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Preliminary evidence of the efficacy of the Reducing Aggressive Driving (RAD) program

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ABSTRACT

Introduction: Aggressive driving contributes to crashes, which often result in serious or fatal injuries. Efforts to reduce road trauma need to include strategies to reduce emotional and aggressive driving. Thus far, solutions have not comprehensively addressed the reasons why drivers become aggressive. This study provides preliminary evidence of the effectiveness of the Reduce Aggressive driving (RAD) program in improving driver behavior. The RAD is based on group discussion, feedback, and goal setting to encourage more positive responses to triggers for aggressive driving. The aim of this study was to evaluate the delivery of the RAD and its impact on driver anger and aggression. *Method:* A total of 94 drivers, ranging in age from 18 to 74 years (Mean = 38; SD = 15; 56% males) attended one two-hour online RAD session during which they identified triggers for their aggression and developed individual strategies to avoid aggressive driving. Most (87%) participants agreed that the RAD helped them generate realistic strategies to avoid aggressive driving. A subset of 67 participants provided self-reported anger and aggressive driving tendencies one month, and four months after the RAD. *Results:* When these were compared to baseline measures taken before participation in the RAD, decreases across all measures were observed. Thus, anger and aggressive driving significantly decreased one month after the RAD, and these decreases were maintained at the four month follow up; providing evidence of the effectiveness of the RAD in reducing these dangerous behaviors. Further research is needed to objectively measure changes in behavior to and support broader roll-out of the RAD program.

1. Introduction

Without serious changes to road safety in Australia, approximately 12,000 road users will lose their lives on Australian roads in the next decade and almost half a million more will be seriously injured (NRSS, 2018). Consequently, Australia, like many other countries has adopted the goal of halving the road toll within the next 10 years: "50 by 30" established under the *Global decade of action* (WHO, 2020). Key to this is supporting safe road use. To achieve this goal, it is critical to develop targeted intervention focused on common and unsafe driving behaviors.

Aggressive driving is one such behavior. This includes the risky use of the vehicle to display anger or intimidate other drivers, such as speeding, tailgating or dangerous overtaking. These behaviors have been well established as a problem, with almost 50% of drivers engaging in them (Sullman & Stephens, 2021). When drivers are aggressive, their odds of being involved in a crash increase up to 15-fold (Dingus et al., 2016). To put this into perspective, aggressive driving poses similar risks to distracted or impaired driving (Dingus et al., 2016), but with more serious injury consequences (Hosseinpour et al., 2021). Despite the threat to road safety, most current countermeasures are reactive and rely on punitive actions (i.e. fines) or mandatory attendance at training as a result of a driver committing certain acts. This method of enforcement does not support all drivers in understanding the causes of their aggression. While some early driver licensing may include higher order understanding of emotions and driver behavior, this is not regulated and not examined at licensing. This study will describe development of an evidence-based program to support a range of drivers in reducing aggressive driving and present evaluation data on its impact in a population of drivers.

In most cases, aggression is an expression of anger and is underpinned by a heightened state of arousal that negatively influences decision making and risk perceptions (Lerner & Keltner, 2001). Stresses and annoyances occurring before the drive influence how a driver behaves and responds when subsequently driving (Stephens & Groeger, 2011). This is why most drivers will report

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moderate frequencies of aggressive driving (Bogdan, Măirean, & Havârneanu, 2016; Deffenbacher, Lynch, Oetting, & Swaim, 2002) engaging in certain behaviors "sometimes" or "often" rather than "always." Further, due to the high cognitive demand of the driving task, in some situations, drivers may have little capacity to adequately assess the situation. Instead, they make decisions based on existing stereotypes, judging what has previously happened, rather than what is currently happening (Stephens, Trawley, Madigan, & Groeger, 2013). The driving culture also supports aggressive behaviors, allowing drivers to feel they can express their anger in ways that they are not likely to do in other settings (Parkinson, 2001). Given the complexity of this behavior, it is critical that intervention targets the range of reasons why a person acts aggressively in the vehicle, rather than penalize the behavior after the fact.

Evidence suggests that anger and aggression can be reduced through cognitive training, behavioral therapy, or focusing on reducing physical arousal (see Deffenbacher, 2016). To illustrate, Osgood, Kase, Zaroukian, and Quartana (2021) used a brief online computerized task (hostile bias modification training) to encourage more positive interpretations of ambiguous cues using abstract non-driving cues. The aim of this study was to modify the tendency to misattribute blame for circumstances outside of one's control or misconstrue behaviors as being aggressive (i.e., hostile attribution biases: Nasby, Hayden, & DePaulo, 1980). Osgood et al. found that 96 hours after the task, participants reported lower levels of aggressive driving than they had prior to the task. Aggressive driving was measured by the frequency of engaging in a range of behaviors from minor aggression such as verbal responses, to using the vehicle aggressively and personal aggression (i.e., trying to start a fight). However, no follow up was undertaken to see if this effect was maintained for longer. Using a more ecologically valid intervention, Haustein, Holgaard, Ābele, Andersen, and Møller (2021) developed a cognitive-behavioral intervention to reduce driver aggression. This program focused on education and the development of cognitive strategies to avoid hostile attributions that underpin anger and aggressive driving. In this course, drivers discussed pre-determined driving situations and practiced approaching these with different mindsets (i.e., not allocating blame). In comparison to a control group, drivers who completed the 90-minute course reported more frequent adaptive responses to anger three months after the session. There was weak evidence of a reduction in self-reported minor aggression (i.e., verbal) but little evidence of a reduction in more serious aggression, either measured by self-reports or in a driving simulator study. It may be that the focus on hostile attributions made while driving worked for drivers prone to these and that there are other drivers whose aggression is generated via other mechanisms (i.e., running late, general mood or contexts outside of driving). These drivers may need strategies that work for their specific triggers, which are not generated in programs focusing only on one element of aggression.

For example, the General Aggression Model (GAM; Anderson & Bushman, 2002) demonstrates the complexity of aggressive driving as a response to personal, internal (arousal, cognition, affect), and situational factors. According to the GAM, aggression occurs when a person becomes aroused, angry, or has maladaptive thoughts about a situation. These are interrelated. For example, a driver who is forced to brake suddenly due to the behavior of another road user may experience arousal due to the perceived threat, become angry as a result of the threat, and blame that person for their behavior. They are likely to become aggressive if they believe they have control over the outcome, and that the outcome will be positive. These decisions and appraisals are influenced by individual factors (such as personality traits that predispose drivers to be impulsive, easily angered or aggressive), attitudes or motivations toward driving and perceptions of skill or risk, and the outcomes of previous experiences (personal driving history). Behaviors will also differ according to elements of the situation. Thus, intervention needs to focus on addressing the range of processes that lead to a driver becoming aggressive. This argument supports a multidimensional approach in reducing aggressive driving that targets cognitive, behavioral, and affective underpinnings.

