|  |
| --- |
| **CRITICALLY APPRAISED TOPIC** |

**FOCUSED CLINICAL QUESTION**

|  |
| --- |
| Is dual-task training better at improving function than single task training in active-duty military personnel post TBI? |

**AUTHOR**

|  |  |  |  |
| --- | --- | --- | --- |
| **Prepared by** | Michael Kress | **Date** | 01/04/2022 |
| **Email address** | Michael\_kress@med.unc.edu | | |

**CLINICAL SCENARIO**

|  |
| --- |
| **Another task in CAMP is a dual-task event that requires physical exertion with and without a weighted vest while also trying to remember and repeat back the 10 digit grid given in the beginning of the task. I have always felt that I have a bad memory and prided myself more on the ability to figure things out rather than purely remembering something. This task was quite challenging to me as a relatively healthy individual. Dual-tasking ability is the backbone of military training and without it, we become incompetent and unsafe to those around us.**  **This is important because it is pertinent that we challenge this patient population with the correct amount of difficulty in order to assess their ability to perform their duties at a proficient level. A static dual-task is less common than a dynamic dual task in my military experience and believe we are losing specificity for this patient population if we use treatments that are more static such as the semi-tandem stance and spelling words with their eyes closed.** |

**SUMMARY OF SEARCH**

[Best evidence appraised and key findings]

|  |
| --- |
| **Key Findings:**   * DTT that include functional skills for balance, gait and cognitive tasks should be prescribed in a progressive manner to improve common deficits of unsteady and slow walking in persons w/ mTBI * Dual-task conditions can experience task prioritization which a participant makes either the motor or the cognitive task a priority and losses are seen in performance of the other task in order to maintain the level of performance in the prioritized task. Younger adults tend to prioritize cognitive tasks and older adults tend to prioritize the motor task when a cognitive-balance dual-task paradigm is in place. * Dual-task training can have additional benefits compared to standard PT in regards to functional mobility and ability to dual task (measured by walking with talking test). * Demographic differences between healthy control civilian populations and military populations exist and can influence the differences in cognitive and postural stability measures. The civilian population outperformed the military population under both ST and DT conditions in terms of cognitive tasks, but it was reverse for the postural stability tasks. * Dual spatial working memory tasks improved stability during standing and increased cadence in controls and mTBI. * Improvement in the ability to DT can be achieved through dual-task training which can lead to improved gait, balance and cognition. * In a healthy population, dual-task training does not provide additional benefits compared to STT. DTT showed similar results as single-task training and has proven to be feasible.   **Summary of Evidence:**  Anywhere from Level IV to Level I of evidence was reviewed with no study specifically addressing my PICO. A combination of evidence must be used to draw up guidelines for future research protocols and research questions as there is very limited research for this patient population and even less with regards to the intervention and comparison. |

**CLINICAL BOTTOM LINE**

|  |
| --- |
| DTT has benefits in improving balance, cognition, and dual-task ability with no to little increased risk. DTT is feasible and applicable in the clinical setting however further research is required to more accurately examine how applicable this is to the military TBI population. The jury is still out to whether DTT provides additional benefit when compared to STT but none the less still provides improvement. |

|  |
| --- |
| ***This critically appraised topic has been individually prepared as part of a course requirement and has been peer-reviewed by one other independent course instructor*** |

*The above information should fit onto the first page of your CAT*

**SEARCH STRATEGY**

|  |  |  |  |
| --- | --- | --- | --- |
| **Terms used to guide the search strategy** | | | |
| **P**atient/Client Group | **I**ntervention (or Assessment) | **C**omparison | **O**utcome(s) |
| Active-duty military acute stage post-TBI | Motor task training | Cognitive task training | Improved dual-task performance |

**Final search strategy (history):**

*Show your final search strategy (full history) from PubMed. Indicate which “line” you chose as the final search strategy.*

PubMed:

**dual-task intervention AND (TBI OR concussion) AND (humans[Filter])**

dual-task performance AND (TBI OR concussion) AND (humans[Filter])

dual-task assessment AND (TBI OR concussion) AND (humans[Filter])

dual-task training AND (TBI OR concussion) AND (humans[Filter])

dual-task training AND TBI AND (humans[Filter])

single task AND dual task AND (TBI OR concussion) AND effects AND (humans[Filter])

*In the table below, show how many results you got from your search from each database you searched.*

|  |  |  |
| --- | --- | --- |
| **Databases and Sites Searched** | **Number of results** | **Limits applied, revised number of results (if applicable)** |
| **PubMed** | **110** | **Human only (93)** |
| **Cochrane Library** | **15** |  |
| **PEDro (Dual-Task effect)** | **141** | **Sub discipline neurology (47)** |

