) advocated the need to move beyond the on-going debate of whether advertising was effective as a road safety intervention and to instead invest efforts into understanding the relative effectiveness of different message approaches. This seminal paper contributed to a large body of research that sought to understand more about the effects of different types of emotion-based messages as well as the effectiveness of messages delivered via different message media (Lewis et al., 2021).

Regarding message media, this aspect was explored in Elliott's (1993) *meta*-analysis. At that time, television was associated with the largest effect size and thus deemed the most effective message medium. However, since then, the communication landscape has changed substantially with the introduction of online communication platforms. Evidence attests to the fact that certain target demographics such as young adults are more likely to seek information and communicate via such online platforms than via more traditional mass media (Murray & Lewis, 2011). That is not to say that television or radio as more traditional broadcast media no longer have a role to play in delivering road safety messaging but just that there needs to be a preparedness to disseminate messages via different media in efforts to ensure reach of an intended target audience (Lewis et al., 2021; Wundersitz & Hutchinson, 2011). Indeed, when it comes to a medium such as radio, evidence has suggested that there may be situational-specific benefits of delivering road safety messages at the time that someone may in fact be engaging in risky behaviours such as when behind the wheel and speeding (Phillips et al., 2011). Extending upon this, Glendon and Lewis (2022) found that speeding messages delivered via portable trailers with variable message signs (VMSs) positioned roadside at locations where speeding occurred, could reduce objectively measured drivers' speeds (as measured by on-road pneumatic tubes). Collectively, such findings highlight that it is not just the message content approach that needs to be considered as determinants of message effectiveness but also, equally important, is type of message media.

The aim of the current study was to evaluate the effects of brief, hard-copy anti-speeding messaging included within warning notices issued by the Queensland State Government Transport Agency, the Department of Transport and Main Roads (TMR), to drivers who had committed a driving offence. Given that TMR use such warning notices as part of standard practice, to demonstrate that the addition of a brief anti-speeding message within such notices could offer positive benefits in terms of influencing intentions to not speed, would suggest that such an approach could offer a relatively easy-to-implement and potentially cost-effective strategy. This dissemination method represents a rather novel message media for road safety advertising messages, and for which limited evidence currently exists regarding its potential effectiveness in influencing positive change among recipients. Although they did not specifically examine anti-speeding messages within warning notices, a recent study by Bates et al. (2023) found positive effects were associated with the sending of a police-issued letter together with a speeding infringement notice to offending drivers. Specifically, Bates

et al. examined the effect of police-issued letters that were devised in accordance with the principles of procedural justice and which were sent to those drivers detected for speeding via a speed camera. Those in the intervention group received both the letter and the infringement notice while those in the control condition received only the infringement notice. In analysing the effect of this intervention on administrative data for the 12-month period following receipt of the intervention, those drivers in the intervention condition had significantly fewer speeding offences compared with drivers in the control condition.

The Bates et al. (2023) study and the current study draw upon a similar perspective in terms of considering ways of implementing additional strategies together with core or business-as-usual activities to achieve (or potentially enhance) positive behaviour change effects. With speeding infringements from police or warning notices from transport agencies already been sent to offending drivers, it is possible that such happenings represent opportune times where an individual may reconsider their actions and look at ways to improve their behaviour in the future – akin to a 'teachable moment'. Bates et al.'s study suggests that this is approach is possible. The current study explores whether a similar type of effect (in this instance, in terms of improvements in future self-reported driving intentions) may be achieved through the combination of anti-speeding messages within warning notices. The more evidence can establish the effects of such approaches, the more options that may emerge for police and transport agencies in identifying low-cost options for ultimately encouraging positive changes in driver behaviour.

The Step approach to message design and testing (SatMDT)

The Step approach to Message Design and Testing or SatMDT (see Fig. 1; Lewis et al., 2016) is a theoretical framework used to guide the design and evaluation of road safety messages. This framework comprises four steps, specifically (1) "Pre-existing individual characteristics", (2) "Message-related characteristics", (3) "Individual responses", and (4) "Message Outcomes". The framework is accompanied by measures and methods to facilitate implementation of the steps (Lewis et al., 2017a). A growing body of research attests to the value of applying the SatMDT to aid the development and/or evaluation of numerous road safety advertising campaigns (Lewis et al., 2021). This evidence is based upon studies featuring campaigns delivered via various message media and addressing an array of risky driving behaviours including speeding (for an example relating to anti-speeding messaging design and evaluation, see Lewis et al., 2017b). As Lewis et al. (2016) posit, the framework can be applied in its entirety from initial message content development and message media selection through to concept testing and final evaluation or it can aid particular tasks relevant to a specific project or context. This study evaluates messaging that was devised by the Queensland State Road transport agency, the Department of Transport and Main Roads (TMR). Consequently, pertinent in underpinning the current study's approach were considerations relating to the SatMDT's final step, Step 4, the evaluation step. Similar to the approach implemented by Elrose et al. (2022) the following four aspects informed by the SatMDT were especially pertinent to informing the current study's design to evaluate message effectiveness.

First, various outcome measures, both direct and indirect measures, were to be included as indicators of message effectiveness. It is important to include various outcome measures of effectiveness as it is through examining patterns of results across different measures, that increasing confidence may be given to the findings (for an example, see Lewis et al., 2017b). Direct measures assess effectiveness 'directly' through asking respondents about the perceived effectiveness of a message. Direct measures include how persuasive a message was, to what extent there may be third-person effects (TPEs) associated with the message, how likely it is that a message would be rejected, as well as the extent to which respondents believe a message featured useful and helpful strategies (Lewis et al., 2016).

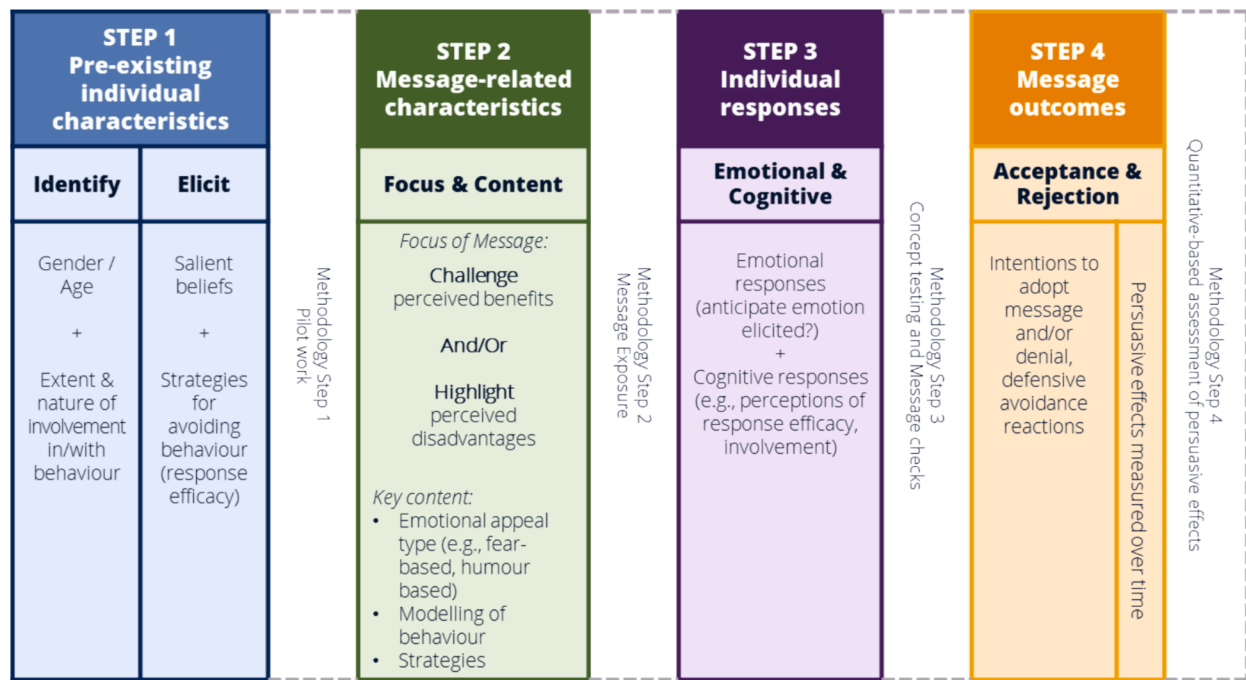The TPE is a long-standing perceptual phenomenon from the

Fig. 1. The Step approach to Message Design and Testing (SatMDT; Lewis, Watson, & White, 2016). Image reproduced from Lewis et al. (2016).

persuasion literature whereby individuals are known to make judgements as to the relative influence of a communication on themselves and others (Davison, 1983). The TPE has been shown to impact upon the perceived effectiveness of road safety messages including anti-speeding advertisements (Lewis et al., 2007; Lewis et al., 2008). Specifically, evidence has shown that males report classic TPEs (i.e., perceived more influence on others relative to self) in response to fear-based messaging and reverse TPEs (i.e., more influence on the self, relative to others) in response to humour-based messaging. Females, in contrast, report contrary perceptions in response to the same messaging (Lewis et al., 2008). Beyond just a perceptual disparity, the direction of these TPEs has also been shown to impact intentions to adopt the recommendations of messaging. For instance, males reported less intention to not speed in response to fear- relative to humour-based messages while females' intentions to not speed were stronger in response to fear- relative to humour-based messaging (Lewis et al., 2008). Such evidence highlights that the TPE may offer important insights into message effectiveness and it is crucial that gender effects in response to different types of messaging be considered.

