Available online at www.sciencedirect.com

ScienceDirect

Cognitive and Behavioral Practice 25 (2018) 296-309

Cognitive and Behavioral Practice

www.elsevier.com/locate/cabp

Virtual Reality and Cognitive-Behavioral Therapy for Driving Anxiety and Aggression in Veterans: A Pilot Study

Heidi M. Zinzow, Johnell O. Brooks, Patrick J. Rosopa, Stephanie Jeffirs, Casey Jenkins, Julia Seeanner, Alyssa McKeeman, Larry F. Hodges, *Clemson University*

Within the U.S. military, motor vehicle accidents (MVAs) are the leading cause of preventable morbidity and mortality. Prior combat exposure and anxiety symptoms are associated with risky and aggressive driving, which is responsible for over half of MVA fatalities. Therefore, interventions are needed to reduce driving anxiety and aggression in veterans in order to mitigate the public health impact of MVAs. Virtual reality exposure therapy (VRET) offers safe, controlled exposure to distressing stimuli. The current study piloted a novel virtual reality and cognitive behavioral intervention (VRET + CBT) for veterans that integrated both anxiety and anger management components. Virtual reality driving scenarios were delivered in a driving simulator and tailored for the military population. Six previously deployed veterans completed eight intervention sessions, as well as pre/post, one month follow-up and six to nine month follow-up assessments. Repeated measures ANOVAs demonstrated significant decline and large effect sizes for PTSD symptoms, driving phobia, hyperarousal in driving situations, anxiety/anger-related thoughts and behaviors, and risky driving. Hyperarousal in driving situations declined by 69%, aggressive driving declined by 29%, and risky driving declined by 21%. Treatment gains were maintained at follow-up. Recruitment, retention, immersion, simulator sickness scores, and qualitative feedback demonstrated feasibility of the intervention. Implications for future research and adaptation are discussed.

Driving Anxiety and Aggression in Veterans

Within the U.S. military, motor vehicle accidents (MVAs) are the leading cause of preventable morbidity and mortality (Hooper et al., 2005). Estimated costs are $36–$71 million annually in injury and property damage alone (Rossen, Pollack, Canham-Chervak, Canada, & Baker, 2011). MVAs are also a significant problem among returning veterans, particularly among those with high combat exposure (Hooper et al., 2006). Therefore, interventions are needed to reduce the prevalence of MVAs in this population.

Risky and aggressive driving is responsible for over half of MVA fatalities (106,727 out of 191,611 fatal crashes from 2003 to 2007; AAA Foundation for Traffic Safety, 2009), as well as increased risk of injury in representative samples of U.S. drivers (Wells-Parker et al., 2002). Risky and aggressive driving is particularly prevalent among veterans. In a study of posttraumatic stress disorder (PTSD) and risk taking among veterans, 72% of post-9/11 veterans reported yelling or using angry hand gestures while driving, and 59% reported sacrificing safety to speed while driving (Strom et al., 2012). One study found that 37% of combat veterans with PTSD reported aggressive driving over the past 4 months (Kuhn, Drescher, Ruzek, & Rosen, 2010). Prior combat exposure, PTSD, and anxiety symptoms serve as significant risk factors for risky and aggressive driving in active duty and veteran samples (Fear et al., 2008; Kuhn et al., 2010).

In comparison to prior conflicts, post-9/11 warfare has involved the chronic threat of roadside bombs, and improvised explosive devices (IEDs) that take place during road patrols and convoys (Seal, Bertenthal, Miner, Sen, & Marmar, 2007). Therefore, previously deployed veterans are likely to encounter a variety of trauma cues while driving (e.g., being boxed in by other cars, sighting unexpected items by the side of the road; Hannold, Classen, Winter, Lanford, & Levey, 2013; Zinzow, Brooks, & Stern, 2013). Furthermore, military personnel are often instructed in driving maneuvers that may be adaptive in combat scenarios but considered risky upon transition to civilian life (e.g., driving down the center of a lane, speeding, and not stopping; Hannold et al., 2013; Lew, Amick, Kraft, Stein, & Cifu, 2010). Not surprisingly, over half of post-9/11 veterans have reported increased postdeployment anxiety while driving (Zinzow et al., 2013), and post-9/11 veterans report particularly high rates of aggressive driving in comparison to veterans of prior conflicts (Kuhn et al., 2010).

Keywords: driving anxiety; driving anger; aggressive driving; veterans; posttraumatic stress

1077-7229/17/© 2018 Association for Behavioral and Cognitive Therapies. Published by Elsevier Ltd. All rights reserved.

Interventions for Driving Anxiety and Aggression

Since both driving anxiety and aggression are significant correlates of risky driving, efficacious interventions are likely to entail components that address each of these concerns. Furthermore, driving-related anxiety and aggression span a variety of psychological disorders, including PTSD, driving phobia, generalized anxiety disorder, panic disorder, agoraphobia, social anxiety disorder, and intermittent explosive disorder (Blanchard & Hickling, 2004; Clapp, Olsen, Danoff-Burg, et al., 2011; First, Spitzer, Williams, & Gibbon, 1995). Increasingly, transdiagnostic approaches are being applied to address clinically significant problems that cut across multiple psychological disorders (Harvey, 2004). These approaches can be employed to target common underlying factors (e.g., emotion dysregulation, negative affect). They also distill interventions by incorporating common principles from empirically supported treatments for various clinical syndromes, such as exposure therapy and cognitive restructuring (Farchione et al., 2012). An intervention that addresses both driving anxiety and aggression can be situated with these recent developments in the field of cognitive-behavioral therapies.

Exposure Therapy

Regarding treatment of anxiety disorders, exposure-based treatments represent the "gold standard" (Foa & Meadows, 1997; Hamblen, Schnurr, Rosenberg, & Eftekhari, 2009; Hood & Antony, 2012). In exposure therapy, individuals are repeatedly exposed to feared stimuli either in an imaginal fashion (e.g., imagined encounters with feared stimuli), or in vivo (i.e., confronting the actual stimulus). There are several barriers to implementing exposure therapy for driving-related anxiety, including (a) the risks of conducting exposures in actual vehicles with anxious participants, (b) inability to control in vivo exposure environments, (c) difficulties engaging in imaginal exposure, (d) unwillingness of participants to initiate in vivo exercises, and (e) risks to confidentiality of conducting exposures in public places (Beck, Palyo, Winer, Schwagler, & Ang, 2007). For example, because individuals with driving anxiety make more mistakes and have impaired driving performance in comparison to nonanxious drivers, driving in an actual vehicle may be risky (Matthews, 2001; Taylor, Deane, & Podd, 2007). Military training that emphasizes mental toughness and emotional detachment could lead to difficulty experiencing fear or actively engaging in imaginal exposure exercises, thereby inhibiting the extinction process (Creamer & Forbes, 2004). Virtual reality exposure therapy (VRET) offers an alternative treatment modality that addresses these barriers by offering safe, controlled exposure to anxiety-provoking cues in an immersive virtual environment. Furthermore, stigma is a significant barrier to care among service members (Zinzow, Britt, McFadden, Burnette, & Gillispie, 2012) and VRET can be appealing to individuals who enjoy video games and are uncomfortable talking to a mental health professional (Rizzo, Reger, Gahm, Difede, & Rothbaum, 2009).

Virtual Reality Exposure Therapy

Although VRET has been successfully applied to treatment of specific phobias and combat-related PTSD (McLay et al., 2011; Rothbaum et al., 2006), applications to driving-related anxiety have been limited to small pilot and case studies. Studies using driving simulators and gaming systems to implement VRET have reported significant reductions in PTSD (Beck et al., 2007; Walshe, Lewis, Kim, O'Sullivan, & Wiederhold, 2003) and driving phobia symptoms (Wald, 2004; Wald & Taylor, 2000, 2003; Walshe et al., 2003). Several of these interventions also included relaxation skills training and cognitive reappraisal techniques intended to reduce anxiety. None of the VRET interventions for driving anxiety were applied to military service members or included anger management components.

Anger Management Interventions

Anger management treatment generally involves cognitive-behavioral therapy (CBT) techniques such as identification of triggers and altering maladaptive thought patterns (Reilly & Shopshire, 2002). Only two known interventions have been evaluated for treatment of aggressive driving. In a controlled trial, an intervention that combined relaxation skills training and cognitive therapy evidenced greater reductions in driving anger and risky driving in comparison to relaxation alone and a control condition (Deffenbacher, Lynch, Oetting, & Swaim, 2002). In a related study that compared the combined and relaxation only conditions, the combined intervention resulted in greater reductions in risky driving and the relaxation condition resulted in greater reductions in driving anger (Deffenbacher, Huff, Lynch, Oetting, & Salvatore, 2000). A separate intervention for driving aggression was evaluated in a study by Galovski and Blanchard (2002). This group therapy intervention included education about negative consequences, motivational techniques, and relaxation training, as well as cognitive and behavioral coping strategies. The treatment group showed greater reductions in comparison to a control group on driving anger, aggressive driving, and state anxiety (Galovski & Blanchard, 2002).

