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# The Development Of A Multiple Errands Test For Pre/Post Concussive Testing On A College Campus: The University Multiple Errands Test - Lessons Learned

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# The Development of a Multiple Errands Test for Pre/Post Concussive Testing on a College Campus

## The University Multiple Errands Test - Lessons Learned

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**Abstract**

The Multiple Errands Test (MET) is an occupation-based assessment tool, used to determine if someone who has sustained an acquired brain injury can successfully complete everyday errands, such as purchasing items at a gift shop, mailing a letter, and determining what hours a store is open. The MET has been used successfully in a hospital setting. Due to the MET's ecological validity, we sought to determine if an adapted MET (revised for a college campus setting) would be an appropriate alternative to the ImPACT, an often-required, on-line pre and post-concussion neuropsychological assessment for high school and college athletes. Students may underperform on the ImPACT, thinking that this would result in quicker return to sport. A University MET was designed and pilot-tested on 29 undergraduate student volunteers. The study taught us many lessons, including that college campuses are dynamic settings and real-life task testing is time intensive. Expecting the University MET to take the place of a quick, on-line, group administered test such as the ImPACT was not realistic. Nonetheless, as a clinical rehabilitation assessment tool, a setting-specific MET can continue to contribute valuable information to occupational therapy intervention planning and goal setting.

# The University Multiple Errands Test - Lessons Learned

## Background

The profession of occupational therapy prides itself on its commitment to enhancing occupational performance for clients in the activities that they want and/or need to do. Successful collaborative goal setting with clients is based on accurate baseline data (as well as measurable objectives). Occupational therapists (OTs) often use clinical reasoning and professional experience as their preferred method of assessment, to interview and observe clients completing everyday tasks. While informal observation may be the favored method, both the Centers of Medicare and Medicaid Services (2012) and the American Occupational Therapy Association (AOTA, 2020) recommend that OTs use standardized testing when available. The advantages of using standardized assessment tools that have adequate validity and reliability include more consistent documentation, more precision in defining baseline performance, and enhanced interprofessional communication. The optimal standardized assessment tools for the profession have a high degree of ecological validity (real-life relevance), meaning that they are useful for directly assessing performance in everyday tasks.

One such assessment tool is the Multiple Errands Test (MET) originally designed by Shallice and Burgess (1991) and revised (the MET-R) by Morrison et al. (2013). The MET-R is a performance-based assessment tool often used in a hospital setting to assess if a patient can complete a series of "errands." It is designed to detect subtle deficits in high-level executive functioning, which may follow an acquired brain injury (ABI) (Morrison et al., 2013). The MET needs to be adapted for each setting, but the test tasks remain similar.

Athletes, especially those engaging in contact sports, more frequently sustain ABIs than the general population. These head injuries may impact cognitive, emotional, and physical performance. In school-age and college athletes, a widely-used test (as a pre- post- concussive measure) is the neuropsychological Immediate Post-Concussion Assessment and Cognitive Test (ImPACT) published by Lovell et al., (2000). The online test has been administered to10 million test takers over 15 million times since 2002 [ImPACT Applications, Inc., n.d.]). The ImPACT items assess attention, memory, processing speed, and reaction time, as well as concussion symptoms related to the sequelae of brain injuries (e.g., executive cognitive skills which may be impaired following a frontal lobe insult). Its purpose is to first establish a baseline and then (post-ABI) to determine if an athlete has returned to baseline cognitive performance. Two primary concerns have surfaced about the ImPACT: athletes may take the ImPACT several times during their athletic careers, which may lead to a learning effect (Bruce et al., 2014), and some athletes may be scoring lower on their baseline testing purposefully (e.g., "sandbagging") so that they will be allowed to return to play sooner (Peak & Raab, 2018).

Since the frontal lobe of the brain is not fully developed until adulthood, detecting cognitive deficits before athletes return to play is essential in offering protection for the immature, and thus vulnerable, brain. Being cleared to re-engage in sports activities while still experiencing the sequelae of brain trauma, not only puts a young athlete's athletic career in jeopardy, but also may increase the risk for adverse health events throughout life.

## Methods

Given the concerns about the ImPACT, and the impetus to use occupation-based testing, we set out to design and then psychometrically analyze a university-based MET. Our hypothesis was that the scores on the university MET would be moderately correlated to the scores of the current "gold-standard" in pre- and post-concussive testing (the ImPACT), and that students taking both tests would tend to perceive the MET as more applicable to real life.

