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## Development And Content Validity Of The Military Concussion Readiness Inventory For Service Members

Michelle L. Gutierrez  
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DEVELOPMENT AND CONTENT VALIDITY OF THE MILITARY CONCUSSION  
READINESS INVENTORY FOR SERVICE MEMBERS

by

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A DISSERTATION

Submitted to the graduate faculty of The University of Alabama at Birmingham  
in partial fulfillment of the requirements for the degree of  
Doctor of Science

BIRMINGHAM, ALABAMA

2012

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# DEVELOPMENT AND CONTENT VALIDITY OF THE MILITARY CONCUSSION READINESS INVENTORY FOR SERVICE MEMBERS

MICHELLE L. GUTIERREZ

DOCTOR OF SCIENCE IN PHYSICAL THERAPY

## ABSTRACT

The aim of this study was to develop and establish content validity of a new questionnaire entitled the Military Concussion Readiness Inventory (MCRI). The MCRI was designed to identify functional impairments and predict readiness for return-to-duty in service members (SM) who experienced mild traumatic brain injury (mTBI) due to a blast. The items on the MCRI were linked to the *The International Classification of Functioning, Disability and Health* (ICF) classifications. Nineteen male SM participated in a nominal group technique process to generate items for the MCRI. The items were classified according to the ICF before sending items to the Delphi group. Subsequently, thirteen physical therapy experts participated in a Delphi survey to determine content validity of the items generated. Consensus was defined as agreement with an item by at least 70% of participants. After round two of the Delphi survey, consensus was achieved to keep sixty-two items and delete eleven items. No consensus was achieved on twenty-one items. However, eleven items that had 60-70% agreement were considered by the investigators and four of these items were retained, and seventeen were excluded. In this study we successfully combined the use of SMs experiences to develop survey items and with expert opinion determined the content validity of the MCRI. The development of the MCRI is an instrument that may be used for assessment of SM who have experienced mTBI to help identify functional activities, environmental factors, and body functions that may limit these SM from safely and efficiently performing their duties. The MCRI

may be useful as a tool to determine return-to-duty status. Further research is needed to fully develop psychometric qualities of this survey.

Key words: military, concussion, questionnaire, dizziness, balance

## ACKNOWLEDGEMENTS

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## INTRODUCTION

Traumatic brain injuries (TBI) secondary to blasts or explosions are the most common mechanism of injury seen in Iraq and Afghanistan,<sup>1-7</sup> and have been described as the “signature injury” of these military conflicts.<sup>2,6</sup> Traumatic brain injuries can be classified as penetrating/open, severe, moderate, or mild.<sup>8,9</sup> According to the Defense and Veterans Brain Injury Center (DVBIC), a concussion or mild TBI (mTBI) is the most frequent type of TBI among service members (SM) (i.e. all active duty, reservists, National Guard, and veterans of all branches of the military).<sup>8,10</sup> The Department of Defense (DoD) characterizes mTBI as meeting one or more of the following criteria: loss or decreased level of consciousness for less than 30 minutes, altered state of consciousness for less than 24 hours, posttraumatic amnesia for less than 24 hours, and normal structural imaging.<sup>7,9</sup> The DVBIC have estimated that 244,217 SM have sustained TBI (penetrating, severe, moderate, mild, and not classifiable) since 2000, while the total number of mTBI is 187,539.<sup>8</sup> These statistics only represent SM who are medically evacuated or self-report the injury.<sup>2,7</sup> The accuracy of the before mentioned statistics may be questioned since some SM may be reluctant to report symptoms of mTBI until later in their medical care or after deployment because they do not want to be removed from their unit.<sup>7,10</sup>

The leading causes of mTBI in SM are from blasts, fragments, bullets, motor vehicle accidents, and falls.<sup>9</sup> Soldiers sustaining mTBI due to blast injuries have a

challenging clinical presentation. Blast induced mTBI is more complex than a blunt head injury<sup>10,11</sup> resulting in a more global and bilateral injury patterns, difficulty with postural stability and the inability to adapt to perturbations.<sup>11</sup> Blast induced mTBI commonly result in complaints of vertigo, gaze instability (e.g. inability to see clearly with head movement), motion intolerance, and unsteadiness of balance.<sup>2</sup> Service members with blast injuries may have persistent dizziness and/or imbalance limiting their ability to serve fully.<sup>2</sup>

Several investigators have identified specific recommendations for physical therapy assessments for SM with blast induced mTBI.<sup>2,5,7</sup> The physical examination should be directed toward improving the functional impairments identified in the history and systems review. Recommended clinical tests include measures of vestibular function (e.g. head thrust, dynamic visual acuity, and Dix-Hallpike),<sup>7,11,12</sup> balance function (e.g. computerized sensory organization test<sup>7,13</sup> and Functional Gait Assessment<sup>7,14</sup>), attention and dual tasking performance,<sup>7,14-16</sup> activity intolerance, and examination for headache, neck and temporomandibular joint function.<sup>7</sup> Defense and Veterans Brain Injury Center recommendations of their Exertional Testing Protocol for activity intolerance include achieving 65-85% of target heart rate using push-ups, step aerobics, treadmill, or hand crank while assessing for symptoms such as headache, vertigo, photophobia, balance, dizziness, nausea, tinnitus, and/or visual changes.<sup>7,9</sup>

In addition to physical examination, subjective determination of a SM self-perceived functional rating is an important assessment. Several different questionnaires (e.g. Activities-specific Balance Confidence (ABC) scale<sup>17</sup> and Dizziness Handicap Inventory (DHI)<sup>12,18</sup>) are used to assess subjective function but these survey tools are not

sensitive enough to determine impairments<sup>4</sup> specific to military activities. One test, the ABC is a reliable test used to measure confidence in balance in elderly adults,<sup>17</sup> however this 16 question scale may lack the sensitivity to determine higher level functional impairments. According to Weightman et al<sup>7</sup> there are currently no specific measures of participation and reintegration to a military or civilian lifestyle, so global measures such as the 36-item Short Form Health Survey (SF-36)<sup>19</sup> tend to be used in this population until a military participation measure is developed. Scherer et al<sup>4</sup> also reports that additional clinical research are needed to develop more sensitive tests to assess blast injured SM. The SM deficits from blast injuries may be very subtle but of sufficient magnitude as to limit their ability to perform full military requirements. Therefore, more sensitive and job specific tests must be developed for this population. The nominal group technique (NGT) and Delphi technique are appropriate methods for developing valid items for inclusion in a survey to assess functional impairments in SM who experience a mTBI.<sup>20-32</sup>

The nominal group technique is a well-structured technique to facilitate useful decision-making to identify and rank problems and promote equal participation from group members in a face-to-face meeting.<sup>20-23</sup> This technique is an effective way to generate ideas while insuring all members participate freely without influence from other participants when making collective decisions.

Linking items generated for a questionnaire to *The International Classification of Functioning, Disability and Health* (ICF) is often used as a common reference structure for functioning and may assist to improve outcome research.<sup>33-35</sup> (Figure 1) Linking items to the ICF allows researchers to categorize items to better determine change in a

domain (e.g. body functions; activities and participation; and response to environment), and allows a standard language to compare between studies. After items are generated for a questionnaire and linked to the ICF, establishing the content validity can be determined by use of the Delphi technique. The Delphi technique is an interactive, anonymous process that involves a group of experts deliberating on a particular subject, usually through a series of questionnaires to establish consensus opinions.<sup>22,23,27,30,32</sup> This technique is useful when face-to-face meetings are impossible with opinion leaders. Many researchers use this technique to establish content validity in questionnaires because one strong member cannot sway group opinion.<sup>22,25,29</sup>

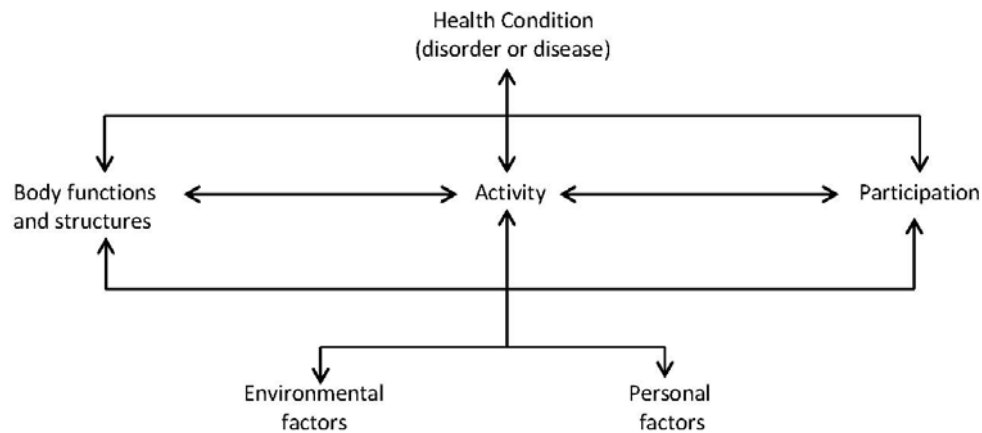


Figure 1: Interactions between the components of the WHO International Classification of Functioning, Disability and Health (ICF)

The purpose of this study was to develop and establish content validity of a new questionnaire entitled the Military Concussion Readiness Inventory (MCRI) to identify functional impairments of balance and dizziness and predict readiness for return-to-duty in SM who experienced a blast injury. The items on the MCRI will also be classified/linked to the ICF.

## METHODS

The study was approved by the Institutional Review Boards of University of Alabama Birmingham (UAB) (Appendix A) and William Beaumont Army Medical Center (WBAMC) (Appendix B). The NGT data were collected between May 4, 2012 and Jun 27, 2012 and the Delphi survey data were collected between August 12, 2012 and September 10, 2012.