Study Purpose

Although VRET has demonstrated preliminary utility for treating driving-related anxiety, prior studies have not integrated VRET and CBT methods to address both driving-related anxiety and aggression. In addition, virtual reality tools have thus far been used for exposure therapy and anxiety reduction, but could offer further utility as a

mechanism for practicing CBT coping strategies and anger management. Finally, interventions for driving anxiety and aggression have not been applied to the high-risk population of military veterans. Veterans not only represent an at-risk population but are also likely to have anxiety- and anger-provoking cues that are specific to their combat experiences. Zinzow et al. (2013) laid the groundwork for a military-specific intervention by identifying the most common distressing driving-related cues among recently deployed active duty personnel, veterans, and Army Reserves. The purpose of the current study was to evaluate a military-specific, combined VRET + CBT intervention for driving-related anxiety and aggression in previously deployed veterans. A pilot study was conducted to evaluate the feasibility and to explore the potential impact of this intervention on anxiety, aggression, and risky driving. Feasibility objectives included (a) completion of recruitment, intervention, and 1-month follow-up assessments in 1 year; (b) retention rates similar to controlled trials of clinical interventions for military populations (61–84% for military-related PTSD; Steenkamp, Litz, Hoge, & Marmar, 2015); (c) ability of the driving simulator to replicate feared situations and achieve immersion without inducing simulator sickness; and (d) participants' perceived utility of the intervention.

Material and Methods

Participants and Procedure

Participants were recruited via a local community organization that works with veterans to connect them with services and community supports. The investigators briefed staff members on the study and provided them with a written description of the study. The staff members both identified and referred veterans who they knew to have driving anxiety or aggression problems, and verbally informed their clientele and other colleagues of the study. Eligible participants included previously deployed service members who indicated moderate to high levels of driving anxiety/aggression on the Driving Behavior Survey (Clapp, Olsen, Beck, et al., 2011) and/or screened positive for driving phobia. Cutoffs for moderate to high anxiety/aggression were determined by scoring each of three subscales on a seven-item version of the Driving Behavior Survey (Performance Deficits, Exaggerated Safety/Caution Behavior, and Hostile/Aggressive Behavior). Participants who scored more than 1 standard deviation above the mean on two or more subscales were considered to meet the cutoff (above 2.7, 4.7, and 3.8, respectively). Means were derived from a general sample of undergraduate students who participated in the scale construction and validation study (Clapp, Olsen, Beck, et al., 2011). Exclusion criteria included substance use disorders (assessed by the Simple Screening Instrument for Alcohol and Other Drugs; Center for Substance Abuse Treatment, 1994); psychotic symptoms (assessed by the Screener for Psychotic Disorders From Mini Neuropsychiatric Interview; Sheehan et al., 1998), moderate to severe traumatic brain injury (assessed by Traumatic Brain Injury Screening Tool; Schwab et al., 2006), physical disabilities that impair driving (endorsed a condition or injury that affected vision, legs, or arms and prevented driving), lack of a valid driver's license, driving for less than 1 year, inability to ride in a passenger's seat in the mountains without getting motion sickness, and concurrent enrollment in therapy to address driving behavior. Exclusion criteria were listed in the recruitment materials, and no participants screened out of the study due to exclusion criteria.

Participants completed eight intervention sessions plus baseline, posttest, and 1-month follow-up assessments. Baseline assessments were completed immediately prior to Session 1 of the intervention, and posttest assessments were completed immediately after completion of Session 8. Participants also completed assessments during Sessions 2–7. Including the 1-month follow-up assessment, this resulted in nine assessment time points. Participants received $75 gift cards after completion of each of these assessment time points. Participants also completed a follow-up phone interview approximately 6–9 months following completion of the intervention, for which they were not compensated. Assessment and intervention sessions were conducted in a driving simulator lab at Clemson University's International Center for Automotive Research. The university IRB approved the study, and all participants provided written informed consent.

Feasibility Assessment

Eleven participants were referred by the community organization for veterans. Although both male and female participants were eligible, only male participants were referred. Ten participants met study criteria and screened into the intervention. All 10 met screening criteria for driving phobia. Six out of 10 reported moderate to high scores on the Driving Behavior Survey. Out of the 10 participants who screened into the intervention, 8 participated in the study. Two of the 10 did not participate due to time commitments. One of the veterans who did not participate was a 30-year-old male and one was a 34-year-old male. Enrollment was closed after 1 month because we had already recruited 7 participants. Based on funding constraints, the goal was to enlist 5 participants to complete the entire study. Enrollment was reopened for another 2 months to recruit 3 more participants after declined to participate and 1 dropped out. After enrollment closed, several veterans were referred by friends or study participants and continued to contact the investigator for the next 2 years regarding their desire to participate.

Two out of the eight participants dropped out after four sessions, and six completed all intervention sessions and the 1-month follow-up. Therefore, of participants who screened into the study, 60% were completers. Of those who agreed to participate, 75% were completers. All completers participated in the 1-month follow-up assessment, and four completers participated in the subsequent follow-up phone interview. Three of the completers had reported moderate to high scores on the Driving Behavior Survey prior to the intervention. Demographics including age, race, military experience, combat exposure, trauma history, and mental health history are provided in Table 1 for both completers and the intent-to-treat sample. All participants had been deployed to either Iraq or Afghanistan.

Recruitment took place during August 2014 and during November through December 2014. Intervention sessions took place from August 2014 to March 2015. One-month follow-up assessments took place from December 2014 to May 2015. Six to 9-month follow-up interviews took place from November 2015 through January 2016. Further elements of feasibility, including immersion in the virtual environment, simulator sickness, and participant feedback on intervention components, are described below.

Intervention

The study employed a DriveSafety CDS-250 driving simulator, featuring a partial cab, adjustable driver's seat, center console, instrument cluster, rear- and sideview mirror insets, a high-quality sound system, and standard vehicle controls (steering wheel with torque feedback, accelerator, brake, turn signals). The display consisted of three 19-inch LCD screens. The left and right screens are rotated 23° off-plane from the center screen toward the driver. Using visual compression, the three screens provide a 110° virtual field of view in a 67° physical field of view space (Goodenough, Brooks, Pagano, & Evans, 2012). All participants completed nine scenarios for adaptation and training purposes (DriveSafety scenarios: Lane Keeping Straight©, Speed Control Straight©, Lane Keeping–Changing Lanes©, Lane Keeping–Mirrors©, Pedals and Stopping©, Functional Object Detection–Basic©, Turning Left©, Turning Right©, Merging©). An additional seven scenarios were used to present participants with potentially distressing driving stimuli (DriveSafety scenarios: Functional Object Detection Roadside©, Obstacles on Hills©, Level 2 Hazards©, City and Highway©, Residential and Suburban©, Residential and Suburban–Advanced©, and City and Highway–Advanced©). Five of the scenarios were modified to incorporate multiple stimuli based on prior research with service members (Zinzow et al., 2013). The original stimuli included highways, urban and rural streets, merging, fog, and road hazards. Military-based additions included loud noises (e.g., helicopter, car backfire); unexpected items beside the road (e.g., trash bags); road construction; dead and live animals; abrupt movements by other vehicles; heavy traffic; left turns into oncoming traffic; being passed by other cars; being boxed in by other cars or impediments; tailgating vehicles; and various pedestrians, including those dressed in traditional Middle Eastern attire and/or holding objects that could resemble weapons (e.g., umbrellas, phones). A tablet PC-based operator interface allowed the clinician to select and alter the scenarios (e.g., select level of traffic, fog, tailgating vehicles).

