The Dissertation Committee for Mandy Marie Salinas
Certifies that this is the approved version of the following dissertation:

How Young and Older Healthy Adults Negotiate Competing Task Goals During Treadmill Walking

Committee:

Jonathan B. Dingwell, Supervisor

Darla M. Castelli

Jody L. Jensen

James S. Sulzer

Joseph P. Cusumano

How Young and Older Healthy Adults Negotiate Competing Task Goals During Treadmill Walking

by

Mandy Marie Salinas

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Dedication

This dissertation is dedicated to all my Teachers.

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How Young and Older Healthy Adults Negotiate Competing Task Goals During Treadmill Walking

Mandy Marie Salinas, PhD

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Supervisor: Jonathan B. Dingwell

We investigated how younger and older healthy adults modify their stepping when new step goals are introduced that drive them away from their preferred walking patterns. Across both studies, physically high-functioning older adults exhibited executive function decrements that were significantly associated to overall poorer stepping performance in these contexts. In Study 1, **t**he observed EF declines were significantly associated to decreased overall stepping performance (% Green strides). However, analyses of how participants modified their stepping to accommodate the competing step goals revealed stepping variability was the primary contributor to better overall stepping performance. Across the different experimental conditions, group differences in variability suggested that the young adult group was more successful at manipulating the magnitude of their stepping variability compared to the older adult. In Study 2, our results again demonstrated performance decrements in the Stroop Interference task (response inhibition) compared to the YH group. Better Stroop Color-Word performance was significantly associated with the better stepping GNG performance. However, no group differences were observed in response inhibition measures assessed in the computer GNG task. That said, we contend the stepping GNG task allowed us to create stepping conditions that incorporated (varying) cognitive and physical demands that are relevant in

walking contexts. In fact, the stepping Go-NoGo (GNG) task conditions revealed older adults made more stepping errors compared to the young adults when navigating obstacles but not targets. Furthermore, older adults made more stepping errors when navigating an obstacle that was preceded by a target (as opposed to a preceding obstacle). These results demonstrated that healthy adults are not simply challenged by a single target or obstacle in their path, but specific sequences of target and/or obstacles.

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Chapter 1: Introduction

The high frequency of falls is a serious public health challenges in older adult populations. More than 30% of community dwelling older adults and 50% of those living in long-term care fall at least once per year (Tinetti et al. 1988, Rubenstein et al. 1994). Falls are the leading cause of fatal and nonfatal injuries in older adults (Sterling et al. 2001), yielding extremely high injury rates and injury severity (Sterling et al. 2001), with nearly 3.5 million older adults treated in emergency rooms in 2015 (www.cdc.gov). Direct medical costs related to falls already exceed $30 billion per year, with total fall-related costs likely to exceed $68 billion by 2020 (Englander et al. 1996, Rizzo et al. 1998).

Older adults also exhibit significant declines in cognitive function (particularly executive function) (Zelazo et al. 2004), that affect their motor performance (Ble et al. 2005, Yogev et al. 2005, Coppin et al. 2006, Holtzer et al. 2006, Springer et al. 2006), and are directly associated with their increased fall risk (Anstey et al. 2006, Anstey et al. 2009, Herman et al. 2010, Mirelman et al. 2012). Executive function (EF) is a domain of cognition that includes a set of skills necessary for deliberate, goal-directed thinking and behavior (Zelazo et al. 2004) focused on modifying an on-going plan when a situation requires novel action (Norman and Shallice 1986).

Fallers performed more poorly on EF and attention tasks compared to non-fallers (Hausdorff et al. 2006). These EF score was related to tasks that tested *response inhibition* or the ability to suppress automatic or dominant responses to a stimulus (Nigg 2000). *Attention* scores were related to tasks requiring sustained focus or the ability to recognize and attend to a stimulus (Parasuraman and Yantis 1998). Prospective studies also found similar cognitive deficits in these constructs of attention (Mirelman et al. 2012) and response inhibition (Anstey et al. 2009, Herman et al. 2010, Mirelman et al. 2012) for fallers. These results imply that *early* changes in attention and response inhibition may potentially be associated with greater fall risk. Critically, however, these studies had only correlated performance on EF tests to general fall risk in completely unrelated contexts.