## INCLUSION and EXCLUSION CRITERIA

|  |
| --- |
| **Inclusion Criteria** |
| * Available in English * Human study * RCT, Review, Meta-Analysis, Systematic Review * Studies since 2000 |
| **Exclusion Criteria** |
| * Published in language other than English * Non-human subjects * Case-study, expert opinion, cohort study * Studies before 2000 |

**RESULTS OF SEARCH**

**Summary of articles retrieved that met inclusion and exclusion criteria**

*For each article being considered for inclusion in the CAT, score for methodological quality on an appropriate scale, categorize the level of evidence, indicate whether the relevance of the study PICO to your PICO is high/mod/low, and note the study design (e.g., RCT, systematic review, case study).*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Author (Year)** | **Risk of bias (quality score)\*** | **Level of Evidence\*\*** | **Relevance** | **Study design** |
| **Ana Isabel Useros Olmo (2020)**[1](https://sciwheel.com/work/citation?ids=11725847&pre=&suf=&sa=0&dbf=0) | **Low (6/11 PEDro)** | **III** | **Moderate** | **Quasi-Eperimental Controlled Trial** |
| **NE Fritz (2015)**[2](https://sciwheel.com/work/citation?ids=5642767&pre=&suf=&sa=0&dbf=0) | **Moderate (AMSTAR-2)** | **I** | **Moderate** | **Systematic Review** |
| **Susan M Linder (2019)**[3](https://sciwheel.com/work/citation?ids=11725828&pre=&suf=&sa=0&dbf=0) | **Low (QUADAS-2)** | **III** | **Low** | **Diagnostic Study** |
| **Joseph M. Ingriselli (2014)**[4](https://sciwheel.com/work/citation?ids=3964822&pre=&suf=&sa=0&dbf=0) | **Low (11/11 PEDro)** | **II** | **Moderate to High** | **RCT** |
| **Nora E. Fritz (2013)**[5](https://sciwheel.com/work/citation?ids=4504817&pre=&suf=&sa=0&dbf=0) | **Low (7/8 JBI Critical Appraisal Checklist for Case Report)** | **IV** | **Low to Moderate** | **Case Study** |
| **Margaret M. Weightman (2010)**[6](https://sciwheel.com/work/citation?ids=2455860&pre=&suf=&sa=0&dbf=0) | **Low (5/6 AGREE II)** | **I** | **Moderate** | **CPG** |
| **Morgan K. McGrath (2020)**[7](https://sciwheel.com/work/citation?ids=11882869&pre=&suf=&sa=0&dbf=0) | **Moderate (5/11 PEDro)** | **III** | **Moderate** | **RCT** |
| **Luke M. Ross (2011)**[8](https://sciwheel.com/work/citation?ids=4742346&pre=&suf=&sa=0&dbf=0) | **Low (6/11 PEDro)** | **III** | **Moderate** | **Quasi-Experimental Controlled Trial** |

\*Indicate tool name and score

\*\*Use Portney Table 36-1: Summary of Levels of Evidence (2020). If downgraded, indicate reason why.

**BEST EVIDENCE**

The following 2 studies were identified as the ‘best’ evidence and selected for critical appraisal. Rationale for selecting these studies were:

|  |
| --- |
| * **Fritz NE, Cheek FM, Nichols-Larsen DS.** **Motor-Cognitive Dual-Task Training in Persons With Neurologic Disorders: A Systematic Review. J Neurol Phys Ther. 2015;39(3):142-153. doi:10.1097/NPT.0000000000000090 This was chosen because it included TBI as a population despite it not being specifically military TBI. This study also looked at multiple outcome measures in a generalized neurological disorder population.** * **Ingriselli JM, Register-Mihalik JK, Schmidt JD, Mihalik JP, Goerger BM, Guskiewicz KM. Outcomes, utility, and feasibility of single task and dual task intervention programs: preliminary implications for post-concussion rehabilitation. J Sci Med Sport. 2014;17(6):580-585. doi:10.1016/j.jsams.2013.11.006 This was chosen because it specifically compares STT to DTT in a population of similar age range as the population in my PICO. It is a high level of evidence with moderate relevance to my PICO.** |