### Nominal Group Technique

A nominal group technique was used to develop items for the questionnaire. Service members were recruited for one of two groups; a “blast group” and a “non-blast group.” The “blast group” membership included SM who have been diagnosed with a concussion from a blast injury in the Warrior Care Center - TBI Clinic at WBAMC and have experienced dizziness and/or imbalance due to the blast injury. The “non-blast group” was comprised of SM who have worked with or observed a SM who had dizziness or imbalance due to a blast injury.

Recruitment for the blast and non-blast individuals occurred through flyers that were posted in the TBI and Physical Therapy clinics at WBAMC. Clients seen in the TBI clinic who were diagnosed with concussion with dizziness and/or imbalance from a blast injury were referred by TBI medical providers (e.g. MD, Neuropsychologist, Speech Therapist, Occupational Therapist, or Physical Therapist) for the “blast group”.

At the medical visit prospective participants (identified by the medical provider) were informed that they might qualify for the study. If the client was interested in being a subject, the medical provider obtained verbal permission to notify the primary investigator (PI) of the SM's interest in the study and the SM's phone number. The PI contacted the SM to discuss the study. If the SM was willing to participate, the SM met face-to-face with the PI who obtained consent.

Service members who have worked with or observed a SM who had dizziness and/or imbalance due to a blast injury were sought by face-to-face recruitment by the PI at Ft. Bliss and White Sands Missile Range for the "non-blast group". The primary investigator met with the SM to discuss the study and obtain consent.

All SM in the blast and non-blast groups ambulated independently and were between the ages of 19-50. Service members were excluded from participation if they had a cardiac disorder that cause dizziness, had any other neurological disorders, including seizure disorders, did not speak English proficiently, were cognitively impaired, or currently experiencing uncontrolled psychiatric conditions. The nominal group meetings were divided into separate blast and non-blast groups.

Four meetings of 4-5 SM lasted approximately one hour and fifty minutes each. The PI was the facilitator and was assisted by a student physical therapist who recorded the responses that the group generated on a flipchart. The nominal group participants were asked to share their thoughts about the following two questions concerning military tasks: 1) What military or non-military tasks do you think will be difficult to perform due to balance trouble in someone who has had a blast injury? 2) What military or non-military tasks do you think will cause or increase dizziness in someone who has had a



blast injury? For each question, the participants were given time to write items before sharing them with other group members. Group members took turns, without interruption, sharing ideas until no further ideas were generated. A student wrote the items on the flipchart. The group then clarified responses and removed any responses that were redundant. Participants were then asked to individually rate what they felt were the top five responses to each question. The same technique was used for all four groups. Member checking was performed after all groups met by sending the complete list of items generated to nominal group participants so that any items they felt were not included could be added without peer influence. Member checking is used in many qualitative studies to clarify and determine if the outcome represents its' participants.<sup>36</sup>

### Classification/Linking

After the nominal group items were generated, the PI combined the items that described similar tasks between groups (Appendix C) and clarified the military tasks. Collaborating investigators (J.B.C. and S.L.W.) classified the items according to the ICF.<sup>33</sup> The classification process included two rounds, similar to a previous study.<sup>37</sup> The two investigators first coded the items independently. Disagreements were then discussed until both investigators agreed on the category for each item.

### Delphi

A Delphi technique was used to develop content validity. The Delphi group members were military physical therapist, identified by the primary and collaborating authors. An email invitation explaining the study was sent to the subject matter experts.

The selection criteria for the experts included at least one year experience evaluating and treating SM who have blast induced TBI and post-entry level training in vestibular rehabilitation.

Expert opinions were used to determine the best items to be used in the questionnaire. The list of items generated from the nominal group was sent to the experts electronically. Experts were asked to rate each item on a four-point scale. 1) This item should definitely not be included in the questionnaire; 2) This item, although acceptable, is not necessary for the questionnaire; 3) Although not essential, this item would contribute to the questionnaire; and 4) It is essential that this item be included in the questionnaire. They were also asked to comment on any other items that should be added to the survey.

Although there are no recognized guidelines for the percentage of the level of consensus to use with the Delphi technique, 70-80% agreement was used in several studies as an acceptable level of agreement.<sup>22,24,26,29,31</sup> Therefore 70% is the agreement criterion that was used to determine content validity index of each MCRI item.

The responses were analyzed by the PI using the predetermined 70% for agreement of inclusion and exclusion of each item. Analysis of the experts' agreement on each round of the Delphi was conducted and the percentage agreement per item was calculated. The scores were calculated for two subsets<sup>25</sup>, one for inclusion and one for exclusion. The responses "This item should definitely not be included in the measure" and "This item does not need to be included for the measure to be useful" signified "exclusion". The responses "Although not essential, this item would contribute to the measure" and "It is essential that this item be included in the measure" signified

"inclusion". The items that had 70% agreement or more on inclusion of an item were included in the MCRI. For round 2, all items were sent showing the scoring of each item but the experts only voted on the questions that did not meet consensus. Experts were again asked to rate their opinions to include or exclude items on the four-point scale on the items that did not reach consensus. We also asked for any comments related to the items. We planned to continue until there was a 70% or greater agreement on all items. However, items that consistently had < 70% consensus with no changes in responses with repeated Delphi rounds and no comments regarding the items would be dropped from the survey. Items with 60-70% agreement would be considered for inclusion following discussion by the PI and collaborators (J.B.C. and S.L.W.) All responses remained confidential.

## RESULTS

### Nominal Group

Twenty-three SM were recruited and volunteered for this study. Four were not able to attend the scheduled meetings secondary to duty purposes or emergency leave. Nineteen male SM participated in the nominal groups (n= 10 blast; 9 non-blast). All were in the Army with a mean age of  $32 \pm 7.5$  years (range 21-45). Participants' years in service ranged from 2-24 years and number of deployments ranging from 0-3 in the non-blast group and 1-8 in the blast group. The NGT generated 221 total items from the four nominal groups (Appendix C). The PI removed duplicates and combined similar items leaving 115 items. Member checking did not add any items to the list.

### ICF Classification

After the 115 nominal group items were generated, the PI clarified the military tasks and the collaborating investigators (J.B.C. and S.L.W.) classified the items according to the ICF before sending items to the Delphi group. In the first round, there was agreement by both coders on the ICF code for forty-seven items and there was agreement to delete twenty-one items. Deleted items were either too broad of a category (e.g. Virtual Training Simulators, Air Operations, Real World Combat Missions), were already included in other items (e.g. Physical Readiness Training), or would cause dizziness in most individuals, not specifically those with blast injuries (e.g. Tasers,

spinning in a chair, hitting the head). There was disagreement by the investigators following individual coding on ICF category for 47 items. These were discussed and consensus was obtained on the remaining 94 items for the Delphi. The items were linked to 36 different ICF- codes describing relevant aspects of functioning (Table 1; Table 2). Fourteen of the items belonged to the component body functions, 54 to the component activity and participation, 12 to the component environmental factors, five items had multiple ICF categories, and 9 items were not linkable to the ICF due to the complex nature of the activity. None of the items were linked to the component body structures.

Table 1

*Items included in the Military Concussion Readiness Inventory after the nominal group and the Delphi survey*

Included Items (n=66):	ICF Codes:	*% Include	+% Exclude
<b>Body Functions (n=8)</b>			
Anxiety, worry, fear	b1522: Range of emotions	100%	0%
Migraines/ headaches	b28010: Pain in head and neck	100%	0%
Sleep deprivation: waking up at early hours/working long hours >24 hrs	b1340: Sleep functions	100%	0%
Over exerting/physical exertion/ excessive physical activity	b455: Exercise tolerance functions	92%	8%
Tinnitus/inner ear disturbance	b2400 Ringing in ears or tinnitus	92%	8%
Nuclear Biological Chemical Mask	b210: Seeing functions	85%	15%
Strain/bearing down	b152: Emotional functions		
Dehydration	b5250: Elimination of feces	85%	15%
	b54501: Maintenance of water balance	77%	23%
<b>Activities &amp; Participation (n=36)</b>			
Abrupt movement	d410: Changing basic body position	100%	0%
Mental exertion	d240: Handling stress and other psychological demands	100%	0%
Riding in military vehicle/enclosed vehicles	d4709: Using transportation, unspecified	100%	0%
Running	d4552: Running	100%	0%
Standing in formation	d4154: Maintaining a standing position	100%	0%
Uneven surfaces	d4502: Walking on different surfaces	100%	0%
Walking in crowds	d469: Walking and moving, other specified and unspecified	100%	0%
Walking a straight line	d469: Walking and moving, other specified and unspecified	100%	0%
Adrenaline rushes, stress	d240: Handling stress and other psychological demands	92%	8%