This approach can be supported using traditional behavior change programs found to be effective for increasing safe behavior (Ludwig & Geller, 2000; Newnam & Watson, 2009; Newnam, Lewis, & Warmerdam, 2014). For example, the Antecedent-Behavior-Consequence (ABC) framework has been used to underpin programs to manage safety behavior (Luthans & Kreitner, 1985). The ABC framework focuses on the role of reinforcers within the learning process to modify salient behavior (e.g., speeding, aggression). The main premise of the theory is that behavior that positively affects performance must be contingently reinforced; feedback and goal setting have been identified as powerful reinforcers for behavioral change (Stajkovic & Luthans, 2001). In road safety, these interventions are tailored to the personal circumstances of the driver using feedback gained on their own behavior. Using this approach, drivers are then asked to reflect on the reasons for engaging in unsafe driving behavior and are guided to generate strategies to avoid situations that place them at risk in their future driving. Thus, an aggressive driver may be asked to reflect on when they are aggressive, and the situations that trigger this behavior. Consideration can be given to how they were feeling, what they were thinking, and how they behaved, thus covering a number of aspects underlying aggression.

The Reducing Aggressive Driving (RAD) program has therefore been designed on these principals. Fundamental to the RAD is the idea that behavior is not a singular concept – thus, interventions to improve road safety need to understand that not all behaviors are the same and not all drivers will react the same way in the same situation each time. Thus, the program is tailored to the driving context and integrates strategies to help them avoid and manage the triggers in their future driving.

The RAD is delivered in one session, via Zoom, that lasts for 2-hours. The RAD is structured into four components (see Table 1 in Methods). These include: (1) Presentation of relevant statistics regarding the road toll and risks of aggressive driving; (2) Presentation of empirical evidence regarding local and international prevalence of aggression and situations that trigger anger and subsequent aggression; (3) Group discussion of triggers for aggression, with the triggers generated by the participants and covering affect, cognition and behavior; (4) Group generation of strategies to avoid aggression.

The RAD approach focuses on instilling knowledge and motivating safer driver behavior through introducing feedback and goal setting with feedback provided across all sections of the program and goal setting during the final quarter.

Through components 1 and 2, drivers are educated about the road safety implications of aggressive driving and the uniqueness of the driving situation, outlining the lack of social cues and the perception of depersonalization that can lead to anger. These sections also provide information on the influence of stereotypical thinking and current mood (driver characteristics and internal states) on how they react to driving events. Components 1 and 2 can be focused for the population of interest, for example, younger drivers or drivers in specific jurisdictions.

The discussions facilitated in the third and fourth component of the RAD incorporate multiple contributors for aggression based on the GAM. Importantly, drivers are supported to identify their specific triggers for aggression, which may be elements of the situation, current mood, or stress levels. Drivers are then encouraged to

Table 1
Overview of the RAD program components and learning outcomes.

Stages and timing	Description	Process and lead (i.e. facilitator or participant)	RAD approach and Learning outcome
Stage 1 (up to 35 mins depending on group size)	Introduction and ice-breaker activity	All participants. Each participant introduces themselves and explains their reasons for participating in the course	
Stage 2 (component 1) (approx. 10 mins)	Discussing the road toll and global strategy to reduce road trauma. Defining anger and aggressive driving and placing these behaviors within road trauma	Facilitator led. This involves presentation of material related to risks of aggression and situations and factors that may contribute to it.	RAD approach. Feedback on what aggressive driving is and its risk RAD Learning outcome. Define aggressive driving and its consequences
Stage 3 (Component 2) (approx. 10 mins)	Provide survey data collected from like populations regarding anger and aggressive driving.	Facilitator led. Presentation of data on the types and prevalence of aggression as well as on general level of anger across different situations	RAD approach. Feedback on the extent of anger and aggressive driving in Australia Learning outcome. Provide relevant feedback on the extent of aggressive driving
Stage 4 (Component 3) (up to 25 mins)	Explore reasons for becoming angry while driving and expressing this aggressively. Facilitating conversation focussing on all elements of the GAM.	Group led. Scenario presented to initiate discussion on what set of circumstances leads to anger and aggression for each participant. Facilitators support conversation by providing relevant data related to antecedents discussed by participants and broadening discussion to include affect, behavior and cognition.	RAD approach. Feedback and prelude to goal setting through exploring the triggers for anger and subsequent aggression for each participant; Learning outcome. Challenge key beliefs leading to, or associated with, anger and aggressive driving; and
Stage 5 (Component 4) (up to 40 mins)	Generate strategies to manage the triggers of anger and aggressive driving, as a group with a focus on each member setting individual goals	Group led. Participants develop and work together to generate realistic strategies to avoid anger or aggression. This conversation is supported by facilitators who provide relevant data to support strategies and ensure all participants have at least one strategy they can try by the end of the program.	RAD approach. Goal setting Learning outcome. Generate realistic strategies to avoid becoming angry or aggressive while driving.

develop and discuss strategies to apply to these situations that could realistically work for them and their circumstance.

The RAD format is based on other road safety programs that have been evaluated and shown to improve driver speed choice (see Ludwig & Geller, 2000; Newnam & Watson, 2009; Newnam et al., 2014). However, this study represents the first evaluation of such a program focusing on aggressive driving. Hence, the aim of this study is to describe the design of the RAD and conduct a preliminary evaluation of its implementation in terms of achieving the learning outcomes (learning outcome evaluation) and assess its efficacy in reducing anger and aggression in drivers (impact evaluation).

2. Method

2.1. RAD design and delivery

The RAD is a group-based online program. To ensure small group sizes, there were 10 sessions conducted for the project all facilitated by authors (AS & SN). These were delivered between April to June, 2021. Participants only attended one session and group sizes ranged between 5 to 14 participants in each. Table 1 shows the structure of the RAD.

2.2. Procedure

Ethical approval for the study was obtained from the Authors' University Human Research Ethics Committee. Participants were recruited by University social media (e.g. Facebook, Twitter), local radio and newspaper advertisements, and emails sent to community groups and universities. Potential participants registered their interest via an online survey link and were subsequently contacted by a researcher with further details of the study. Inclusion criteria were: being aged over 18, holding a valid driver's license, and experiencing some level of anger or aggression while driving. Participants accepted into the study were provided with a unique identifier to link survey responses across the study period. All survey data were collected online via Qualtrics.

Fig. 1 displays the study procedure and timeline. The learning outcome evaluation survey was sent to the participants the same day they completed the RAD session and involved a 15-minute survey assessing learning outcomes and opinions of the RAD. The impact evaluation involved issuing a survey at three time-points: no more than one week before participation in the RAD (Baseline), one month after participation in the RAD (One Month Follow Up), and four months after participation in the RAD (Four Month Follow Up). This survey included measures for driving anger propensities and aggressive driving frequencies. The follow up surveys also sought information regarding specific strategies adopted as a result of the RAD. Participants received a $50AUD digital shopping voucher for completing the RAD and the learning outcome evaluation, and a further $20AUD digital shopping voucher for completing both follow up surveys (impact evaluation).