**SUMMARY OF BEST EVIDENCE**

**(1) Description and appraisal of Motor-Cognitive Dual-Task Training in Persons With Neurologic Disorders: A Systematic Review by (Fritz et al., 2015)**

|  |
| --- |
| **Aim/Objective of the Study/Systematic Review:** |
| The purpose of this systematic review was to determine the effectiveness of dual-task training (DTT) compared to usual care in individuals with neurologic disorders which includes TBI. |
| **Study Design**  [e.g., systematic review, cohort, randomised controlled trial, qualitative study, grounded theory. Includes information about study characteristics such as blinding and allocation concealment. When were outcomes measured, if relevant]  Note: For systematic review, use headings ‘search strategy’, ‘selection criteria’, ‘methods’ etc. For qualitative studies, identify data collection/analyses methods. |
| **Data Sources and Searches**: Data searches were conducted using Biosis, CINAHL, Cochrane, ERIC, PsychInfo, EBSCO Psychological & Behavioral, PubMed, Scopus, and Web of Knowledge as databases using any literature from their origin up until January 19, 2014.  **Study Selection**: Two investigators screened titles and obtained copies of the articles if the title potentially met inclusion criteria (>18 years old with central neurologic disorder diagnosis, received motor-cognitive DTT, and were assessed on outcomes of mobility or mobility and one domain of cognition) or if there wasn’t enough information to make a decision. They also searched the reference lists of every retrieved article. A total of 14 studies that were identified were eligible for inclusion. Initial search yielded 3472 results, 1211 duplicates were removed, an additional 1858 were then removed after screening titles, 387 more were removed after reviewing abstracts and 6 more removed after review of the full articles leaving 10 of the original 3472. They then added 4 more articles from reviewing reference lists of these 10 articles bringing the total articles included to 14.  **Data Extraction and Quality Assessment**: Two authors extracted data independently and recorded it on standardized spreadsheets (sample sizes, trial settings, population characteristics, intervention details, and study results). Included studies focused on motor-cognitive DTT with primary outcome of interest being mobility (single and dual-task gait velocity and stride length). Outcomes were assessed at the conclusion of training and were compared to either usual care (exercise or null – no treatment) or baseline (if repeated measure design was used). All outcome measures used were assessed due to wide variety in study outcome. The methodological quality was independently evaluated using the 5 criteria recommended by the Cochrane Back Review Group.  **Data Synthesis and Analysis**: Two independent raters used a standardized table to synthesize the data (study design, participant characteristics, intervention, comparison interventions, and all outcome measures). The effectiveness of DTT on single-task gait, dual-task gait, balance and cognition were analyzed to examine the results across studies since over 30 different outcome measures were used as primary and secondary outcomes. If the study presented full data, raw data was extracted to derive standardize mean differences (RCTs) and mean change (repeated measures) as well as 95% CI. |
| **Setting**  [e.g., locations such as hospital, community; rural; metropolitan; country] |
| Literature included all took place in the outpatient setting. |
| **Participants**  [N, diagnosis, eligibility criteria, how recruited, type of sample (e.g., purposive, random), key demographics such as mean age, gender, duration of illness/disease, and if groups in an RCT were comparable at baseline on key demographic variables; number of dropouts if relevant, number available for follow-up]  Note: This is not a list of the inclusion and exclusion criteria. This is a description of the actual sample that participated in the study. You can find this descriptive information in the text and tables in the article. |
|  |
| **Intervention Investigated**  [Provide details of methods, who provided treatment, when and where, how many hours of treatment provided] |
| *Control* |
| Baseline data was used as controls for repeated measures designs (11 out of 14) and usual care/general exercise controls used in RCTs (3 out of 14). |
| *Experimental* |
| The experimental groups sample size median (IQR) were 14(5.5), age of 69.5 (11.5) years, and a male-female ratio of 9(2.5): 7(11.5). In studies with control groups, the sample size was 12(6.3), age 72.3(11.1) years, and male-female ratio of 8.5(3): 8.5(10.5). 12 different DTT protocols were utilized among the studies (3 used single-sessions of cueing to improve gait parameters during DT-gait, 7 used multi-session training including various cognitive tasks paired with either gait or balance/strength tasks, 4 used VR or gaming, and 4 combined DTT with additional therapies such as aerobic exercise). |
| **Outcome Measures**  [Give details of each measure, maximum possible score and range for each measure, administered by whom, where] |