Bending/reaching beyond neutral	d4105: Bending	92%	8%
Combat load/wearing gear	d4303: Carrying on shoulders, hip and back	92%	8%
Drill and ceremony (D & C)	d4502: Walking on different surfaces	92%	8%
Driving	d4751: Driving motorized vehicles	92%	8%
Picking things off the ground	d4105: Bending	92%	8%
Maintaining equip/vehicles	d4550: Pulling	92%	8%
	d4551: Pushing		
Obstacle course	d455: Moving around	92%	8%
Ruck marching	d4501: Walking long distances	92%	8%
	d4303: Carrying on shoulders, hip and back		
Sprinting w/ quick stops	d4552: Running	92%	8%
Dismounting vehicles in gear	d455: Moving around	85%	15%
Driving during the night	d4751: Driving motorized vehicles	85%	15%
Getting up (bed, chair, toilet)	d410: Changing basic body position	85%	15%
Getting in/out of bed	d4100: Lying down	85%	15%
Navigate on rough terrain	d4502: Walking on different surfaces	85%	15%
Walking/ hiking narrow paths	d4509: Walking, unspecified	85%	15%
Climbing	d4551: Climbing	83%	17%
Carrying heavy objects	d430: Lifting and carrying objects	77%	23%
Clearing houses	d2402: Handling crisis	77%	23%
Facing backwards while flying	d4709: Using transportation, unspecified	77%	23%
Firing large caliber weapons/ missile firing	d4308: Lifting and carrying, other specified	77%	23%
Jumping (trampoline)	d4553: Jumping	77%	23%
Riding in back of vehicles	d470: Using transportation	77%	23%
Traveling (trains/planes/ auto/bus/boat)	d470: Using transportation	77%	23%
Walking down/up stairs	d4551: Climbing	77%	23%
Wearing Advanced Combat Helmet (ACH)	d4304: Carrying on the head	77%	23%
Showering	d510: Washing oneself	69%	31%
Swimming	d4554: Swimming	62%	38%
<b>Environmental Factors (n=9)</b>			
Alcohol/ drugs/ medication	e1101: Drugs	100%	0%
Bright lights/flash bangs/ loud noises	e2400: Light intensity	100%	0%
Busy Vision (transitioning through change in light, looking at busy background)	e2401: Light quality	100%	0%
Flashing lights	e2400: Light intensity	100%	0%
Sound	e250: Sound	100%	0%
Confined areas (rooms/vehicles)	e299: Natural environment and human-made changes to environment, unspecified	85%	15%
Excessive light	e2400: Light intensity	85%	15%
Heat	e2250: Temperature	85%	15%
Staring at TV/computer	e2400: Light intensity	77%	23%
	e2401: Light quality		
<b>Multiple ICF categories (n=5)</b>			
Land navigation	b140: Attention functions	100%	0%
	d4502: Walking on different surfaces		
	d4551: Pushing		
Food/caffeine (too much/too little)	b5153: Tolerance to food	92%	8%
	e1100: Food		
Reading	d166: Reading	92%	8%
	b2100: Visual acuity functions		
Rifle marksmanship/ shooting a weapon	d4102: Kneeling	92%	8%
	d430: Lifting and carrying objects		

Playing video games	d450: Walking	69%	31%
	b140: Attention functions		
	b210: Seeing functions		
	d4402: Find hand use: manipulating		

**Unable to be coded to a specific ICF code (n=8)**

Looking Up	Not coded	100%	0%
Moving head w/ eyes closed	Not coded	100%	0%
Heights	Not coded	92%	8%
Turning around	Not coded	92%	8%
Mounted gun turrets	Not coded	85%	15%
Night vision goggles (NVG)	Not coded	83%	17%
Multiple transition colors	Not coded	77%	23%
Using gym equipment	Not coded	69%	31%

\*Include: SME's each item: "Although not essential, this item would contribute to the measure" or "It is essential that this item be included in the measure".

+Exclude: SME's coded each item: "This item should definitely not be included in the measure" or "This item does not need to be included for the measure to be useful".

Table 2

*Items excluded from the Military Concussion Readiness Inventory following the nominal group and the Delphi survey*

Excluded Items (n=28):	ICF Codes:	*% Include	+% Exclude
<b>Body functions (n=6)</b>			
Intimate relations /sex	b640: Sexual functions	54%	46%
Not eating/ hunger/dehydration	b545: Water, mineral and electrolyte balance functions	62%	38%
Not wearing proper prescription eye glasses	b2100: Visual acuity functions	62%	38%
Smells: cooking smells/ smell of blood/ burnt flesh	b1562: Olfactory perception	62%	38%
Watching 3D movies	b210: Seeing functions	15%	85%
Wearing eye protection	b210: Seeing functions	23%	77%
<b>Activities and Participation (n=18)</b>			
Cleaning/ housework	d640: Doing housework	15%	85%
Clearing obstacles	d455: Moving around	54%	46%
Constructing obstacles	d430: Lifting and carrying objects	23%	77%
Construction	d6501: Maintaining dwelling and furnishing	8%	92%
	d4453: Turning or twisting the hands or arms		
Dancing	d4106: Shifting the body's center of gravity	15%	85%
Driving long distances	d4751: Driving motorized vehicles	46%	54%
Driving through change of weather/elevation	d4751: Driving motorized vehicles	62%	38%
Grenade throwing	d4454: Throwing	15%	85%
Mowing lawn	d4502: Walking on different surfaces	8%	92%
Operating power tools	d4453: Turning or twisting the hands or arms	46%	54%
Parachute rigging	d540: Dressing	23%	77%
Picking up children	d4105: Bending	31%	69%
Sports: basketball/volleyball/football	d9201: Sports	54%	46%

Rappelling	d4401: Grasping	38%	62%
	d4350: Pushing with lower extremities		
Riding motorcycle	d4751: Driving motorized vehicles	31%	69%
Roller coasters/amusement park rides	d4709: USING transportation, unspecified	46%	54%
Sports: surfing/snow/wake boarding/skate boarding	d9201: Sports	46%	54%
Wading	d4502: Walking on different surfaces	15%	85%
<b>Environmental Factors (n=3):</b>			
Altitude/elevation	e2100: Land forms	62%	38%
Changes in temperature	e2250: Temperature	23%	77%
High altitude/ elevation	e2252: Atmospheric pressure	62%	38%
<b>Unable to be coded to a specific ICF code (n=1):</b>			
Wear MOPP (mission oriented protective posture) gear:	Not coded	46%	54%
<b>Deleted items (n=21):</b>			
Activities of daily living			
After an MRI			
Airborne/air assault Operations			
Clearing IED/mine sweeping			
Combatives			
Demolitions			
Environmental conditions			
Field sobriety test			
Flight duty/operations			
Hitting your head			
Keeping up with the kids			
Long power point presentations			
Medical training/mass casualty evacuation			
Physical readiness training (PRT )			
Real world combat missions			
Spatial orientation			
Spinning in chair			
Tasers			
Teaching a class			
Using sight optics			
Virtual training simulators			

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\*Include: SME's coded each item "Although not essential, this item would contribute to the measure" or "It is essential that this item be included in the measure".

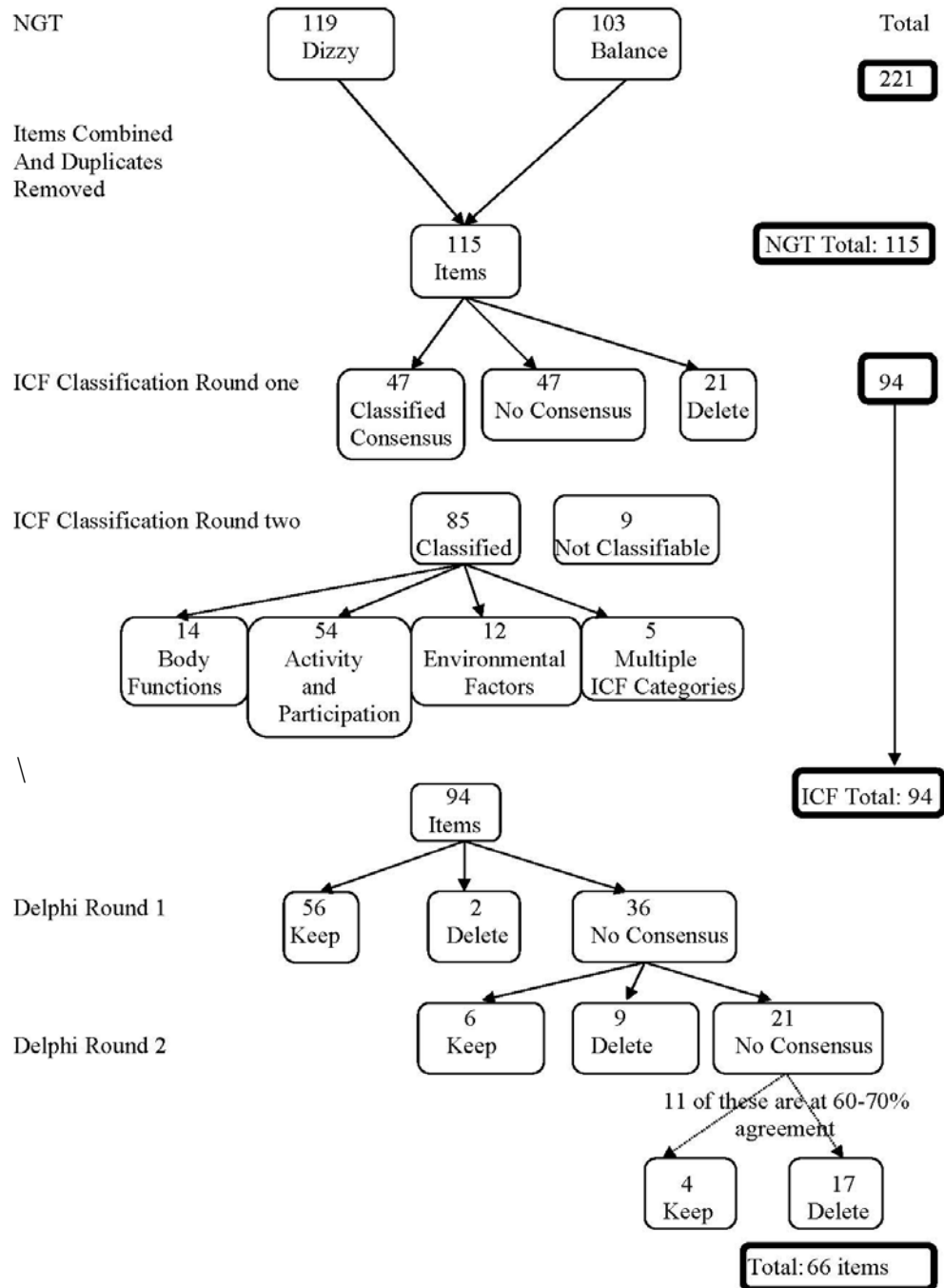
+Exclude: SME's coded each item "This item should definitely not be included in the measure" or "This item does not need to be included for the measure to be useful".



## Delphi

Eighteen experts were recruited and 14 agreed to participate. The experts included eleven female and three male physical therapists (PT) ranging in age from 29-57 years with a mean age of  $37 \pm 7.6$  years. There were five active duty PTs and nine civilian PTs, three of which were also reservists, and one civilian who was retired from Service (experience ranged from 6-35 years). Ten of the experts treat primarily Army SM, and three primarily treat Marine and Navy SM, while one treats all branches of the service. All experts were currently or within the last year working with SM with TBI. Thirteen participants completed both rounds of the Delphi and one was lost to deployment.