Message rejection as another direct measure of effectiveness relates to the extent to which individuals may report avoidance or denial of a message (Witte, 1992). Evidence supports message rejection and the degree of accepting a message (or message acceptance) as not being mutually exclusive outcomes (Lewis et al., 2016; Witte, 1992). Despite such evidence, it remains relatively uncommon for studies to incorporate measures of message rejection and, consequently, such an omission may compromise a comprehensive understanding of a message's effectiveness (Lewis et al., 2016).

Finally, as another direct measure of effectiveness is the extent to which a message is perceived as containing useful strategies. This aspect is known in the literature from models such as the Extended Parallel Process Model (EPPM), as response efficacy and message self-efficacy, respectively (see Witte, 1992). The EPPM positions response efficacy and message self-efficacy as key components of the persuasive process (Witte, 1992). Evidence supports this with the provision of strategies shown to enhance the extent of message acceptance and minimise the extent of message rejection in road safety messaging (Lewis et al., 2010). However, arguably, such constructs can also be used in the capacity of

outcome measures of effectiveness to the extent that it has been long-established that increased perceptions of response efficacy and message self-efficacy are associated with enhanced persuasion (Floyd et al., 2000).

Relative to direct measures, indirect measures assess message effectiveness without making any reference to a message. Typically, such measures focus on the behaviour outlined in the message and thus individuals' attitudes and intentions regarding that behaviour. In relation to speeding, for example, indirect measures may assess individuals' reported intentions to speed as well as their actual speeding behaviour. These measures are consistent with key outcomes derived from the behaviour prediction model, the Theory of Planned Behaviour ([TPB]; Ajzen, 1991).

In the current study, given features of the study design (to be discussed further in the Method section), consistent with the TPB, the key outcome variable was future intentions to speed as opposed to actual speeding behaviour. Although evidence has shown that there is a gap between intentions and behaviour (Sniehotta et al., 2005), it has long been accepted that intentions are reliable and the most proximal predictors of behaviour (Ajzen, 1991; see also Armitage & Conner, 2001; Fishbein & Ajzen, 2010; Fishman et al., 2020; Sheeran, 2022).

As a second key consideration of the current study's design based on the SatMDT was the inclusion of a control group of participants who did not see any messaging. By including the control group and comparing their responses on applicable outcome measures with participants in the intervention group, who were shown messaging, enables insights into the effects of messaging relative to a baseline of there being no messaging (for examples of this, see Elrose et al., 2022; Gauld et al., 2017; Lewis, White, Ho, et al., 2017).

Third, was the need to understand not just overall outcome effects in terms of effectiveness but also to provide some insight into the way the messaging may be influencing intentions. Based on the standard constructs from the TPB, these constructs can be used as predictors of intentions. The TPB posits that its standard constructs of attitude, subjective norm, and perceived behavioural control (PBC) predict intentions. Attitude refers to how favourably an individual considers a behaviour, subjective norm refers to the extent to which an individual perceives important others would approve of their engagement in the

behaviour, while PBC refers to an individual's perception of how easy it would be to engage in and their control over engaging in the behaviour. The TPB suggests that an individual who has positive attitudes, a supportive subjective norm, and a high level of PBC will be more likely to intend to engage in a behaviour.

Extending upon this aspect of understanding mechanisms influencing intentions, beyond application of the TPB's standard constructs of attitudes, subjective norms, and PBC, it may also be worthwhile for additional predictors to be considered to explain further variance. Ajzen (1991) suggests that the addition of other constructs is feasible within the TPB providing such constructs make theoretical sense and that they add to the variance explained. For a behaviour such as speeding, a range of psychosocial factors may influence the behaviour with evidence attesting to a range of normative influences including group norm,

Fig. 2. Brief anti-speeding messaging featuring on the Transport and Main Roads' accumulation of demerit point warning notice (.
Source: Queensland Government)

descriptive norms, and moral norms.

Group norm relates to individuals seeking to be consistent with the way they believe specific groups of important others, such as friends and peers, think and behave. Regarding speeding, if an individual believes that their friends and peers would approve of, and engage in the behaviour themselves, it will increase individuals' intentions to also engage in speeding to be consistent with the perceived group norm (Allen & Brown, 2008).

Descriptive norm relates to the perception individuals have as to the extent others are engaging in a specific behaviour; so, in this instance, the extent to which other drivers in general are engaging in speeding (Forward, 2009). The inclusion of descriptive norm as an independent predictor within extended TPB frameworks has been supported, with meta-analytic evidence reporting the measure increasing the model's ability to explain variance in intention by five percent (Rivis & Sheeran, 2003). Descriptive norm has also been found to significantly predict
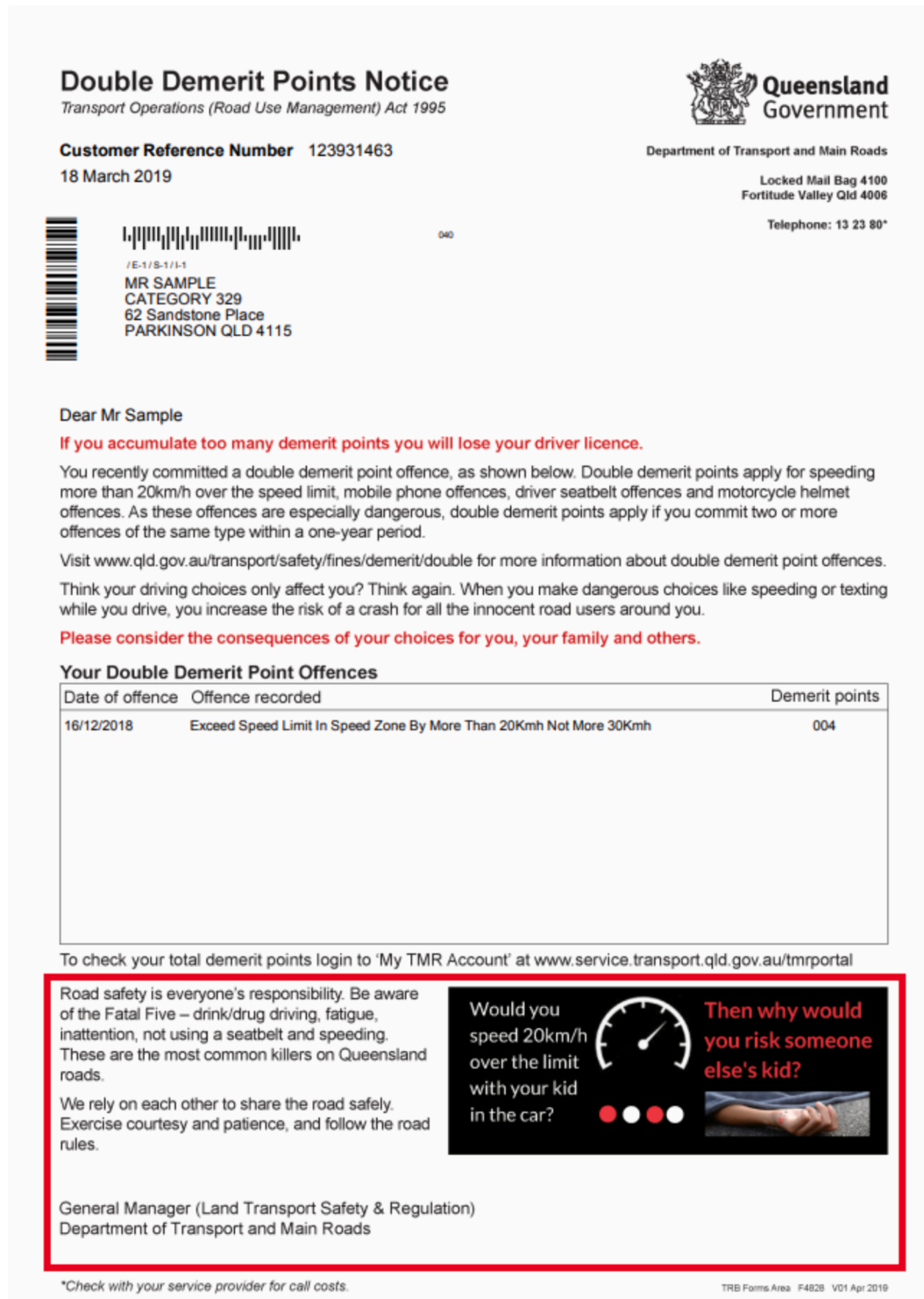
Fig. 3. Brief anti-speeding messaging appearing on TMR's double-demerit-point warning notice
(Source: Queensland Government)

intention to engage in speeding over and above the standard TPB constructs (Cestac et al., 2014).

Moral norm refers to individuals' perceptions as to whether one ought to engage in a behaviour; that is, whether an action is morally right or wrong and, ultimately, one's perception of moral norm may influence their decision to engage in a particular behaviour (Chorlton et al., 2012). In previous studies investigating speeding intentions, moral norms were found to be a significant predictor of intention over and above the standard TPB normative construct of subjective norm (Chorlton et al., 2012; Elliott & Thomson, 2010).