2.3. Participants

A total of 94 participants completed the RAD and the learning outcome evaluation (Mean age = 38 years; SD = 15; 56% males). Almost all were invited to participate in the impact evaluation (93/94; with one participant excluded due to not wishing to try any strategies). Most (90%; 84/93) provided responses at Month

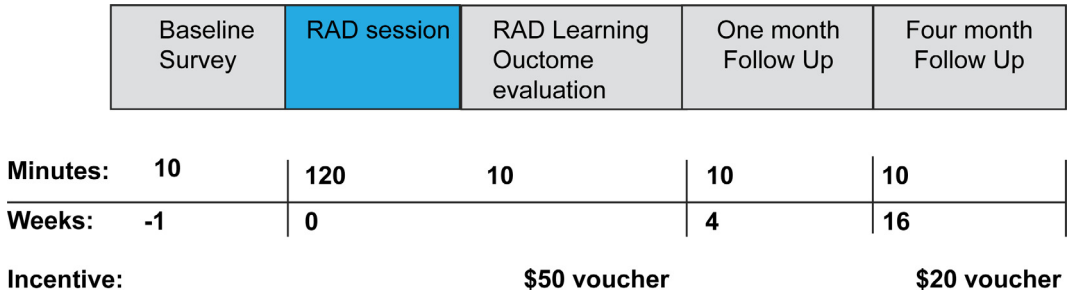

Fig. 1. RAD study procedure and timeline for each participant.

One Follow up and 76% (71/93) also provided responses at Month Four. This represents an attrition rate of 24% from Baseline. The final sample contained 67 participants, as four were excluded due to not driving during COVID (n = 2), withdrawing due to a change in circumstances (n = 1), or providing Month Four follow up responses after the study closed (n = 1). This final subset had a mean age of 38 years; SD = 15, and 55% identified as male). There were no demographic differences between the drivers who completed the full study and those who only completed the evaluation measures (see Table 2 in results).

2.4. Materials

2.4.1. Participant demographics

Demographic information was sought regarding annual mileage (later recoded into low < 10,000 km; medium: 10,001 to 30,000kms and high: 30,001+), crash and infringements in the previous year, age, gender (male, female, non-binary), and postcode.

2.4.2. Evaluation measures

Learning outcome evaluation: to assess the learning outcomes, participants were asked to rate on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree) the extent to which the RAD: (1) effectively defined aggressive driving and its practices; (2) provided relevant feedback on the extent of aggressive driving; (3) effectively explored reasons for engaging in aggressive driving; (4) generated realistic strategies to avoid the triggers of aggression in future driving; and (5) challenged key beliefs regarding aggressive driving.

Open text boxes collected qualitative responses regarding additional comments about the learning objectives, the key learnings from the RAD, and what was liked, disliked, or could be changed.

Impact evaluation: Anger and aggression were measured in two ways. Two single 11-point items asked drivers to rate their: (1) general level of anger and (2) aggression while driving (0–10 = low to high). In addition, validated scales were used to understand more specifically how anger or aggression may have changed after participation in the RAD. For example, whether anger in specific situations was lower, or what types of aggression were less frequent after the RAD. This approach was adopted to comprehensively measure perceived changes in anger or aggression, with single items providing general changes that may not be captured with the validated scales, and validated scales providing more specific changes.

The Measure for Angry Drivers (Stephens, Lennon, Bihler, & Trawley, 2019) was used to measure propensities for driving anger. The scale contains 23 items that describe a potentially anger provoking situation and participants rate how angry they are likely to become (1 = not at all, 3 = fairly angry, 5 = extremely angry). These items group into three broad types of situations: travel delay (example item: "You have a green left turn arrow, however a driver ahead is travelling straight and blocking the turn"); hostility from other drivers (example item: "Another driver indicates anger/hostility when you do a legal maneuver"); and, danger from other drivers (example item: "Someone moves in front of you suddenly and without leaving enough room, forcing you to brake hard"). The items are averaged within each factor with higher scores representing higher anger tendencies. A total score is also calculated by averaging the 23 items. The scale has demonstrated good reliability with Cronbach alphas ranging from 0.89 to 0.93 across the factors (Stephens et al., 2019). In the current study alphas ranged between (0.81 and 0.94).

The Driving Anger Expression Inventory (DAX: Deffenbacher et al., 2002) short form (Stephens & Sullman, 2014) was used to measure the frequency of aggressive displays of anger. The DAX was used to measure aggression in the studies by Osgood et al. (2021: long form) and Haustein et al. (2021: short form). The short form contains 15-items each depicting a potential response to anger. Participants rate how frequently they engage in each one on a four-point scale (1 = Almost never, 4 = Almost always). Items form four different ways of expressing anger classified as verbal aggression (example item: "I swear at the driver"), use of the vehicle to display anger (example item "I drive a lot faster"), personal physical aggression (example item: "I try to get out of the car and tell the other driver off") and adaptive responses (example item: "I tell myself not to worry about it"). Subscale scores represent the item averages. A total average aggressive driving score is also calculated from the aggressive items (i.e., verbal, vehicle, and personal physical). Except for adaptive responses, which represent positive outcomes, higher scores represent more frequent aggression. Cronbach alphas on these factors have shown acceptable reliability (ranging between 0.78 and 0.87; Stephens & Sullman, 2014). In the current study these ranged between 0.62 to 0.84.

The follow up questionnaires contained additional questions to assess the effectiveness of the RAD. These were: "To what degree

Table 2
Sample characteristics for RAD learning outcome evaluation (N = 94) and impact evaluation (n = 67).

Demographics	Learning outcome evaluation (N = 94)	Impact evaluation (N = 67)
Age	M = 38.03 (15.23)	M = 37.56 (15.33)
Gender	Males = 56%	Males = 56%
Crashes in the previous year	Yes = 15.1%	Yes = 15.2%
Infringement notices in the previous year	Yes = 23.7%	Yes = 21.2%
Annual mileage		
Low. less than 10,000 km per year	Low = 24.7%	Low = 30.0%
Medium. 10,001 to 30,000 km per year	Med = 63.4%	Med = 59.1%
High. 30,001 or higher per year	High = 11.9%	High = 10.6%
Non work drivers	Yes = 66.7%	Yes = 69.7%

has the RAD been helpful in managing your frustrations while driving?" and "To what degree has the RAD been helpful in managing your aggression while driving?" Participants responded to each question using a five-point scale (1 = not at all; 3 = somewhat; 5 = extremely helpful).