After the first round, there was agreement to include 56 items and agreement to exclude 2 items. The second round consisted of the 36 items that did not meet the 70% consensus rule. After round two there was at least 70% agreement to include 6 additional items and to exclude 9 items. The Delphi survey was stopped after two rounds due to the fact that there was little change in reaching 70% consensus and no suggestions were made by the experts to modify any of the twenty-one remaining items. Twenty one items did not reach consensus. Eleven of those items that had 60-70% agreement were considered by the investigators. Four of those items were rated as top 5 by the SM who generated the items during the NGT. Those four items were retained, and 17 were excluded (Figure 2).



NGT: Nominal Group Technique  
 ICF: International Classification of Functioning, Disability and Health

Figure 2. Model of Item Analysis

Sixty-six items comprise the final questionnaire (Appendix D). These sixty-six items include ICF concepts from activity and participation, body functions, and environmental factors. The final survey items ranged from light activities like reading or looking up to high functional activities like running, jumping, or wearing gear/combat load. Most items were linked to activities and participation concepts.

## DISCUSSION

The MCRI was developed as a new self-report measure to potentially identify functional impairments and predict readiness for return-to-duty in SM who have experienced a blast induced mTBI. This study describes 66 items deemed important to SM who have experienced mTBI or worked with SM with mTBI. These items were agreed upon by experts who concurred that the items should be included.

Although a SM might experience impairments in many areas of function following mTBI due to a blast injury, the questions asked in the NGT were specific to dizziness and balance. The purpose of the questionnaire was to focus specifically on these functional and physical aspects of the evaluation. The specific line of questioning during the NGT encourage the SM to provide items related to environmental factors, body functions, and activities and participation. The final list of items on the MCRI can be addressed with physical therapy.

Questionnaires are commonly used during clinical evaluations to establish a patient's baseline, to focus the evaluation and treatment, and to determine readiness for discharge. Determining the confidence a SM has performing military duties may help to determine the readiness of a SM to return to work. The MCRI was developed using input from SM with concussion. The questionnaire consists of military and non-military tasks to predict readiness for return-to-duty in SM who experienced mTBI due to a blast. Although the MCRI has not yet been tested on SM with dizziness or imbalance due to

concussion, with further development it will potentially be a valuable clinical tool for this population.

The tests and questionnaires currently used to assess SM with TBI have been validated on other populations, such as the elderly. Clinically, when the ABC is administered to soldiers who sustained TBI, particularly mTBI, they routinely score very high or perfect scores (no deficits), but these same soldiers continue to report balance impairments in performing military duties. The MCRI includes high level activities that are not included in the ABC, such as running, climbing, showering, looking up, driving, sports, carrying heavy objects, carpentry, intimate relations, and swimming to name a few. Service members tend to perform high level activities on a daily basis and do not tend to have difficulty performing many of the items included in the ABC, such as “walk around the house” or “sweep the floor.” As indicated by the SM who participated in the NGT, there are many high level activities that SM who have experienced a blast induced mTBI have difficulty performing. Like the MCRI, the items on the ABC have been linked to the ICF by Alghwiri.<sup>24</sup> There were twenty items linked to activities and participation concepts and three to body functions, no items were linked to environmental factors or body structures concepts. The ABC is more limited than the MCRI in high level activities and in the concepts included from the ICF.

As stated earlier the DHI is another tool commonly used by clinicians to assess self-perceived disability due to dizziness. The DHI includes easier tasks that other populations, such as elderly, may have difficulty performing due to dizziness and includes “more ambitious activities such as sports, dancing, household chores” and “strenuous housework or yard work” as the highest level activities. Similar to the ABC,

the MCRI includes high level activities that are not included in the DHI. The MCRI might be used like the DHI to identify if the dizziness is caused by a functional, emotional, or physical problem. But unlike the DHI, the MCRI might also help to determine return-to-duty for SM. The items on the DHI have also been linked to the ICF by Alghwiri.<sup>24</sup> Alghwiri linked twenty-nine items to activities and participation concepts and nine items to body functions, no items were linked to environmental factors or body structures concepts. Again, this demonstrates that the DHI is more limited than the MCRI in the concepts included from the ICF.

The SF-36 is a global health measure that can also be used as a subjective questionnaire in light of not having a military specific tool. There are some specific tasks on this tool that include vigorous activities, moderate activities, and light activities. However, it does not specifically address dizziness or imbalance, as opposed to the MCRI which includes specific tasks that affects dizziness or imbalance in the military population. The military population has a skill set that is different than the civilian population. The MCRI targets specific skill sets of the military that the DHI, ABC and SF-36 do not address.

Using the NGT with SM to develop the MCRI helped to identify actual tasks SM who have dizziness or imbalance due to blast injuries have difficulty performing making this instrument suitable for SM who have been exposed to blasts. The strength of using NGT is that this technique is driven by the people who are affected. The use of experts to develop the questionnaire might not have generated items that actually affect SM dizziness or balance. Use of a focus group would not be as effective. The NGT unlike a focus group allows full participation and no one person can dominate the group.

The use of the Delphi technique in the development of the MCRI contributed to its content validity. Experts who treat this population understand what therapists need to identify impairments and what is missing in the tools they use for SM who have dizziness or imbalance due to blast induced mTBI. The use of this technique helped to narrow down the responses generated from the NGT.

Therapists are encouraged to consider all concepts of the ICF when evaluating and treating SM according to Weightman et al.<sup>7</sup> The items in this questionnaire were mapped to the ICF where applicable. Although the ICF does not specifically reflect military tasks, it is important that the instrument include items that measure all aspects of military duty to include body functions, activities and participation, and environmental factors. The ICF mapping will also improve the generalizability of the instrument in its measurement of change in a military sample.

## LIMITATIONS

The Delphi survey was delivered by electronic file with an opportunity for the experts to rate each of the 94 items on the four-point scale. There was no place on the survey for any comments. However, the experts were asked to include any comments during each round but they would have had to include their response in a separate email rather than on the survey. This may have discouraged comments.

The nominal group was recruited at Ft. Bliss and WSMR, which are two Army posts. Therefore, some challenging tasks specific to other military occupations may not have been included in the MCRI which may limit its use with other military branches.

Generalization of this survey may also be limited since only male Army SM participated in this study. Women were not omitted from this study; nevertheless, none qualified for recruitment, due to either having blunt head injuries or were currently experiencing uncontrolled psychiatric conditions. However, this tool may be applicable for female SM doing the same tasks as men in the military.



## FUTURE STUDIES

Twenty-one items that did not meet the 70% criteria were to be excluded in the final items of the MCRI. Four of these items were retained due to the high rating in the NGT. On further examination of the twenty-one items, we found that some experts switched votes between rounds one and rounds two. Therefore, another round of the Delphi may possibly change the definitive outcome of the items included in the MCRI.

Future studies should continue to develop the MCRI to determine its reliability and validity. Sixty-six items are potentially too many to include in a self-report instrument. Therefore, the first step is to determine which items should be included to fully capture the effect of mTBI on dizziness and balance problems in SM. Factor analysis could help to accomplish the development of a shorter but still comprehensive tool.<sup>28</sup> After the final items are determined, it should be administered to SM experiencing mTBI to determine the feasibility, internal consistency and test-retest reliability. The MCRI should also be performed for all branches of the service to see the generalizability of the questionnaire.

## CONCLUSION

With over 240,000 SM who have experienced TBI since 2000, assessment and treatment of these SM has been an ongoing priority of the DoD. According to the Congressionally Directed Medical Research Programs, the main concern of psychological health and TBI research are to complement the efforts of the DoD to “ensure the health and readiness of our military forces.”<sup>38</sup>

In this study we successfully combined the use of SM experiences to develop content for an outcome tool and with expert opinion determined the content validity of the MCRI. The development of the MCRI as an instrument that can be used for assessment of SM who have experienced mTBI can help to identify functional activities, environmental factors, and body functions that may limit these SM from safely and efficiently performing their duties. The MCRI may be useful as a tool to determine return-to-duty status. Further research on the psychometric properties of the MCRI is needed to validate the tool.

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## APPENDIX A

### THE UNIVERSITY OF ALABAMA AT BIRMINGHAM INSTITUTIONAL REVIEW BOARD APPROVAL FORM



Institutional Review Board for Human Use

Form 4: IRB Approval Form  
Identification and Certification of Research  
Projects Involving Human Subjects

UAB's Institutional Review Boards for Human Use (IRBs) have an approved Federalwide Assurance with the Office for Human Research Protections (OHRP). The Assurance number is FWA00005960 and it expires on January 24, 2017. The UAB IRBs are also in compliance with 21 CFR Parts 50 and 56.

Principal Investigator: GUTIERREZ, MICHELLE

Co-Investigator(s):

Protocol Number: X110802008

Protocol Title: *Development and Content Validity of the Military Concussion Readiness Inventory for Service Members*

The IRB reviewed and approved the above named project on 8-21-12. The review was conducted in accordance with UAB's Assurance of Compliance approved by the Department of Health and Human Services. This Project will be subject to Annual continuing review as provided in that Assurance.

This project received EXPEDITED review.

IRB Approval Date: 8-21-12

Date IRB Approval Issued: 8-21-12

Marilyn Doss, M.A.  
Vice Chair of the Institutional Review  
Board for Human Use (IRB)

Investigators please note:

The IRB approved consent form used in the study must contain the IRB approval date and expiration date.

IRB approval is given for one year unless otherwise noted. For projects subject to annual review research activities may not continue past the one year anniversary of the IRB approval date.

Any modifications in the study methodology, protocol and/or consent form must be submitted for review and approval to the IRB prior to implementation.