The fourth consideration of the current study's approach which was informed by the SatMDT was the need to consider the message medium (Lewis et al., 2016). The current study explored a unique and innovative message media strategy. Specifically, brief anti-speeding messaging was developed by TMR and incorporated within hard-copy warning notices that were mailed to drivers who had committed a driving offence/s in the designated trial period. The warning notices included text typical of what would be included in a warning notice regarding double demerit points or accumulation of demerit points and potential implications for licence loss. In addition, for the current study, intervention group participants also received a warning notice that featured one of two different anti-speeding messages (see Figs. 2 and 3 for the warning notices regarding the accumulation of demerit points and double demerit points, respectively as well as the brief anti-speeding messaging that featured on each of these notices). The control group, representing the non-message condition, received the standard warning notice only without either of the anti-speeding messages. The control condition's responses were compared to the intervention group participants who had received a warning notice with an anti-speeding message.

The current study

Consistent with other applications of the SatMDT framework (Lewis et al., 2016), this study sought to first understand the relative effectiveness of the messaging based on direct measures of effectiveness (i.e., self-reported effectiveness, TPE, and message rejection) as well as differences between the intervention and control conditions on indirect measures of effectiveness (i.e., intentions to comply with the posted speed limit). Second, to help understand the manner in which messaging may be influencing intentions, predictors of intentions in terms of extended TPB constructs were explored based on a series of regressions conducted with each study condition. This approach is consistent with other studies based on applications of the SatMDT framework (e.g., Elrose et al., 2022). Please note that the results of the overall study were outlined in a report prepared for TMR (Lewis et al., 2020).

Method

Participants

The study comprised 219 individuals (71.7 % male) aged between 18–87 years ($M_{age} = 51.70$ years, $SD = 15.18$ years). Although the study was conducted in Queensland, individuals from States and Territories outside of Queensland could potentially be participants if they had driven in Queensland and committed a traffic offence during that time. That said, the participant sample comprised mostly individuals who reported currently residing in Queensland ($n = 215$, 98.2 %) with $n = 1$ (0.5 %) from New South Wales, $n = 1$ (0.5 %) from Victoria, and $n = 2$ unspecified/missing. On average, the participants reported 12.81 h ($SD = 11.31$ h) of driving per week. Most licence holders reported holding an Open or full, unrestricted driver licence (98.2 %).

Sampling procedure

According to eligibility requirements, participants had to have received a TMR accumulation of demerit point warning notice or a

double demerit point warning notice during the trial period from 1 April 2019 to 30 September 2020. The participant recruitment procedure was carefully devised in close collaboration between TMR and the authors (i. e., the research team) to ensure the procedure adhered to legislative and ethical requirements. Briefly, the research team were not provided details beyond the first name and contact email address of those who had received a notice and who had consented to TMR to pass on their details to a third party (i.e., the research team) to be contacted for research purposes. In contrast, TMR was not to be aware of whom ultimately chose to participate in the study. TMR sent through monthly spreadsheets to the research team containing the first names and email addresses of those individuals who had committed an offence and received a warning notice and who had indicated willingness to be contacted. The research team would subsequently email study information and consent procedures as well as a link to the online survey to individuals who consented to be contacted. While it was possible that an individual could be detected for more than one offence and thus receive more than one warning notice in the study trial period, to prevent multiple responses from any individual, the very first question of the study survey enquired as to whether a participant had previously completed a survey in this study. If they responded "yes" they were automatically directed out of the survey and received the message, "Thank you very much for your interest in this survey. Unfortunately, we are looking for participants who have not already completed a survey in this study".

In accordance with logistical constraints associated with the time that TMR required to switch between the printing of warning notice types, TMR disseminated the warning notice types in 'batches' of 3-monthly intervals. Thus, the research team devised a survey administration approach that aligned with these 3-monthly intervals and based on the two levels (i.e., messages) within the Intervention conditions and a Control condition. The Intervention condition surveys were administered to participants who received a warning notice featuring one of the two anti-speeding messages. The accumulation of demerit points condition and the double demerit points condition each contained a particular anti-speeding message (see Figs. 2 and 3). For brevity, these two Intervention conditions are referred to herein as "Condition 1- A" and "Condition 2 – DD", respectively. The control group survey was administered to participants who received a warning notice which, similar to the Intervention conditions, was either the accumulation of demerit points or double demerit points notices. For brevity, these two Control conditions are referred to herein as "Control – A" and "Control – DD", respectively. The aspect that made these conditions the control conditions was that the notices were devoid of any anti-speeding message. Thus, all participants in this study whether in an Intervention or Control condition, received a warning notice and a notice that was either the accumulation of demerit points or double demerit points and what differed between the Intervention and Control conditions was that the Control conditions did not receive any anti-speeding messaging in their warning notice.

Based on these survey types, dissemination commenced first with the Condition 1-A survey, followed by the Control – A survey, then the survey applying to Condition 2 – DD, followed by the Control – DD survey. This process of warning notice and survey dissemination continued throughout the 18-month trial period. This approach also meant that a participant would be surveyed, at most, up to approximately three months after having received the notice (if they received their warning notice at the early stages of a new 'batch').

During the trial period of 18 months, TMR disseminated 233,060 warning notices. Accompanying these notices was the documentation inviting notice recipients to consent to participate in research. A total of 469 individuals consented to being contacted by the research team: representing <1.0 % of all recipients of warning notices in the 18-month trial period. However, of the N = 469 contacted, a total of 219 returned completed surveys representing a 46.7 % response rate. It was also determined that individuals who received an accumulation of demerit point warning notice had slightly higher response rates (with 46.7 %

completing the survey) than offenders who received a double demerit point warning notice (of whom 45.6 % completed the survey) and that, overall, those in the intervention conditions had higher response rates than either of the control groups. Overall response rates per condition are shown in Table 1.

Data collection procedure

This study consisted of three online surveys hosted on the survey platform, Qualtrics© (Qualtrics, Provo, UT). These conditions comprised two intervention surveys and one control group survey (i.e., the Control condition). As noted previously, participants were able to complete only one of the three surveys. All participants were eligible to enter a prize draw to win one of 10 $AUD 100 gift e-vouchers upon completion of the survey. As part of informed consent procedures, participants were advised of the prize draw prior to commencing the survey. Prior to data collection commencing, this study was approved by the authors' University Human Research Ethics Committee (Ref Number: 1800001148).

Materials and measures

Study stimulus materials: Warning notices featuring the anti-speeding messages. Figs. 2 and 3 provide the anti-speeding messages evaluated in this study in the intervention conditions of Condition 1 – A and Condition 2 – DD, respectively. As previously noted, the control conditions received the applicable warning notices (i.e., either accumulation of demerit points or double demerit points) but without an anti-speeding message included (i.e., Control – A or Control – DD conditions, respectively). As the Figures reveal, both Intervention group warning notices featured anti-speeding messaging which addressed the physical consequences of speeding. That is, both referred to the fact that speeding contributes to crashes and crashes cause injury and death and, as such, constituted physical threats (Lewis et al., 2016). The message content was developed by TMR and, thus, the focus of this study was on evaluating the effectiveness of the existing messaging as opposed to devising it.

Survey items. Irrespective of study condition (i.e., Condition 1 – A, Condition 2 – DD, Control – A, and Control –DD), all surveys first assessed demographics (e.g., age, gender, licence type and status). Next, participants in the Intervention conditions only, were asked if they recalled having seen a road safety message on the TMR warning notice they had received and, if so, could they briefly describe, within an open-response text box, what they believed the main message had been. Specific reference to an "anti-speeding message" was avoided in this question in place of a more generic reference to "road safety message" in the effort to assess via free recall what participants may have remembered about the message. If they responded "no" that they did not recall a road safety message, the survey progressed to the cued recall question. For this question, all intervention group participants were provided with

a copy of the anti-speeding message applicable to their warning notice type they had received. For participants who had previously indicated, in response to the free recall question, that they did not recall a "road safety message", they were asked to confirm if they now recalled the message provided. Intervention condition participants only then continued with a section of survey questions comprising the direct measures of effectiveness. The items assessing direct measures of effectiveness are shown in Table 2.

The Intervention condition participants next received the indirect measures of message effectiveness; namely, intentions to stay within the posted speed limit. Given that the measure of intentions did not refer to having seen a road safety message but, rather intention regarding complying with the speed limit (i.e., the behaviour of focus in the messaging), the Control condition participants also received these items. This enabled comparison between the responses provided to such items to be conducted between the intervention and control condition participants. Table 3 shows the items measuring intention.

Regarding the potential predictors of intentions and, thus, those constructs which may help to understand the manner in which the anti-speeding messages were influencing Intervention condition participants' intentions relative to those in the Control condition, items relating to an extended TPB framework were assessed comprising the standard TPB constructs of attitude, subjective norm, and PBC as well as

Table 1
Response rates by condition.

Condition	Consented	Completed	Response rate (%)
Condition 1 – A	150	79	52.67
Condition 2- DD	89	46	51.69
Control – A	151	64	42.38
Control – DD	79	30	37.97
Total	469	219	46.70

Note: Condition 1 – A = Intervention condition for accumulation of demerit points; Condition 2 – DD = Intervention condition for double demerit points; Control – A = Control condition for accumulation of demerit points and no message; Control – DD = Control condition for double demerits and no message. *All Control condition participants were similar in that they did not receive an anti-speeding message as part of their warning notice (their warning notices were either for accumulation of demerits or double demerits similar to the Intervention conditions).