Considering that most falls occur during walking, researchers sought to incorporate EF processes into stepping tasks. In a task requiring cognitive flexibility and visual scanning (i.e. step on sequential numbered stepping targets), healthy older adults exhibited significantly longer completion times compared to young adults, and disproportionally longer times as the cognitive demand was increased (Alexander et al. 2005). Moreover, in tasks that required stepping precision (e.g. step on targets or avoid obstacles), healthy older adults (Potocanac et al. 2015) and high fall risk older adults (Yamada et al. 2011) made more stepping errors compared to healthy young adults and low fall risk older adults, respectively. Response inhibition and simple reaction times have also discriminated participants that made stepping errors in similar contexts (Caetano et al. 2016).

Most recently, a large multi-site randomized control trial using virtual reality treadmill training reported a decrease in incident fall rate for high fall risk older adults that trained with Treadmill + VR training compared to a Treadmill only training (Mirelman et al. 2016). The 6-week training program introduced "obstacles, multiple pathways, and distractors that required continual adjustment of steps" to target both motor and cognitive functions. However, it is still not well understood what aspects of this VR training program were most critical to the study outcome measure of reduced fall incident rate.

Research gaps remain regarding stepping scenarios that require participants to attend to a stepping goals for extended periods (i.e. continuously). A variety of experimental manipulations could provide more information on both how healthy adults actively modify their stepping in these contexts, and specifically the circumstances in which stepping performance declines and/or stepping failures occur.

OBJECTIVES

Our overall hypothesis was that *early* changes in EF directly contribute to impaired motor performance and increase the risks of harmful physical consequences (e.g. collisions, loss of balance, and ultimately a fall). To further understand how differences in EF affect the mechanisms healthy adults use to regulate their stepping behavior during complex walking tasks, we used virtual reality environments to systematically introduce new step goals designed to drive young and older adults to manipulate how they walk. We manipulated both the cognitive and physical demand of walking in two different treadmill experiments. We provided visual and/or auditory feedback of their stepping performance to examine their ability to correct errors or modify their on-going stepping strategies. We sought to enhance our understanding of the types of stepping scenarios that are cognitively and/or physically challenging for healthy young and older adults (Figure 1).

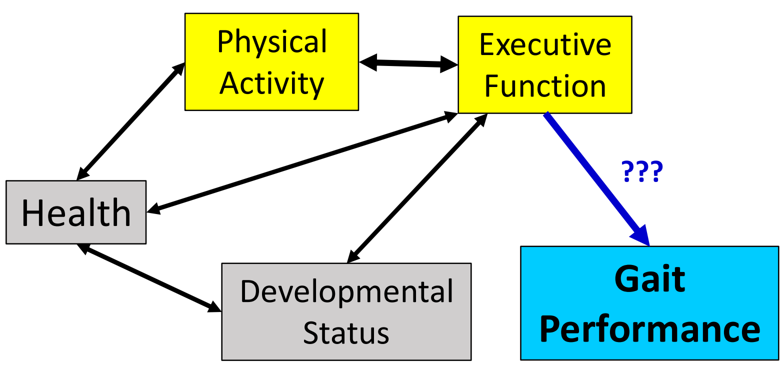


Figure 1. Depiction of complicated interactions between Physical Activity, Executive Function, and Gait Performance (and Falls as a Public Health Challenge).

To do this, we not only examined (i) overall stepping performance differences between young and older healthy adults, but (ii) *how* they modified their stepping to accommodate these new step goals, and (iii) explored the cognitive and/or physical factors that contributed to (any) identified stepping performance differences.