| More than 35 measures were used to assess the effectiveness of DTT which included more than 7 different tasks to assess DT-gait. This led to the analysis of DTT on single-task gait, dual-task gait, balance and cognition. |
| **Main Findings**  [Provide summary of mean scores/mean differences/treatment effect, 95% confidence intervals and p-values etc., where provided; you may calculate your own values if necessary/applicable. You may summarize results in a table but you must explain the results with some narrative.] |
| In this review, the authors used any DTT protocol and analyzed its effectiveness on gait velocity and stride length (single- and dual-task) balance and cognition. Compared to a general exercise control group, individuals with Alzheimer’s disease showed reduced dual-task cost for both gait velocity and stride length after DTT. Specifically to TBI, single-task gait was not assessed and for dual-task balance, further inquiries to the author did not receive a response and no statistics were reported. DTT effect on cognition showed no significant treatment effect with the memory span and tracking task or the telephone search while counting task when compared to a null control in the TBI population. However, significant improvements in DT gait speed with an effect size of 1.52 was reported with a between group difference of 6.11. Meta-analyses was not performed due to the heterogeneity of training protocols, disparate disability levels, variable treatments and treatment duration. In other populations such as Alzheimer’s disease and Parkinson’s disease, DTT was demonstrated to be effective in improving ST-gait, DT-gait, balance, cognition, and ability to dual task. |
| **Original Authors’ Conclusions**  [Paraphrase as required. If providing a direct quote, add page number] |
| On page 6, the authors state that DTT is supported as an intervention regardless of the protocol/method used can result in improving ST and DT gait while also improving balance and cognition to a lesser effect in neurologically impaired population. They also mention on page 8 that more studies with more standardized protocols along with more specific diagnosis populations. |
| **Critical Appraisal** |
| **Validity**  [Summarize the internal and external validity of the study. Highlight key strengths and weaknesses. Comment on the overall evidence quality provided by this study.] |
| This systematic review is a higher level of evidence being that it is a systematic review however no meta-analyses was done and of the 14 studies included, only 3 were RCTs where the rest were repeatable measures design. The authors did not include risk of bias for any of the studies included or any conflict of interest statements. However, this review searched multiple databases with little restrictions and clear inclusion criteria. They also explained the use of repeated measures design while also justifying the statistical analysis used due to the heterogeneity of outcome measures and protocols used amongst the studies. In regards to my specific PICO, this evidence is moderately strong as it looks at DTT as the intervention and includes TBI amongst other neurologic disorders in the population. It also looks at several outcome measures including ability to dual-task which is a big deal in the military population. However, the baseline demographics of those included in the studies in this review are significantly different than a military population which also requires a higher level of dual-task ability to return to duty. |
| **Interpretation of Results**  [This is YOUR interpretation of the results taking into consideration the strengths and limitations as you discussed above. Please comment on clinical significance of effect size / study findings. Describe in your own words what the results mean.] |
| DTT has its benefits with little, if any, additional cost when aiming to improve gait (both ST and DT) velocity and stride length, ST cognition and ST balance, and the ability to dual task. Although there is not a specific protocol or guideline to the DTT training program, using interventions that target DTT in a neurologically impaired population can lead to additional benefits when compared to usual care. |
| **Applicability of Study Results**  [Describe the relevance and applicability of the study to your clinical question and scenario. Consider the practicality and feasibility of the intervention in your discussion of the evidence applicability.] |
| This review shows little additional benefit for DTT in the TBI population but additional benefit for little increased risk or cost none the less. DTT has additional benefits in improving gait, balance, cognition, and ability to dual task with greater effect in other neurologic disorder populations which bodes well for TBI in future studies due to the generalized belief of motor-cognitive interference being a factor in all neurologic disorders. This review does not specifically include a military population which might differ in mechanism of injury but also the baseline and required skills needed to perform their duties properly. |