In the follow up questionnaires, participants were also asked whether they had used (or were still using if it was the four month follow up) any of the strategies developed during the workshop. This had a yes/no response. "No" responses triggered a text box to seek further information as to why not. "Yes" responses triggered a dropdown box to select all strategies that were still being used. The options in the dropdown list contained all the strategies generated during the workshops. Thus, not all participants would recognize all the strategies. A general frequency of using any strategy was obtained with a three-point scale (1 = not often; 2 = sometimes; 3 = always). In the four month follow up, participants were also asked whether any of the strategies had helped manage anger outside of driving with a yes/no response.

2.5. Data handling

All analyses were conducted in SPSS v.26 for windows. Open text box responses were coded in NVivo and themes created based on responses. Figures were developed in R studio and Adobe Illustrator. Missing data were untreated and are reflected in smaller reported sample sizes. For example, the primary outcome analyses of changes in self-reported anger and aggression are reported on 64 participants due to missing data on MAD or DAX scales at either baseline (n = 2), or Month One follow up (n = 1). To assess differences after the RAD, a repeated measures within-subjects design was used comparing anger or aggression scores across three time periods (Baseline, Month One follow up, and Month Four follow up). When Mauchly's test of sphericity was violated, Greenhouse-Geisser adjustments were made, and this is reflected in the reported degrees of freedom. Post hoc testing used Bonferroni adjustments for multiple comparisons. Effect sizes are presented in partial eta squared (η_p^2) with small, medium, and high effects being defined as 0.01, 0.06, and 0.14, respectively. Comparisons of mean for two groups was conducted with independent t-test with Cohen's d effect sizes of 0.2, 0.05, 0.08 interpreted as small, medium, and large. Chi-square tests of independence (X^2) were used to compare categorical responses across groups with Phi (φ) showing size of the effect (0.1, 0.3, 0.5 being small, medium, and large effects).

A list of strategies from the 10 workshops was generated. Each strategy was classified by the researchers as either: cognitive -- changing/challenging how a driver thinks about the situation (e.g., is it worth it?); behavioral -- changing a behavior in the situation (e.g., pulling over); and relaxation -- efforts to reduce arousal (e.g., deep breaths). These broad types of strategies align with the underlying routes to aggression (i.e., affect, cognition, and behavior).

3. Results

3.1. Characteristics of the learning outcome evaluation sample and impact evaluation subset

The sample characteristics are displayed in Table 2 for the 94 people who completed the learning outcome evaluation and for the subset of 66 who also completed the impact evaluation. There was mostly an even distribution of gender, and the average age was around 38 years across the full sample and also in the subset. Most drivers had medium to low mileage, and only one third drove as part of their job.

The full sample and impact evaluation subset had moderate levels of anger with scores just under the mid-point on the 0–10 scale for anger (e.g., M = 4.78; SD = 2.29 and M = 4.65, SD = 2.31, respectively) and similar scores for aggression (e.g., M = 4.22; SD = 2.17 and M = 4.17, SD = 2.15, respectively), demonstrating average levels of each. Mean scores for anger measured with the MAD, ranged between 2.19 (SD = 0.72)/2.26 (SD = 0.74) for travel delays to 3.46 (SD = 0.77)/3.50 (0.72) for perceived danger from others across the full group and the subset. As the highest possible score for these was 5, this demonstrates moderate level of anger in the participants.

Aggressive driving was also of moderate frequency. As is to be expected, minor aggression was more frequent (scoring on average 2.58 (SD = 0.73) and 2.62 (SD = 0.72), respectively, out of a possible high score of 4). Extreme physical aggression less frequent scoring on average (1.25 (SD = 0.38) and 1.26 (SD = 0.39) out of a possible 4). Despite the moderate ranges for anger and aggression, these scores were significantly higher than previously published levels using an Australian sample (all p values were <0.001; see Table 3). This demonstrates that while collectively the current sample exhibited only moderate anger or aggression, the recruitment method was successful in obtaining drivers who exhibit some level of anger and aggression.

3.2. Learning outcome evaluation

The RAD content was also well received by most participants (see Fig. 2). Most participants agreed that they effectively explored reasons for engaging in aggressive driving (96%: 90/94) and generated realistic strategies to avoid aggressive driving (87%; 82/94).

Table 3
Baseline anger and aggression scores in the full sample and subset of those in the outcome evaluation.

	Learning outcomes evaluation (N = 90*)	Impact evaluation (N = 65†)	Australian sample (Stephens et al., 2019) M (SD) (N = 414)
General anger (0–10)	4.78 (2.29)	4.65 (2.31)	n/a
General aggression (0–10)	4.22 (2.17)	4.17 (2.15)	n/a
MAD danger from others (1–5)	3.46 (0.77)	3.50 (0.72)	2.75 (0.77)
MAD travel delays (1–5)	2.19 (0.72)	2.26 (0.74)	2.24 (1.02)
MAD hostility (1–5)	3.12 (1.18)	3.19 (1.13)	1.68 (0.64)
DAX verbal aggression (1–4)	2.58 (0.73)	2.62 (0.72)	1.88 (0.73)
DAX use of vehicle (1–4)	1.83 (0.63)	1.80 (0.63)	1.33 (0.43)
DAX personal physical aggression (1–4)	1.25 (0.38)	1.26 (0.39)	1.12 (0.24)
DAX adaptive constructive responses (1–4)	2.46 (0.69)	3.80 (0.67)	2.62 (0.78)

* Four people did not provide baseline measures on theses scales.
† Two people did not provide baseline measures on these scales; t-tests between published means and means from the full sample, and published means and means from the subset in the impact evaluation showed significant differences across all scores at p < 001 level.