This pilot study was an attempt to develop a performance-based measure of executive functioning modeled after the MET-R (Morrison et al., 2013), specifically for an undergraduate university setting. Our intention was to begin to determine if the university MET would be appropriate as a pre- and post-concussion assessment for collegiate athletes, since concerns about the ImPACT have been raised, and it has questionable ecological validity (real life applicability).

The research team was made up of graduate occupational therapy students, and two occupational therapists, who developed a MET specifically for the university campus. The project was supported by faculty mini-grants and approved by the Institutional Review Board of the University of New England in Maine.

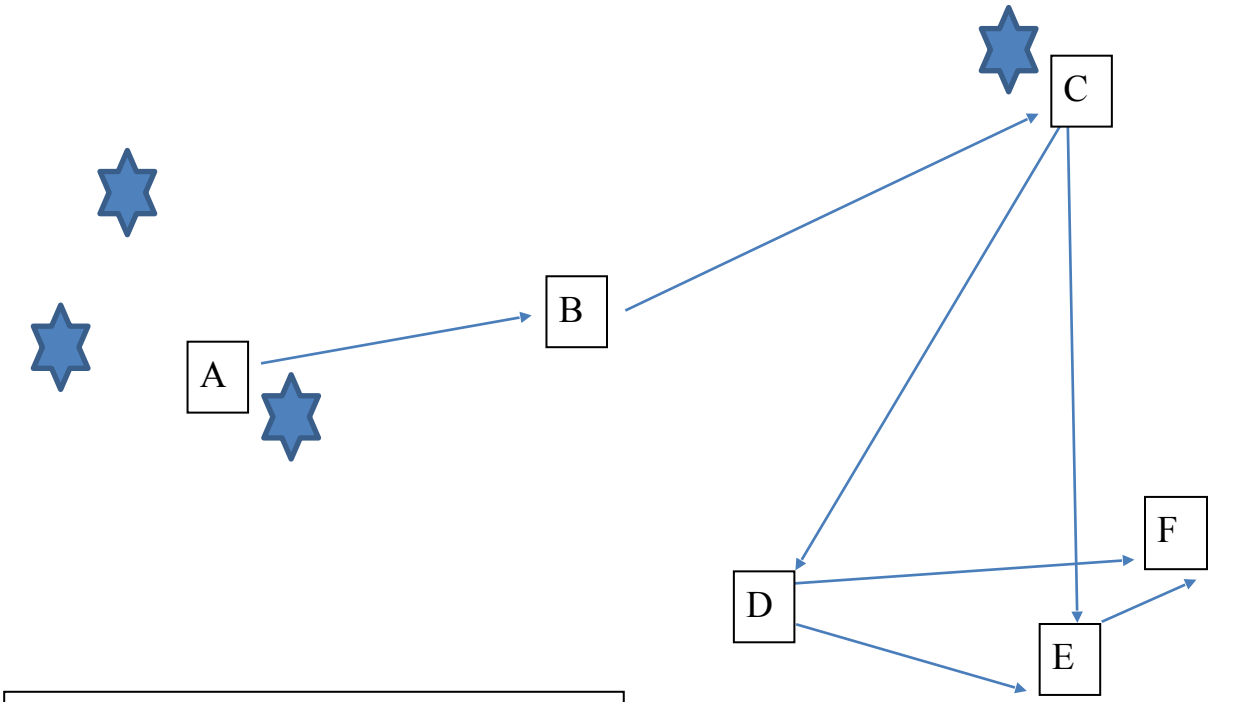
Our participants who took the university MET were 29 undergraduate students, including 24 females and 5 males aged 18 to 23, recruited as a convenience sample over a two-year period. They were all typical undergraduate students studying in a variety of disciplines, mostly health care related. The research group had intended to test at least 30 participants (and had received funding for up to 50, which was our original intent). However, significant barriers presented themselves, resulting in fewer participants than expected, and ultimately the inability to continue with testing as planned, as explained below.

After reviewing and signing the informed consent form, each student participant was

instructed to complete 18 tasks “in any order.” We timed each test, and the test taker was to meet one of the administrators in 25 minutes at a specific (end) location. Each test participant was given just enough money to make specific purchases (a snack, a lanyard, and a drink) as directed. They were able to keep their purchases as a token of appreciation. The test locations were scattered throughout the college campus. Figure 1 shows the approximate distance between sites and the intended logical route. The locations were chosen because they offered opportunities for “errand” completion using tasks similar to the MET-R but on a campus setting, versus in a hospital. The test was designed for test takers to easily follow the most logical route, the sequence from A to F [see Figure 1 below].