The intervention consisted of eight 90-minute sessions that were outlined in a treatment manual. The intervention was delivered by the principal investigator, a licensed clinical psychologist. The treatment manual may be obtained from the corresponding author upon request. See Table 2 for an overview of the intervention components. The first two sessions focused on psychoeducation, relaxation skills training, developing an exposure therapy hierarchy, and an introduction to cognitive restructuring. Sessions 3–8 entailed approximately 30–40 minutes of CBT skills training, followed by exposure exercises in the driving

Table 1
Demographics for Completers and Intent-to-Treat Sample

	Age	Race	Rank	Education	Combat Exposure Scale (total score)	Combat exposure while driving	Years since deployment	Prior mental health treatment
Completers								
1	52	White	Officer	Master's	21	Yes	10	Yes
2	32	White	Enlisted	High school	27	Yes	4	No
3	31	Black	Enlisted	Associate's	18	Yes	1	No
4	49	White	Officer	Master's	9	Yes	3	Yes
5	33	White	Enlisted	Bachelor's	13	No	5	Yes
6	35	White	Enlisted	High school	28	No	4	Yes
Intent-to-treat								
1	33	White	Enlisted	High school	33	Yes	6	No
2	27	White	Enlisted	High school	31	Yes	4	Yes

Table 2
Intervention Content

Session number	Session content
1	Psychoeducation on CBT, PTSD, driving anxiety, and aggression Developing an exposure therapy hierarchy based on baseline survey Relaxation skills training Homework: breathing exercise log, self-monitoring of driving situations that cause distress, reviewing psychoeducation handouts
2	Training on the driving simulator Cognitive distortions introduction Relaxation skills training Homework: thought record, breathing exercise log
3	Exposure to driving scenarios Build on cognitive restructuring and relaxation skills Psychoeducation on anger, rationale for anger management Relaxation skills training Homework: thought records, identify relevant anger myths and develop challenges to myths
4	Exposure to driving scenarios Identifying anger triggers and cues Relaxation practice while visualizing anger-provoking scenario Identifying values and how aggression interferes with them Identifying negative consequences of their driving habits Homework: self-monitoring worksheet for anger-provoking driving situations, anger levels, aggressive behaviors used, negative consequences, values compromised
5	Exposure to driving scenarios Identifying anger cues (physical, behavioral, emotional, cognitive) Relaxation skills training Homework: self-monitoring worksheet with driving situations and identification of anger cues
6	Exposure to driving scenarios Challenging common anger-provoking thoughts Homework: worksheet to challenge additional anger-provoking thoughts
7	Exposure to driving scenarios Strategies for anger and anxiety management (e.g., time-out, distraction) Homework: self-monitoring worksheet for driving situations, skills used, skills that could have been used, obstacles to practicing skills
8	Exposure to driving scenarios Review of coping skills Relapse prevention Worksheets to identify specific triggers and cues and how to cope with them Presenting graphs of individual participant data depicting his or her symptoms over the course of treatment

Note. CBT = cognitive-behavioral therapy; PTSD = posttraumatic stress disorder.

simulator. Exposure therapy stimuli were selected prior to each session based on participants' individualized hierarchy of distressing scenarios. Participants began with least distressing scenarios and moved to most distressing. The therapist ensured that subjective units of distress (SUDS) had decreased by at least 50% from their peak over the course of an exposure exercise. Although none of the participants required repeated exposure, the scenario could be repeated if SUDS had not decreased by 50%. Each scenario took approximately 5–10 minutes to complete—therefore, participants completed approximately three to five scenarios per session. Each scenario was repeated two to three times over the course of Sessions 3–8—however, stimuli were added to each scenario to increase their challenge and to address aspects of the participant's hierarchy (e.g., tailgating, poor visibility, traffic). The therapist stood behind the participant during each exposure exercise and prompted participants to rehearse CBT skills in the simulator as appropriate to the scenario (e.g., diaphragmatic breathing, distraction from tailgaters, reframing hostile thoughts). The amount of coaching time increased as new skills were introduced. SUDS ratings were taken immediately before the exposure, halfway through, and immediately after. Participants were also prompted to report their peak SUDS after completion of each exercise. For each session, participants were

assigned homework that was reviewed at the beginning of the subsequent session.

Measures

Baseline Demographic Measures

A demographic questionnaire assessed age, race, rank, education, deployment history, mental health treatment history, and whether participants had experienced a combat-related IED, enemy fire, direct injury, or witnessed injury/death while in a vehicle.

The Combat Exposure Scale (Keane et al., 1989) is a seven-item questionnaire that assesses exposure to wartime stressors ranging from combat patrols to witnessed injury and death. Participants rated items on a 5-point scale that assessed duration, frequency, and degree of loss. A total score ranging from 0 to 41 was derived based on a sum of weighted scores ranging from "light" to "heavy" categories.

The Life Events Checklist for DSM-5 (LEC-5; Weathers, Blake, et al., 2013) is a 16-item questionnaire that assesses exposure to 16 potentially traumatic events (e.g., sexual assault, physical assault). Participants indicated whether they had learned about the events, witnessed them, or experienced them personally ("happened to me"). Coding included 1 (*witnessed or experiencing events*) and 2 (*learning about or not experiencing events*). The items were summed for a total score.

Baseline, Posttest, and 1-Month Follow-Up

The following measures were completed at baseline, posttest, and 1-month follow-up. Except where specified, mean scores were used. Means and Cronbach's alpha reliability coefficients are reported in Table 1.

The Driving Behavior Survey (Clapp, Olsen, Beck, et al., 2011) is a 21-item measure that assesses behaviors characteristic of anxious drivers and consists of three seven-item subscales: Performance Deficits, Exaggerated Safety/Caution Behavior, and Hostile/Aggressive Behavior. Participants rated items on a scale ranging from 1 (*never*) to 7 (*always*). The instrument has demonstrated adequate validity and reliability (Clapp, Olsen, Beck, et al., 2011).

The Hyperarousal in Driving Situations (Stern, Riley-Chiabotti, & Hieb, 2010; Zinzow et al., 2013) is a 23-item measure that asks how anxious, nervous, tense, or uncomfortable participants would feel in a variety of anxiety- and anger-provoking situations (e.g., being tailgated, being boxed in or surrounded by other cars, cars approaching quickly). Responses ranged from 0 (*not at all*) to 10 (*extremely*). The measure demonstrated high reliability in a prior study of Army Reserves (Zinzow et al., 2013).

The Driving Cognitions Questionnaire (Ehlers et al., 2007) is a 20-item measure that assesses anxious thoughts while driving and consists of three subscales: Panic-Related Concerns (seven items), Accident-Related Concerns (seven items), and Social-Related Concerns (six items). Participants rated items on a scale ranging from 0 (*never*) to 4 (*always*). The instrument has demonstrated good reliability and validity (Clapp, Olsen, Beck, et al., 2011; Ehlers et al., 2007).

The Risky Driving Scale is a seven item measure that assesses how regularly participants engaged in risky driving behavior over the past 30 days. Four of the items were derived from a harm risk scale for veterans with PTSD (verbal outbursts/angry gestures while driving; tailgating/cutting off/chasing other drivers; drinking/psychoactive drugs while driving; driving in an aggressive manner; Ruzek et al., 2000). Three items were derived from a study of postdeployment driving behavior among veterans (driving 10 miles over the speed limit, making turns without signaling, driving through a stop sign; Stern et al., 2010). Responses ranged from 1 (*rarely*) to 7 (*regularly*).

The Driving Violations Scale (Stern et al., 2010) is a four-item measure that assesses whether participants had received a police warning or ticket, or had experienced a crash in the past 30 days. Responses ranged from 1 (*never*) to 4 (*three or more times*).

The Structured Clinical Interview for DSM Disorders–Specific Phobia (SCID; First, Spitzer, Gibbon, & Williams, 2002) was used to assess DSM symptoms of driving phobia. The interview was adapted so that items were specific to driving and were consistent with revised DSM-5 criteria (American Psychiatric Association, 2013). Five items were scored 0 (*no*) or 1 (*sometimes* or *yes*), and summed for a total score ranging from 0 to 5. A dichotomous score was also created to represent whether the participant met DSM criteria for driving phobia (scored positively on four or more items).

The PTSD Checklist for DSM-5 (PCL-5; Weathers, Litz, et al., 2013) uses the mean of 20 items to assess DSM-5 PTSD symptoms. Participants were asked to respond to the items in reference to a traumatic event they experienced while in a vehicle, if they had experienced such an event. Otherwise, they were asked to respond in reference to the worst event they had experienced. Stressful events were defined as experiences involving "actual or threatened death, serious injury, or sexual violence." Participants rated items on a scale ranging from 0 (*not at all*) to 4 (*extremely*). A sum of all items was used to obtain a total score ranging from 0 to 80. Reliability and validity of the measure has been established (Blevins, Weathers, Davis, Witte, & Domino, 2015).

All Sessions

The following measures were administered at each assessment point (10 total), with the exception of driving frequency (not administered at the follow-up phone interview). Assessments were administered at baseline (before Session 1), six subsequent intervention sessions, posttest (after Session 8), 1-month follow-up, and a 6- to 9-month follow-up phone interview.