Adverse Events and/or unanticipated risks to subjects or others at UAB or other participating institutions must be reported promptly to the IRB.

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APPENDIX B

WILLIAM BEAUMONT ARMY MEDICAL CENTER  
INSTITUTIONAL REVIEW BOARD APPROVAL FORM



DEPARTMENT OF THE ARMY  
U.S. ARMY MEDICAL RESEARCH AND MATERIEL COMMAND  
504 SCOTT STREET  
FORT DETRICK, MD 21702-5012

MCMR-RPC

30 January 2012

MEMORANDUM FOR Commander, Madigan Army Medical Center, ATTN: MCHJ-CI, 9040  
Fitzsimons Dr, Tacoma, WA 98431-1100

SUBJECT: Protocol Titled, "Development and Content Validity of the Military Concussion  
Readiness Inventory for Service Members," (dated 3 January 2012), by Michelle Gutierrez,  
MPT, (IRBNet # 369637-1)

1. The subject William Beaumont Army Medical Center protocol (dated 3 January 2012) was approved by the Madigan Army Medical Center (MAMC) Institutional Review Board (IRB) on 3 January 2012, through an expedited review process in accordance with 32 CFR 219.110 (under Category 7). The U.S. Army Medical Research and Materiel Command (USAMRMC) Office of Research Protections (ORP), Clinical Investigation Regulatory Office (CIRO) completed a Headquarters-level review on 30 January 2012 and found the study to comply with applicable DOD, U.S. Army, and USAMRMC human subjects protection requirements. Please refer to the ORP CIRO reviewer worksheet(s) for review details and recommendations. The study is approved pending issuance of the MAMC DCI's letter to implement/start the research.
2. The USAMRMC ORP CIRO concurs with the MAMC IRB's review and approval of the protocol as minimal risk, and with the IRB-approved informed consent process. The waiver of the requirement for informed consent for Group 2 is appropriate.
3. The USAMRMC ORP CIRO concurs with the MAMC IRB's review and approval of the study's individual privacy protections and with the partial waiver of HIPAA authorization for recruitment of Group 1 subjects.
4. Point of contact is the undersigned at (301) 619-3069.

SANO.  
HAROLD.  
STANLEY.  
1053367263

Digitally signed by: SANO.  
HAROLD STANLEY.1053367263  
DN: CN = SANO.HAROLD.  
STANLEY.1053367263 C = US O  
= U.S. Government OU = DoD  
Date: 2012.01.30 16:35:46 -0500

HAROLD S. SANO, Pharm.D, MBA  
LTC, MS  
Deputy Director, Clinical Investigation Regulatory  
Office



## APPENDIX C

ALL ITEMS GENERATED FROM FOUR NOMINAL GROUP MEETINGS

Item	Group #	# votes/Ranking by NGT members	Combined:, Deleted:, or Kept:
What military or non-military tasks do you think will be difficult to perform due to <u>balance trouble</u> in someone who has had a blast injury?			
1	Walking down/up stairs	1 n=5	1: 3 2: 0 3: 0 4: 0 5: 0  Combined: #1, 28, 53, 91, 206 Kept: Walking down/up stairs
2	Marching	1	No Votes  Combined: #2, 6, 45, 52, 78, 190 Kept: Ruck marching
3	Rifle marksmanship	1	1: 1 2: 0 3: 0 4: 1 5: 0  Combined: #3, 30, 50, 82, 113 Kept: Rifle Marksmanship/ Shooting a Weapon
4	Patient care while flying	1	No Votes  Combined: multiple categories Flight Duty/Operations Medical Training/Mass Casualty evacuation Deleted: Very broad.
5	Running	1	1: 0 2: 0 3: 1 4: 1 5: 0  Combined: #5, 32, 52, 86, 201 Kept: Running
6	Ruck marching	1	No Votes  Combined: #2, 6, 45, 52, 78, 190 Kept: Ruck marching
7	Carrying heavy objects	1	No Votes  Combined: #7, 26, 49, 192 Kept: Carrying heavy objects
8	Land navigation	1	No Votes  Combined: #8, 36 Kept: Land navigation
9	Virtual training simulators	1	No Votes  Deleted: Not defined well enough, could be computer simulators to roll over simulators, too broad.
10	Roofing	1	No Votes  Combined: # 10, 14, 64 Kept: Construction
11	Nuclear Biological Chemical (NBC) mask	1	No Votes  Combined: #11, 151 Kept: Nuclear Biological Chemical (NBC) Mask
12	Climbing	1 n=5	1: 0 2: 0 3: 1 4: 0 5: 0  Combined: # 12, 25, 53, 76, 83 Kept: Climbing
13	Rappelling	1	No Votes  Combined: #13, 92, 127, 196 Kept: Rappelling
14	Construction	1	No Votes  Combined: # 10, 14, 64 Kept: Construction
15	Showering	1	1: 0 2: 1 3: 1 4: 0 5: 0  Combined: #15, 57 Kept: Showering
16	Moving head with eyes closed	1	1: 1 2: 1 3: 0 4: 2 5: 0  Kept: Moving head with eyes closed

Item		Group #	# votes/Ranking by NGT members	Combined:, Deleted:, or Kept:
17	Walking a straight line	1	1: 0 2: 0 3: 1 4: 1 5: 3	Kept: Walking a straight line
18	Looking up	1	1: 0 2: 2 3: 0 4: 0 5: 0	Kept: Looking up
19	Jumping (trampoline/PRT)	1	1: 0 2: 0 3: 0 4: 0 5: 1	Combined: #19, 95, 106 Kept: Jumping
22	Driving	1	1: 0 2: 1 3: 0 4: 0 5: 0	Combined: # 22, 48, 158, 210 Kept: Driving
21	Sports: basketball/volleyball/football	1	1: 0 2: 0 3: 1 4: 0 5: 1	Combined: #21, 31, 163, 187 Kept: Sports: Basketball/Volleyball/ Football
22	Sprinting with quick stops	1 n=5	No Votes	Kept: Sprinting with quick stops
23	Facing backwards while flying	1	No Votes	Kept: Facing backwards while flying
24	Roller coasters	1	No Votes	Combined: #24, 154, 179 Kept: Roller Coasters/ Amusement park rides
25	Climbing up/down vehicles	2 n=5	1: 0 2: 0 3: 1 4: 1 5: 1	Combined: # 12, 25, 53, 76, 83 Kept: Climbing
26	Carrying Ruck/combat load	2	1: 0 2: 1 3: 0 4: 1 5: 0	Combined: multiple Kept: Carrying heavy objects Combat Load/Wearing Gear
27	Physical Readiness Training (PRT )	2	1: 1 2: 0 3: 0 4: 0 5: 0	Combined: #27, 56, 103, 131, 170, 220 Deleted: too broad of an item to classify, includes many other items already listed
28	Climbing stairs	2	1: 0 2: 0 3: 0 4: 0 5: 1	Combined: #1, 28, 53, 91, 206 Kept: Walking down/up stairs
29	Riding motorcycle	2	1: 1 2: 0 3: 0 4: 0 5: 0	Combined: #29, 48, 87 Kept: Riding motorcycle
30	Operating a weapon (kneeling/standing	2	1: 1 2: 1	Combined: #3, 30, 50, 82, 113 Kept: Rifle Marksmanship/

Item		Group #	# votes/Ranking by NGT members	Combined:, Deleted:, or Kept:
	unsupported with weight)		3: 2 4: 0 5: 0	Shooting a Weapon
31	Sports	2	1: 0 2: 0 3: 0 4: 0 5: 1	Combined: #21, 31, 163, 187 Kept: Sports: Basketball/Volleyball/ Football
32	Walking/running	2 n=5	1: 0 2: 1 3: 1 4: 0 5: 1	Combined: #5, 32, 52, 86, 201 Kept: Running
33	Traveling (trains/planes/auto)	2	1: 0 2: 0 3: 0 4: 0 5: 1	Combined: #33, 71, 148, 195, 212 Kept: Traveling (Trains/Planes/ Auto/Bus/Boat)
34	Getting in/out of bed	2	1: 0 2: 0 3: 1 4: 0 5: 0	Kept: Getting in/out of Bed
35	NVG (night vision goggles)	2	No Votes	Combined: 35, 120, 198 Kept: Night Vision Goggles
36	Land navigation over terrain	2	No Votes	Combined: #8, 36 Kept: Land navigation
37	Parachute rigging	2	No Votes	Kept: Parachute rigging
38	Dismounting vehicles in gear	2	No Votes	Kept: Dismounting vehicles in gear
39	Standing in formation	2	No Votes	Combined: #39, 51, 94, 176 Kept: Standing in formation
40	Obstacle course	2	No Votes	Combined: #40, 99, 189 Obstacle course Kept: Obstacle course
41	ADLs	2	1: 2 2: 2 3: 0 4: 0 5: 0	Combined: # 41, 156 Deleted: Included in 15, 34, 43, 57, 68
42	Dancing	2	No Votes	Kept: Dancing
43	Sitting on toilet (up/down)	2	No Votes	Combined: #43, 68 Kept: Getting up (Bed, Chair, Toilet)
44	Airborne/air assault operations	2	1: 0 2: 0 3: 1 4: 0 5: 0	Combined: #44, 144 Airborne/air assault operations Deleted: too broad. Airborne; jumping out of airplanes at altitude; air assault: jumping out of helicopters at height above ground, like repelling on a rope. Both require preparation. Too numerous to mention.
45	Marching in formation	2 n=5	No Votes	Combined: #2, 6, 45, 52, 78, 190 Kept: Ruck marching
46	Swimming	2	1: 0 2: 0 3: 0	Combined: #46, 93 Kept: Swimming

