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TITLE: Reintegrating Troops with Mild Traumatic Brain Injury (mTBI) into Their Communities: Understanding the Scope and Timeline of Post-Deployment Driving Problems.

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<b>13. SUPPLEMENTARY NOTES</b> –					
<b>14. ABSTRACT</b> This study examines the extent to which combat driving behaviors and anxieties are carried-over into driving on American roads post-deployment from service in Operation Enduring Freedom/Operation Iraqi Freedom/Operation New Dawn (OEF/OIF/OND) and to compare such behaviors in Service Members (SMs) who have and have not served in these combat operations and who do and do not have traumatic brain injury (TBI). The study has received surveys from 44 Service Members (SMs): no diagnosis (n=6), TBI (n=12), PTSD (n=7), and dual diagnosis (TBI/PTSD) n=19, and from an additional 28 family/friends matched to SMs. Even in this small sample SMs with TBI/PTSD have significantly worse carryover of combat driving behaviors and driving related anxieties onto US roads. SMs with TBI and TBI/PTSD carry significantly more weapons in their personal vehicles and the two most commonly carried are also the most lethal – gun and knife. Family and friends appear to be aware that driving behavior and driving related anxieties are an issue, but tend to underestimate their severity.					
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## INTRODUCTION:

Service Members (SMs) serving in Operation Enduring Freedom/Operation Iraqi Freedom (OEF/OIF) and now Operation New Dawn (OND) use/used combat driving maneuvers to avoid roadway threats when travelling by land. These maneuvers are strongly linked to safety and become automatic as they are performed repeatedly. A regional pilot study by the PI and graduate students (Riley-Chiabotti, Hieb, Welle, **Stern**, 2008; **Stern**, 2009; Christensen, Escobar, Riess, **Stern**, 2009) found that post-deployed Soldiers had high levels of carryover behaviors and anxieties and that these behaviors lasted for at least three months in the post-deployment in the sub-sample that was examined. Reflecting Killgore, Cotting, Thomas, et al's. (2008) finding that general combat trauma influences risky behaviors post-deployment (including risky driving), driving carryover behaviors and anxieties regressed significantly on the level of Soldiers' OIF/OEF driving-related trauma (Polzin, Wenker, **Stern EB**, 2009). USAA, a major insurer of SMs, studied 171,000 deployments (6 months pre, 6 months post) and found that reported at-fault crashes significantly increased from before deployment to return (USAA, 2012). The current CDMRP study builds on these findings, using a drop-off-mail-back (or unengaged pickup-mail-back) survey to provide national data on the scale, incidence, and timeline of combat-driving behaviors and anxieties among post-deployed SMs with and without traumatic brain injury (TBI), post-traumatic stress syndrome (PTSD) or TBI with post-traumatic stress syndrome (TBI/PTSD), and compares SMs who are post-deployment to SMs who have not served in OEF/OIF/OND. Participating SMs are asked to handoff a parallel survey to a Family/Friend who knows their driving – providing validation of the SMs' responses.

**KEYWORDS:** Driving, traumatic brain injury (TBI), dual diagnosis, post-traumatic brain injury (PTSD)

**OVERALL PROJECT SUMMARY:** The study uses an unengaged pickup-mail-back method of surveying SMs with a handoff of a parallel survey to a Family/Friend. The project goals are to determine the extent to which combat driving tendencies are carried over into post-deployment driving on American roads by SMs with TBI and without TBI, to separate driving behaviors associated with military service from those associated with brain injury or deployment, to examine the impact of PTSD as a sole or dual diagnosis on driving and to establish military respondents' self-recognition of driving behaviors relative to an informed third party report as a measure of self-awareness. **IN PROCESS**  
The ultimate purpose of the study is to describe post-driving behaviors and to help guide post-deployment program development for SMs, families, and communities **WAITING FOR DATA COMPLETION**

## KEY RESEARCH ACCOMPLISHMENTS

- **Survey response:** We have more than doubled the numbers of surveys being returned, including those returned by family/friends. The project has received returned surveys from the original site (Dwight D. Eisenhower Medical Center, FT Gordon) and from three additional sites (Fox Army Health Center at Redstone Arsenal; Medical Task Force Shelby (MTFS), Camp Shelby; and Blanchfield Army Community Hospital at Fort Campbell). Medical Task Force Shelby closed this Spring, and no longer distributes surveys. We are requesting a final year without additional funds to focus on gaining surveys from non-deployed SMs – most likely through USARIEM where we are part way through IRB approval.
- **Reportable outcomes:**  
Statistical significance was set at  $p \leq .05$  for all analyses.

**Subjects:** A total of 44 Service Members' surveys have been received, entered, checked and analyzed.

- Neither TBI nor PTSD (0Dx) n= 6
- TBI/post-concussion only (TBI only) (n= 12)
- PTSD only (n=7)
- Dual (TBI/PTSD) n=19

28 of these 44 SMs had a paired survey returned by a Family/Friend (thus additional n=28 Family/Friends) See that section in OUTCOMES for more information.