PRIMARY SIGNIFICANCE

This work significantly enhanced our understanding of the mechanisms healthy adults use to regulate their stepping in challenging environments, and the cognitive factors that contributed to stepping performance differences in young and older adults in these walking contexts. Further, this work provides detailed descriptions of the stepping scenarios that challenged both young and older healthy adults and the stepping failures that occurred when they were required to actively modify their stepping.

DISSERTATION AIMS

Aim #1: Determine how young and older healthy adults adapt their stride-to-stride stepping strategies to accommodate *competing* step goals during treadmill walking. In Study 1, virtual reality was used to introduce step goals that *competed* with an individual's preferred stepping strategy during fixed-speed treadmill walking. The step goals required individuals to modify *and* maintain a new stepping pattern. Continuous performance (visual and auditory) feedback of their stepping movements was provided to each participant to allow them to monitor their own stepping performance, detect and correct errors, and change their current stepping strategy as they deemed necessary.

Hypothesis 1: Across Conditions, participants would exhibit stride-to-stride control strategies that sought to mediate the different *competing* step goals presented. Specifically, participants would modify their stride-to-stride control strategies to accommodate the competing step goals.

Hypothesis 2: Between Groups, OH adults would demonstrate higher prioritization of the implicit task goals to (i) walk at their preferred stride length and stride time, and (ii) maintain speed at each stride over the *competing* step goals.

Hypothesis 3: Across Groups, better EF abilities in response inhibition, attention, and working memory would be associated with better stepping performance (i.e. ability to modify their stepping to accommodate the competing step goals).

Differences in stepping variability and stride-to-stride error correction would indicate that stepping strategies can be directly and purposefully manipulated to achieve pre-defined stepping goals in healthy adults (Hypothesis 1). In contrast, no change in stepping strategy to accommodate the competing step goals would indicate higher prioritization of the implicit task goals (Hypothesis 2). A significant association between better EF and superior stepping performance would suggest that attention, response inhibition, and/or working memory were important in these contexts (Hypothesis 3**)**.

A strength of Study 1 was that the *competing* step goals were developed based our past experimental results indicating that young and older healthy adults use the simple strategy of trying to maintain constant speed at each stride and choose a "Preferred Operating Point" (combination of stride length and time, POP) (Dingwell et al. 2010, Bohnsack-McLagan et al. 2015, Dingwell et al. 2017) that approximately minimizes energetic cost (Kuo 2001, Dingwell et al. 2010). Thus, the introduced new step goals were constructed to specifically *compete* with these implicit goals of POP and speed. Secondly, another study strength was that we performed a battery of cognitive and physical assessments. This battery examined multiple EF behavioral outcomes (working memory, attention, and response inhibition) and well-established physical assessments.

A potential limitation of Study 1 is that although we structured this experiment to account for each participant's individual POP at a given walking speed, we did not account for differences in within-trial walking variability across study participants. Although, during normal (unmodified) treadmill walking, older healthy adults implement the same stride-to-stride strategy to maintain speed as young adults, they exhibit greater stepping within-trial variability (Dingwell et al. 2017) compared to young adults. However, prior to Study 1, the extent healthy adults could modify their within-trial variability when given direct stepping feedback of their movements was unknown in these contexts.