Item		Group #	# votes/Ranking by NGT members	Combined:, Deleted:, or Kept:
			4: 1 5: 0	
47	Walking/ hiking narrow paths	2	No Votes	Kept: Walking/ Hiking Narrow Paths
48	Operating a vehicle/motorcycle	3 n=4	1: 1 2: 0 3: 0 4: 0 5: 0	Combined: multiple Kept: Driving/ Riding motorcycle
49	Carrying bulky items	3	1: 0 2: 0 3: 0 4: 1 5: 0	Combined: #7, 26, 49, 192 Kept: Carrying heavy objects
50	Shooting a weapon	3	1: 1 2: 1 3: 1 4: 0 5: 0	Combined: #3, 30, 50, 82, 113 Kept: Rifle Marksmanship/ Shooting a Weapon
51	Standing in formation	3	No Votes	Combined: #39, 51, 94, 176 Kept: Standing in formation
52	Running/walking/ruck/ patrolling	3	1: 0 2: 1 3: 1 4: 0 5: 0	Combined: multiple categories Kept: Running/ Ruck Marching
53	Climbing (ladders/stairs/vehicles)	3	1: 1 2: 0 3: 0 4: 0 5: 0	Combined: multiple Kept: Climbing, Walking down/up stairs
54	Maintaining equipment/vehicles	3 n=4	No Votes	Combined: #54, 77 Deleted: Too broad. Climbing up and down vehicles, into, crawl underneath, check components, compartments, and antennas. Not mechanical, just checks they call it PMCS (preventative maintenance checks and services). Included in other items.
55	Clearing houses	3	No Votes	Kept: Clearing houses
56	PRT	3	1: 0 2: 0 3: 0 4: 1 5: 0	Combined: #27, 56, 103, 131, 170, 220 Deleted: too broad of an item to classify, includes many other items already listed
57	Taking showers (washing feet)	3	1: 0 2: 1 3: 1 4: 1 5: 1	Combined: #15, 57 Kept: Showering
58	Providing first aid care	3	1: 0 2: 0 3: 0 4: 1 5: 1	Combined: #4, 58, 88 Medical Training/Mass Casualty evacuation Deleted: Very broad. Making life and death decisions, increased physical tasks with fast movement, moving patients, change in positions (kneeling, standing, and

Item		Group #	# votes/Ranking by NGT members	Combined:, Deleted:, or Kept:
				lifting).
59	Field sobriety test	3	No Votes	Combined: #59, 75 Kept: Field sobriety test
60	Constructing obstacles	3	No Votes	Kept: Constructing obstacles
61	Clearing obstacles	3	No Votes	Kept: Clearing obstacles
62	Demolitions	3	1: 1 2: 0 3: 0 4: 0 5: 0	Combined: #62, 171 Deleted: very broad, making bombs, tearing down structures, using bulldozers. Can be stress situations to detonate explosives/bombs, wearing full battle gear and hard to move, have to stand up quick
63	Mine sweeping	3 n=4	1: 0 2: 1 3: 0 4: 0 5: 0	Combined: #63, 65 Clearing IED/Mine Sweeping Deleted: too broad, falls under demolitions/stress
64	Carpentry	3	1: 0 2: 0 3: 1 4: 0 5: 0	Combined: # 10, 14, 64 Kept: Construction
65	Clearing IED	3	No Votes	Combined: #63, 65 Clearing IED/Mine Sweeping Deleted: too broad, falls under demolitions/stress
66	Operating power tools	3	No Votes	Kept: Operating power tools
67	Mowing lawn	3	No Votes	Kept: Mowing lawn
68	Getting up (bed, chair, toilet)	3	No Votes	Combined: #43, 68 Kept: Getting up (Bed, Chair, Toilet)
69	Picking up children	3	1: 0 2: 0 3: 0 4: 0 5: 1	Kept: Picking up children
70	Intimate relations	3	1: 0 2: 0 3: 0 4: 0 5: 1	Combined: #70, 102, 152, 203 Kept: Intimate Relations /Sex
71	Traveling (trains/boats/bus)	3	No Votes	Combined: #33, 71, 148, 195, 212 Kept: Traveling (Trains/Planes/ Auto/Bus/Boat)
72	Using gym equipment	3	No Votes	Kept: Using gym equipment
73	Surfing/snowboarding/skate boarding	3	No Votes	Combined: #73, 90 Kept: Sports: Surfing/Snow/Wake Boarding/Skate boarding
74	Wading	3 n=4	No Votes	Kept: Wading
75	Field sobriety test	4 n=5	No Votes	Combined: #59, 75 Kept: Field sobriety test
76	Climbing in/out vehicles	4	1: 0 2: 0 3: 2 4: 0 5: 0	Combined: # 12, 25, 53, 76, 83 Kept: Climbing



Item		Group #	# votes/Ranking by NGT members	Combined:, Deleted:, or Kept:
77	Vehicle/ equip maintenance	4	1: 0 2: 1 3: 0 4: 0 5: 0	Combined: #54, 77 Deleted: Too broad. Climbing up and down vehicles, into, crawl underneath, check components, compartments, and antennas. Not mechanical, just checks they call it PMCS (preventative maintenance checks and services). Included in other items.
78	Ruck marches/dismounted patrols	4	1: 0 2: 0 3: 1 4: 0 5: 0	Combined: #2, 6, 45, 52, 78, 190 Kept: Ruck marching
79	Wearing gear	4	1: 1 2: 0 3: 1 4: 0 5: 0	Combined: #26, 79, 190 Kept: Combat Load/Wearing Gear
80	Real world combat missions	4	1: 2 2: 1 3: 0 4: 0 5: 0	Deleted: This is way too broad. Could be foot patrol in all gear to fire fight, etc. This is like answering that "being a soldier" is what makes me dizzy - this answer includes most of the other items
81	Grenade throwing	4	No Votes	Kept: Grenade throwing
82	Weapon firing	4	1: 1 2: 0 3: 0 4: 1 5: 0	Combined: #3, 30, 50, 82, 113 Kept: Rifle Marksmanship/ Shooting a Weapon
83	Pulling tower guard	4 n=5	No Votes	Combined: # 12, 25, 53, 76, 83 Kept: Climbing
84	Wear MOPP gear	4	1: 0 2: 0 3: 0 4: 1 5: 0	Combined: #84, 221 Kept: Wear MOPP gear
85	Combatives	4	1: 0 2: 1 3: 0 4: 0 5: 0	Deleted: Too broad. mixed martial arts/wrestling, can be with weapons (sticks, etc.) high exertion, valsalva maneuvers
86	Physical training/ running	4	1: 0 2: 0 3: 1 4: 1 5: 0	Combined: #5, 32, 52, 86, 201 Kept: Running
87	Riding motorcycle / scooter/bicycle	4	1: 0 2: 0 3: 0 4: 0 5: 1	Combined: #29, 48, 87 Kept: Riding motorcycle
88	Medical training/mass casualty evacuation	4	No Votes	Combined: #4, 58, 88 Medical Training/Mass Casualty evacuation Deleted: Very broad. Making life and death decisions, increased physical tasks with fast movement,

Item		Group #	# votes/Ranking by NGT members	Combined:, Deleted:, or Kept:
				moving patients, change in positions (kneeling, standing, and lifting).
89	Spatial orientation	4	No Votes	Combined: #89, 193 Deleted: too broad
90	Skating/snowboarding/surfing/wakeboarding	4	No Votes	Combined: #73, 90 Kept: Sports: Surfing/Snow/Wake Boarding/Skateboarding
91	Stairs	4	1: 0 2: 0 3: 0 4: 0 5: 1	Combined: #1, 28, 53, 91, 206 Kept: Walking down/up stairs
92	Rappelling	4 n=5	No Votes	Combined: #13, 92, 127, 196 Kept: Rappelling
93	Swimming	4	No Votes	Combined: #46, 93 Kept: Swimming
94	Standing in formation/ D & C	4	1: 0 2: 0 3: 0 4: 1 5: 1	Combined: multiple Kept: Standing in formation Drill and Ceremony (D & C)
95	Trampoline	4	No Votes	Combined: #19, 95, 106 Kept: Jumping
96	Uneven surfaces	4	No Votes	Kept: Uneven surfaces
97	Night operations (night vision goggles/driving at night)	4	1: 1 2: 2 3: 0 4: 0 5: 1	Combined: #97, 122 Kept: Driving during the Night
98	Missile firing	4	No Votes	Combined: #98, 202 Kept: Firing Large Caliber Weapons/ missile firing
99	Obstacle course	4	1: 0 2: 0 3: 0 4: 0 5: 1	Combined: #40, 99, 189 Obstacle course Kept: Obstacle course
100	Altitude/elevation	4	1: 0 2: 0 3: 0 4: 1 5: 0	Kept: Altitude/elevation
101	Environmental conditions	4	No Votes	Deleted: too broad
102	Sex	4	No Votes	Combined: #70, 102, 152, 203 Kept: Intimate Relations /Sex
What military or non-military tasks do you think will <u>cause or increase dizziness</u> in someone who has had a blast injury?				
103	PRT	1 n=5	1: 0 2: 0 3: 0 4: 0 5: 1	Combined: #27, 56, 103, 131, 170, 220 Deleted: too broad of an item to classify, includes many other items already listed
104	Flight duty	1 n=5	No Votes	Combined: #4, 104, 211 Flight Duty/Operations Deleted: Too broad of a category, may be difficulty due to movement of the aircraft (airplane vs.