All responding SMs were Army and had been deployed to Iraq/Afghanistan, nor in their most recent deployment (e.g., 51% to Iraq, 55% to Afghanistan).

**Group Equivalence:** Statistical significance was set at  $p \leq .05$  for all analyses.

Frequency data were compared using Fisher's Exact Test; interval/ratio data were compared using Analysis of Variance (ANOVA) with follow-up independent t-test to determine where differences existed across comparisons.

**Demographics:** There were no significant differences across the four groups in age (mean age ranged from 38 to 41 years across the four groups), sex (all but 2 were male), marital status (86%

were married or in a marriage-like relationship), ethnicity (16% were Hispanic/Latino), race (70.5% were white), or education level (91% had at least some college experience).

**Military and Combat Experiences:** There were also no significant differences across the groups in terms of pay grades (62% were enlisted), years in military service (mean range across groups was 15.5 to 17.3 years), percentage or how often they had driven in convoy (75%; 58% weekly), or frequency that they'd been drivers or passengers outside of the wire or estimated weekly miles ridden outside of the wire. The groups reported similar exposure to improvised explosive devices (IEDs) and artillery/rocket propelled grenades, and similar numbers of vehicle crashes due to enemy fire. I

**In the US:** Forty-two percent of the SMs drove cars and 49% drove SUVs or pick-up trucks as their primary US vehicle. Only 2% of the SMs drove for a living (e.g., taxi, delivery). There was no significant difference across diagnoses in these items or in weekly miles driven in the US.

**DIFFERENCES:** There were only two statistically significant differences across the groups: Whereas 100% of service members with 0Dx or TBI were in *active service*, only 57% and 63% of those PTSD or TBI/PTSD were *active service* ( $p=.02$ ). Also, a larger percentage of the TBI/PTSD group reported driving through small arms fire more frequently while deployed ( $p=.04$ ). It was not believed that these two differences (percent in active service and exposure to small arms) across all of the assessed parameters required statistical correction in this interim analysis.

**Summary of Groups:** There were no consistent or important differences across groups in terms of demographics or military exposure.

**Driving after return to the US:** Items asking about the past 30 days driving on U.S. roads were formed into five scale scores. These were compared using Fisher Exact tests for categorical frequencies and ANOVA followed by independent t-tests for interval/ratio data.

1. **Violations** (e.g., warnings, tickets for moving violations, vehicle crashes). There were no significant difference in violation items or mean score across the four diagnosis groups (i.e., 0Dx, TBI, PTSD, TBI/PTSD).
2. **Driving behaviors** (i.e., 20 common post-deployment driving behaviors such as moving through stop signs or red lights, chasing cars, hypervigilance). These were derived from the literature, interviews with SMs and from data from the earlier regional study of driving.

There were significant differences across the groups regardless of whether the comparison was of mean total score across items ( $p=.0006$ ) (Figure 1), or the number of items that were rated at the highest levels (i.e., occurring *usually* or *always*) ( $p=.0004$ ) (Figure 2). In both cases, TBI/PTSD reported the worst driving behaviors. The percentage of SMs who had had a family/friend refuse to drive with them in the past 30 days did not differ across groups ( $p=.08$ ).

Problem driving behaviors differed across the diagnoses for 45% of the items (i.e., 9/20 items), with TBI/PTSD scores consistently highest (i.e., worst). Items with significant differences were:

- Turned or changed lane without signaling ( $p=.004$ ) with TBI/PTSD reporting this as more common behaviors than both PTSD and 0Dx.
- Intentionally stayed in right lane of multi-lane road ( $p=.05$ ) with TBI/PTSD reporting this as more common than 0Dx.
- Been startled by common road sounds ( $p=.02$ ) with TBI/PTSD reporting this more common than PTSD and 0Dx.
- Ask someone else to drive in situations when SM would typically drive ( $p=.02$ ) with TBI/PTSD reporting this more common than TBI and 0Dx.
- Move to middle of road or onto shoulder to avoid road kill, litter, manhole cover, small potholes, other small objects ( $p=.005$ ) with all 3 diagnoses reporting this more common than 0Dx.
- Driven erratically in a tunnel or under and overpass ( $p=.02$ ) with TBI/PTSD reporting this as more common than TBI and 0Dx.
- Rerouted to avoid overpasses, tunnels, or littered roads ( $p=.02$ ) with TBI/PTSD reporting this more common than TBI and 0Dx.
- Moved to the median or into oncoming traffic ( $p=.005$ ) with TBI/PTSD reporting this more common than PTSD, TBI, and 0Dx.

- Paid excessive attention to things on or around the road ( $p=.007$ ) with TBI/PTSD reporting this more common than TBI and ODx.

Only SMs with ODx believed that deployment neither improved nor reduced their driving skill. Thirty-three percent of SMs with TBI and 43% with PTSD believe that they *drove worse* due to deployment whereas 79% of SMs with TBI/PTSD believed this ( $p<.0001$ ).