Hyperarousal in Driving Situations–Brief used 12 items from the full scale, based on the most frequently endorsed

anxiety- and anger-provoking situations among veterans in a prior study (Zinzow et al., 2013).

Driving frequency was assessed via one item that asked how many days over the past week (0–7 days) that the participant had driven a car.

Global driving anxiety was assessed with one item that asked, "In the past 7 days, how regularly did you feel nervous or anxious while driving?" Response options ranged from 1 (*rarely*) to 7 (*regularly*).

Global driving anger was assessed with one item that asked, "In the past 7 days, how regularly did you feel angry while driving?" with response options ranging from 1 (*rarely*) to 7 (*regularly*).

Feasibility, Qualitative Feedback, and Immersion

The Presence Questionnaire was administered after Sessions 4 and 8. The Motion Sickness Assessment Questionnaire (MSAQ)–Brief was administered before and after each driving simulator scenario. Qualitative feedback was solicited during the follow-up phone interview.

The Presence Questionnaire (Witmer & Singer, 1998) is a 19-item self-report questionnaire that was administered after Session 4 and at posttest to assess immersion experiences in the driving simulator. Responses range from 1 (*not at all*) to 7 (*very much*) and a total score was used. Items assessed included (a) the extent to which the experiences in the simulator reflect reality, (b) whether the devices used distracted from task performance, and (c) perceived control over events in the virtual reality environment. The scale was validated on a variety of virtual environments, with a mean of 98.11 (SD = 15.78) and Cronbach's alpha of .88 (Witmer & Singer, 1998).

The MSAQ (Gianaros, Muth, Mordkoff, Levine, & Stern, 2001) used four items that have been found to be most predictive of simulator sickness (Brooks et al., 2010). Participants rated the severity of three types of symptoms on a scale from 0 (*not at all*) to 10 (*severe*): (a) gastrointestinal (nauseated, might vomit), (b) central (dizzy), and (c) peripheral (sweaty). A study of 114 drivers using a comparable simulator to the one used in the current study reported means and standard deviations of queasy (M = 0.64, SD = 1.25), as if I might vomit (M = 0.01, SD = 0.08), dizzy (M = 0.56, SD = 1.25), and sweaty (M = 0.41, SD = 1.37).

The Qualitative Survey is a combination of 14 open- and close-ended questions that assessed the effects of the training, utility of the driving simulator, utility of the nonexposure CBT components, and recommendations for improving the intervention.

Results

To examine whether the intervention affected mental health and driving outcomes, one-way repeated measures analyses of variance (ANOVAs; King, Rosopa, & Minium, 2010) were conducted with the six completers. An examination of q-q plots and normality tests did not indicate violation of the normality of residuals assumption in ANOVA. In addition, Mauchly's test of sphericity indicated that the sphericity assumption was not violated—thus, adjusted df were not used. Although standard assumptions of ANOVA were not violated, as a supplemental analysis, we also conducted Friedman's test, which is the distribution-free alternative to the repeated measures F test in ANOVA (King et al., 2010). Because all Friedman's tests were consistent with the results of the F tests, we report the results of the repeated measures ANOVAs.

Variables Assessed at Baseline, Posttest, and 1-Month Follow-Up

The following scores demonstrated significant decline over time: PCL-5 (PTSD symptoms), Driving Phobia, Hyperarousal in Driving Situations (full scale), and Risky Driving (Table 3). A change of 10–20 points on the PCL-5 is considered clinically significant (Weathers, Litz, et al., 2013), and the mean change on the PCL-5 was 16.00 points from baseline to post, and 17.33 points from baseline to follow-up. This equates to a 20–21% decrease in PTSD symptoms. In addition to declining on continuous scores for driving phobia, only one participant met criteria for driving phobia at posttest and no participants met criteria for driving phobia at follow-up.

There were also significant changes on the full-scale Driving Behavior Survey, as well as all three subscales (Performance Deficits, Exaggerated Safety/Caution, and Aggressive Driving). Finally, results indicated significant changes on the full scale of the Driving Cognitions Scale, as well as on all three subscales: Panic-Related Concerns, Accident-Related Concerns, and Social Concerns. With the exception of anxiety-based performance deficits (which remained the same), all scores continued to decline from posttest to follow-up. No significant changes in driving violations were found. From baseline to follow-up the largest effects were observed for the Driving Situations Scale (69% decrease in mean scores, partial eta squared = .88), Aggressive Driving (29% decrease in mean scores, partial eta squared = .88), and Risky Driving (21% decrease in mean scores, partial eta squared = .87).

Variables Assessed at All Assessment Points

Repeated measures ANOVAs examined changes on variables that were measured at all assessment points. The first set of analyses excluded the follow-up phone interview data because only four of six completers participated in the interview (9 time points). The second set of analyses included the follow-up phone interview data (10 time points).

Table 3
Repeated Measures Analysis of Intervention Effects on Study Outcomes

Variable	Baseline		Posttest		Follow-up						
	M	*SD*	*M*	*SD*	*M*	*SD*	α	*F*(2, 10)	Partial Eta sq	F_{linear} (1, 5)	Partial Eta sq
PCL-5	30.33	14.01	14.33	14.51	13.00	8.34	.86–.96	11.43**	0.70	36.44**	0.88
SCID–Driving Phobia	4.20	0.45	1.40	1.67	1.00	1.00	—	24.65***	0.86	73.14**	0.95
Hyperarousal in Driving Situations	4.44	1.55	1.39	0.92	1.01	0.74	.88–.98	34.99***	0.88	38.73**	0.89
Driving Frequency	4.67	1.33	4.08	0.74	4.17	0.61	—	1.00	0.17	0.88	0.15
Driving Violations Scale	1.00	0.00	1.08	0.20	1.00	0.00	—	—		—	
Risky Driving Scale	3.21	0.91	1.79	0.69	1.74	0.54	.71–.72	34.74***	0.87	46.20**	0.90
Driving Behavior Survey (full scale)	3.37	0.51	2.16	0.75	1.91	0.59	.87–.93	30.96***	0.86	391.12***	0.99
Anxiety-Based Performance Deficits	2.50	0.66	1.55	0.51	1.55	0.45	.64–.86	29.41***	0.86	33.90**	0.87
Exaggerated Safety/Caution	3.94	0.59	3.12	1.18	2.55	0.88	.59–.89	4.66*	0.48	22.86**	0.82
Hostile/Aggressive Behavior	3.71	1.18	1.81	0.99	1.64	0.62	.88–.96	37.97***	0.88	66.05***	0.93
Driving Cognitions Questionnaire (full scale)	0.82	0.42	0.49	0.32	0.28	0.25	.82–.92	18.98***	0.72	28.20**	0.85
Panic-Related Concerns	0.55	0.38	0.21	0.25	0.14	0.22	.52–.71	9.02**	0.64	11.56*	0.70
Accident-Related Concerns	1.17	0.63	0.81	0.33	0.40	0.35	.60–.79	16.68**	0.77	22.86**	0.82
Social Concerns	0.72	0.40	0.44	0.43	0.28	0.31	.62–.90	5.39*	0.52	7.81*	0.61

Note. $N = 6$; *M* = mean; *SD* = standard deviation; α = Cronbach's alpha; F_{linear} refers to the test for the linear trend; PCL-5 = PTSD Checklist-5; SCID = Structured Clinical Interview for DSM Disorders; — indicates cannot be calculated because no variability.
*$p < .05$, **$p < .01$, ***$p < .001$.

In the first set of analyses, three primary outcomes exhibited significant decline over time. First, Hyperarousal in Driving Situations–Brief declined: $F(8, 40) = 29.04$, $p < .001$, partial eta squared = 0.85; $F_{linear}(1, 5) = 339.44$, $p < .001$, partial eta squared = 0.98. Global Driving Anger declined: $F(8, 40) = 7.46$, $p < .001$, partial eta squared = 0.60; $F_{linear}(1, 5) = 23.69$, $p < .01$, partial eta squared = 0.83. Finally, Global Driving Anxiety declined: $F(8, 40) = 5.30$, $p < .001$, partial eta squared = 0.51; $F_{linear}(1, 5) = 10.82$, $p < .05$, partial eta squared = 0.68. Figures 1–3 depict changes over time for these variables for each participant. No changes in driving frequency were observed.