**(2) Description and appraisal of Outcomes, utility, and feasibility of single task and dual task intervention programs: preliminary implications for post-concussion rehabilitation by (Ingriselli et al., 2014)**

|  |
| --- |
| **Aim/Objective of the Study/Systematic Review:** |
| The purpose of this study was to examine DT neurocognitive and balance performance in healthy collegiate recreational athletes, prior to and following a DTT intervention compared to a ST intervention control group. |
| **Study Design**  [e.g., systematic review, cohort, randomised controlled trial, qualitative study, grounded theory. Includes information about study characteristics such as blinding and allocation concealment. When were outcomes measured, if relevant]  Note: For systematic review, use headings ‘search strategy’, ‘selection criteria’, ‘methods’ etc. For qualitative studies, identify data collection/analyses methods. |
| Thirty healthy and physically active recreational athletes (DT=15, ST=15) completed both neurocognitive and balance assessments prior to and after completing a 4-week intervention period. This included the SOT, BESS total score, and 9 CNS Vital Signs composite scores serving as outcome measures. Mixed model analyses were used to examine each measure.  The SOT was performed which consisted of 6 conditions, each lasting 20s, and performed 3 times in random order. Each condition was used to compute a weighted-average of each sensory condition called a composite score. This was used to calculate contributions of each participant’s visual, somatosensory, and vestibular system to their overall balance (3 sensory ratio forms) with higher scores representing improved ability to maintain postural control the other 2 systems are altered.  All participants reported for pre- and post-intervention testing sessions (2 balance assessments and a computerized neurocognitive exam). The PI was blinded to the baseline and post-intervention performance until the study was complete. The computer monitor was covered during administration of the SOT to assure blinding to the test administrator of balance scores. A different member of the research team analyzed the CNS Vital Signs scores for validity.  The participants performed an additional training session each week at home which consisted of exercises they have previously included during an in-person intervention session which they kept track of in their personally tailored log. They were also asked if they completed their training sessions at home each training session. The 4 weeks intervention period consisted of 12 training sessions (8 in person and 4 at home) that were included in the study analysis. If observed sessions were missed due to academic breaks or scheduling issues, a 5th week in the intervention period was allowed to have makeup sessions.  The ST group completed activities broken down into either balance or cognitive exercises with different degrees of difficulty. The DT group completed activities from all 4 difficulty DT levels. Each week the difficulty progression occurred regardless of performance. |
| **Setting**  [e.g., locations such as hospital, community; rural; metropolitan; country] |
| This study used participants that were all a volunteer sample from sports clubs at UNC Chapel Hill. |
| **Participants**  [N, diagnosis, eligibility criteria, how recruited, type of sample (e.g., purposive, random), key demographics such as mean age, gender, duration of illness/disease, and if groups in an RCT were comparable at baseline on key demographic variables; number of dropouts if relevant, number available for follow-up]  Note: This is not a list of the inclusion and exclusion criteria. This is a description of the actual sample that participated in the study. You can find this descriptive information in the text and tables in the article. |
| Participants were stratified by gender than randomly assigned to either DT or ST intervention group. All participants were blinded to their group assignment, unaware of differences in training between groups, and to study hypothesis. One additional participant was dropped due to lack of compliance.  **Table 1**  Demographic information.   |  |  |  |  | | --- | --- | --- | --- | |  | ST (*n* = 15)  Mean (SD) | DT (*n* = 15)  Mean (SD) | Total sample (*n* = 30) Mean (SD) | | Age (years) | 20.87 (2.23) | 19.73 (1.33) | 20.30 (1.90) | | Height (m) | 1.68 (0.11) | 1.62 (0.18) | 1.65 (0.15) | | Mass (kg) | 70.65 (14.71) | 65.86 (12.81) | 68.25 (13.77) | | Days between pre- | 33.27 (5.02) | 34.80 (3.23) | 34.03 (4.22) | | and post-test |  |  |  | |
| **Intervention Investigated**  [Provide details of methods, who provided treatment, when and where, how many hours of treatment provided] |
| *Control* |