Table 2
Direct measures of effectiveness assessed in the Intervention condition survey only.

Construct	Number of items	Items wording (*response options*)	Scale reliability in current study
Message effectiveness	2	"How persuasive[convincing] do you think the road safety message is?" ((1) *Not at all persuasive/ convincing* to (5) *Very persuasive/convincing*)	$r(1\,2\,3) = 0.88$, $p < 0.001$
Third-person effect (TPE)*	2	"How much do you think the following people [you/other drivers in general] would be influenced by the message?" ((1) *Not at all influenced* to (5) *Very influenced*)	Not applicable
Message rejection	2	"In response to the road safety message, how likely are you to do the following [think about the message**/simply ignore it]" ((1) *Very unlikely* to (5) *Very likely*)	$r(1\,2\,2) = 0.66$, $p < 0.001$
Response efficacy	1	"Does the road safety message include strategies that would help you stay within the posted speed limit when driving?" ("*Yes/No*" and, "*If yes, what was/were the strategy/strategies you took from the road safety message?*" [free response])	Not applicable
Self-efficacy***	2	"How likely are you to adopt these strategies when you next drive?" ((1) *Not at all likely* to (5) *Very likely*)	$r(50) = 0.94$, $p < 0.001$

*A third-person differential perception score was created from subtracting the "influence on self" score from the "influence on other drivers in general" score, with a negative score reflecting greater perceived influence on self than others (i.e., reversed TPE), and a positive score reflecting greater perceived influence on others than oneself (i.e., classic TPE). **Scores on this first item measuring message rejection were reversed so that higher scores were indicative of more message rejection. ***Responses to the self-efficacy items were contingent on how many participants indicated that they thought the messaging contained strategies (i.e., response efficacy).

Table 3

Indirect measure of effectiveness (i.e., Intention to stay within the posted speed limit) assessed in both the Intervention and Control condition surveys.

Construct	Number of items	Items wording/ (*Response options*)	Scale reliability in current study
Intention	2	"To what extent do you intend to stay within the posted speed limit when driving in the next week?" and "How likely are you to stay within the posted speed limit when driving in the next week?" ((1) *Definitely do not intend to* (5) *Definitely intend to*)	$r (2\,1\,1) = 0.89$, $p < 0.001$*

*Reliability computed based on overall sample as assumed measuring same construct in all conditions.

the extended constructs of descriptive norm, group norm, and moral norm. These items are shown in Table 4.

Results

Descriptive statistics regarding sample allocation across the study's three conditions

Regarding the number and proportion of the total sample of participants in each of the study's three conditions; namely, Condition 1 – A, Condition 2 – DD, Control – A, and Control – DD conditions as a function of gender, Table 5 shows that most cells of the study design comprised sufficient participant numbers (for statistical power) with the only exception being the relatively small number of female participants in Condition 2 – DD of $n = 7$. Acknowledging this aspect upfront as a potential limitation of the study's sample, although the intent was to devise demographic subgroups based on both age and gender to comprehensively understand the effects of the messaging, the decision was made to only include gender and not age as an independent variable in the study's analyses. This decision was based on a number of previous studies over time which have indicated that gender is a factor that impacts the likely effectiveness of road safety messaging (e.g., see Lewis et al., 2008).

Of note, to control for family-wise error rate, a Bonferroni adjustment of alpha was applied based on $\alpha = 0.01$.

Free and cued recall of the anti-speeding messaging (Intervention conditions only)

As shown in Table 6, based on the free recall measure, more than half of the participants in both Condition 1 – A (51.3 %) and Condition 2 – DD (67.4 %) did not recall seeing the message on the warning notice posted to them within the last 3 months. After being presented the message in the survey as part of the cued recall measure, reported recall of the message in Condition 1 – A did increase with 62.8 % indicating that, "yes", they did now recall the message; in contrast, the majority of participants in Condition 2 – DD (52.2 %) responded with, "no" they still did not recall seeing the message. Chi-squared results revealed non-significant differences in "yes" or "no" responses between the two intervention groups conditions in the free call measure ($\chi^2 (1, 124) = 3.07, p = 0.080$) and cued recall measure ($\chi^2 (1, 124) = 2.66, p = 0.103$). Of those participants in both conditions who responded "yes" to seeing the message, their free responses indicated that they were able to correctly identify the main points being made by the message, specifically, "*speeding kills*" regarding Condition 1 – A's anti-speeding message, and *"be a responsible driver to ensure the safety of other road users"* regarding Condition 2 – DD anti-speeding message.

Table 4

Predictors of message outcome (i.e., intentions) assessed in both the Intervention and Control condition surveys as per the extended TPB framework.

Construct	Number of items	Items wording/ (*Response options*)	Scale reliability in current study
Attitude*	3	"Thinking about the next week, if you were to stay within the speed limit in any given speed zone, to what extent would that be…"	Cronbach's α = 0.94**
		((1) *Bad* to (7) *Good*, (1) *Unsafe* to (7) *Safe*, and (1) *Unfavourable* to (7) *Favourable*)	
Subjective norm	2	"Most people who are important to me would approve of me staying within the speed limit when driving in the next week" and "Most people whose opinions I value would approve of me staying within the speed limit when driving in the next week"	$r (2\,1\,2) = 0.57$, $p < 0.001$**
		((1) *Definitely does not apply* to (5) *Definitely applies*)	
Perceived behavioural control	4	"I have complete control over whether or not I stay within the speed limit when driving in the next week", "Staying within the speed limit when driving in the next week would be easy for me", "I am confident that I could stay within the speed limit when driving in the next week', and "Staying within the speed limit when driving in the next week would be mostly up to me"	Cronbach's α = 0.66**
		((1) *Definitely does not apply* to (5) *Definitely applies*)	
Group norm	1	"Most of my friends and peers would think it is good for me to stay within the speed limit when driving in the next week"	Not applicable
		((1) *Definitely does not apply* to (5) *Definitely applies*)	
Descriptive norm	1	"I think most drivers often stay within the speed limit when driving in the next week"	Not applicable
		((1) *Definitely does not apply* to (5) *Definitely applies*)	
Moral norm	2	"It would be morally wrong if I didn't stay within the speed limit when driving in the next week" and "I feel I ought to stay within the speed limit when driving in the next week"	$r (2\,1\,2) = 0.59$, $p < 0.001$**
		((1) *Definitely does not apply* to (5) *Definitely applies*)	

*Attitude was measured by a semantic differential scale while all other constructs measured via Likert-scale items. **Reliability computed based on overall sample as assumed measuring same construct in all conditions.

Table 5

Numbers and percentages of participants in Condition 1 − A, Condition 2 − DD, Control − A and the Control − DD conditions as a function of gender and within the overall sample.

	Males		Females		Total	
	n	%	n	%	n	%
Condition 1 − A	55	35.0	24	38.7	79	36.1
Condition 2 − DD	39	24.8	7	11.3	46	21.0
Control − A	39	60.9	25	39.1	64	29.2
Control − DD	24	80.0	6	20.0	30	13.7
Total	157	100	62	100	219	100

Note: Condition 1 − A = Intervention condition for accumulation of demerit points; Condition 2 − DD = Intervention condition for double demerit points; Control − A = Control condition for accumulation of demerit points and no message; Control − DD = Control condition for double demerits and no message.

Table 6

Number and proportion of participants in Condition 1 − A and Condition 2 −DD who recalled (free and cued) the messaging in the warning notice.

Free Recall		N*	%
Condition 1- A	Yes	38	48.7 %
	No	40	51.3 %
Condition 2- DD	Yes	15	32.6 %
	No	31	67.4 %
Cued Recall		n	%
Condition 1- A	Yes	49	62.8 %
	No	29	37.2 %
Condition 2- DD	Yes	22	47.8 %
	No	24	52.2 %

Note: Condition 1 − A = Intervention condition for accumulation of demerit points; Condition 2 − DD = Intervention condition for double demerit points. *One participant did not respond resulting in n = 78.

Direct measures of message effectiveness (Intervention conditions only)

Based on Intervention condition (Condition 1 − A versus Condition 2 − DD) and gender (females versus males), three 2 x 2 ANOVAs were conducted on the three outcome variables of (i) message effectiveness, (ii) TPE, and (iii) message rejection. Statistical assumptions were met with acknowledgement that ANOVA is considered reasonably robust to violations of assumptions with Levene's test of homogeneity of variance considered at $p < 0.01$ given recognised sensitivity of this test.

Message effectiveness. The results revealed a significant main effect of gender, $F(1, 119) = 7.54$, $p = 0.007$, $\eta^2 = 0.06$, no significant main effect of condition type, ($F(1, 119) = 2.34$, $p = 0.130$, $\eta^2 = 0.02$), as well as no interaction between condition type and gender, ($F(2, 119) = 0.68$, $p = 0.413$, $\eta^2 < 0.01$). Regarding the significant main effect, follow-up pairwise comparisons revealed that females ($M = 3.48$; $SD = 1.14$) reported significantly higher ratings of message effectiveness than males ($M = 2.87$; $SD = 1.20$). Although not significant, inspection of the mean message effectiveness scores revealed higher (albeit not significantly) ratings for the anti-speeding message displayed within the double demerit points warning notice ($M = 3.14$; $SD = 1.22$) than that shown in the accumulation of demerit points warning notice ($M = 2.96$; $SD = 1.21$). Given the 5-point scale, these mean scores corresponded to participant ratings of "*somewhat persuasive/convincing*" to "*quite persuasive/convincing*" for both messages.