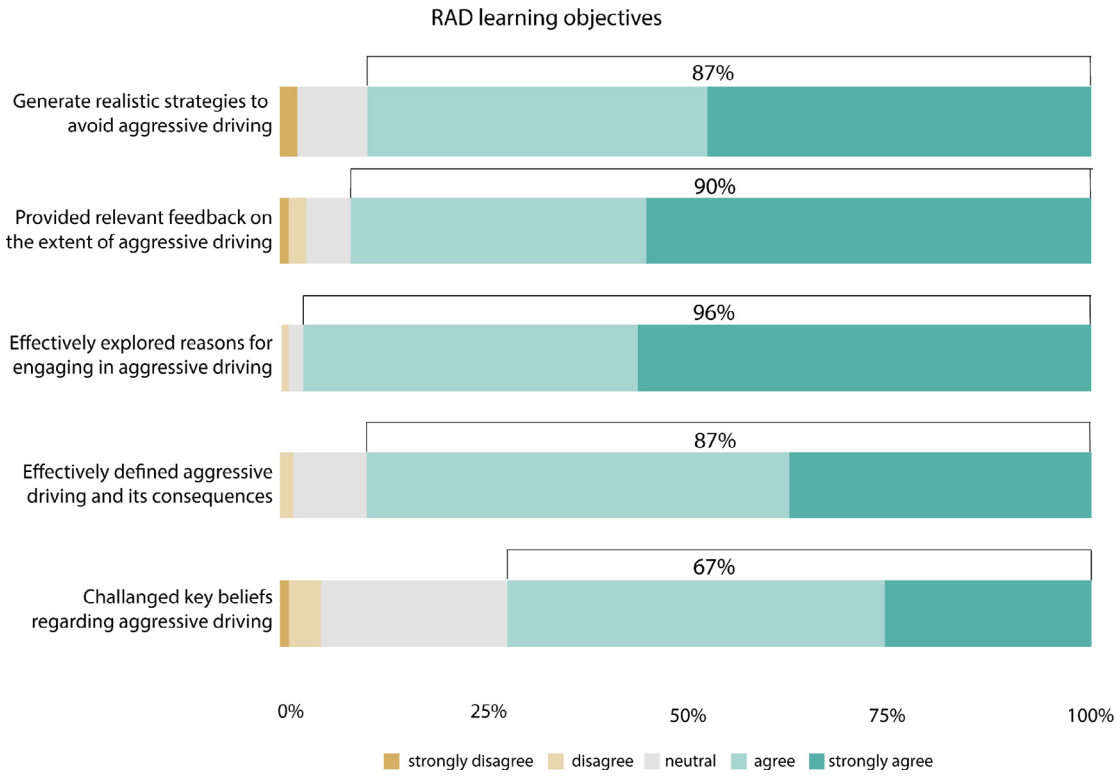

Fig. 2. Participant ratings of the RAD learning objectives (N = 94).

Thus, these results provide support for the learning outcomes of the RAD.

All but one participant (n = 93) provided comments in the open text box seeking feedback on the RAD approach and learning objectives. These comments formed 137 responses. The most common response was that they learned take-home strategies (51% of participants included this in their responses (48/93); and covered 35% (48/137) of all noted responses.

The following quotes represent discussions of the strategies:

> *"I liked the stepwise approach to dive into the topic, with subtle nudges to challenge self-perception. Had a lightbulb moment that I actually have not tried any self-regulation strategies prior to this."*
> *"I really liked the interactive approach, being able to exchange ideas, and everybody participating. It felt very non-judgmental which I appreciated as I feel embarrassed by my own behavior in being too stressed and cranky when driving at times. The flowing exchange of thoughts and strategies. Very user friendly"*
> *"It recognizes what drivers can do to minimize bad behavior on roads and the overall result to their families and friends"*

Other common responses were that they enjoyed the shared experience with other frustrated drivers (39% of participants (37/93), and 27% (37/137) of all responses)). This is demonstrated in the following quotes:

> *"Hearing about other people's experiences and their own concerns when they get on the road - a very shared experience that isn't often spoken about in a helpful, strategy-based forum such as this one."*
> *"Other (decent) people are feeling irritated behind the wheel. I'd like to continue to give a wave of thanks to another motorist who moves over to make room for me to pass by. I can make extra effort to be polite to other road users. I will probably be less hasty in tooting, swearing & muttering about the behavior of other motorists. Even as road users we're still all imperfect humans trying to do what we think appropriate.".*
> *"I've learned what a frustrated driver looks like. I've also learned what frustrates other people because what might not bother me can really bother other people and vice versa. I've also learned that there is a general dislike towards faster drivers cutting off slower drivers which I might find myself guilty of doing. So in a way this workshop has made me more aware of what I'm doing wrong.".*
> *"That everyone has different struggles with road rage, some are anxiety, some are general frustration. It was interesting to hear other people's experiences and how they handle them. It made me realize that my aggression on the road is over the top (I sort of already knew) but it's made me more aware that yelling at someone won't make them a better driver so what's the point."*

Some participants also mentioned they liked that the RAD approach raised awareness of the road statistics and risk of crash when aggressive (16% of the participants mentioned this (15/93) forming 11% of the responses (15/137). This is evidenced in the following quote:

> *"I didn't realize how much more likely you were to have an accident when driving aggressive or angry, that'll definitely make me stop and think next time I'm in a frustrating situation."*

3.3. Impact evaluation

3.3.1. Differences between the impact evaluation group, with those who dropped out

There were no significant differences between demographics of the group of 67 people who completed all the study and the 27 who dropped out. This was evidenced by p values greater than 0.05. There were also no differences on anger or aggression scores for the group who completed the outcome evaluation with scores between the group who did not complete the follow-up surveys (all p values were greater than.05).

The learning outcome evaluation ratings were also compared between the two groups. Only one significant difference emerged,

demonstrated by a p value < 0.05. Participants who did not complete the full study were over-represented as "neutral" on the question of whether they generated realistic strategies to avoid the triggers of aggressive driving in future driving (75% compared to 25% in the full participation group: X^2 (3) = 13.35, p =.004; φ = 0.38.

3.3.2. Identified triggers and strategies

In each of the 10 sessions, participants, as a group, generated a list of triggers for their own anger and aggression, as well as a list of strategies to help avoid or reduce anger and aggression. The compiled lists of these are included in Appendix A1 and B1. Infographics for each were also provided to participants upon completion of the Month Four follow up for their own records.

Triggers that were generated included poor journey management (running late, unfamiliar route) and person centered such as existing mood or state (i.e., tired, hungry). Triggers with the road environment included danger from others, hostility, and discourtesy (including discrimination and lack of etiquette) and travel delays (or certain road infrastructures). Other environmental triggers included car parking, known dangers (i.e. animals), and interactions between different sized vehicles. Triggers within the vehicle included GPS failure and vehicle handling (i.e., having to change or drop gears, operate truck brakes).

A total of 38 strategies were generated across the 10 sessions. While some were unique to one session, others reoccurred on numerous occasions. The strategies were classified by the researchers as either behavioral (37%; 14/38), cognitive (60%; 23/38), or relaxation (3%; 1/38) based. Some of the behavioral strategies include pulling over, stop driving, use an apology wave, and plan journey to avoid aggression hotspots or traffic. Some of the cognitive strategies included the 5x5x5 rule ("will this matter in 5 minutes, 5 hours or 5 days?") and rethinking the situation ("it could be worse," "so what if you are late"). Relaxation strategies focused on breathing.

The three most adopted strategies were cognitive: ignore it and the 5x5x5 strategy, and behavioral: listen to music. Four months after the RAD, approximately half of the impact evaluation group were using these strategies (45%, 45%, and 50%).