Item		Group #	# votes/Ranking by NGT members	Combined:, Deleted:, or Kept:
				helicopter)
105	Stopping/turning quickly	1	1: 0 2: 1 3: 0 4: 3 5: 0	Combined: #105, 109, 124, 125, 140, 141, 171 Kept: Abrupt movement
106	Jumping	1	1: 0 2: 0 3: 0 4: 1 5: 1	Combined: #19, 95, 106 Kept: Jumping
107	After an MRI	1	No Votes	Deleted: This is not typically performed in military setting
108	Picking things off the ground	1	1: 0 2: 1 3: 0 4: 0 5: 0	Kept: Picking things off the ground
109	Standing up quickly	1	1: 1 2: 0 3: 2 4: 0 5: 0	Combined: #105, 109, 124, 125, 140, 141, 171 Kept: Abrupt movement
110	Riding in enclosed vehicle	1	1: 0 2: 1 3: 0 4: 1 5: 0	Combined: #110, 112 Kept: Riding in Military Vehicle/Enclosed Vehicles
111	Hitting head	1	No Votes	Deleted: This would cause dizziness in most people
112	Riding in military vehicle	1	No Votes	Combined: #110, 112 Kept: Riding in Military Vehicle/Enclosed Vehicles
113	Firing a weapon	1	1: 0 2: 0 3: 0 4: 0 5: 1	Combined: #3, 30, 50, 82, 113 Kept: Rifle Marksmanship/ Shooting a Weapon
114	Headaches	1 n=5	1: 2 2: 0 3: 1 4: 0 5: 0	Combined: #114, 126 Kept: Migraines/ Headaches
115	3D movies	1	No Votes	Combined: #115, 175 Kept: watching 3D movies
116	Excessive reading	1	1: 0 2: 0 3: 0 4: 0 5: 1	Combined: 116, 142, 177 Kept: Reading
117	Mental exertion	1	1: 0 2: 1 3: 0 4: 0 5: 0	Kept: Mental exertion
118	Physical exertion/ lifting weights (immediately after)	1	1: 1 2: 1 3: 2	Combined: #118, 145, 178 Kept: Over exerting/physical exertion/ excessive physical

Item		Group #	# votes/Ranking by NGT members	Combined:, Deleted:, or Kept:
			4: 0 5: 1	activity
119	Navigate on rough terrain	2 n=5	1: 0 2: 0 3: 0 4: 0 5: 1	Combined: #119, 130 Kept: Navigate on Rough Terrain
120	NVG (night vision goggles)	2	No Votes	Combined: 35, 120, 198 Kept: Night Vision Goggles
121	Sleep deprivation: waking up at early hours/working long hours >24 hrs.	2	1: 0 2: 0 3: 1 4: 0 5: 0	Combined: #121, 162, 217 Kept: Sleep deprivation: Waking up at early hours/Working long hours >24 hrs.
122	Driving during the night	2	1: 0 2: 0 3: 1 4: 0 5: 0	Combined: #97, 122 Kept: Driving during the Night
123	Multiple transition colors	2 n=5	No Votes	Kept: Multiple transition colors
124	Abrupt movement	2	1: 1 2: 0 3: 1 4: 0 5: 0	Combined: #105, 109, 124, 125, 140, 141, 171 Kept: Abrupt movement
125	Moving at high speeds	2	No Votes	Combined: #105, 109, 124, 125, 140, 141, 171 Kept: Abrupt movement
126	Migraines	2	1: 1 2: 0 3: 1 4: 0 5: 0	Combined: #114, 126 Kept: Migraines/ Headaches
127	Rappelling	2	No Votes	Combined: #13, 92, 127, 196 Kept: Rappelling
128	Changes in temperature	2	No Votes	Kept: Changes in temperature
129	Dehydration	2	No Votes	Combined: #129, 219 Kept: Dehydration
130	Navigate on rough terrain	2	1: 0 2: 0 3: 0 4: 0 5: 1	Combined: #119, 130 Kept: Navigate on Rough Terrain
131	PRT (physical readiness training)	2	1: 0 2: 1 3: 0 4: 0 5: 1	Combined: #27, 56, 103, 131, 170, 220 Deleted: too broad of an item to classify, includes many other items already listed
132	Medication	2	1: 0 2: 2 3: 0 4: 0 5: 0	Combined: #132, 172, 180, 191 Kept: Alcohol/ Drugs/ Medication
133	Strain/bearing down	2	No Votes	Kept: Strain/bearing down
134	Tinnitus/inner ear disturbance	2	No Votes	Kept: Tinnitus/inner ear disturbance
135	Heights	2	No Votes	Combined: #135, 216

Item		Group #	# votes/Ranking by NGT members	Combined:, Deleted:, or Kept:
				Kept: Heights
136	Not wearing proper eye prescription	2	No Votes	Kept: Not wearing proper eye prescription
137	Excessive heat	2 n=5	No Votes	Combined: #137, 166 Kept: Heat
138	Transition through change in light	2	1: 0 2: 0 3: 1 4: 0 5: 1	Combined: #138, 160, 185 Kept: Busy Vision (transitioning through change in light, looking at busy background)
139	Enclosed tight spaces	2	1: 0 2: 0 3: 0 4: 1 5: 0	Combined: #139, 209 Kept: confined areas (rooms/vehicles)
140	Suddenly getting up	2	No Votes	Combined: #105, 109, 124, 125, 140, 141, 171 Kept: Abrupt movement
141	Turning head to quickly	2	No Votes	Combined: #105, 109, 124, 125, 140, 141, 171 Kept: Abrupt movement
142	Reading fine print	2	No Votes	Combined: 116, 142, 177 Kept: Reading
143	Stressful situations	2	No Votes	Combined: #146, 146, 173, 181, 197 Kept: Anxiety, worry, fear
144	Sky diving	2	No Votes	Combined: #44, 144 Airborne/air assault operations Deleted: too broad. Airborne; jumping out of airplanes at altitude; air assault: jumping out of helicopters at height above ground, like repelling on a rope. Both require preparation. Too numerous to mention.
145	Excessive physical activity	2	No Votes	Combined: #118, 145, 178 Kept: Over exerting/physical exertion/ excessive physical activity
146	Anxiety Attack	2	1: 1 2: 0 3: 0 4: 1 5: 0	Combined: #146, 146, 173, 181, 197 Kept: Anxiety, worry, fear
147	Flashing Lights	2 n=5	No Votes	Kept: Flashing Lights
148	Riding In a Boat	2	No Votes	Combined: #33, 71, 148, 195, 212 Kept: Traveling (Trains/Planes/ Auto/Bus/Boat)
149	Sound	2	No Votes	Kept: Sound
150	Excessive light	2	1: 0 2: 1 3: 0 4: 1 5: 1	Kept: Excessive light
151	Nuclear biological chemical mask (NBC)	2	No Votes	Combined: #11, 151 Kept: Nuclear Biological Chemical (NBC) Mask

Item		Group #	# votes/Ranking by NGT members	Combined:, Deleted:, or Kept:
152	Sex	2	1: 1 2: 1 3: 0 4: 0 5: 0	Combined: #70, 102, 152, 203 Kept: Intimate Relations /Sex
153	Walking in crowds	2	1: 0 2: 0 3: 1 4: 0 5: 0	Kept: Walking in crowds
154	Roller coaster	2	1: 1 2: 0 3: 0 4: 0 5: 0	Combined: #24, 154, 179 Kept: Roller Coasters /Amusement park rides
155	Bending/reaching beyond neutral	2	No Votes	Kept: Bending/reaching beyond neutral
156	ADLs	2	1: 0 2: 0 3: 0 4: 0 5: 1	Combined: # 41, 156 Deleted: Included in 15, 34, 43, 57, 68
157	Ride in back of vehicles	2	1: 0 2: 0 3: 0 4: 1 5: 0	Combined: #157, 194 Kept: Riding in Back of Vehicles
158	Driving POV	2 n=5	No Votes	Combined: # 22, 48, 158, 210 Kept: Driving
159	Staring at TV/computer	2	No Votes	Kept: Staring at TV/computers
160	Focusing on moving object	2	No Votes	Combined: #138, 160, 185 Kept: Busy Vision (transitioning through change in light, looking at busy background)
161	Wearing eye protection	2	No Votes	Kept: Wearing eye protection
162	Lack of sleep	3 n=4	1: 0 2: 1 3: 1 4: 1 5: 0	Combined: #121, 162, 217 Kept: Sleep deprivation: Waking up at early hours/Working long hours >24 hrs.
163	Playing sports	3	No Votes	Combined: #21, 31, 163, 187 Kept: Sports: Basketball/Volleyball/ Football
164	Not eating/ hunger/dehydration	3	1: 1 2: 0 3: 1 4: 0 5: 0	Kept: Not eating/ hunger/dehydration
165	Drill and ceremony (D & C)	3	1: 1 2: 0 3: 0 4: 0 5: 0	Combined: #94, 165, 199 Kept: Drill and Ceremony (D & C)
166	Heat	3	1: 0 2: 0 3: 0 4: 1 5: 0	Combined: #137, 166 Kept: Heat

Item		Group #	# votes/Ranking by NGT members	Combined:, Deleted:, or Kept:
167	Keeping up with the kids	3	1: 0 2: 0 3: 0 4: 1 5: 0	Deleted: Too broad
168	Cleaning/ housework	3 n=4	No Votes	Kept: Cleaning/ housework
169	Teaching a class	3	No Votes	Deleted: This is not typically performed in military setting
170	PRT	3	No Votes	Combined: #27, 56, 103, 131, 170, 220 Deleted: too broad of an item to classify, includes many other items already listed
171	Stand up too fast/demolitions	3	1: 0 2: 0 3: 0 4: 0 5: 1	Combined: #105, 109, 124, 125, 140, 141, 171 Kept: Abrupt movement
172	Drugs	3	No Votes	Combined: #132, 172, 180, 191 Kept: Alcohol/ Drugs/ Medication
173	Worry/fear	3	No Votes	Combined: #146, 146, 173, 181, 197 Kept: Anxiety, worry, fear
174	Turning around	3	No Votes	Kept: Turning around
175	Watching 3D movies	3	1: 0 2: 1 3: 0 4: 0 5: 0	Combined: #115, 175 Kept: watching 3D movies
176	Standing in formation	3	1: 0 2: 0 3: 0 4: 0 5: 1	Combined: #39, 51, 94, 176 Kept: Standing in formation
177	Reading/testing (paper/computers)	3	1: 1 2: 0 3: 0 4: 0 5: 0	Combined: 116, 142, 177 Kept: Reading
178	Over exerting/physical exertion	3	1: 0 2: 0 3: 1 4: 1 5: 0	Combined: #118, 145, 178 Kept: Over exerting/physical exertion/ excessive physical activity
179	Amusement park rides	3 n=4	No Votes	Combined: #24, 154, 179 Kept: Roller Coasters /Amusement park rides
180	Alcohol	3	No Votes	Combined: #132, 172, 180, 191 Kept: Alcohol/ Drugs/ Medication
181	Stress/pressure	3	1: 0 2: 1 3: 0 4: 0 5: 0	Combined: #146, 146, 173, 181, 197 Kept: Anxiety, worry, fear
182	Playing video games	3	1: 0 2: 0 3: 0	Kept: playing video games