In the second set of analyses (including follow-up phone interview), significant decline was again observed on the three primary outcomes. First, Hyperarousal in Driving Situations declined: $F(9, 27) = 15.82$, $p < .001$, partial eta squared = 0.98; $F_{linear}(1, 3) = 119.85$, $p < .01$, partial eta squared = 0.98. Second, Global Driving Anger declined: $F(9, 27) = 4.01$, $p < .01$, partial eta squared = 0.57; $F_{linear}(1, 3) = 10.51$, $p < .05$, partial eta squared = 0.78. Finally, Global Driving Anxiety declined: $F(9, 27) = 3.31$, $p < .01$, partial eta squared = 0.52; $F_{linear}(1, 3) = 4.66$, $p = .12$, partial eta squared = 0.61. For all analyses except Driving Frequency, partial eta squared values ranged from .48 to .88. These values were well above the 0.25 suggested cutoff for considering an effect size to be large (Cohen, 1988).

Immersion, Simulator Sickness, and Participant Feedback

Means on the Presence Questionnaire after Session 4 were 86.62 ($SD = 11.21$) and after posttest were 89.17 ($SD = 6.24$). Although lower means were not significantly different from the mean on the normative sample ($M = 98.11$, $SD = 15.78$; Session 4: $t(157) = 1.90$, $p = .06$; posttest: $t(156) = 1.38$, $p = 0.17$).

Means on the MSAQ–Brief were queasy ($M = 0.00$, $SD = 0.00$), as if I might vomit ($M = 0.00$, $SD = 0.00$), dizzy ($M = 0.04$, $SD = 0.32$), and sweaty ($M = 0.13$, $SD = 0.54$). These means were well below the levels of simulator sickness reported in a validation study of the MSAQ (Brooks et al., 2010).

Four participants completed the follow-up phone interview and provided qualitative feedback. All four participants indicated that the intervention had a positive impact on (a) driving anxiety; (b) driving anger or aggression; and (c) other forms of worry, distress, relationship issues, work issues, or problems. Sample quotes include "Overall my driving experience has reduced in stress and anxiety tremendously. Aggressiveness has also dramatically decreased," "[The intervention] reinforced calming down in all areas of my life," "I'm a calmer person overall and calmer while driving," "I am not an angry driver any more," "[Anxiety] is more manageable when driving," and "I'm a happier driver. My family doesn't fuss in the car." All of the participants felt that the CBT strategies learned outside of the simulator were useful, and all would recommend the training to another veteran. Examples include "The biggest take-away for me was the awareness that I feel like that when in those situations in the car," "[The CBT educational piece] was the best part of the study. Finding

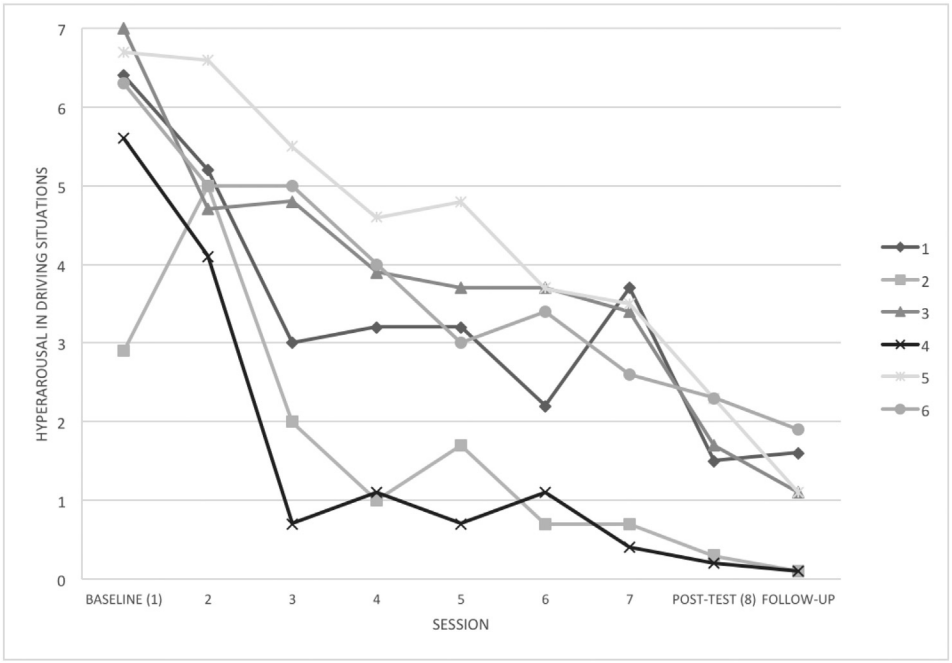

Figure 1. Mean hyperarousal in driving situations over time.

ways to cope and being able to talk about it worked best for me," and "Relaxation techniques were the most helpful."

Three out of four phone interview participants agreed that (a) the intervention had a positive impact on driving behavior or risky driving, (b) the driving simulator was a useful tool in addressing driving anxiety and aggression, (c) the combination of the simulator and CBT strategies added value to CBT alone, and (d) they were able to apply the strategies to real-life situations. Regarding the impact on risky driving, participants stated: "It got rid of engaging in risky driving," "Decreased tailgating," "I try to stay in my lane and slow down," and "I move over when being tailgated." Participants indicated that the CBT strategies (e.g., relaxation skills, self-monitoring, cognitive restructuring) were the most essential piece, but that the

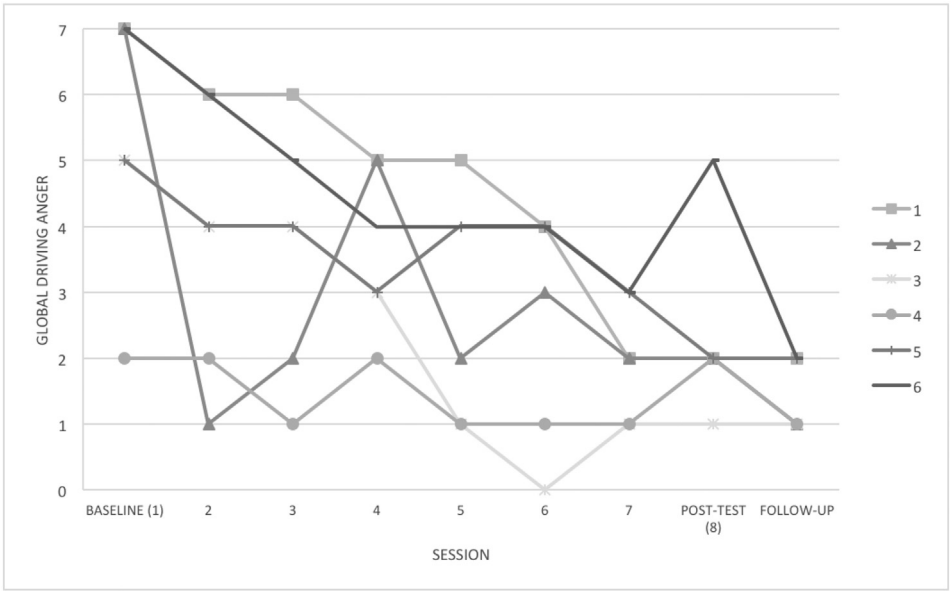

Figure 2. Global driving anger over time.

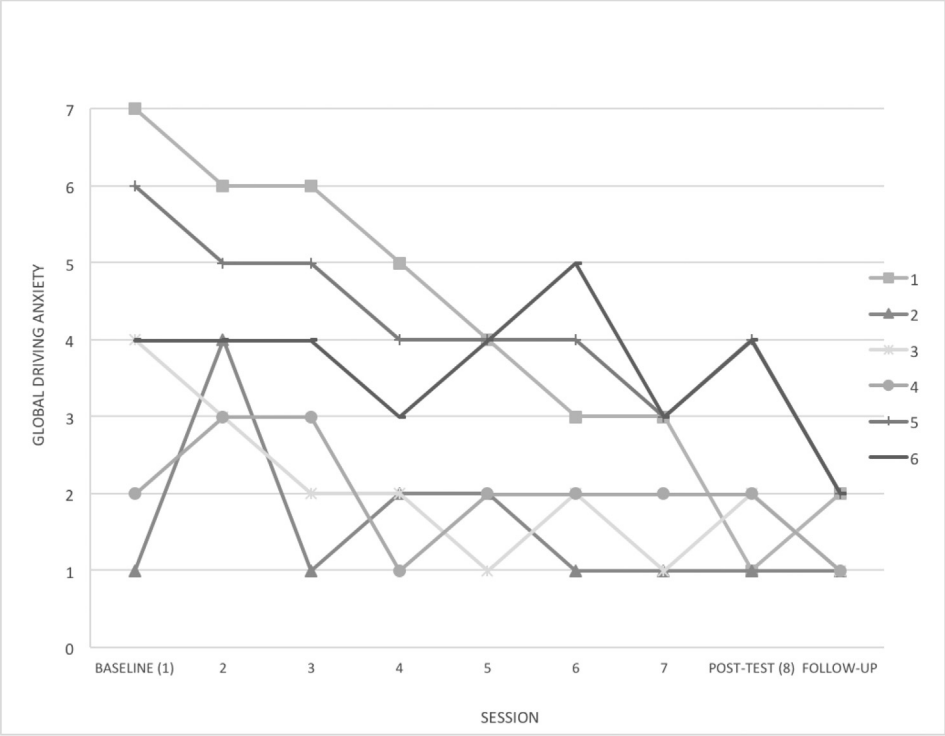

Figure 3. Global driving anxiety over time.

simulator was important for applying what they had learned. For example, participants described the strengths of the intervention as "identification of the issue and then applying it in the simulator," "being able to practice relaxation techniques while in the driving simulator," and "the education part and intertwining that part with the driving simulator part." One participant stated, "[The therapist] listened and was able to tie in what you talked about to the driving scenes." Another noted that "You need the driving simulator part to apply what [the therapist] talked about. You need both parts for sure." Regarding the most useful driving scenarios, two participants stated a dog running out in front of the car and other cars slamming on brakes were most effective. Another stated, "Being boxed in. People walking out in front of you."