TPE. The results revealed no significant main effects of gender, $F(1, 119) = 4.88$, $p = 0.029$, $\eta^2 = 0.04$ or condition type ($F(1, 119) = 0.06$, $p = 0.806$, $\eta^2 < 0.01$), nor a significant interaction between demographic gender and condition type ($F(2, 119) = 0.002$, $p = 0.965$, $\eta^2 < 0.01$). While not statistically significant, visual inspection of the mean scores as shown in Table 7 revealed that, based on the direction of the mean scores, females' scores, across both conditions, were negative indicating reversed TPEs while the scores for males were positive and indicative of classic TPEs. In addition, while also not significantly different between

Table 7

Descriptive statistics (M, SD) for TPE scores for Condition 1 – A and Condition 2 – DD based on the overall study sample and by gender.

Condition	Overall sample	Females	Males
	M SD	M SD	M SD
Condition 1 − A	−0.12 1.10	−0.50 0.66	0.06 1.22
Condition 2 − DD	0.02 0.94	−0.43 0.53	0.11 0.98

Notes: TPE = third-person effect. Participants rated the message from *Not at all influenced* [1] to *Very influenced* [5] for self and others. Negative scores reflect TPE reversals (i.e., more influence on self relative to others) while positive mean scores reflect classic TPEs (i.e., more influence on others relative to self). Condition 1 – A = Intervention condition for accumulation of demerit points; Condition 2 – DD = Intervention condition for double demerit points.

conditions, the overall sample in Condition 1 – A reported negative TPE scores indicating reversed TPEs (i.e., perceived greater influence on oneself than others), while the overall sample in Condition 2 – DD reported positive scores yielding classic TPEs (i.e., perceived greater influence on others than oneself).

Message rejection. The results revealed no significant main effects of gender, $F(1, 119) = 0.60$, $p = 0.441$, $\eta^2 < 0.01$, or condition type, $F(1, 119) = 0.70$, $p = 0.404$, $\eta^2 < 0.01$, nor a significant interaction between gender and condition type, $F(2, 119) = 0.01$, $p = 0.945$, $\eta^2 < 0.01$. Inspection of the mean scores as shown in Table 8 revealed that the overall sample was quite unlikely to reject the anti-speeding message included with both the accumulation of demerit points warning notice ($M = 2.62$; $SD = 1.28$) and the double demerit points warning notices ($M = 2.42$; $SD = 1.10$). Given the 5-point scale, these mean scores of around 2 corresponded to a rating of "*quite unlikely*".

Response efficacy and message self-efficacy. As noted in Table 1 of the Method section, participants first responded to the response efficacy items as to whether (yes/no) they considered the messaging to incorporate strategies (and if they responded "yes", they could offer a brief description via a free-response option). Following these items, message self-efficacy then enquired as to whether participants could themselves use the strategies. Thus, responses to the latter measure were contingent on how many participants had indicated that they agreed that the messaging incorporated any strategies (i.e., "yes" in response to the response efficacy measure).

For response efficacy, the greatest proportion of respondents in Condition 1 – A (i.e., $n = 44$, 55.7 %) and Condition 2 – DD ($n = 29$, 63.0 %) reported that the messages did not include strategies that would help them stay within the posted speed limit when driving. Of the participants who reported "yes" that they identified strategies in the messaging, a few examples of the sorts of strategies noted in relation to Condition 1 – A included, "*watch my speed, use cruise control to help me, leave earlier to reduce need for rushing*" and "*to ignore aggressive behaviours from other drivers and be mindful of keeping my eye on the speedometer*". While, in Condition 2 – DD, of those who indicated they had identified some strategies, the sorts of strategies noted in the free-response box included "*drive to conditions*" and "*more observation to the signs*".

Regarding message self-efficacy, as mentioned, the sample of participants responding to this item was contingent on responses to the

Table 8

Descriptive statistics (M, SD) for message rejection scores for Condition 1 – A and Condition 2 – DD based on the overall study sample and by gender.

Condition	Overall sample	Females	Males
	M SD	M SD	M SD
Condition 1 − A	2.62 1.23	2.48 1.40	2.69 1.23
Condition 2 − DD	2.42 1.10	2.21 1.04	2.46 1.12

Notes: Condition 1 – A = Intervention condition for accumulation of demerit points; Condition 2 – DD = Intervention condition for double demerit points. Scored on a 5-point scale with higher scores indicating more message rejection.

prior response efficacy item about whether strategies had been identified in the messaging. A total of $n = 50$ participants (22.8 %) identified strategies and, it follows, these participants then provided responses to the message self-efficacy items as to their intended use of the strategies. Based on Condition type (Condition 1 – A versus Condition 2 – DD) and gender (female versus male), a 2 x 2 ANOVA was conducted with message self-efficacy scores as the dependent variable. The results revealed no significant main effects of Condition type, $F(1, 46) = 0.01$, $p = 0.976$, $\eta^2 < 0.01$, or gender, $F(1, 46) = 0.19$, $p = 0.662$, $\eta^2 < 0.01$, nor a significant interaction between condition type and gender, $F(1,46) = 0.06$, $p = 0.815$, $\eta^2 < 0.01$. As Table 9 shows, mean message self-efficacy scores revealed participants in both Condition 1 – A ($M = 4.28$; $SD = 0.93$) and Condition 2 – DD ($M = 4.28$; $SD = 0.63$) reported that they were "*quite likely*" to adopt and incorporate strategies into their driving.

Indirect measure of message effectiveness based on intentions to stay within the speed limit (Intervention and Control conditions)

For the indirect measure of message effectiveness, there were four groups given that participants from the Control conditions were able to respond to this measure. Based on Condition (Condition 1 – A, Condition 2 – DD, Control – A, and Control – DD) and gender (females versus males), it was originally planned to conduct a 2-way ANOVA with intentions to stay within the speed limit as the outcome variable. However, a significant Levene's test indicated a violation of the homogeneity assumption, $F(7, 202) = 3.57$, $p = 0.001$ (and acknowledging the unequal sample sizes between conditions which was further emphasised with the addition of gender as an independent variable – which meant that the Condition – DD and the Control – DD comprised only 7 and 6 females, respectively), the decision was made to instead conduct a 1-way ANOVA to assess differences in mean intention scores between the conditions. Levene's test was no longer significant in this 1-way ANOVA ($F(3, 206) = 1.78$, $p = 0.152$) and the ANOVA results revealed no significant difference between the conditions on mean intention scores, $F(3, 206) = 1.60$, $p = 0.170$, $\eta^2 = 0.02$ Table 10 outlines the descriptive statistics for mean intention scores for each condition for the overall sample.

In addition to the 1-way ANOVA, an independent-samples *t* test was conducted to assess the mean intention scores between males and females (which remained consistent with our a priori intentions; albeit not enabling the assessment of the gender x condition interaction). The results indicated a significant difference between male ($M = 4.08$, $SD = 1.09$) and females' ($M = 4.53$, $SD = 0.65$) mean intention scores, $t(209) = -2.95$, $p = 0.004$, such that females reported significantly higher intentions to stay within the speed limit than males.

Factors influencing intentions to stay within the posted speed limit (Intervention conditions and Control condition)

Consistent with previous applications of the SatMDT (Lewis et al., 2017a; for example, see Elrose et al., 2022), separate hierarchical regressions were conducted to identify the factors influencing the key outcome measure of message effectiveness, message acceptance as

Table 9
Descriptive statistics (M, SD) for message self-efficacy scores for Condition 1 – A and Condition 2 – DD based on the overall study sample and by gender.

Condition	Overall sample		Females		Males	
	M SD		*M SD*		*M SD*	
Condition 1 – A	4.28 0.93		4.42 0.67		4.20 1.05	
Condition 2 – DD	4.28 0.63		4.33 0.58		4.28 0.60	

Notes: Condition 1 – A = Intervention condition for accumulation of demerit points; Condition 2 – DD = Intervention condition for double demerit points. Scored on a 5-point scale with higher scores indicating more message self-efficacy.

Table 10
Descriptive statistics (*M, SD*) for intention to stay within the posted limit scores for Condition 1 – A, Condition 2 – DD, Control – A, and Control – DD based on the overall study sample.

Condition	Overall Sample
	M SD
Condition 1 – A	4.13 1.11
Condition 2 – DD	4.13 0.99
Control – A	4.16 0.92
Control – DD	4.59 0.87

Notes: Condition 1 – A = Intervention condition for accumulation of demerit points; Condition 2 – DD = Intervention condition for double demerit points; Control – A = Control condition for accumulation of demerit points; Control – DD = Control condition for double demerit points. Scored on a 5-point scale with higher scores indicating more intention to stay in the posted speed limit.

measured by participants' intentions (in this study, intentions to stay within the posted speed limit) in each of the study's conditions. From the outset it is acknowledged that the SatMDT statistical approach to understanding the mechanisms at play in each of the messages in terms of what factors are influencing intentions necessitate a regression to be conducted on each of a study's relevant conditions including both Intervention and Control conditions. Unfortunately, however, this was not possible in the current study given the relatively small sample size of $N = 30$ in the Control – DD condition and, thus, the insufficient statistical power for the planned regression analysis. Consideration was given to collapsing the two Control conditions into one overall Control condition (given that all participants in the Control conditions did not receive an anti-speeding message even though they all received one of two types of warning notices). Initial statistical checks confirmed that the gender composition of the two Control conditions was similar (i.e., not statistically different; $\chi^2(1, 93) = 3.54$, $p = 0.060$); however, the two conditions were found to significantly differ on their mean intention scores (Control – A condition $M = 4.16$ ($SD = 0.92$) versus Control DD condition $M = 4.59$ ($SD = 0.87$); $t(89) = -2.09$, $p = 0.040$). With intentions representing a key outcome measure of focus, it was thus determined that only one regression would be run based on Control condition data and that would be in relation to the Control – A condition.