Item		Group #	# votes/Ranking by NGT members	Combined:, Deleted:, or Kept:
			4: 0 5: 2	
183	Driving long distances	3	1: 1 2: 0 3: 0 4: 0 5: 0	Kept: Driving long distances
184	Long power point presentations	3	No Votes	Deleted: This is not typically performed in military setting
185	Looking at collages	3	No Votes	Combined: #138, 160, 185 Kept: Busy Vision (transitioning through change in light, looking at busy background)
186	Spinning in chair	3	No Votes	Deleted: Most people get dizzy
187	Sports/ combative	4 n=5	1: 0 2: 0 3: 0 4: 0 5: 1	Combined: #21, 31, 163, 187 Kept: Sports: Basketball/Volleyball/ Football
188	Tasers	4	No Votes	Deleted: This would make anybody "dizzy"
189	Obstacle courses	4	No Votes	Combined: #40, 99, 189 Obstacle course Deleted: too broad; included in other items already listed
190	Ruck marches/ combat	4 n=5	1: 1 2: 2 3: 0 4: 0 5: 0	Combined: multiple Kept: Ruck marching Combat Load/Wearing Gear
191	Medication/supplements	4	1: 0 2: 0 3: 1 4: 0 5: 0	Combined: #132, 172, 180, 191 Kept: Alcohol/ Drugs/ Medication
192	Weight issues	4	No Votes	Combined: #7, 26, 49, 192 Kept: Carrying heavy objects
193	Spatial orientation	4	No Votes	Combined: #89, 193 Deleted: too broad
194	Riding in back of vehicles	4	1: 0 2: 0 3: 1 4: 0 5: 0	Combined: #157, 194 Kept: Riding in Back of Vehicles
195	Airplanes/pressure/depression	4	1: 0 2: 0 3: 1 4: 0 5: 0	Combined: #33, 71, 148, 195, 212 Kept: Traveling (Trains/Planes/ Auto/Bus/Boat)
196	Rappelling	4	No Votes	Combined: #13, 92, 127, 196 Kept: Rappelling
197	Anxiety	4	No Votes	Combined: #146, 146, 173, 181, 197 Kept: Anxiety, worry, fear
198	Night operations	4	1: 0 2: 0 3: 1 4: 0	Combined: 35, 120, 198 Kept: Night Vision Goggles



Item		Group #	# votes/Ranking by NGT members	Combined:, Deleted:, or Kept:
			5: 1	
199	Drill & ceremony	4	1: 0 2: 0 3: 0 4: 1 5: 0	Combined: #94, 165, 199 Kept: Drill and Ceremony (D & C)
200	Wearing ACH	4	No Votes	Kept: Wearing ACH
201	Running	4	1: 0 2: 0 3: 0 4: 1 5: 1	Combined: #5, 32, 52, 86, 201 Kept: Running
202	Firing large caliber weapons	4 n=5	No Votes	Combined: #98, 202 Kept: Firing Large Caliber Weapons/ missile firing
203	Sex	4	No Votes	Combined: #70, 102, 152, 203 Kept: Intimate Relations /Sex
204	Bright lights/flash bangs/ loud noises	4	1: 1 2: 1 3: 0 4: 1 5: 0	Kept: Bright lights/flash bangs/ loud noises
205	Food/caffeine (too much/too little)	4	No Votes	Kept: Food/Caffeine (too much/too little)
206	Stairs	4	No Votes	Combined: #1, 28, 53, 91, 206 Kept: Walking down/up stairs
207	Smells: cooking smells/ smell of blood/ burnt flesh	4	1: 0 2: 1 3: 0 4: 0 5: 0	Kept: Smells: cooking smells/ smell of blood/ burnt flesh
208	Mounted gun turrets	4	1: 0 2: 0 3: 0 4: 1 5: 0	Kept: Mounted gun turrets
209	Confined areas (rooms/vehicles)	4	No Votes	Combined: #139, 209 Kept: confined areas (rooms/vehicles)
210	Driving	4	1: 1 2: 0 3: 0 4: 0 5: 0	Combined: # 22, 48, 158, 210 Kept: Driving
211	Flight operations	4	1: 1 2: 0 3: 0 4: 0 5: 0	Combined: #4, 104, 211 Flight Duty/Operations Deleted: Too broad of a category, may be difficulty due to movement of the aircraft (airplane vs. helicopter)
212	Boats	4 n=5	No Votes	Combined: #33, 71, 148, 195, 212 Kept: Traveling (Trains/Planes/ Auto/Bus/Boat)
213	Using sight optics	4	1: 0 2: 0 3: 0 4: 0 5: 2	Deleted: Too broad of category; Can be rifle scope or computer screen

Item		Group #	# votes/Ranking by NGT members	Combined:, Deleted:, or Kept:
214	Adrenaline rushes	4	No Votes	Kept: Adrenaline Rushes, stress
215	High altitude/ elevation	4	No Votes	Kept: High altitude/ elevation
216	Heights	4	No Votes	Combined: #135, 216 Kept: Heights
217	Sleep deprivation	4	1: 0 2: 0 3: 0 4: 1 5: 0	Combined: #121, 162, 217 Kept: Sleep deprivation: Waking up at early hours/Working long hours >24 hrs.
218	Driving through change of weather/elevation	4	No Votes	Kept: Driving through change of weather/elevation
219	Dehydration	4	No Votes	Combined: #129, 219 Kept: Dehydration
220	PRT	4	1: 0 2: 0 3: 1 4: 0 5: 0	Combined: #27, 56, 103, 131, 170, 220 Deleted: too broad of an item to classify, includes many other items already listed
221	MOPP gear / pro mask	4	1: 0 2: 1 3: 0 4: 0 5: 0	Combined: #84, 221 Kept: Wear MOPP gear

ACH – advanced combat helmet  
 ADLs – Activities of daily living  
 D & C – drill and ceremony  
 MRI – magnetic resonance imaging  
 MOPP - mission oriented protective posture  
 NVG – night vision goggles  
 NBC – nuclear biological chemical  
 POV – privately owned vehicle  
 PRT – physical readiness training

APPENDIX D

MILITARY CONCUSSION READINESS INVENTORY

### MILITARY CONCUSSION READINESS INVENTORY (MCRI)

For each of the following activities, please indicate your level of self-confidence by choosing a corresponding number from the following rating scale:		
0%	10	20
30	40	50
60	70	80
90	100%	
No Confidence		Completely Confident
“How confident are you that you will not lose your balance or become dizzy when you are performing or exposed to...”		
Activity and Participation		
1	... abrupt movement	%
2	... adrenaline rushes, stress	%
3	... bending/reaching beyond neutral	%
4	... carrying heavy objects	%
5	... clearing houses	%
6	... climbing	%
7	... combat load/wearing gear	%
8	... dismounting vehicles in gear	%
9	... Drill and Ceremony (D & C)	%
10	... driving	%
11	... driving during the night	%
12	... facing backwards while flying	%
13	... firing large caliber weapons/missile firing	%
14	... getting in/out of bed	%
15	... getting up (bed, chair, toilet)	%
16	... jumping (trampoline)	%
17	... maintaining equipment/vehicles	%
18	... mental exertion	%
19	... navigating on rough terrain	%
20	... obstacle course	%
21	... picking things off the ground	%
22	... riding in back of vehicles	%
23	... riding in military vehicle/enclosed vehicles	%
24	... ruck marching	%
25	... running	%
26	... showering	%
27	... sprinting with quick stops	%
28	... standing in formation	%
29	... swimming	%
30	... traveling (trains/planes/auto/bus/boat)	%
31	... uneven surfaces	%
32	... walking a straight line	%
33	... walking down/up stairs	%
34	... walking in crowds	%
35	... walking/ hiking narrow paths	%
36	... wearing an Advanced Combat Helmet (ACH)	%

### MILITARY CONCUSSION READINESS INVENTORY (MCRI)

For each of the following activities, please indicate your level of self-confidence by choosing a corresponding number from the following rating scale:										
0%	10	20	30	40	50	60	70	80	90	100%
No Confidence					Completely Confident					
<p>“How confident are you that you will not lose your balance or become dizzy when you are performing or exposed to...”</p>										
Body Functions										
37	... anxiety, worry, fear									%
38	... dehydration									%
39	... migraines/headaches									%
40	... Nuclear Biological Chemical (NBC) mask									%
41	... over exerting/physical exertion/excessive physical activity									%
42	... sleep deprivation: waking up at early hours/working long hours >24 hrs.									%
43	... strain/bearing down									%
44	... tinnitus/inner ear disturbance									%
Environmental Factors										
45	... alcohol/drugs/medication									%
46	... bright lights/flash bangs/ loud noises									%
47	... busy vision (transitioning through change in light, looking at busy background)									%
48	... confined areas (rooms/vehicles)									%
49	... excessive light									%
50	... flashing lights									%
51	... heat									%
52	... sound									%
53	... staring at TV/computer									%
Multiple ICF categories										
54	... food/caffeine (too much/too little)									%
55	... land navigation									%
56	... playing video games									%
57	... reading									%
58	... rifle marksmanship/shooting a weapon									%
Unable to be coded to a specific ICF category										
59	... heights									%
60	... looking up									%
61	... mounted gun turrets									%
62	... moving head with eyes closed									%
63	... multiple transition colors									%
64	... night vision goggles (NVG)									%
65	... turning around									%
66	... using gym equipment									%