Three participants disagreed that the intervention would be effective if shortened by two to three sessions. Three participants commented that the virtual realism of the driving simulator scenarios should be improved. For example, "The simulator sometimes irritated me because it was not as realistic," "It felt like playing a video game. Needs to be more realistic," and "Make it more realistic without making me sick." One suggested that a final in vivo exposure component of the intervention should be added (i.e., driving in an actual car). One participant noted that he was attracted to the intervention because it involved virtual reality components, and that it was described as "skills training" as opposed to "counseling" or "therapy." Another participant commented that he thought the intervention should be part of reintegration training for everyone during the first month, with the CBT skills delivered in small groups.

Other comments were provided from participants during the course of the intervention, particularly regarding stimuli that could be added to incorporate other forms of anger- and anxiety-provoking stimuli. These included potholes that look freshly patched, smells like burning rubber, simulation of being a passenger, horns honking in traffic, and shouting voices while stopped in the city.

Discussion

Findings from this pilot study demonstrated feasibility of a virtual reality, cognitive-behavioral intervention for driving anxiety and aggression in veterans. In contrast to prior studies, this intervention targeted both driving anxiety and aggression in a high-risk population. It also employed a driving simulator as a versatile tool for both anxiety reduction and rehearsal of CBT skills. Both feasibility and potential impact of the intervention were supported.

Regarding feasibility, goals for recruitment and retention were reached. Enrollment goals were met during the 1- to 2-month enrollment periods, and veterans continued to make inquiries beyond the enrollment periods. Our recruitment strategies were limited to a few staff members

at one veterans' organization, and a much larger group of participants for a controlled trial could likely have been recruited by expanding to Veterans Affairs health care facilities and broader marketing strategies. The intervention and 1-month follow-up assessments were completed within 8–9 months. The 75% retention rate is consistent with prior controlled trials with military-specific interventions (Steenkamp et al., 2015).

Findings also supported the feasibility of using a driving simulator to implement a combined VRET and CBT intervention for driving anxiety and aggression. Results from the MSAQ indicated that participants experienced minimal simulator sickness using the format of a partial cab and three-screen display. Results from the Presence Questionnaire indicated that immersion and perceived reality within the driving simulator was somewhat lower, but not significantly different from prior studies. However, qualitative feedback indicated that many participants felt that the realism of the simulator could be improved. Despite this perceived lack of realism, most indicated it as a useful tool and exhibited treatment gains after completing the intervention. Participants specifically commented on the utility of practicing CBT techniques in the simulator and felt that the simulator added value to the skills training components. Participant feedback indicated that the intervention not only reduced driving anxiety and aggression but had broader effects on quality of life. The comment regarding conceptualizing the intervention as virtual reality-based skills training highlighted the potential value of reducing stigma via this treatment modality.

Participants in the intervention reported significant changes on all anxiety- and aggression-relevant outcomes, and effect sizes were large for each of these measures. In addition, all treatment gains were maintained at follow-up and scores declined from posttest to follow-up. In reference to anxiety, participants reported declines on anxious thoughts, behaviors, and clinical symptoms of PTSD and driving phobia. Participants also reported declines in perceived hyperarousal during driving situations that are frequently distressing for previously deployed veterans. Not only were these changes statistically significant but clinically significant change was observed on both PTSD and driving phobia measures. Participants also indicated that changes were not restricted to driving, and that they noticed improvements in other areas of their lives.

Results furthermore demonstrated significant change on measures of driving aggression and anger. Both aggressive behavior and global driving anger scores declined. Although not directly targeted by the intervention, participants also reported decreases in risky driving behavior. Future research is needed to determine whether anxiety and anger management interventions such as these could indirectly reduce risky driving and MVAs, thereby exerting a meaningful public health impact.

No changes were observed on driving frequency or violations. Participants were already driving on most days of the week prior to the intervention, and primarily reported avoiding specific situations (e.g., busy roads) as opposed to driving altogether. Therefore, anxiety-related avoidance was likely better assessed by the other driving anxiety measures. Violations likely did not change significantly because they are low base rate phenomena (e.g., crashes) and therefore risk for violations may be best captured by the risky and aggressive driving measures.

Limitations and Future Directions

Limitations of the study include small sample size and lack of a control group. A randomized controlled trial comparing the intervention to a control condition is needed to establish efficacy, and to compare the relative efficacy of VRET versus other forms of CBT. A larger study would also allow for implementation by multiple therapists, thereby controlling for therapist effects. Another limitation is the study's reliance on self-report data. Future studies could be improved by incorporating behavioral assessments such as behavioral avoidance tests and driving skills observations. Beyond the assessments of driving anger and aggression used in this study, there are other well-validated measures of these constructs that could be used in subsequent studies (e.g., the Driving Anger Scale; Deffenbacher, Oetting, & Lynch, 1994). As opposed to the global ratings of anger and anxiety that were employed at each session, lengthier measures may more accurately assess these constructs. In addition, a few of the measures had Cronbach's alpha coefficients less than .80, indicating potential problems with reliability (Risky Driving Scale, Panic-Related Concerns, Accident-Related Concerns). While this is likely due to small sample size and low base rates for certain risky driving behaviors, the inclusion of further measures to assess these constructs may be warranted. Another consideration regarding the measures was that risky driving and violations were assessed in reference to a 30-day time frame, meaning that the posttest assessment time frame overlapped with the last half of the intervention. The posttest may therefore not reliably indicate postintervention status, and the follow-up assessment is likely the best indicator of pre-/postchange. Measures such as these pose a challenge due to the infrequency of certain risky behaviors, necessitating the use of broad time frames and/or lengthy instruments. Social desirability may also attenuate reporting on these measures (e.g., underreporting use of alcohol or other drugs prior to driving). Finally, the analyses were conducted on treatment completers (not intent to treat), limiting generalizability of findings to those who completed the intervention.

These findings suggest several avenues for future research and practice. First, controlled trials are needed

to determine whether a VRET intervention improves efficacy beyond CBT without virtual reality components. The added benefits of virtual reality intervention components need to be established in order to determine that they outweigh the costs of making these tools widely available. However, this study supports further pursuit of this line of inquiry, given participant feedback highlighting the utility of combining CBT with driving simulator exercises. Per participant recommendations, the utility could be even further enhanced with improved virtual immersion and realism. As described below, there may also be ways to improve cost effectiveness of virtual reality therapy.

Intervention studies can also help determine the minimum number of sessions needed to accomplish clinically significant change. Participants generally felt that the intervention length should not be shortened, and in fact that the intervention could be extended to include in vivo components. However, veterans encounter multiple barriers to care that could make lengthier interventions difficult to implement (Zinzow et al., 2012).

If the intervention's efficacy is established, several options could be explored to improve cost effectiveness and widespread dissemination. These include developing and evaluating the use of easily transportable driving systems, and use of driving simulators that are already in place at rehabilitation facilities. Collaboration across disciplines and health care settings will also be needed to disseminate interventions for driving anxiety and aggression. For example, occupational therapists who provide driving rehabilitation need the skills and resources to address anxiety and aggressive behavior that arises during treatment. Finally, the intervention could be adapted and evaluated for its application to other high-risk populations, including men, young drivers, and individuals with clinical disorders such as panic disorder and intermittent explosive disorder.