3.3.3. Frequency and usefulness of strategies

Participants were asked whether they were still using these strategies at the Month Four follow up. A total of 64 replied. Eight percent (5/64) of the sample were not using the strategies because they had reduced driving due to COVID-19 restrictions, while 86% (55/64) reported they were still using the strategies they generated. In general, participants reported adopting strategies sometimes (60%) to always (40%) when driving and found them somewhat (29%), very (49%), or extremely helpful (6%) in reducing anger and aggression while driving. Further, 74% said the strategies had also helped with anger and aggression in other contexts.

3.3.4. Driving anger

Repeated measures ANOVAs were conducted to compare self-reported anger scores from the MAD and the single anger item from Baseline with Month One and Month Four after the RAD (see Fig. 3). Across all measures of anger, there were significant decreases in self-reported anger tendencies from Baseline to Month One after the RAD, and these lower scores were maintained at the Month Four follow up. This was evidenced by the following F statistics[1]: Anger over danger from others (F(2,108) = 20.90, p <.001, η_p^2 = 0.07); Anger over travel delays (F(2,108) = 13.10, p <.001, η_p^2 = 0.17); Anger over hostility from others (F(2,112) = 17.22, p <.001, η_p^2 =.); and the total average anger score (F(2,104) = 23.72, p <.001, η_p^2 = 0.27). Likewise, participants' scores on the single measure of general anger while driving (low = 0 to high = 10) showed a significant decrease from Baseline (M = 4.72, SD = 2.31) to the Month Four follow up (M = 3.94, SD = 1.94; Month One scores were 4.93, SD = 1.82; F(2,128) = 4.73, p =.01, η_p^2 = 0.07.

3.3.5. Driver aggression

Driver aggression showed a similar pattern as anger in that baseline scores across the single item measure and the driving anger expression inventory (DAX) were higher than scores taken after the RAD (see Fig. 4). Drivers reported higher levels of general aggression at Baseline (M = 4.14, SD = 2.16) compared to Month One (M = 3.49, SD = 2.21) and these lower scores were sustained at the four month follow up (M = 3.32, SD = 2.04; F(2,128) = 6.16, p =.008, η_p^2 = 0.14). Likewise, scores on the DAX showed that drivers reported less frequent verbal aggression and aggressive use of the vehicle one month after the RAD, and these frequencies remained low at the four month stage[2] (F(2,115) = 14.09, p <.001, η_p^2 = 0.18) and F(2,126) = 10.13, p <.001, η_p^2 = 0.14, respectively). Personal physical aggression, which was uncommon to start with, showed a significant decrease at the four month follow up compared to Baseline (F (2,126) = 3.82, p =.025, η_p^2 = 0.06). This may indicate that a longer period was needed to notice changes in less frequent behaviors. Adaptive constructive responses to anger were lower at Baseline (M = 2.33, SD = 0.67) compared to Month One (M = 2.62, SD = 0.58) and Month Four (M = 2.63, SD = 0.65; F(2,126) = 9.96, p <.001, η_p^2 = 0.14,). This provides further evidence that drivers reported an increased frequency of adaptive behaviors after the RAD compared to before the RAD.

4. Discussion

The aim of this study was to evaluate the Reducing Aggressive Driving (RAD) program. The results provide preliminary support for the effectiveness of the program in aligning with its learning outcomes and its impact on reducing anger and aggression on the road. This is an important contribution to road safety given that current road safety organizations stress the importance of strategies that resonate with drivers in order to achieve reductions in the road toll (NRSS, 2021).

The RAD program builds upon previous interventions designed to reduce anger and aggressive driving (e.g., Haustein et al., 2021; Osgood et al., 2021). This is because the RAD approach allows drivers to generate their own strategies to avoid what triggers their bad driving behavior. Furthermore, the range of triggers and strategies identified across the 10 RAD sessions is testament to the complexity of aggressive driving and the need for targeted approaches to align with specific contexts. While some triggers identified by participants aligned with previous research into driver anger (e.g., Deffenbacher, Oetting, & Lynch, 1994; Shinar & Compton, 2004; Stephens & Groeger, 2009; Stephens et al., 2019), some were specific to the Australian road network (i.e., roundabouts or lack of road etiquette that is embedded within specific road cultures) or the driver (i.e., family dynamics). Further, the identified strategies covered cognitive, behavioral, and relaxation techniques (respectively comprising 60%, 37%, and 3% of the identified strategies). The effectiveness of allowing drivers to generate their own strategies was demonstrated by a large amount of agreement (87%) that their individual strategies were realistic for their circumstances. Further, 86% of those who completed follow-up questionnaires

[1] Greenhouse-Geisser reported for all MAD variables due to Maulchey's Test of Sphericity being violated.

[2] Greenhouse-Geisser reported for DAX verbal due to Maulchy's Test of Sphericity being violated.