There was no evidence that driving behaviors were related to personal beliefs that item behaviors were inherently safe or dangerous (non-parametric correlations -Spearman rho- were neither significant nor large). There was neither strong nor significant relationship between mean driving behavior scores and mean violation scores or violation items scores.

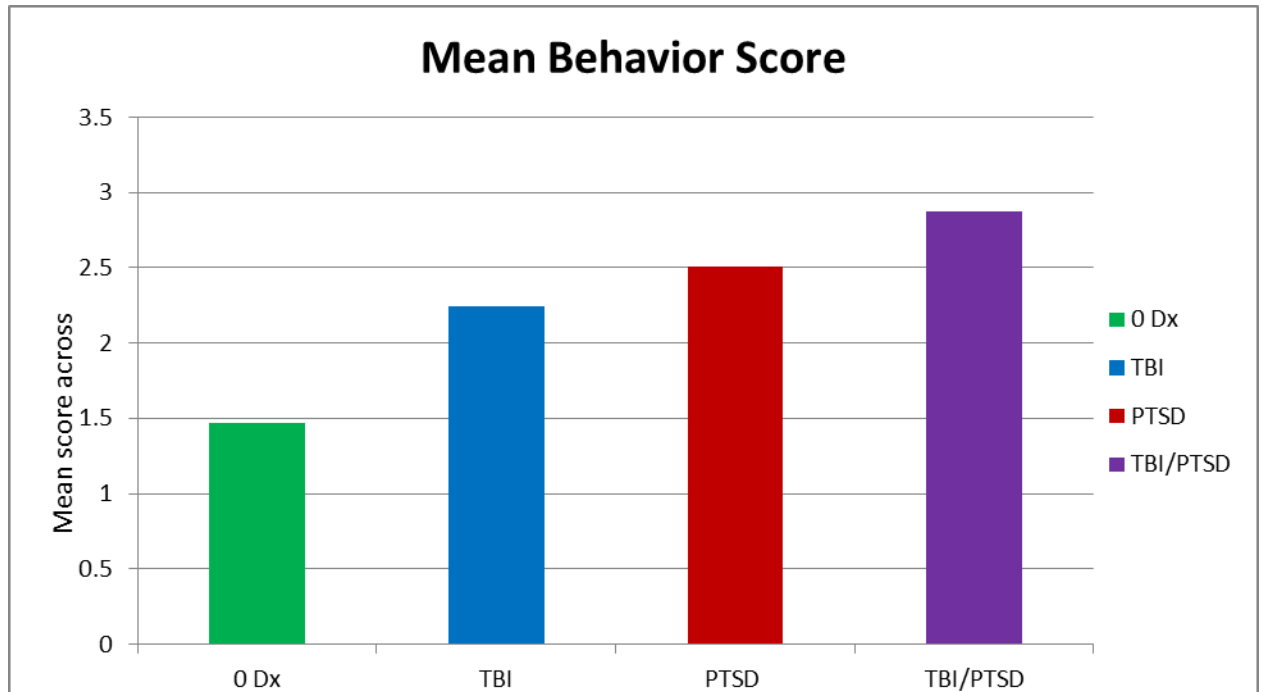


Figure 1 Mean Driving Behavior Scores by Groups

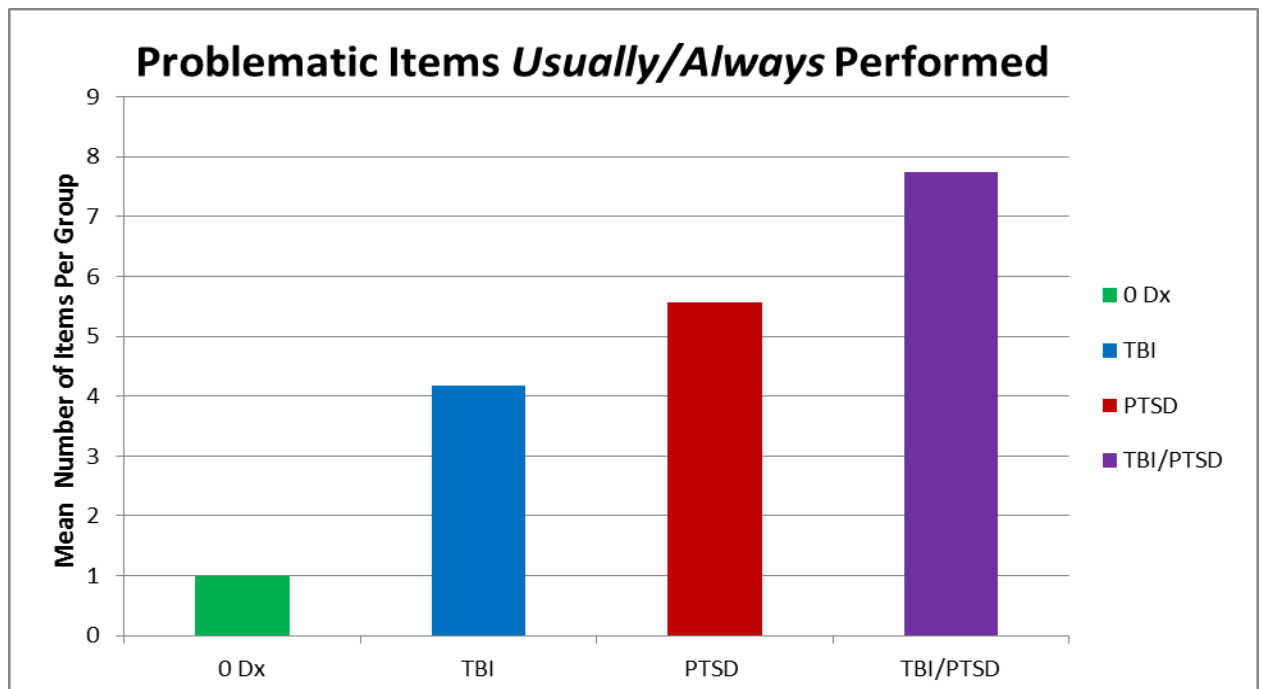


Figure 2 Mean number of Driving Behavior Items Reported as Usually/Always Performed by Groups

3. **Driving related anxieties** ( i.e., anxiety during 14 driving actions, such as driving near road trash, having another car cut in front, being stopped at a stop light). There were significant differences across the groups for both the mean total score across items ( $p=.0002$ ) (Figure 3), and the number of items that were rated at the highest levels (i.e making them feel somewhat or very uncomfortable, anxious, or angry) ( $p=.0003$ ) (Figure 4). Mean anxiety scores across items was similar for SMs with TBI/PTSD and PTSD, but both groups had significantly worse driving related anxieties than did SMs with TBI only or 0Dx.