In terms of order of entry into each of the three regression models that were run, these were in accordance with the tenets of the TPB whereby the standard TPB variables of attitude, subjective norm, and PBC were entered into the first step of the model, and the extended TPB variables of group norm, descriptive norm, and moral norm were entered into the second step.

Descriptive statistics of the predictors and outcome measure of intentions in each of the regression models are shown in Table 11 while the bivariate correlations between these constructs are shown in Tables 12, 13, and 14 for Condition 1-A, Condition 2 – DD, Control A condition, respectively.

Table 11 shows that most responses across all three conditions were based on mean responses falling on approximately 3 to 4 of the given 5-point Likert-scale responses (or 7-point semantic differential scales in the case of the attitude measure). Such scores suggest that participants were, on average, indicating that they tended to consider that they were uncertain if it applied to them (3) or that it probably applied to them (4) with higher scores representing more desirable responses in terms of views about staying within the posted speed limit. The only exception to such scores was the attitude mean scores for the Control- A condition which was above 6 and indicating strong positive views towards staying within the speed limit.

Tables 12 to 14 inclusive show the bivariate correlations between the extended TPB constructs as predictors of the outcome measure of intentions to stay within the posted speed limit in the next week for

Table 11

Descriptive statistics from regressions models with TPB predictors of intentions to stay within the speed limit, by condition.

Constructs	Condition 1- A			Condition 2- DD			Control − A		
	M	SD	n	M	SD	n	M	SD	n
Intention	4.13	1.11	75	4.17	0.99	42	4.15	0.93	60
Attitude	4.46	0.83	75	4.46	0.80	42	6.12	1.21	60
Subjective norm	4.33	0.91	75	4.21	0.98	42	4.33	0.73	60
PBC	4.33	0.66	75	4.53	0.53	42	4.29	0.60	60
Group norm	4.43	0.90	75	4.07	1.16	42	4.32	0.81	60
Descriptive norm	3.27	1.18	75	3.40	1.21	42	3.35	1.15	90
Moral norm	3.79	1.26	75	3.57	1.31	42	3.83	1.07	90

Notes. TPB = Theory of Planned Behaviour. PBC = perceived behavioural control. Condition 1 – A = Intervention condition for accumulation of demerit points; Condition 2 – DD = Intervention condition for double demerit points; and Control – A = Control condition for accumulation of demerit points and no message. No information is provided for Control −DD = Control condition for double demerit points and no message given that the condition sample size (N = 30) was insufficient to conduct the regression analysis.

Table 12

Bivariate correlations for hierarchical regression model (Condition 1 – A).

	Intention	Attitude	Subjective norm	PBC	Group norm	Descriptive norm
Intention						
Attitude	0.76***					
Subjective norm	0.63***	0.69***				
PBC	0.68***	0.56***	0.61***			
Group norm	0.63***	0.75***	0.79***	0.51***		
Descriptive norm	0.36**	0.39***	0.45***	0.25*	0.34**	
Moral norm	0.63***	0.67***	0.76***	0.65***	0.62***	0.38***

***$p < 0.001$, **$p < 0.01$, *$p < 0.05$.

Table 13

Bivariate correlations for hierarchical regression model (Condition 2 – DD).

	Intention	Attitude	Subjective norm	PBC	Group norm	Descriptive norm
Intention						
Attitude	0.61***					
Subjective norm	0.77***	0.69***				
PBC	0.22	0.14	0.25			
Group norm	0.69***	0.71***	0.78***	0.20		
Descriptive norm	0.49***	0.36*	0.53***	0.09	0.59***	
Moral norm	0.87***	0.64***	0.66***	0.23	0.66***	0.49**

***$p < 0.001$, **$p < 0.01$, *$p < 0.05$.

Table 14

Bivariate correlations for hierarchical regression model (Control − A).

	Intention	Attitude	Subjective norm	PBC	Group norm	Descriptive norm
Intention						
Attitude	0.90***					
Subjective norm	0.46***	0.48***				
PBC	0.33***	0.40**	0.31**			
Group norm	0.49***	0.55***	0.76***	0.34**		
Descriptive norm	0.25**	0.35**	0.28*	0.27*	0.19	
Moral norm	0.71***	0.66***	0.58***	0.36**	0.60***	0.29*

$p < 0.001$, **$p < 0.01$, *$p < 0.05$.

Condition 1-A, Condition 2 – DD, and Control – A conditions, respectively. Overall, in all three conditions, most predictors are significantly positively correlated with intentions, as expected. The only exception to this result was in relation to the correlation between PBC and intention in Condition 2 −DD. Although not expected, the decision was made to retain PBC in this regression model given it is consistent with theory (Ajzen, 1991) and across the other regression models. Also in Condition 2 – DD, the correlation between moral norm and intention, while in the Control – A condition, the correlation between attitude and intention were both significant strong positive correlations of >0.80 and thus was potentially indicative of multicollinearity issues. Despite the strong positive correlations in Condition 2 – DD and Control – A involving

intention, the decision was made to retain both moral norm and attitude in each of the aforementioned regression models, respectively, to be consistent with the extended TPB framework applied across all the three conditions.

Condition 1 – A. As can be seen in Table 15, the overall model explained 65 % of the variance in intentions to stay within the posted speed limit among those participants who were exposed to the message in Condition 1 – A. At the final step of the model, attitude and PBC emerged as the significant predictors of intentions.

Condition 2 – DD. As can be seen in Table 16, the overall model explained 80 % of the variance in intentions to stay within the posted speed limit among those participants who were exposed to the message

Table 15

Hierarchical multiple regression analysis predicting intentions to stay within the posted speed limit- Condition 1 – A from the extended TPB predictors.

	Variable	β	R^2	sr^2	B [95 % CI]
Step 1	Attitude	0.53***	0.66***	0.75	0.71 [0.46, 0.97]
	Subjective norm	0.05		0.06	0.06 [−0.18, 0.30]
	PBC	0.36***		0.55	0.60 [0.31, 0.89]
Step 2	Attitude	0.50***	0.65***	0.59	0.67 [0.36, 0.98]
	Subjective norm	0.00		0.00	0.00 [−0.35, 0.34]
	PBC	0.36***		0.53	0.60 [0.29, 0.91]
	Group norm	0.04		0.05	0.05 [−0.26, 0.37]
	Descriptive norm	0.06		0.10	0.05 [−0.09, 0.20]
	Moral norm	0.01		0.01	0.01 [−0.20, 0.22]

Notes. TPB = Theory of Planned Behaviour. PBC = perceived behavioural control. β = standardised regression coefficient; R^2 = coefficient of determination; sr^2 = squared semi-partial correlations; B = unstandardized regression coefficient. ***$p < 0.001$, ** $p < 0.01$.

Table 16

Hierarchical multiple regression analysis predicting intentions to stay within the posted speed limit- Condition 2 – DD from the extended TPB predictors.

	Variable	β	R^2	sr^2	B [95 % CI]
Step 1	Attitude	0.15	0.57***	0.22	0.19 [−0.17, 0.54]
	Subjective norm	0.65***		0.92	0.66 [0.36, 0.95]
	PBC	0.04		0.07	0.07 [−0.33, 0.47]
Step 2	Attitude	−0.10	0.80***	−0.13	−0.13 [−0.41, 0.15]
	Subjective norm	0.39**		0.45	0.40 [0.14, 0.65]
	PBC	−0.02		−0.04	−0.03 [−0.31, 0.24]
	Group norm	0.02		0.02	0.02 [−0.21, 0.25]
	Descriptive norm	−0.02		−0.03	−0.02 [−0.17, 0.13]
	Moral norm	0.68***		0.92	0.51 [0.35, 0.67]

Notes. TPB = Theory of Planned Behaviour. PBC = perceived behavioural control. β = standardised regression coefficient; R^2 = coefficient of determination; sr^2 = squared semi-partial correlations; B = unstandardized regression coefficient. **$p < 0.01$, ***$p < 0.001$.

Table 17

Hierarchical multiple regression analysis predicting intentions to stay within the posted speed limit- Control – A from the extended TPB predictors.