| They were required to report to research center 2x/week to complete their intervention program along with an additional training session each week at home. Participants were required to follow their specific training log and log their activity before and during the intervention period. The ST (control) performed their activities in separate balance exercises and cognitive exercises. Each starting at entry level for both types of exercises and progressed each week regardless of performance. |
| *Experimental* |
| They were required to report to research center 2x/week to complete their intervention program along with an additional training session each week at home. Participants were required to follow their specific training log and log their activity before and during the intervention period. The DT (intervention) performed their activities concurrently including both balance and cognitive exercises. Each starting at entry level for both types of exercises and progressed each week regardless of performance. |
| **Outcome Measures**  [Give details of each measure, maximum possible score and range for each measure, administered by whom, where] |
| SOT: each of the 6 conditions was used to compute a weighted-average of all the sensory conditions and called it the composite score. The data was also used to calculate contributions of each vestibular, somatosensory, and visual participant’s overall balance performance using three sensory ratio scales with higher scores representing improved postural control ability. Each condition was in a random order and performed 3x with each condition lasting about 20s.  BESS: This composed of 6 total trials, each being 20s and consisting of 3 different conditions (DL, SL on non-dominant leg, and tandem stance with non-dominant foot in rear). Each condition was performed on girm surface and repeated on a foam surface. Scoring was done by adding 1 (max of 10) for each error committed during each condition (i.e. lifting ones hands of iliac crest, opening eyes, etc.)  CNS Vital Signs: Contained a battery of 7 sub-tests: verbal memory, visual memory, finger tapping, symbol-digit coding, Stroop, shifting attention, continuous performance, and non-verbal reasoning. Domain raw-scores were analyzed for the battery from verbal memory, visual memory, processing speed, executive function, psychomotor speed, reaction time, complex attention, cognitive flexibility, and reasoning. |
| **Main Findings**  [Provide summary of mean scores/mean differences/treatment effect, 95% confidence intervals and p-values etc., where provided; you may calculate your own values if necessary/applicable. Use a table to summarize results if possible.] |
| **Table 2**  Descriptive and statistical results for study outcome measures.   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | |  | Pre-test mean (SD) | Post-test mean (SD) | Collapsed group mean (SD) | Group interaction effect | Session main effect | Group main effect | | SOT composite |  |  |  |  |  |  | | Single task | 54.8 (3.5) | 54.6 (3.5) | 54.7 (6.3) |  |  |  | | Dual-task | 53.6 (6.3) | 52.5 (5.7) | 53.0 (6.3) | *F*1,28 = 0.39; *p* = .535 | *F*1,28 = 0.80; *p* = .377 | *F*1,28 = 1.05; *p* = .315 | | Entire sample | 54.2 (5.0) | 53.5 (4.8) | – |  |  |  | | SOT vestibular ratio |  |  |  |  |  |  | | Single task | 0.77 (0.10) | 0.85 (0.07) | 0.81 (0.13) |  |  |  | | Dual-task | 0.76 (0.13) | 0.79 (0.14) | 0.78 (0.13) | *F*1,28 = 1.47; *p* = .235 | *F*1,28 = 6.55; *p* = .016 | *F*1,28 = 1.04; *p* = .317 | | Entire sample | 0.76 (0.11) | 0.82 (0.11) | – |  |  |  | | SOT somatosensory ratio | | | | | | | | Single task | 0.98 (0.08) | 1.00 (0.05) | 0.99 (0.07) |  |  |  | | Dual-task | 0.97 (0.05) | 1.00 (0.07) | 0.99 (0.07) | *F*1,28 = 0.02; *p* = .891 | *F*1,28 = 2.74; *p* = .108 | *F*1,28 = 0.13; *p* = .724 | | Entire sample | 0.98 (0.06) | 1.00 (0.06) | – |  |  |  | | SOT visual ratio |  |  |  |  |  |  | | Single task | 0.90 (0.11) | 0.92 (0.07) | 0.91 (0.10) |  |  |  | | Dual-task | 0.87 (0.08) | 0.90 (0.07) | 0.88 (0.10) | *F*1,28 = 0.01; *p* = .951 | *F*1,28 = 3.95; *p* = .057 | *F*1,28 = 0.98; *p* = .332 | | Entire sample | 0.88 (0.09) | 0.91 (0.07) | – |  |  |  | | BESS total error score | | | | | | | | Single task | 8.23 (1.79) | 5.00 (2.86) | 6.62 (3.28) |  |  |  | | Dual-task | 8.73 (3.73) | 4.00 (2.12) | 6.37 (3.05) | *F*1,26 = 1.51; *p* = .231 | *F*1,26 = 42.34; *p* < .001 | *F*1,26 = 0.09; *p* = 771 | | Entire sample | 8.50 (2.95) | 4.46 (2.50) | – |  |  |  | | Verbal memory |  |  |  |  |  |  | | Single task | 54.8 (3.5) | 54.6 (3.5) | 54.7 (6.3) |  |  |  | | Dual-task | 53.6 (6.3) | 52.5 (5.7) | 53.0 (6.3) | *F*1,28 = 0.39; *p* = .535 | *F*1,28 = 0.80; *p* = .377 | *F*1,28 = 1.05; *p* = .315 | | Entire sample | 54.2 (5.0) | 53.5 (4.8) | – |  |  |  | | Visual memory |  |  |  |  |  |  | | Single task | 50.5 (3.9) | 50.7 (4.2) | 50.6 (5.6) |  |  |  | | Dual-task | 50.7 (5.9) | 50.8 (4.5) | 50.8 (5.6) | *F*1,28 = 0.01; *p* = .937 | *F*1,28 = 0.03; *p* = .875 | *F*1,28 = 0.01; *p* = .929 | | Entire sample | 50.6 (4.9) | 50.8 (4.3) | – |  |  |  | | Processing speed |  |  |  |  |  |  | | Single task | 73.6 (13.7) | 77.2 (10.3) | 75.4 (13.4) |  |  |  | | Dual-task | 67.7 (11.6) | 