Given permission, the research team also used a Gopro camera attached to the jacket or shirt of the participant (directed outward) to record each session and thus further ensure accuracy of scoring. All participants gave permission for the recording of sessions, and the videos were reviewed for any scoring discrepancies occurred thus supporting excellent interrater reliability. The errands included making purchases, picking up, addressing, and mailing a study sheet to a specific professor, asking for information and directions, determining hours of bookstore operation, and meeting at a specific place and time.

Figure 1 - Locations of MET Testing (not drawn to scale)




As can be seen in the figure, several participants took unanticipated pathways.

In addition to on-campus testing, we also compared the University MET scores with the ImPACT scores of those who had taken the ImPACT. ImPACT scores were potentially available for those who had given the research team permission (on their consent forms) to view their former scores, as well as those who were willing to take the ImPACT within a few days of the MET testing. This procedure was conducted to compare the University MET with the more established “gold standard” (the ImPACT), as a way to begin to assess concurrent validity (Kielhofner, 2006).

## Results

The average time for completion of the University MET was nearly 30 minutes with a range from 23 to 46 minutes. On average, participants completed 16 out of 18 tasks. Twenty-one participants had no passes (during which they entered a location but did not complete the intended task), and only one participant had more than one pass (3). Rule breaks are defined as a violation of the instructions. Examples included unnecessarily interacting with the test administrators, not handing in receipts, or spending too much money. The average number of rule breaks was 1.7 (range 0-3). The total score was calculated based on a perfect score of 25 with subtractions for the number of tasks not completed, the number of passes, the number of rule-breaks, and 1 point was subtracted if the total number of locations visited was not accurate. The university MET included at least one-half mile of walking. Since we were, at least potentially, assessing athletes, we determined that this distance would also include an informal assessment of the athlete's endurance, which may also be compromised after an ABI (e.g., Carulli et al., 2018).

Results comparing MET and ImPACT scores for those who had both scores (n=8) were insignificant. We compared both raw scores and ranked-order scores, but neither of the scores were significantly correlated. Fourteen ImPACT scores should have been available, but unbeknownst to the research team, these were only available for tests taken at the current institution.

## Discussion

Overall, the testing results which were consistently insignificant, were disappointing. They rendered little concrete information that would advance the trajectory of functional

cognitive testing in the field of occupational therapy. However, the research team did gain valuable information through this process: we learned how difficult and time-consuming occupation-based test development (or adaptation) can be. Our results reinforced that one must never assume adequate psychometric properties of any test or testing procedure unless the statistical analysis bears out that assumption. Even though both the ImPACT and the MET are intended to assess high-level brain functioning impairments, obviously more research is needed to determine how and why these test results seem so dissimilar.

One explanation for this lack of association could be that the MET-R (and potentially the university MET) assesses executive performance skills in real life contexts (Morrison et al., 2013) while on the other hand, the ImPACT is designed to test skills at the impairment level. The ImPACT uses symbols, letters, words, and shapes to test attentional processes, verbal recognition memory, visual working memory, visual processing speed, reaction time, numerical sequencing, and learning. One could argue that performance on each of the individual component segments of the ImPACT may not add up to a comprehensive overview of authentic everyday functioning. This idea will need to be examined in future research endeavors on occupation-based testing, which the authors strongly encourage.

Although the results of testing were not of the caliber we had hoped, this research project did lead to noteworthy results that warrant dissemination. In our naivety, we had initially anticipated that the University MET could possibly augment or even circumvent the use of the ImPACT for athletes at the university, especially given the concerns about the ImPACT such as sandbagging, lack of ecological validity, and practice effects (Johnson et al., 2009). We believed it was reasonable to explore functional options for concussion testing, based on the view that assessing the student athlete engaging in day-to-day tasks might more accurately predict their

readiness to return to sport.

Major problems soon arose. The research team failed to account for the extreme time element involved in administering the university MET, with each test administration entailing approximately two person-hours of time (including testing, gathering consent, scoring, uploading videos, and returning to site of start of testing). In addition, the researchers had to repeatedly explain the testing process to the employees in the bookstore and the other campus sites, since the university employees tended to be overly helpful unless they understood the purpose of testing.