	Variable	β	R^2	sr^2	B [95 % CI]
Step 1	Attitude	0.76***	0.65***	0.40	0.58 [0.44, 0.73]
	Subjective norm	0.10		0 < 0.01	0.12 [−0.11, 0.35]
	PBC	−0.01		0 < 0.01	−0.01 [−0.28, 0.27]
Step 2	Attitude	0.62***	0.71***	0.19	0.48 [0.31, 0.64]
	Subjective norm	0.03		0 < 0.01	0.04 [−0.27, 0.34]
	PBC	−0.02		0 < 0.01	−0.03 [−0.29, 0.23]
	Group norm	−0.07		0 < 0.01	−0.08 [−0.36, 0.20]
	Descriptive norm	0.06		0 < 0.01	−0.05 [−0.18, 0.09]
	Moral norm	0.35**		0.05	0.30 [0.11, 0.50]

Notes. TPB = Theory of Planned Behaviour. PBC = perceived behavioural control. β = standardised regression coefficient; R^2 = coefficient of determination; sr^2 = squared semi-partial correlations; B = unstandardized regression coefficient. ***$p < 0.001$.

in Condition 2 – DD. Subjective norm and moral norm emerged as the significant predictors of intentions in the final step of the analysis.

Control – A. As can be seen in Table 17, the overall model explained 71 % of the variance in intentions to stay within the posted speed limit among those participants who were not exposed to any road safety message but who had received the accumulation of demerit points warning notice. Attitude and moral norm emerged as the significant predictors of intentions in the final step of the analysis.

Discussion

The main aim of this study was to evaluate the effectiveness of brief, anti-speeding messaging included within warning notices issued by the Queensland State Government Transport agency, TMR, and mailed to drivers who had committed a driving-related offence/s during the study period. Overall, the findings suggest that the effects of the messaging were not overly strong. However, when examining the Intervention condition participants' responses to the messaging (i.e., based on the direct measures of effectiveness), there was evidence of some beneficial outcomes, which one would seek when evaluating message effectiveness. For instance, the overall sample reported relatively low levels of message rejection. Additionally, females responded more favourably to both anti-speeding messages than males, with females reporting higher message effectiveness scores than males for both messages. When comparing Intervention and Control condition participants' responses in terms of the indirect measure of effectiveness, intentions to stay within the posted speed limit, no significant differences in mean scores were found, indicating no difference in scores irrespective of whether a participant received a warning notice with messaging (Intervention condition) or not (Control condition). Mean scores revealed that all participants, irrespective of condition, were reporting generally high intentions to stay within the posted speed limit. In that regard, arguably, the messaging had an especially challenging context in its efforts to shift intentions when reported intentions were already relatively high (as supported by the Control conditions being not significantly different).

Collectively, these findings regarding the direct and indirect measures of effectiveness suggest that there while future intentions did not significantly differ across the study conditions, the findings based on other measures suggest that there is no harm in including such messages within warning notices. To illustrate this latter point, mean message rejection scores were relatively low and when considered in contrast to the relatively high(er) intentional scores and other effectiveness scores, indicates that the positive and beneficial effects seem to be outweighing potentially negative or unwanted rejection or denial of the messaging (as assessed by message rejection). Similarly, mean self-efficacy scores were relatively high and, thus, indicative of participants being '*quite likely*' to adopt and incorporate strategies into their driving in response to seeing the messages. Consistent with the SatMDT framework underpinning this study, this approach advocates the need for an array of outcome measures to help understand messaging effects. As such, it is the pattern of results and the apparent consistency across those different measures which provides a degree of confidence that the effects are true or accurate (see Lewis et al., 2016). The results are discussed in more detail in the subsequent sections as well as considerations for future research and practice in the context of this novel message medium for road safety messaging.

Recall of the messaging (Intervention conditions only)

Participants' recall of the message in the accumulation of demerit points warning notice condition (i.e., Condition 1 – A) appeared proportionally higher than that of participants in the double demerit points warning notice condition (i.e., Condition 2 – DD) based on both the free and cued recall measures, but especially so for the cued recall measure. Although this study did not have capacity to explore the reasons behind why this might have been the case, possible reasons could include the

messaging, the warning notice type, or aspects relating to both the messaging and warning notice type. It is evident that the intervention comprised both the warning notice and the presence or absence of an anti-speeding message.

It is possible that individuals may be more likely to recall warning notices and/or messaging in such notices that relate to fatality-related statistics (i.e., "Speeding killed 50 people in 2017", see Fig. 2) such as that in the accumulation of demerit points warning notice. In addition, the reference to 50 people being killed in 2017 was displayed prominently via a font of distinctively different colour and size compared with the standard text within the warning notice. In comparison, in the double demerit warning notice, while the messaging still comprised a physical threat of potential injury or death from speeding, it instead posed, "Why would you risk someone else's kid [in relation to risking their wellbeing by driving 10 km/hr over the speed limit]?" (see Fig. 3). Although this message featured an image, it was relatively small. As such, this message may not have been as prominent because it did not include crash statistics or was not as visually noticeable as the one included on the accumulation of demerit points notice.

Alternatively, it could be that participants who received the accumulation of demerit points notice were more cognisant of the warning notice overall and thus more diligently read all its content relative to those who received a notice about double demerit points. These suggestions are speculative only as they were not able to be assessed in the current study. Consequently, it would be beneficial for future research to apply in-depth qualitative methods to concept-test the messages (and any future messages to be included in warning notices). In doing so, participants' thoughts about the warning notices and the messages within them could be explored to better understand the independent and combined effects of each of these components of this intervention. Potentially, there may be instances where a specific message is more effective within certain warning notices. Thus, to optimise the potential persuasive effects of road safety messaging delivered via this medium, this would be an important research question to explore in future studies. In addition, concept testing would be consistent with the SatMDT framework and, in particular, Step 3 which highlights the importance of concept testing with members of the intended target audience to ensure that a message is functioning as intended (Lewis et al., 2016). This message media type needs to be understood not just because it represents a novel message medium but the extent to which this medium functions more (or less) effectively with particular message content (e.g., fear- versus humour-based messaging). Evidence has shown that factors including the message medium and a message's emotional appeal type as well as the demographics of the intended target audience can interplay and influence effectiveness (e.g., Eckler & Bolls, 2011; Lewis et al., 2008). Arguably, there is more yet to understand with the role and effectiveness of different types of messaging within warning notices.

From a future research design perspective, should similar methodology be implemented as the current study, the findings also highlight the importance of including measures of both free and cued recall in the survey tool to ascertain the extent to which participants recall a particular message. In this study, it was possible that for some participants, it may have been almost three months since they received their warning notice and when the research team contacted them to invite them to participate in the survey (based on the 'batches' of warning notice and survey type dissemination).

Direct measures of effectiveness (Intervention conditions only)

Regarding the direct measures of effectiveness including message effectiveness, TPE, and message rejection, results indicated that females reported significantly higher message effectiveness scores overall than males, irrespective of the warning notice and its associated message. Although not significant and based on a visual inspection of the direction of the TPE mean scores (which is important to consider when

interpreting results pertaining to the TPE), revealed that females' scores were negative and thus indicative of TPE reversals across both warning notices and messages, whereas males' mean scores were positive indicative of classic TPEs (i.e., more influence on other drivers than oneself). Although not a statistically significant gender difference in the current study, previous literature has found negative and/or fear-based road safety messages (which was the nature of messages used in the current study) to be less effective among males than females with females reporting TPE reversals and males reporting classic TPEs (Lewis et al., 2007). While, for message rejection, no significant main or interaction effects were observed based on Intervention condition and demographic subgroups; the mean message rejection scores as reported by the overall sample suggested that the reported level of rejection of the messages was relatively low.

Regarding efficacy, more than half of the study's sample reported that the messages in both warning notices did not include strategies to help stay within the posted speed limit when driving (i.e., response efficacy; Witte, 1992). Given that evidence attests to the importance of response and message self-efficacy in enhancing message outcomes (Floyd et al., 2000, Lewis et al., 2010), it would be beneficial to ensure future messages included in warning notices include explicit focus on strategies. However, despite the aforementioned finding, it should be noted that out of those participants who reported being able to identify strategies in the messages, the examples they provided (e.g., drive to the conditions, increase awareness of speed) were consistent with the intention of the message and likely strategies to help reduce one's speed when driving.

Furthermore, even though no significant main or interactional effects were found between the Intervention conditions and gender on message self-efficacy, an inspection of the mean scores indicated that they were relatively high and, thus, indicative of participants being '*quite likely*' to adopt and incorporate strategies into their driving. This finding was evident not only from the scores reported based on the study's overall sample but also when visually inspecting the mean message efficacy scores that were reported by both males and females (see Table 10). This finding is encouraging and particularly so when considering that more than half of the study's sample initially reported that the messages did not include strategies to help them stay in the speed limit (i.e., responded "no" in relation to the measure of response efficacy). Potentially, although the majority did not identify strategies (i.e., response efficacy) it would seem that, on average, some participants were able to still appreciate what the message was conveying and identify aspects of the message that they believe could be useful in helping them stay within the posted speed limit when driving (i.e., message self-efficacy). Long standing evidence has attested to the critical role that efficacy plays in influencing positive message outcomes (Witte, 1992). The fact that the messages did not significantly differ on this construct and that mean scores were relatively high may be considered a positive aspect in that it essentially meant high levels of efficacy were controlled for across the messages.

Indirect measure of effectiveness – Intention to comply with the speed limit (Intervention conditions and Control conditions)

Overall, this study found that there was no significant difference in mean intention scores across the four conditions (i.e., the two Intervention conditions [Condition 1 – A and Condition 2 – DD] and the two Control conditions [Control – A and Control – DD]). The unequal sample sizes between conditions, especially compounded when attempting to introduce gender as an additional independent variable into our analysis, meant it was not feasible to conduct the as-planned 2-way ANOVA with condition and gender as independent variables (Levene's test statistic was significant indicating unequal variances). The 1-way ANOVA was thus able to assess differences between conditions but not the gender x condition interaction. Notwithstanding this aspect, intention scores between all conditions were around 4 which, given the 5-point

scale, were relatively high and suggested that participants reported intention to remain within the posted speed limit in the next week.