71.1 (9.9) | 69.4 (13.4) | *F*1,28 = 0.01; *p* = .978 | *F*1,28 = 2.24; *p* = .146 | *F*1,28 = 3.00; *p* = .094 | | Entire sample | 70.6 (12.8) | 74.2 (10.4) | – |  |  |  | | Executive function |  |  |  |  |  |  | | Single task | 50.7 (7.3) | 54.1 (6.2) | 52.4 (9.3) |  |  |  | | Dual-task | 50.1 (7.9) | 51.9 (7.1) | 51.2 (9.3) | *F*1,28 = 1.04; *p* = .317 | *F*1,28 = 4.97; *p* = .034 | *F*1,28 = 0.25; *p* = .978 | | Entire sample | 50.1 (7.5) | 53.0 (6.7) | – |  |  |  | | Psychomotor speed |  |  |  |  |  |  | | Single task | 200.3 (20.9) | 205.4 (16.6) | 202.8 (26.4) |  |  |  | | Dual-task | 191.4 (20.3) | 194.2 (20.5) | 192.8 (26.4) | *F*1,28 = 0.28; *p* = .601 | *F*1,28 = 3.23; *p* = .083 | *F*1,28 = 1.04; *p* = .317 | | Entire sample | 195.8 (20.7) | 199.8 (19.2) | – |  |  |  | | Reaction time |  |  |  |  |  |  | | Single task | 602.5 (55.6) | 608.9 (78.1) | 605.7 (115.4) |  |  |  | | Dual-task | 604.8 (102.9) | 606.5 (88.7) | 605.6 (110.5) | *F*1,21 = 0.03; *p* = .858 | *F*1,21 = 0.10; *p* = .753 | *F*1,21 = 0.00; *p* = .998 | | Entire sample | 603.7 (81.9) | 607.7 (81.9) | – |  |  |  | | Complex attention |  |  |  |  |  |  | | Single task | 7.4 (3.2) | 4.6 (2.2) | 5.9 (3.3) |  |  |  | | Dual-task | 6.9 (2.9) | 6.7 (2.7) | 6.8 (3.3) | *F*1,26 = 5.45; *p* = .027 | *F*1,26 = 6.73; *p* = .015 | *F*1,26 = 0.86; *p* = .362 | | Entire sample | 7.1 (3.0) | 5.6 (2.7) | – |  |  |  | | Cognitive ﬂexibility |  |  |  |  |  |  | | Single task | 49.2 (7.4) | 53.2 (6.7) | 51.2 (9.3) |  |  |  | | Dual-task | 49.3 (7.9) | 50.8 (6.6) | 50.1 (9.3) | *F*1,28 = 1.44; *p* = .240 | *F*1,28 = 6.71; *p* = .015 | *F*1,28 = 0.02; *p* = .639 | | Entire sample | 49.3 (7.5) | 52.0 (6.6) | – |  |  |  | | Reasoning Single task | 8.2 (2.9) | 9.9 (3.2) | 9.0 (4.1) |  |  |  | | Dual-task | 9.2 (4.7) | 9.0 (3.9) | 9.1 (3.9) | *F*1,27 = 1.00; *p* = .326 | *F*1,27 = 0.61; *p* = .440 | *F*1,28 = 0.01; *p* = .952 | | Entire sample | 8.7 (3.9) | 9.4 (3.6) | – |  |  |  |   An increased SOT vestibular ratio score along with fewer errors being committed during the BESS from pre-testing to post-testing was observed regardless of group. All participants also displayed improvement in the executive function, complex attention, and cognitive flexibility from pre-testing to post-testing shown by the significant main effects that were observed. Despite both showing improvement in complex attention, the ST group showed significantly greater improvement from pre-test to post-test. |
| **Original Authors’ Conclusions**  [Paraphrase as required. If providing a direct quote, add page number] |
| As mentioned on page 5, the authors suggest that combining a cognitive task with a balance task does provide beneficial effects, but no additional ones compared to ST interventions in healthy individuals of college age. However, these DT interventions are feasible in this setting. |
| **Critical Appraisal** |
| **Validity**  [Summarize the internal and external validity of the study. Highlight key strengths and weaknesses. Comment on the overall evidence quality provided by this study.] |
| This RCT scores an 11/11 on PEDro for low risk of bias and has PI blinding for intervention group assignment and scoring as testing is going on along with prior testing performance. This study also addresses any conflicts of interest including its source of funding. The study is a strong level of evidence being an RCT but is even stronger due to their methodology. They also randomized participant allocation after stratifying gender. The population is loosely associated with my PICO being around a similar age and of similar baseline demographics however are healthy and non-military. |
| **Interpretation of Results**  [This is YOUR interpretation of the results taking into consideration the strengths and limitations as you discussed above. Please comment on clinical significance of effect size / study findings. Describe in your own words what the results mean.] |
| The results of this RCT support DTT being beneficial in improving cognition and balance but appear to be no better than using STT. In fact, STT has been shown to be more beneficial in the complex attention domain. Regardless of training group, improvement was made and although only 1 domain had significant differences between groups, several domains showed improvement in both groups and both intervention types are feasible clinically. |
| **Applicability of Study Results**  [Describe the relevance and applicability of the study to your clinical question and scenario. Consider the practicality and feasibility of the intervention in your discussion of the evidence applicability.] |
| The age of all participants is similar to a military population and probably similar physical abilities. This study does not utilize a population that is military specific or include any data for a TBI population. However this study does include interventions that are commonly performed in a physical therapy clinic and directly compares STT to DTT. |