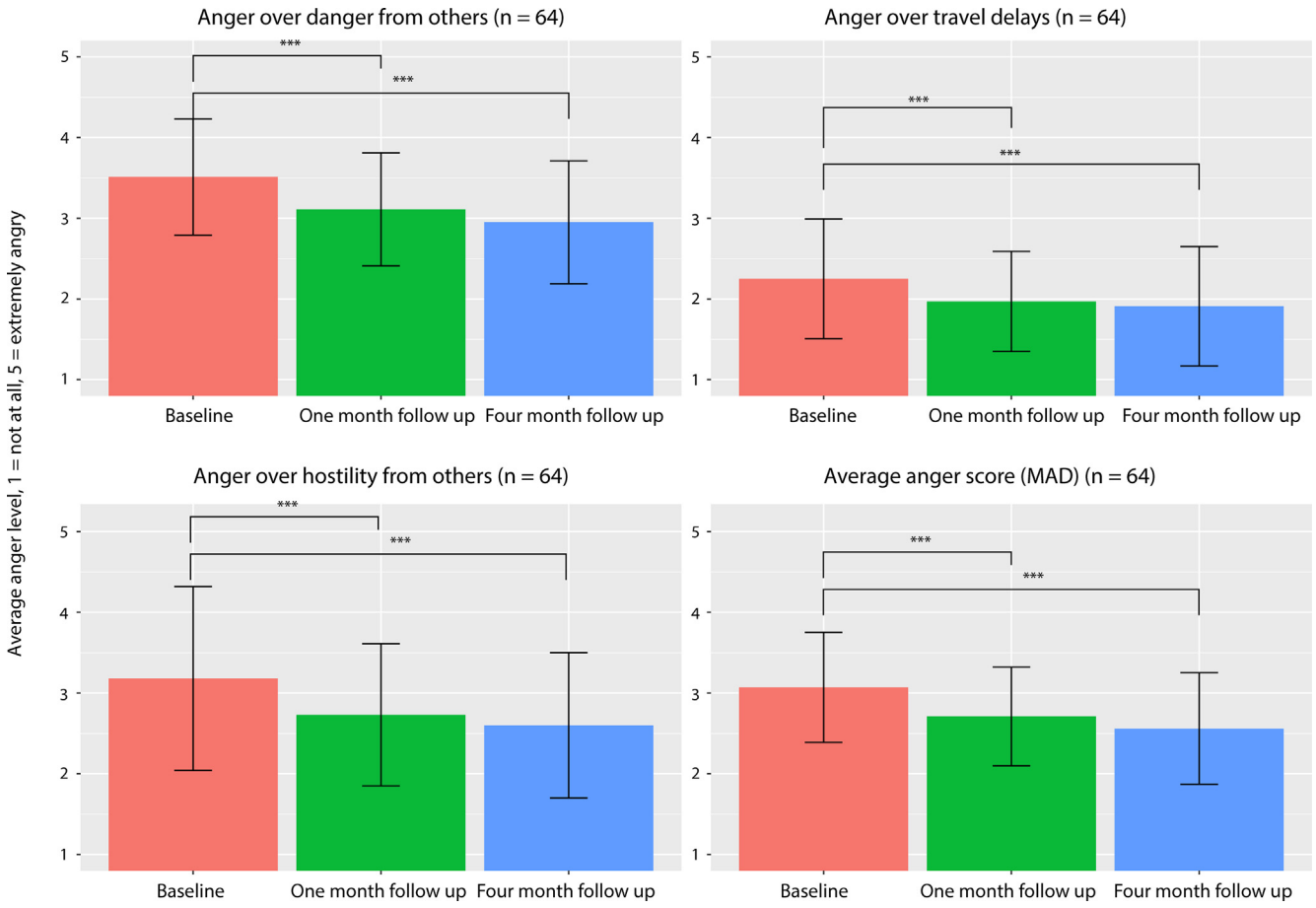

Fig. 3. Measure for Angry Drivers means (and standard deviations bars) across the study.

were still using their strategies four months after the RAD. Many drivers reported using more than one of these types of techniques, demonstrating the range of situations targeted through the RAD and the ability for it to resonate with drivers.

The impact evaluation also supported effectiveness of the RAD program. It was found that the RAD was associated with self-reported decreases in aggressive driving measured using the Driving Anger Expression Inventory (DAX: Deffenbacher et al., 2002; Stephens & Sullman, 2014). This aligns with the findings of Haustein et al. (2021) and Osgood et al. (2021) where a reduction on DAX scale scores were observed soon after the intervention (Osgood et al., 2021) or some reductions were observed sometime after the intervention (Haustein et al., 2021). However, unlike these other studies, and possibly due to the high ecological validity of the individualized approach, participants in the RAD reported decreases across minor aggression (i.e., verbal) and more serious aggressive use of the vehicle (such as those associated with high crash risk) as well as extreme personal physical aggression. These decreases were noted one month after the RAD and sustained four months after the RAD. One exception, personal physical aggression, which was an uncommon behavior, did not show a significant decrease until four months after that RAD. This suggests that more time was needed for drivers to associate strategies with triggers for this type of behavior.

This study was preliminary in that the outcomes relied on self-reported behavior from self-selected participants who were motivated to improve their reactivity on the road. A more formal evaluation is needed using objective measures of behavior. Although, self-reported behaviors of the DAX have shown to correlate with performance in a driving simulator (Ābele, Haustein, Møller, & Zettler, 2020) and naturalistic driving studies have shown strong correlations between behavioral data and self-reported behavior (Wang & Xu, 2019), objective evidence is required to support the RAD effectiveness. Therefore, while the self-report measures provide evidence of the success of the RAD, this could be enhanced through naturalistic driving study methodology that would not only provide objective measures for a range of driving behaviors, but also allow understanding of the types of situations under which this is most effective. Further, the use of a control group, who did not participate in the RAD (or who participated in a different course), would provide further evidence of the specific influence of the RAD approach in improving driver behavior.

Although the study achieved the purpose of providing preliminary evidence of the effectiveness of the RAD, there are some limitations that must be noted. First, there was an attrition rate of 24%. This is lower than was noted by Haustein et al. (2021) in their three-month long study (with attrition rates of 40–50% across their study protocol). Part of the attrition in the current study may be due to unforeseen lockdowns because of COVID-19, which restricted some participants' travel during the follow-up periods and some participants had not driven across that period, so could not complete the follow up. This may have also meant that for those that did travel, they had less exposure to other drivers or heavy traffic, which may have influenced how angry or aggressive they became, or their opportunities to try their generated strategies. It may also be that some of the people who did not complete the follow-up questionnaires may not have felt the RAD helped them. This is evidenced by a higher percentage of these drivers having neutral responses regarding whether they had generated effective strategies during the RAD. Finally, as mentioned above, the sample self-selected and therefore were motivated (by self or significant other) to improve their driving behavior. A more formal