Conclusions

In sum, this VRET + CBT intervention employed a novel approach to addressing both driving anxiety and aggression in a high-risk population of military veterans. Driving simulators offer prospects to reduce risk, improve customization, and increase feasibility of exposure exercises. Simulators also offer opportunities for simultaneously rehearsing anger management, safe driving, and related CBT skills. Larger controlled trials of VRET + CBT interventions for driving anxiety and aggression are needed to determine whether such an approach could ultimately reduce risky driving and MVAs. Innovative transdiagnostic approaches such as these are needed to address problems that cut across psychological disorders and contribute to morbidity, mortality, and functional impairment.

References

AAA Foundation for Traffic Safety. (2009). *Aggressive driving: Research update*. Washington, DC: Author.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, VA: Author.

Beck, J. G., Palyo, S. A., Winer, E. H., Schwagler, B. E., & Ang, E. J. (2007). Virtual reality exposure therapy for PTSD symptoms after a road accident: An uncontrolled case series. *Behavior Therapy*, *38*(1), 39–48. https://doi.org/10.1016/j.beth.2006.04.001

Blanchard, E. B., & Hickling, E. J. (2004). *After the crash: Psychological assessment and treatment of survivors of motor vehicle accidents*. Washington, DC: American Psychological Association. https://doi.org/10.1037/10676-000

Blevins, C. A., Weathers, F. W., Davis, M. T., Witte, T. K., & Domino, J. L. (2015). The Posttraumatic Stress Disorder Checklist for DSM-5 (PCL-5): Development and initial psychometric evaluation. *Journal of Traumatic Stress*, *28*(6), 489–498. https://doi.org/10.1002/jts.22059

Brooks, J. O., Goodenough, R. R., Crisler, M. C., Klein, N. D., Alley, R. L., Koon, B. L., . . . Wills, R. F. (2010). Simulator sickness during driving simulation studies. *Accident Analysis and Prevention*, *42*(3), 788–796. https://doi.org/10.1016/j.aap.2009.04.013

Center for Substance Abuse Treatment. (1994). *Simple screening instruments for outreach for alcohol and other drug abuse and infectious diseases*. Rockville, MD: Substance Abuse and Mental Health Services Administration.

Clapp, J. D., Olsen, S. A., Beck, J. G., Palyo, S. A., Grant, D. M., Gudmundsdottir, B., & Marques, L. (2011). The Driving Behavior Survey: Scale construction and validation. *Journal of Anxiety Disorders*, *25*(1), 96–105. https://doi.org/10.1016/j.janxdis.2010.08.008

Clapp, J. D., Olsen, S. A., Danoff-Burg, S., Hagewood, J. H., Hickling, E. J., Hwang, V. S., & Beck, J. G. (2011). Factors contributing to anxious driving behavior: The role of stress history and accident severity. *Journal of Anxiety Disorders*, *25*(4), 592–598. https://doi.org/10.1016/j.janxdis.2011.01.008

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Erlbaum.

Creamer, M., & Forbes, D. (2004). Treatment of posttraumatic stress disorder in military and veteran populations. *Psychotherapy: Theory, Research, Practice, Training*, *41*(4), 388–398. https://doi.org/10.1037/0033-3204.41.4.388

Deffenbacher, J. L., Huff, M. E., Lynch, R. S., Oetting, E. R., & Salvatore, N. F. (2000). Characteristics and treatment of high-anger drivers. *Journal of Counseling Psychology*, *47*(1), 5. https://doi.org/10.1037/0022-0167.47.1.5

Deffenbacher, J. L., Lynch, R. S., Oetting, E. R., & Swaim, R. C. (2002). The Driving Anger Expression Inventory: A measure of how people express their anger on the road. *Behaviour Research and Therapy*, *40*(6), 717–737. https://doi.org/10.1016/S0005-7967(01)00063-8

Deffenbacher, J. L., Oetting, E. R., & Lynch, R. S. (1994). Development of a Driving Anger Scale. *Psychological Reports*, *74*(1), 83–91. https://doi.org/10.2466/pr0.1994.74.1.83

Ehlers, A., Taylor, J. E., Ehring, T., Hofmann, S. G., Deane, F. P., Roth, W. T., & Podd, J. V. (2007). The Driving Cognitions Questionnaire: Development and preliminary psychometric properties. *Journal of Anxiety Disorders*, *21*(4), 493–509. https://doi.org/10.1016/j.janxdis.2006.08.002

Farchione, T. J., Fairholme, C. P., Ellard, K. K., Boisseau, C. L., Thompson-Hollands, J., Carl, J. R., . . . Barlow, D. H. (2012). Unified protocol for transdiagnostic treatment of emotional disorders: A randomized controlled trial. *Behavior Therapy*, *43*(3), 666–678. https://doi.org/10.1016/j.beth.2012.01.001

Fear, N. T., Iversen, A. C., Chatterjee, A., Jones, M., Greenberg, N., Hull, L., . . . Wessely, S. (2008). Risky driving among regular armed forces personnel from the United Kingdom. *American Journal of Preventive Medicine*, *35*(3), 230–236. https://doi.org/10.1016/j.amepre.2008.05.027

First, M. B., Spitzer, R. L., Gibbon, M., & Williams, J. B. W. (2002). *Structured Clinical Interview for DSM-IV-TR Axis I Disorders, Research*

Version, Non-Patient Edition. New York: Biometrics Research, New York State Psychiatric Institute.

First, M. B., Spitzer, R. L., Williams, J. B. W., & Gibbon, M. (1995). *Structured Clinical Interview for DSM-IV-Patient Edition*. Washington, DC: American Psychiatric Press.

Foa, E. B., & Meadows, E. A. (1997). Psychosocial treatments for posttraumatic stress disorder: A critical review. *Annual Review of Psychology*, *48*, 449–480. https://doi.org/10.1146/annurev.psych.48.1.449

Galovski, T. E., & Blanchard, E. B. (2002). The effectiveness of a brief psychological intervention on court-referred and self-referred aggressive drivers. *Behaviour Research and Therapy*, *40*(12), 1385–1402. https://doi.org/10.1016/S0005-7967(01)00100-0

Gianaros, P. J., Muth, E. R., Mordkoff, J. T., Levine, M. E., & Stern, R. M. (2001). A questionnaire for the assessment of the multiple dimensions of motion sickness. *Aviation, Space, and Environmental Medicine*, *72*(2), 115.

Goodenough, R. R., Brooks, J. O., Pagano, C., & Evans, D. F. (2012). Display configurations in a small footprint clinical driving simulator. *Displays*, *33*(4), 196–205. https://doi.org/10.1016/j.displa.2012.05.002

Hamblen, J., Schnurr, P. P., Rosenberg, A., & Eftekhari, A. (2009). A guide to the literature on psychotherapy for PTSD. *Psychiatric Annals*, *39*(6), 348–354. https://doi.org/10.3928/00485713-20090515-02

Hannold, E. M., Classen, S., Winter, S., Lanford, D. N., & Levey, C. E. (2013). Exploratory pilot study of driving perceptions among OIF/OEF veterans with mTBI and PTSD. *Journal of Rehabilitation Research and Development*, *50*(10), 1315–1330. https://doi.org/10.1682/JRRD.2013.04.0084

Harvey, A. G. (2004). *Cognitive behavioural processes across psychological disorders: A transdiagnostic approach to research and treatment*. USA: Oxford University Press.

Hood, H. K., & Antony, M. M. (2012). Evidence-based assessment and treatment of specific phobias in adults. In T. E. Davis III, T. H. Ollendick, & L. -G. Öst (Eds.), *Intensive one-session treatment of specific phobias* (pp. 19–42). New York, NY: Springer. https://doi.org/10.1007/978-1-4614-3253-1_2

Hooper, T. I., DeBakey, S. F., Bellis, K. S., Kang, H. K., Cowan, D. N., Lincoln, A. E., & Gackstetter, G. D. (2006). Understanding the effect of deployment on the risk of fatal motor vehicle crashes: A nested case-control study of fatalities in Gulf War era veterans, 1991–1995. *Accident Analysis and Prevention*, *38*(3), 518–525. https://doi.org/10.1016/j.aap.2005.11.009

Hooper, T. I., Debakey, S. F., Lincoln, A., Kang, H. K., Cowan, D. N., & Gackstetter, G. D. (2005). Leveraging existing databases to study vehicle crashes in a combat occupational cohort: Epidemiologic methods. *American Journal of Industrial Medicine*, *48*(2), 118–127. https://doi.org/10.1002/ajim.20190

Keane, T. M., Fairbank, J. A., Caddell, J. M., Zimering, R. T., Taylor, K. L., & Mora, C. A. (1989). Clinical evaluation of a measure to assess combat exposure. *Psychological Assessment*, *1*(1), 53–55. https://doi.org/10.1037/1040-3590.1.1.53

King, B. M., Rosopa, P. J., & Minium, E. W. (2010). *Statistical reasoning in the behavioral sciences*. Hoboken, NJ: Wiley Global Education.