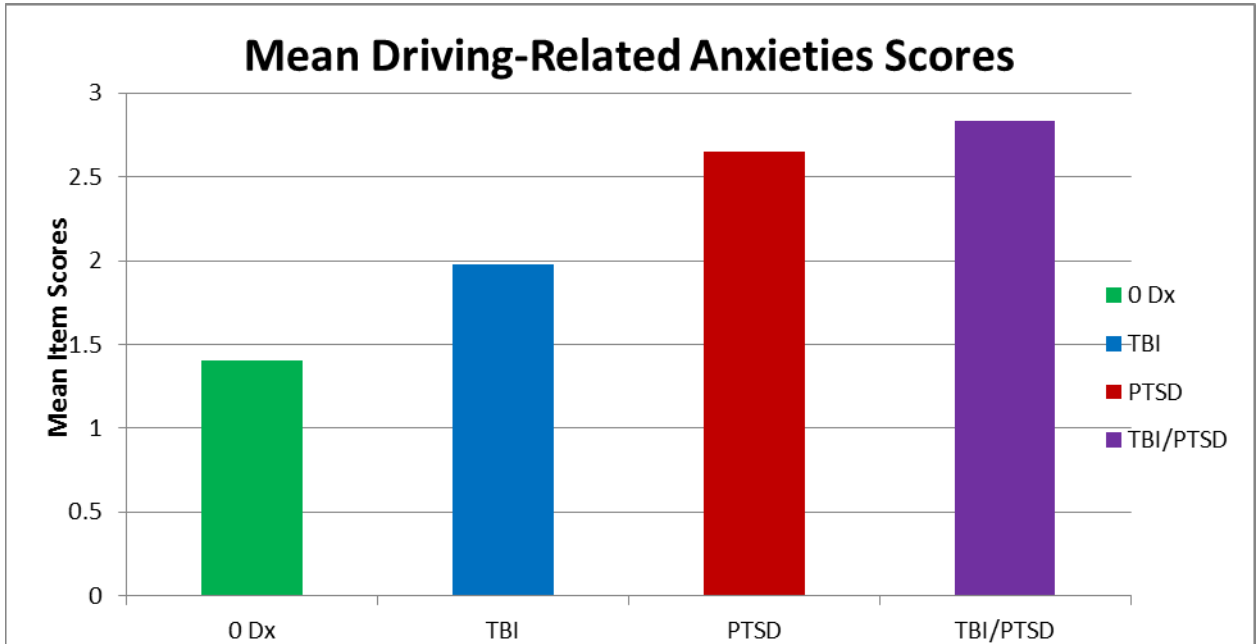


Figure 3 Mean Anxiety Related Driving Scores

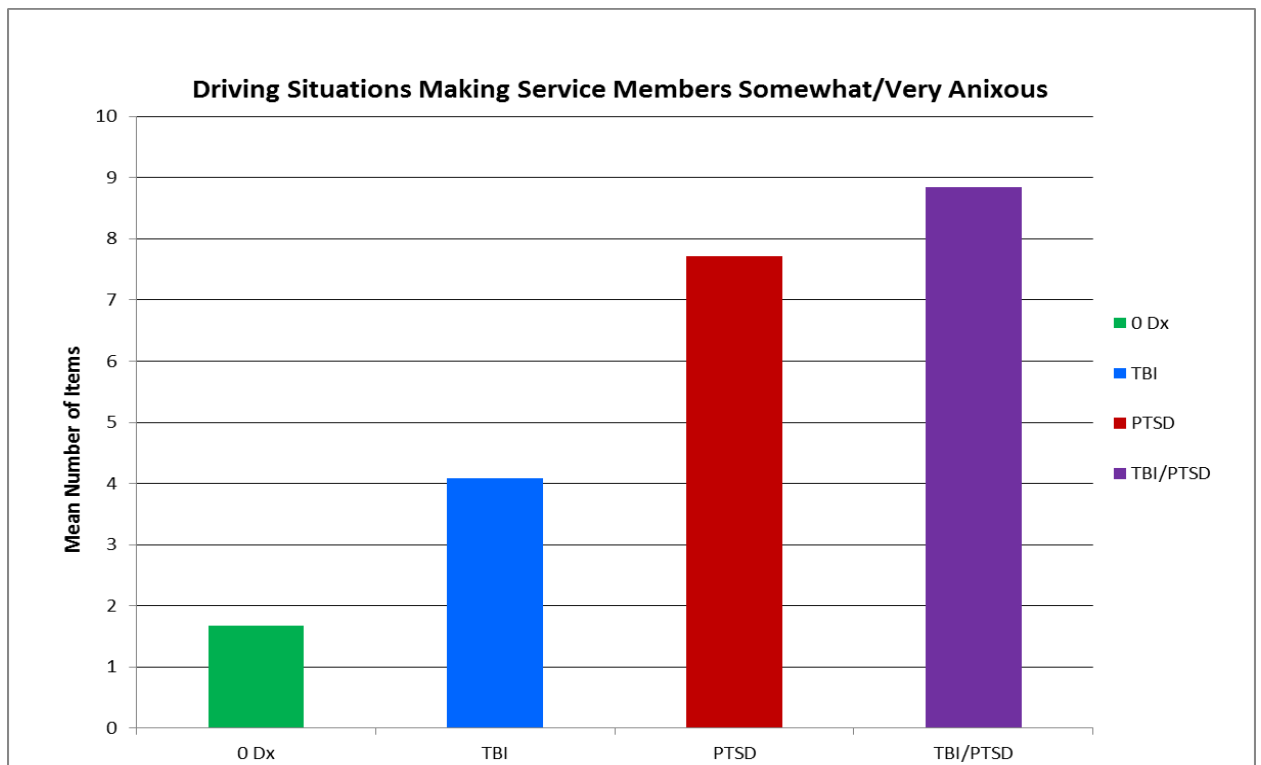


Figure 4 Driving situations making Service Members Somewhat or Very Anxious

Driving-related anxieties differed across the diagnoses for 86% of the items (i.e., 12/14 items), with SMs with TBI/PTSD and with PTSD consistently vying for worst score. SMs with TBI and 0Dx never reported the highest mean value of anxiety. Anxiety items with significant differences were:

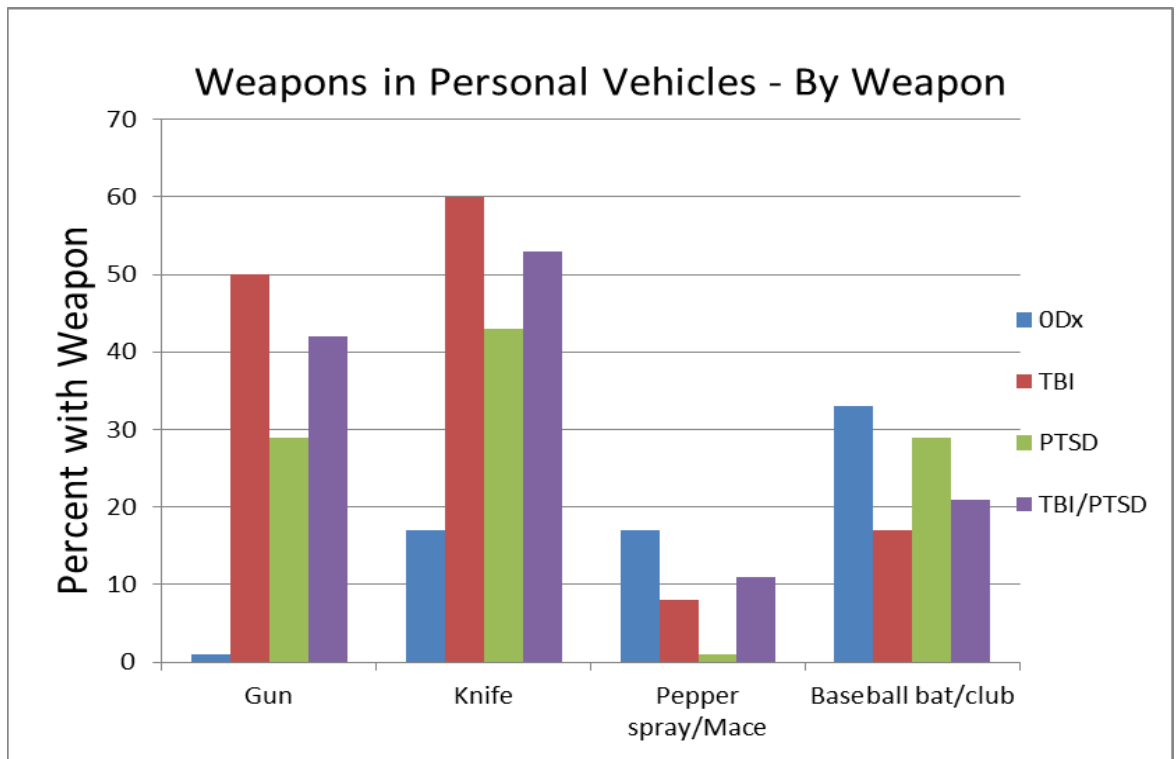
- Driving:
  - in ethnically diverse areas ( $p=.003$ ), with PTSD only being worse than TBI and 0Dx
  - where there are small trucks or vans ( $p=.006$ ), with TBI/PTSD worse than TBI and 0Dx
  - through tunnels or under overpasses ( $p=.006$ ), with PTSD worse than TBI and 0Dx
  - in slow or stop-and-go traffic ( $p=.015$ ), with PTSD only being worse than 0Dx
  - near parked cars ( $p=.0009$ ), with TBI/PTSD being worse than TBI and 0Dx
  - at high speeds (over 55) even if within the speed limit ( $p=.02$ ), with TBI/PTSD worse than TBI and 0Dx.
- When:
  - other cars approach quickly ( $p=.0003$ ) with PTSD worse than TBI and 0Dx
  - your car gets boxed-in ( $p=.015$ ) with TBI/PTSD worse than TBI and 0Dx
  - other cars pass ( $p=.037$ ) with PTSD worse than TBI and 0Dx