We quickly realized that the university MET (or any MET adaptation) is not intended as a quick screening measure that could be used for the hundreds of athletes at the university. While we developed the tool with the sincerest of intentions (to improve pre and post concussive testing procedures), the MET would never be able to replace the use of a test (i.e., the ImPACT) that could be administered easily online simultaneously to a large group. Indeed, to our knowledge most functional task measures need to be administered individually, and therefore are inherently more time-consuming.

The original MET (Shallice & Burgess, 1991), the MET-R (Morrison et al., 2013), or any rendition of the MET designed for a specific setting, all include similar types of high-level cognitive tasks. The idea of using a variety of everyday errands for assessing executive skills, may be shown to be highly effective. Nonetheless, this type of non-linear testing does insert a layer of complexity and time-commitment that some may find difficult to justify in the current hectic health-care context. Scoring also needs to be further developed, for example perhaps using the occupational therapy practice framework (AOTA, 2020) as staging for more detailed point allocation of both motor and process performance skills.  For example, detailed motor skills

involve manipulating (coins or a writing instrument) and process skills involve initiating (starting the MET sequence) as well as inquiring (about prices, times open, etc.).

Although our results were not statistically significant, an individualized university MET may be shown to be helpful as a supplemental assessment especially when the ImPACT results are questionable. For example, if initial ImPACT scores seem suspiciously low or there are inconsistencies in the testing process, the athletic department of a college may want to reach out to the occupational therapy department to have them develop a specific MET for their institution. This was a meaningful learning experience. The use of testing that incorporates real-life tasks, may be more easily explained and justified to athletes and their families than the results of the ImPACT, a test that was described by one respondent as "silly exercises in thinking that don't make a whole lot of sense," and include "seemingly disjointed figures, letters, words, and numbers." Through functional testing the therapist can share and document the strengths and impairments that surfaced during the course of testing (e.g., impairments in process skills such as initiating, pacing, attending, choosing, and sequencing, AOTA, 2020).

**Limitations**

Unfortunately, this pilot study was rife with limitations, to the point the barriers eventually precluded the continuation of testing. Not only was the time and energy factor involved in MET administration much greater than we had anticipated, but the dynamic nature of the college community also proved to be a great challenge. Nearly every testing session presented quirks, from scheduling and minor changes in inventory (e.g., what was available at the bookstore and the price of items that needed for purchase) to overly helpful employees (e.g., one even offered to give the test taker the "extra" money needed for a purchase). One ingenious

test taker talked an employee into giving her a free drink because she had already used more than the allotted amount of money. The obstacle that ended testing altogether, however, was that the university added additional mail centers and moved crucial offices (i.e., the Student Academic Success Center). We could not continue with the same test form and did not have the resources (time or funding) to start over. These lessons learned are worth serious contemplation when research on other MET type tools continues, as it should. Precisely these reasons are why sharing an overview of our experience is important. Many clinicians, including the current research team, tout the many benefits of ecologically valid testing procedures while perhaps continuing to maintain an unrealistic view of the commitment and complexity of "real life" testing.

When designed for a specific site, an adapted MET has significant potential to inform clinical reasoning related to performance skills needed for day-to-day living (including in this case, engagement in sports). However, the MET (as designed and adapted to date) is time consuming, both in the design aspect (every site needs an individualized test, although with similar performance tasks) as well as in the administrative aspect. Nonetheless, more in-depth initial assessments could help focus OT intervention on more precise client needs, thus leading to more efficacious therapy overall. Considering the current population for example, if athletes return to sport prematurely, they are more likely to get hurt again and possibly need additional, or even long term, costly health care.

## Conclusion

Functional testing is a natural fit for the profession. Gillen (2013) in his Slagle presentation, aptly stated that we should embrace "the authentic use of occupation" when developing "valid and accurate measure(s) of everyday cognition" (p. 649). This holds true when

appreciating the MET as described here, as well as when considering a number of other ecologically valid (i.e., everyday occupation-based) tools that our profession has available (e.g., the ADL-focused Occupation-based Neurobehavioral Evaluation [A-ONE; Árnadóttir, 2011], the Executive Function Performance Test [EFPT; Baum et al., 2008], the Assessment of Motor and Process Skills [AMPS; Fisher & Jones, 2011]). OTs are encouraged to regularly administer these and to develop others (an admittedly arduous process). Functional tests can address the assessment of meaningful occupations instead of using paper and pencil substitutes or assessment ideas borrowed from other disciplines. Establishing our own authentic occupational therapy assessment process is essential (Gillen, 2013).

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Readers interested in obtaining a copy of the university MET are invited to contact the corresponding author, Regi Robnett: rrobnett@une.edu.

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