Kuhn, E., Drescher, K., Ruzek, J., & Rosen, C. (2010). Aggressive and unsafe driving in male veterans receiving residential treatment for PTSD. *Journal of Traumatic Stress*, *23*(3), 399–402. https://doi.org/10.1002/jts.20536

Lew, H. L., Amick, M. M., Kraft, M., Stein, M. B., & Cifu, D. X. (2010). Potential driving issues in combat returnees. *NeuroRehabilitation*, *26*(3), 271–278. https://doi.org/10.3233/NRE-2010-0562

Matthews, G. (2001). A transactional model of driver stress. In P. A. Hancock & P. A. Desmond (Eds.), *Stress, workload, and fatigue* (pp. 133–161). Mahwah, NJ: Erlbaum. https://doi.org/10.1080/14639220210124120

McLay, R. N., Wood, D. P., Webb-Murphy, J. A., Spira, J. L., Wiederhold, M. D., Pyne, J. M., & Wiederhold, B. K. (2011). A randomized, controlled trial of virtual reality-graded exposure therapy for post-traumatic stress disorder in active duty service members with combat-related post-traumatic stress disorder. *Cyberpsychology, Behavior and Social Networking*, *14*(4), 223–229. https://doi.org/10.1089/cyber.2011.0003

Reilly, P. M., & Shopshire, M. S. (2002). *Anger management for substance abuse and mental health clients: A cognitive behavioral therapy manual*. Washington, DC: U.S. Department of Health and Human Services, Substance Abuse and Mental Health Services Administration, Center for Substance Abuse Treatment.

Rizzo, A., Reger, G., Gahm, G., Difede, J., & Rothbaum, B. O. (2009). Virtual reality exposure therapy for combat-related PTSD. In J. E. LeDoux, T. Keane, & P. Shiromani (Eds.), *Post-traumatic stress disorder* (pp. 375–399). New York, NY: Humana Press. https://doi.org/10.1007/978-1-60327-329-9_18

Rossen, L. M., Pollack, K. M., Canham-Chervak, M., Canada, S., & Baker, S. P. (2011). Motor vehicle accidents among active duty US Army personnel, 1999 to 2006. *Military Medicine*, *176*(9), 1019–1026.

Rothbaum, B. O., Anderson, P., Zimand, E., Hodges, L., Lang, D., & Wilson, J. (2006). Virtual reality exposure therapy and standard (in vivo) exposure therapy in the treatment of fear of flying. *Behavior Therapy*, *37*(1), 80–90. https://doi.org/10.1016/j.beth.2005.04.004

Ruzek, J. I., Sherker, J., Dorian, E., Ziller, M., Huss, M., & Drescher, K. (2000). *The High Risk Behaviors Questionnaire*. Washington, DC: VA National Center for PTSD.

Schwab, K. A., Baker, G., Ivins, B., Sluss-Tiller, M., Lux, W., & Warden, D. (2006). The Brief Traumatic Brain Injury Screen (BTBIS): Investigating the validity of a self-report instrument for detecting traumatic brain injury (TBI) in troops returning from deployment in Afghanistan and Iraq. *Neurology*, *66*(5, Suppl. 2), A235.

Seal, K. H., Bertenthal, D., Miner, C. R., Sen, S., & Marmar, C. (2007). Bringing the war back home: Mental health disorders among 103 788 US veterans returning from Iraq and Afghanistan seen at Department of Veterans Affairs Facilities. *Archives of Internal Medicine*, *167*(5), 476–482. https://doi.org/10.1001/archinte.167.5.476

Sheehan, D., Lecubrier, Y., Sheehan, K., Amorim, P., Janays, J., Weileer, E., . . . Dunbar, G. (1998). The Mini-International Nueropsychiatric Interview (M.I.N.I.): The development and validation of a structured diagnostic psychiatric interview for DSM-IV and ICD-10. *Journal of Clinical Psychiatry*, *59*, 22–23.

Steenkamp, M. M., Litz, B. T., Hoge, C. W., & Marmar, C. R. (2015). Psychotherapy for military-related PTSD: A review of randomized clinical trials. *Journal of the American Medical Association*, *314*(5), 489–500. https://doi.org/10.1001/jama.2015.8370

Stern, E., Riley-Chiabotti, L., & Hieb, A. (2010). *Shifting gears: Post deployment driving after service in Iraq and Afghanistan*. Paper presented at the American Occupational Therapy Association Convention, Orlando, FL.

Strom, T. Q., Leskela, J., James, L. M., Thuras, P. D., Voller, E., Weigel, R., . . . Holz, K. B. (2012). An exploratory examination of risk-taking behavior and PTSD symptom severity in a veteran sample. *Military Medicine*, *177*(4), 390–396. https://doi.org/10.7205/MILMED-D-11-00133

Taylor, J., Deane, F. P., & Podd, J. V. (2007). Driving fear and driving skills: Comparison between fearful and control samples using standardised on-road assessment. *Behaviour Research and Therapy*, *45*(4), 805–818. https://doi.org/10.1016/j.brat.2006.07.007

Wald, J. (2004). Efficacy of virtual reality exposure therapy for driving phobia: A multiple baseline across-subjects design. *Behavior Therapy*, *35*(3), 621–635. https://doi.org/10.1016/S0005-7894(04)80035-2

Wald, J., & Taylor, S. (2000). Efficacy of virtual reality exposure therapy to treat driving phobia: A case report. *Journal of Behavior Therapy and Experimental Psychiatry*, *31*(3), 249–257. https://doi.org/10.1016/S0005-7916(01)00009-X

Wald, J., & Taylor, S. (2003). Preliminary research on the efficacy of virtual reality exposure therapy to treat driving phobia. *CyberPsychology and Behavior*, *6*(5), 459–465. https://doi.org/10.1089/109493103769710488

Walshe, D. G., Lewis, E. J., Kim, S. I., O'Sullivan, K., & Wiederhold, B.K. (2003). Exploring the use of computer games and virtual reality in exposure therapy for fear of driving following a motor vehicle accident. *CyberPsychology and Behavior*, *6*(3), 329–334. https://doi.org/10.1089/109493103322011641

Weathers, F. W., Blake, D. D., Schnurr, P. P., Kaloupek, D. G., Marx, B. P., & Keane, T. M. (2013). *The Life Events Checklist for DSM-5* (LEC-5).

Washington, DC: National Center for PTSD. Available at www.ptsd.va.gov.

Weathers, F. W., Litz, B. T., Keane, T. M., Palmieri, P. A., Marx, B. P., & Schnurr, P. P. (2013). *The PTSD Checklist for DSM-5* (PCL-5). Washington, DC: National Center for PTSD. Available at www.ptsd.va.gov.

Wells-Parker, E., Ceminsky, J., Hallberg, V., Snow, R. W., Dunaway, G., Guiling, S., . . . Anderson, B. (2002). An exploratory study of the relationship between road rage and crash experience in a representative sample of US drivers. *Accident Analysis and Prevention*, *34*(3), 271–278. https://doi.org/10.1016/S0001-4575(01)00021-5

Witmer, B. G., & Singer, M. J. (1998). Measuring presence in virtual environments: A presence questionnaire. *Presence: Teleoperators and virtual environments*, *7*(3), 225–240

Zinzow, H. M., Britt, T. W., McFadden, A. C., Burnette, C. M., & Gillispie, S. (2012). Connecting active duty and returning veterans to mental health treatment: Interventions and treatment adaptations that may reduce barriers to care. *Clinical Psychology Review*, *32*(8), 741–753. https://doi.org/10.1016/j.cpr.2012.09.002

Zinzow, H. M., Brooks, J., & Stern, E. B. (2013). Driving-related anxiety in recently deployed service members: Cues, mental health correlates, and help-seeking behavior. *Military Medicine*, *178*(3), e357–e361. https://doi.org/10.7205/MILMED-D-12-0030

This work was supported by the South Carolina Clinical and Translational Research (SCTR) Institute, with an academic home at the Medical University of South Carolina CTSA, NIH/NCATS grant UL1TR000062. The contents are solely the responsibility of the authors and do not necessarily represent the official views of the NIH or NCATS. The authors declare that there are no conflicts of interest.

Address correspondence to Heidi M. Zinzow, Ph.D., Department of Psychology, Clemson University, 418 Brackett Hall, Clemson, SC 29634; e-mail: hzinzow@clemson.edu.

Received: September 20, 2016
Accepted: September 2, 2017
Available online 29 September 2017