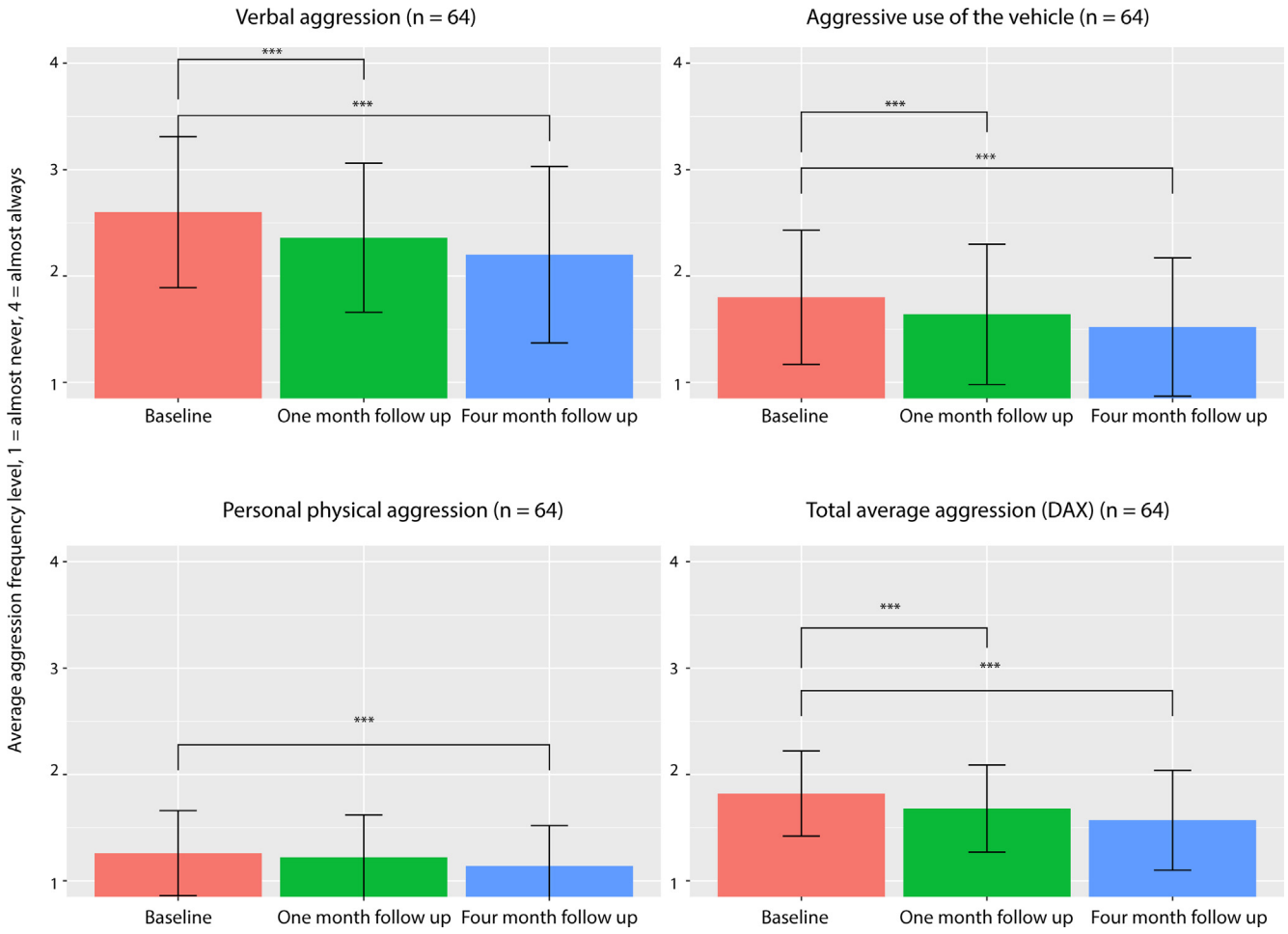

Fig. 4. Driving Anger Expression Inventory means (and standard deviations) across the study.

evaluation using a control group and/or different recruitment method could address these limitations. Future research could also incorporate more comprehensive process evaluation to understand reasons for attrition, and potential barriers to implementation of the RAD.

5. Summary and practical implications

This project has provided preliminary evidence of the effectiveness of the Reducing Aggressive Driving (RAD) program. Intervention, underpinned by behavior change principles, are needed to engage drivers in changing their own driving practices, as opposed to the traditional approach to behavior change that is based on punitive measures. Participation in safety behaviors will be more sustainable in creating a positive road safety culture and in achieving a reduction in crashes by 2030. The next step for the RAD program is to explore opportunities to create a sustainable approach in its implementation across the Australian and international driving populations. Further research is also needed to evaluate the impact of the RAD using objective measures as well as the outcomes of the RAD in reducing crashes.

Acknowledgement

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Appendix A1. Triggers for anger and aggression identified during the workshops

Source of trigger	Description
Poor planning:	Running late
	Unfamiliar route
Person centred triggers:	Bad mood, angry or stressed
	Fatigued
	Hungry
	Hot

Appendix A1 (*continued*)

Source of trigger	Description
Danger from other drivers.	Slower drivers, especially in overtaking lanes
	Unpredictable/indecisive behavior from drivers
	Reckless/dangerous behavior from drivers (tailgating, being on their phone)
	Illegal behavior
Hostility or discourtesy from other drivers	Discrimination due to displaying Learner or Probationary plates, or type of car
	Aggression from other drivers
	Lack of driving etiquette from others
Delays or interruptions to travel	Having to divert route
	Poor infrastructure
	Certain road treatments (i.e. roundabouts)
Other	Certain types of vehicles or road users
	Car-parks and parking
	Known dangers (i.e. animals at night)
	Interactions between different sized vehicles
Increased workload within the vehicle	GPS failure
	Having to interact more with brakes or gears due to the behavior of other drivers

Appendix B1. List of strategies identified during the workshops and % uptake across the 67 participants

Strategy	Classification Behavioral (B), Cognitive (C), Relaxation (R)	% of sample using at One Month (N = 67)	% of sample using at four months (N = 67)	% of sample who maintained the strategy from one to four months	Adopted over the period since the follow up
Ignore it – its not worth it	C	58	45	47	17
Play music/listen to the radio	B	51	50	100	0
$5 \times 5 \times 5$	C	49	45	70	11
Tell yourself to stay calm	C	42	45	57	24
Mindful of others – might be someone you know	C	43	37	46	21
Deep breathing	R	39	27	47	13
Self-talking – don't be the idiot	C	40		33	33
Think of the consequences – avoid a crash	C	36	37	32	35
Swearing to release anger	B	34	35	38	32
"so what" if you are late	C	34	25	38	21
Remember that it could be worse	C	31	30	46	25
Do not take it personally – they may not have intended it	C	33	39	33	39
Drive in the left lane (i.e. the slower lane)	B	31	37	48	32
Focus attention on elements of driving	C	28	39	45	39
Vent to release anger	B	27	26	40	29
Leave plenty of time for disruptions	B	30	36	38	38
Plan journey to avoid congestion/ aggression hot spots	B	28	28	31	35
Apologise – use the wave	B	26	33	39	39
Acknowledge that you can contribute to the problem	C	24	24	33	33
Acknowledge the needs of others	C	25	22	39	26
Be empathetic of other drivers "cut them some slack", they may be having a bad day	C	19	34	33	52
Use google ETA/maps to show where destination is	B	21	25	24	44
Be aware of your state of mind	C	21	10	40	6.7

(*continued on next page*)

Appendix B1 (*continued*)

Strategy	Classification Behavioral (B), Cognitive (C), Relaxation (R)	% of sample using at One Month (N = 67)	% of sample using at four months (N = 67)	% of sample who maintained the strategy from one to four months	Adopted over the period since the follow up
before driving					
Lower your expectations of others – assume they will be dangerous or act badly	C	18	36	33	56
Listen to podcasts	B	20	24	45	35
Take personal responsibility	C	21	33	44	44
Prioritise safety. things can escalate quickly	B	18	36	39	54
Self-talk, reset "maintain the flow"	C	21	9	25	12.5
Be empathetic of passengers – what are we teaching our kids? Be the driver you want them to be	C	18	18	41	29
Make a phone call	B	16	16	100	0
Try not to interpret the behavior of others	C	15	28	31	55
Personalise the driver, imagine it was your Mum, Dad, Grandparent, Sister, Boss, kids etc	C	12	21	22	56
Dissect the situation objectively (make a deeper evaluation and do not rely on stereotypes)	C	8	6	29	29
Think of what your partner/parents/ kids would say	C	8	13	8	62
Pull over/stop driving	B	5	8	40	60
Use your dash cam (record the scene or yourself for playback – do you like what you see?)	B	5	15	30	70
Telecommute to avoid traffic	B	2	2	100	0
Refocus attention on economy (i.e. fuel efficiency)	C	2	11	14	85

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