  - another car cuts in front ( $p=.002$ ) with TBI/PTSD worse than TBI and 0Dx
  - a car pulls between SM's car and another with whom they are travelling ( $p=.002$ ) with TBI/PTSD worse than TBI and 0Dx
  - stopped at a stop light ( $p=.0008$ ) with TBI/PTSD worse than TBI and 0Dx

SMs were bothered about their anxieties to different degrees ( $p<.001$ ): 33% SMs with 0Dx were bothered and 42% of those with PTSD were bothered, whereas 75% of those with PTSD and 98% of those with TBI/PTSD were bothered by their driving related anxieties.

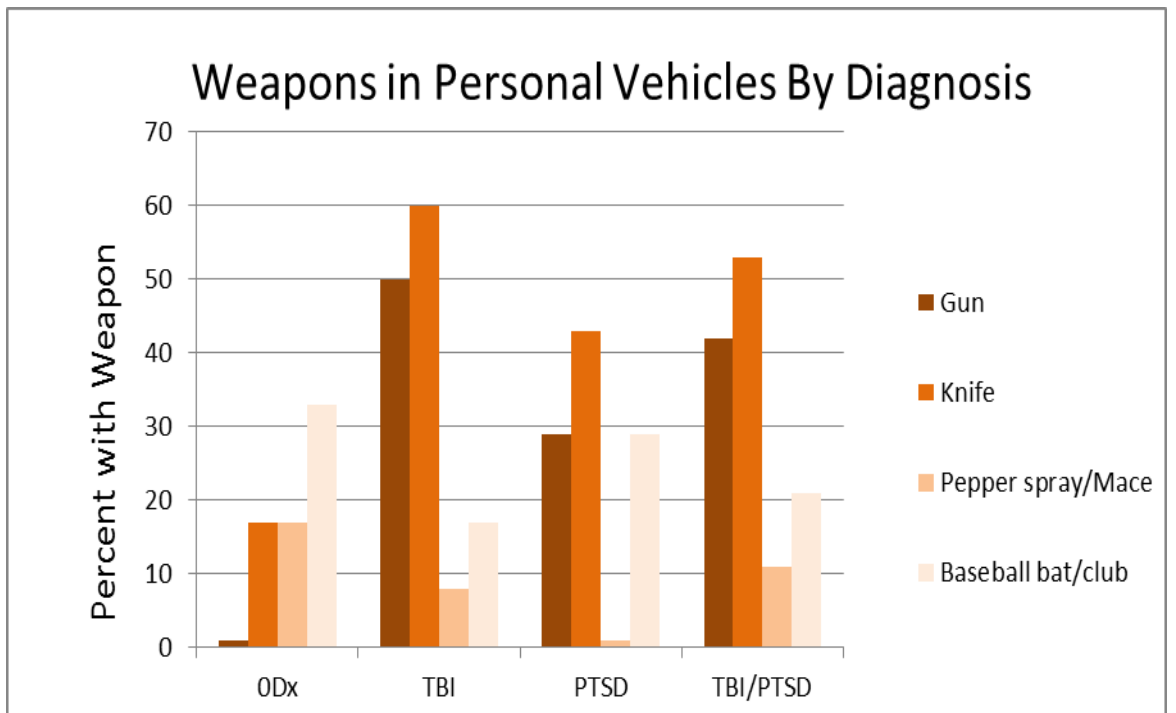
When asked a global question about driving in general, SMs with TBI/PTSD were all anxious to some degree. Higher levels of anxiety (i.e., *anxious* or *very anxious*) were reported exclusively by SMs with TBI only (50%) and TBI/PTSD (58%). The difference across the 4 groups was  $p<.0001$ .