While this result could reflect a genuine strong intention of study participants to avoid speeding in the short-term, it may also reflect the nature of participants who chose to take part in the study, social desirability in responding, or some combination of these or other aspects. However, regarding potential sampling and social desirability biases, the anonymous nature of the survey could be expected to help encourage honest responses. It is possible that the receipt of a warning notice was in and of itself enough to motivate intent to avoid speeding, at least in the short-term.

Subsequent examination of the effect of gender on mean intention scores did reveal a significant difference such that females reported significantly higher intentions to stay within the speed limit than males. This finding is consistent with existing evidence which suggests males are more at-risk and more likely to engage in risky driving including speeding on the road. In that regard, this finding helps to confirm that even though the relative number of females was smaller than males in this study, the findings support existing evidence regarding gender differences in driver behaviours.

Regarding the gender composition of our sample, the current study's sample featured more males than females at a rate of approximately 3:1 which itself is intriguing given that males typically represent a relatively difficult sample of participants to find for road safety research. That aspect aside, in terms of the current study and implications for the findings, previous research has found that males do not always respond as favourably to negative, physical threat-based message approaches as females (Lewis et al., 2007). In this study, the messaging approach was negative and based on physical threats of crash and associated injury and death. Given this message type, it is possible that more significant differences would have been found if the sample comprised equal numbers of males and females. Alternatively, given the greater proportion of males in the study sample, perhaps messaging featuring more positive aspects such as humour or approval for having not sped and driven safely (Lewis et al., 2008) may have also resulted in significant differences in intentions between the Intervention and Control conditions.

Factors predicting intentions to stay within the speed limit (Intervention conditions and the control condition)

As previously noted, despite intent to conduct separate regression analyses for each of the study's four conditions, in accordance with the SatMDT framework and its recommendations to conduct such regressions to understand the mechanisms influencing intentions (as a key outcome measure of message acceptance), this was not possible in the current study. The Control condition who received the double demerit warning notice (without an anti-speeding message) comprised N = 30 which was a relatively small sample and one that lacked sufficient statistical power to conduct the planned analyses.

Regarding the factors influencing reported intentions to stay within the limit, the extended TPB variables predicted a significant 65 % and 80 % of the variance in intentions to stay within the posted speed limit when driving in the next week in the accumulation of demerit points and double demerit points warning notices (and associated messaging) conditions, respectively. Consistent with the proposal that the nature of significant predictors may vary given the impact of messaging, the significant predictors of intentions varied between the two Intervention conditions. Specifically, attitude and PBC were significant predictors of intentions in the accumulation of demerit points and associated anti-speeding message condition. Such findings suggest that the messaging may have functioned to enhance positive views of driving within the speed limit as well as individuals' perceptions of their being able to control their choice to drive within the posted speed limit. The messaging did seek to raise awareness of the risks of speeding in terms of how many people were killed because of speeding in a recent year and,

thus, it is possible that the take-away points of the messaging was that you can control your speed and that sticking to the speed limit is a positive in terms of reducing injury and death to others.

For the double demerit and associated messaging condition, normative influences including subjective norm and moral norm emerged as the significant predictors of intentions. When considering the content of the message within the double demerit warning notice, there is an evident message about the need to consider others (and others' children) and, thus, links to the importance of normative referents in terms of what important others think an individual should do (i. e., subjective norm) and what individuals think is the broader social norm as to what one ought to do regarding driving to the speed limit.

The proposition that the nature of significant predictors of intentions that emerge in response to message exposure may vary depending on the message is also supported by the fact that different predictors emerged in the regression model predicting intentions in the Control condition, Control − A. Specifically, attitude and moral norm emerged as the significant predictors in this condition. It is interesting to acknowledge that the predictors in this Control condition represented a mix of the significant predictors from the Intervention conditions. When no other information has been provided, it is reasonable to expect that how an individual currently values compliance with the speed limit (i.e., attitude) and what they believe they ought to do as valued by society (i.e., moral norm) would influence their intentions to comply. As previously noted, the mean attitude score for the Control – A condition was the only score above 6 on the given 7-point scale on measures pertaining to all three conditions and across all the study's key measures (with all others sitting at around 3–4 on the 5-point Likert scales). Such a finding highlights that even without any messaging to promote the importance of staying within the posted speed limit, Control condition participants appeared highly favourable towards this behaviour and more so than the Intervention group participants. This aspect needs to be kept in mind as it does foreshadow a pre-existing difference between the groups; however, given that all other measures were more in keeping with their respective mean scores across conditions, we can only speculate as to why this was the case for the attitude measure score in the Control condition.

Strengths, limitations, and implications

Overall, the results provide some support for the inclusion of road safety messages in a Government Transport agency-issued warning notices to offenders. Although the intended effect of the messaging on future speeding behaviour was not reflected in the speeding intentions of those in the Intervention condition, the findings highlight that including the messaging appeared to have no adverse or unintended effects. Given the warning notices are already sent to offenders, the addition of brief anti-speeding messages (and any other behaviour for that matter) within the notices represents a potentially cost-effective way to deliver road safety messaging to those individuals at risk (i.e., those who have already committed offences).

Theoretically, the results provide support for the application of the SatMDT and its key tenets regarding evaluation in terms of including a range of outcome measures, both direct and indirect, as well as both measures of acceptance and rejection to understand more about the overall effectiveness of road safety messages. For instance, the findings highlight there was consistency across outcome measures which helped to provide a more comprehensive understanding of message effects. In addition, the application of the extended TPB constructs provided some insight into the mechanisms by which the messages may be influencing individuals' intentions. Also consistent with the conceptual framework, the findings highlight that any future messages used within warning notices need to be concept- tested and, in particular, it must be ensured that the levels of efficacy (response and self-efficacy) are high so as to enhance likely rates of acceptance and minimise rejection.

It is also important to note that this study provided insights into the

feasibility of this method of collecting data via a State Government Transport agency and based on offenders who had received warning notices. It is quite unusual in road safety research to find a method that results in more males than females being recruited, especially given that this study did not include any specific effort (which can often be required) to recruit more males. With males over-represented in road crashes relative to females, it is important to identify a recruitment strategy that may offer the means to effectively recruit males.

These strengths notwithstanding, it is also important to acknowledge the limitations of this study. First, the potential response bias associated with only 0.2 % of the offenders who received the warning notices during the study period consenting to be contacted by the research team needs to be borne in mind. And, of those individuals, only approximately half went on to complete the survey. It is reasonable to presume that those who choose to participate were not representative of the overall offender population.

Second, and extending upon the sampling-related limitations, while the number of males recruited was positive, the reverse of this strength is that there were, overall, a small number of females recruited. In one cell of the study design, there was only $n = 7$ females. Although analyses were conducted with considerations given to age and gender, it is acknowledged that the sample and, it follows, the power of the statistical analyses would have been enhanced with more representation of females across the study conditions.

Third, although a range of outcome measures were used in accordance with the SatMDT, it is acknowledged that measures of actual speeding behaviour, self-report or otherwise, were unable to be collected in the current study. Although intentions have long been shown to be a reliable and the most proximal predictor of behaviour (Ajzen, 1991), the existence of the 'intention-behaviour gap' (Sniehotta et al., 2005) highlights that intentions are not perfect predictors of behaviour.

Fourth, for a number of the study measures, mean scores were high (or very high) on the response scales provided suggesting potential ceiling effects. As noted previously, one explanation is that most participants in the current study's sample genuinely had high intention to stay within the speed limit in the next week and rated other constructs similarly high (in the positive, favourable direction). It is possible that additional response options may have yielded more variability in mean scores. Future research may consider adopting a response scale extending across more scale anchors to ensure further variability, should there have been more, be captured.

Fifth, the messages tested were based only on negative, physical threats. As has been highlighted earlier, it is possible that messaging featuring other types of emotions may have resulted in different effects particularly in light of the sample comprising predominantly males. As is known from existing literature, the type of message for different audiences matters in that those with focus on negative emotions and physical threats are likely to be more effective with females than males and vice versa with positive, humour-based messages (Lewis et al., 2008).

Finally, it is acknowledged that it was not possible to control timings with respect to when an individual received a warning notice and then how long it was before they may have opted to consent to being contacted about research (if they indeed chose to consent) and them subsequently opting to complete the study survey. The study design was based on 3-monthly intervals which was essential to align with TMR's dissemination of notice types. However, the inclusion of free- and cued-recall questions within the survey were included to ensure participants had option to refresh their recollection of the messaging and to see the messaging prior to providing responses about it.

Concluding comments

The study demonstrated that while the overall sample of drivers who chose to participate was relatively small (of those who received warning notices), there are drivers who, on receipt of a warning notice, may be keen to learn from this experience in a positive way. The findings of the current study suggest that warning notices may offer a low-cost option to disseminate road safety messaging as a part of ongoing efforts to encourage drivers' compliance with posted speed limit. Future research does need to explore more about the combined and independent effects of the messaging and warning notice and we suggest qualitative research may be particularly useful in this regard. For future implementation, the importance of targeting messages to cohorts needs to be considered as well as prior piloting.

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