**SYNTHESIS AND CLINICAL IMPLICATIONS**

[Synthesize the results, quality/validity, and applicability of the two studies reviewed for the CAT. Future implications for research should be addressed briefly. Limit: 1 page.]

|  |
| --- |
| Both studies include a couple of components from my PICO but no study was found to include every component of my PICO. In the RCT by Ingriselli et al., DTT was compared to STT using balance scores on the BESS and SOT and scores on the CNS Vital Signs as outcome measures. The quality of this study was high and moderately relevant to my PICO. No additional benefit was shown when comparing STT to DTT, however DTT still resulted in improvement in performance on post-testing compared to pre-testing in executive functioning, complex attention, cognitive flexibility, SOT vestibular ratio scoring, and BESS total error scoring. However, STT did demonstrate significantly greater improvement than DTT in complex attention. Future research is needed to see how this fares in a non-healthy population such as military TBI.  In the review Fritz et al., DTT has been shown to improve gait velocity and stride length in ST and DT gait, the ability to dual-task and ST cognition in the neurologic disorder population. Specifically to brain injury, DTT led to DT gait speed showing significant effects but not in cognitive ST or stride length. Although this study did not use a military population, it did specifically include brain injury as well as other neurologic disorder populations. Further research is needed to determine the effectiveness of standardized DTT protocols as well as to specific neurologic populations instead of analyzing across populations.  Overall the evidence supports the feasibility application in the clinical setting. While it may not necessarily provide additional benefit, it is on par with STT and DTT should continue to be targeted when prescribing interventions to the military TBI population as there is the possibility of additional benefits with no additional cost or harm. Tailoring individualized treatment plans should include one’s baseline and goals which may differ from individual to individual especially when considering occupational requirements such as military return to active duty. |

**REFERENCES**

[List all references cited in the CAT]

|  |
| --- |
| Bibliography  [1.    Useros Olmo AI, Periañez JA, Martínez-Pernía D, Miangolarra Page JC. Effects of spatial working memory in balance during dual tasking in traumatic brain injury and healthy controls. *Brain Inj*. 2020;34(9):1159-1167. doi:10.1080/02699052.2020.1792984](https://sciwheel.com/work/bibliography/11725847)  [2.    Fritz NE, Cheek FM, Nichols-Larsen DS. Motor-Cognitive Dual-Task Training in Persons With Neurologic Disorders: A Systematic Review. *J Neurol Phys Ther*. 2015;39(3):142-153. doi:10.1097/NPT.0000000000000090](https://sciwheel.com/work/bibliography/5642767)  [3.    Linder SM, Koop MM, Ozinga S, Goldfarb Z, Alberts JL. A Mobile Device Dual-Task Paradigm for the Assessment of mTBI. *Mil Med*. 2019;184(Suppl 1):174-180. doi:10.1093/milmed/usy334](https://sciwheel.com/work/bibliography/11725828)  [4.    Ingriselli JM, Register-Mihalik JK, Schmidt JD, Mihalik JP, Goerger BM, Guskiewicz KM. Outcomes, utility, and feasibility of single task and dual task intervention programs: preliminary implications for post-concussion rehabilitation. *J Sci Med Sport*. 2014;17(6):580-585. doi:10.1016/j.jsams.2013.11.006](https://sciwheel.com/work/bibliography/3964822)  [5.    Fritz NE, Basso DM. Dual-task training for balance and mobility in a person with severe traumatic brain injury: a case study. *J Neurol Phys Ther*. 2013;37(1):37-43. doi:10.1097/NPT.0b013e318282a20d](https://sciwheel.com/work/bibliography/4504817)  [6.    Weightman MM, Bolgla R, McCulloch KL, Peterson MD. Physical therapy recommendations for service members with mild traumatic brain injury. *J Head Trauma Rehabil*. 2010;25(3):206-218. doi:10.1097/HTR.0b013e3181dc82d3](https://sciwheel.com/work/bibliography/2455860)  [7.    McGrath MK, Linder SM, Koop MM, et al. Military-Specific Normative Data for Cognitive and Motor Single- and Dual-Task Assessments for Use in Mild Traumatic Brain Injury Assessment. *Mil Med*. 2020;185(Suppl 1):176-183. doi:10.1093/milmed/usz261](https://sciwheel.com/work/bibliography/11882869)  [8.    Ross LM, Register-Mihalik JK, Mihalik JP, et al. Effects of a single-task versus a dual-task paradigm on cognition and balance in healthy subjects. *J Sport Rehabil*. 2011;20(3):296-310. doi:10.1123/jsr.20.3.296](https://sciwheel.com/work/bibliography/4742346) |