Mean driving anxieties and driving behaviors were related strongly and significantly for each group (0Dx, Pearson  $r=.83$ ,  $p=.04$ ; TBI only,  $r=.88$ ,  $p=.0002$ ; PTSD only  $r=.90$ ,  $p=.005$ ; TBI/PTSD  $r=.73$ ,  $p=.0003$ ), with the assumption being that level of driving anxieties predicts levels of behaviors.

4. **Weapons (i.e., gun, knife, pepper spray, Taser, bat/club) carried in SM's privately owned vehicles (POV)** Groups did not differ significantly in their total count of weapons carried in the past 30, however the more lethal weapons were carried more by SMs with TBI and TBI/PTSD. Thus, guns were carried by 50% of SMs with TBI and by 42% of SMs with TBI/PTSD (Figures 5 and 6). Similarly knives were carried by 60% of SMs with TBI and 53% of SMs with TBI/PTSD and 43% of SMs with PTSD.



**Figure 5. Percent of Each Type of Weapon Carried by Service Members in Personal Vehicle**



**Figure 6. Percent of Each Group of Service Members Carrying Weapon in Personal Vehicle**

Fewer than 20% of ODx SMs carried any weapon, except for baseball bats/clubs (33%). When all weapons are considered, SM's with ODx carried less than 1 weapon each (Mean= .67, sd=1.21, Median=0 weapons), whereas those with diagnoses, on average carried at least 1 weapon: SMs with TBI carried 1.33 (sd=1.07, Median=1.00), SMs with PTSD carried 1 (sd=1, median=1.00) and SMs with TBI/PTSD carried 1.42 (sd=1.2, median1.0). No SM carried an explosive/grenade.

## Concurrence between Family/Friends and Service Members

**Family/Friends Demographics:** Eighty –one percent of respondents were spouses/partners, 89% were female, 19% were Hispanic/Latino, and 81% were White. Thirty-three percent were themselves in military service. All had driven with the SM at least 1 day a week, and 89% drove with the SM at least 2-3 times a week. Twenty-two percent drove with them daily. On average they rode with the SM for a mean of 527 miles (sd =1218 miles) in the prior 30 days. Within the 28 pairs: 4 SMs had 0Dx, 9 SMs had TBI only, 4 SMs had PTSD only, and 11 SMs had TBI & PTSD.

**Driving on return to the US:** SMs' responses to items for the past 30 days driving on U.S. roads were compared to those of their Family/Friends. Exploratory analyses showed insufficient power to detect differences between SMs and Family/Friends across diagnoses. Thus, analyses of differences between Friends/Family and SMs were performed using paired t-tests and Fisher's exact tests of the whole paired sample.

1. **Violations:** SM's had few violations in the prior 30 days, and Friends/Family were accurate in their report of these.
2. **Driving behaviors:** In 100% of the items, Family/Friends underestimated their SMs driving problems. This underestimate reached statistical significance in 60% of the individual driving behavior items (i.e., 12/20 items).
  - Driving:
    - through stop signs ( $p=.04$ ),
    - through a red light ( $p=.03$ ),
    - close to a lead car ( $p=.03$ ),
    - slower than other cars ( $p=.01$ ),
    - in the middle of the road ( $p=.02$ ),
    - erratically in a tunnel or underpass ( $p<.0001$ ),
  - Being startled by common road sounds ( $p=.004$ ),
  - Asking someone else to drive in situations when the SM would have normally driven ( $p<.0001$ ),
  - Rerouting to avoid tunnels/underpass/littered road ( $p<.0001$ ),
  - Moving to shoulder to bypass slow or stalled traffic ( $p=.04$ ),
  - Yelling or making rude gestures at other drivers ( $p=.01$ ),
  - Paying excessive attention to things on or around the road ( $p=.003$ )

The same underestimation was seen in the mean frequency across all driving behaviors ( $p=.0004$ ), as well as in the mean number of behaviors that SMs reported as happening often (i.e., *usually* or *almost always*) ( $p=.005$ ).

3. **Driving related anxieties:** Family and Friends significantly underestimated their paired SMs for 79% of the driving-related anxiety items (i.e., 11/14 items). These included the level of anxiety:
  - Driving:
    - near unexpected items on/near the road ( $p=.04$ )
    - in ethnically diverse areas ( $p=.01$ )
    - where there are small trucks or vans ( $p=.003$ )
    - through tunnels or underpasses ( $p<.0001$ )
    - at dusk or night ( $p<.0001$ )
    - at high speed even if within the speed limit ( $p=.03$ )
  - When:
    - other cars approach the SM's car quickly ( $p=.04$ )
    - the SM's car gets boxed in ( $p=.005$ )
    - another car cuts in front of the SM ( $p=.03$ )
    - a car pulls between the SM and a car that they are following ( $p=.03$ )
    - the SM is stopped at a stop light ( $p=.007$ )

Underestimation was also seen in the mean level of driving related anxiety that SMs had ( $p=.02$ ), and the number of items that left SMs feeling *somewhat* or *very* anxious ( $p=.03$ ).

Family/Friends accurately estimated the amount that their SM's anxiety bothered their SM.

4. **Weapons:** Family/Friends accurately estimated the number of weapons kept by their SM in the POV.

- **CONCLUSIONS:**

**Limitations:** The growing sample size (SM n=44; paired SM/FF=28) improves power, but remains small. Absence of a group of non-deployed/non-brain injured, means that the investigators cannot differentiate between impact of military ethos and that of deployment.

**Finding 1 Violations:** Within the current sample, SMs had no difference in their violations across the diagnoses. USAA's study (USAA, 2012) showed a rise in reported at fault crashes at 6 months post-deployment. This study's sample responded to the survey a mean of 19 to 39 months post deployment. It may be that differences in violations exist, but are not statistically shown due to the study SMs' long duration post-deployment, the short time period studied (i.e., 30 days), and the rarity of violations in any population.

**Finding 2: Behaviors/Anxieties:** Even in the current sample, SMs with TBI/PTSD consistently demonstrated the most frequent behaviors and largest number of severe driving behavior problems. The single item 'chasing cars' did not discriminate between groups, failing to support earlier findings in the literature that strongly related this behavior to PTSD (Kuhn, Drescher, Ruzek, and Rosen, 2010).

SMs with TBI/PTSD and PTSD reported the worst driving related anxieties and the largest numbers of the most severe anxiety problems. The amount to which they were bothered by these anxieties may be more associated with the TBI diagnosis as demonstrated by 98% of SMs with TBI, 100% of those with TBI/PTSD reporting being bothered by their anxieties.

The current report's sample was larger than prior ones and allowed us to differentiate across the 4 diagnostic groups, the significantly greater scores in the TBI/PTSD and PTSD groups supports prior research associating several driving problems and driving related anxieties with a PTSD diagnosis (Kuhn, Drescher, Ruzek, and Rosen, 2010; Lew et al, 2011; Sayer et al., 2010).

**Finding 3: Weapons:** SMs across diagnoses carried similar numbers of weapons, but the highest frequency of the most deadly weapons, i.e., guns and knives, were carried by SMs with TBI and with TBI/PTSD. This is disconcerting when one recognizes that TBI (the diagnosis shared by the two groups) is associated with impulsivity. The combined presence of impulsivity and a deadly weapon, seems a recipe for problems. Although in total, a similar percentage of SMs with 0Dx carried a weapon, those who did this favored the lower risk, less lethal mace/pepper spray, Taser, or baseball bat/club.

**Finding 4 Family and Friends' knowledge of their SM's driving behaviors/anxieties:** Comparisons of SMs and Family/Friends (n=28 pairs) consistently showed that Family/Friends know that SMs have driving behavior and anxiety problems, but underestimate the frequency and severity of these problems. These results are similar to those found by Hieb's study (2008) of a normal returning Company of SMs. It remains unclear if Family/Friends are unaware of even consistent driving behaviors and anxieties, or are in a state of denial.

**Finding 5 Clinical Suggestions:** The small sample there are strong indications that SMs with TBI, PTSD, or TBI/PTSD have issues with driving behaviors and anxieties and that these may not be fully realized by Family/Friends. SMs with TBI/PTSD appear to be in special need for program development to address anxiety, driving behaviors, and the danger associated with weapons in POV. Such intervention should be a regular part of treatment – not waiting for SMs or their family/friends to specifically seek it out. It appears that education for Family/Friends should emphasize open communication between SMs and Family/Friends. Data from persons who have not been deployed will clarify what part of these issues may be associated with military ethos rather than deployment or injury.

- **PRESENTATIONS:** Presentations/Platform papers

- **Stern, EB, Rockwood T.** (2014) *Driving behaviors and anxieties of military service members with and without traumatic brain injury/post-traumatic stress disorder after service in Iraq or Afghanistan* 16<sup>th</sup> International Congress of World Federation of Occupational Therapists, Yokohama, Japan (Refereed)
- **Davis E.S., Stern, EB** (2013) *Addressing Driving Transition and Community Mobility: Tools You Can Use*. Minnesota Occupational Therapy Association Annual Conference, Bloomington, MN (Refereed)

- **Stern, EB** (2013) *PostDeployment Reintegration: Shifting Gears*, Virginia Military/Civilian Transportation Safety Workshop, Joint Base Langley-FT Eustis (Invited)

- **REPORTABLE OUTCOMES: None**

- **OTHER ACHIEVEMENTS: Nothing to report**

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