Aim #2: Determine how young and older healthy adapt their stepping strategies to navigate *virtual* targets and obstacles during treadmill walking. Our aim was to assess response inhibition abilities in the same way as a computer "Go-NoGo" (GNG) paradigm, (Bezdjian et al. 2009) but in a walking task. In Study 2, these virtual stepping targets and obstacles were projected onto the walking belt in two different colors (yellow and red). The distance between stepping objects was fixed to each participant's average step length determined during normal treadmill waking (condition 1, in which no virtual objects were projected on the walking belt). At the start of each condition, each participant was instructed to step on a specific color ("targets") and to avoid the other color ("obstacles"). This was the "stepping rule". The targets reinforced their preferred (average) step pattern, whereas the obstacles disrupted their preferred step pattern. In condition 2 (Step on Yellow or "GoYel"), most of the stepping objects were targets (yellow colored) and fewer of the stepping objects were obstacles (red colored). The primary aim was to accustom each participant to step on yellow objects. In condition 3 (Step on Red or "GoRed"), the "stepping rule" was reversed. Most of the stepping objects were obstacles (yellow colored) and fewer of the stepping objects were targets (red colored). The primary aim of was to examine how well each participant inhibited the previously conditioned stepping response (step on yellow objects). Across both conditions, participants had to *continuously* modify their stepping to be successful. Performance feedback was provided at each stepping target or obstacle to allow them to monitor their own performance ("success" versus "failure") and modify their current stepping strategy if they deemed necessary. Stepping errors were separated into "Go errors" and "NoGo errors". Stepping Go errors were stepping errors made when a participant did not step on a target. Stepping NoGo errors were stepping errors made when a participant stepped on obstacle.

Hypothesis 1: Between Groups, OH adults would exhibit more stepping NoGo errors in "GoRed" (condition 3, the reversal condition) compared to YH adults, as this condition would require the most inhibitory control.

Hypothesis 2: Across Groups, participants would make more stepping errors while navigating the Obstacle-to-Target and Target-to-Obstacle transitions compared to Target-to-Target and Obstacle-to-Obstacle transitions respectively. As we anticipated the former sequences would require active stepping adjustments.

Hypothesis 3: Across Groups, higher response inhibition capacities (in the cognitive assessments) would yield fewer stepping NoGo errors. Specifically, in the "GoRed" condition due to the greater response inhibition demand.

More stepping NoGo errors in GoRed would indicate OH adults were challenged when required to inhibit of the previously conditioned stepping response (Hypothesis 1). The quantity and types of stepping errors (in Obstacle-to-Target and Target-to-Obstacle sequences) would identify which specific contexts challenged OH adults when stepping from one target to an obstacle or vice versa (Hypothesis 2**)**. A significant association between better EF and fewer stepping errors would suggest that attention and/or response inhibition were important in these contexts (Hypothesis 3).

A notable strength of Study 2 was that the stepping task required participants to navigate a *continuous* sequence of virtual targets and obstacles (specifically 300 stepping objects per trial). This stepping task design allowed us to report (1) how healthy adults actively modify their stepping and (2) identify the circumstances in which stepping failures occurred. As in Study 1, we also performed a battery of cognitive and physical assessments.

A potential limitation of Study 2 was that the computer "Go-NoGo" (GNG) paradigm (Bezdjian et al. 2009) cannot be replicated explicitly within a stepping task. This is due to the NoGo requirement(s) within these tasks. Specifically, in our stepping task ("GoRed"), the NoGo feature incorporated both cognitive and physical requirements: (a) inhibit the previously trained stepping response *and* (b) avoid the obstacle respectively. However, in the computer task, the NoGo feature requirement was simply cognitive: (a) inhibit a previously trained key response (i.e. no motor response). The latter is not exactly possible during *continuous* walking, as an individual must execute a step. However, considering that both cognitive and physical demands are strongly intertwined during complex everyday walking, the physical requirement or this cognitive-physical association cannot be disregarded or overlooked in stepping contexts.

Chapter 2: Literature Review

FREQUENCY OF FALLS

Falls are commonly defined as “inadvertently coming to rest on the ground, floor or other lower level” (Bischoff et al. 2003) and are a substantial cause of unintentional injury. In the United States, unintentional falls are the overall leading cause of non-fatal injuries (www.cdc.gov). For older adult (60+ years of age) populations, frequency of falls and fall-related injuries are major public health challenges. A reported 30% of community dwelling older adults and 50% of those living in long-term care fall at least once per year (Tinetti et al. 1988, Rubenstein et al. 1994).

In 2015, an estimated 3.5 million older adults were treated medically for unintentional non-fatal falls (www.cdc.gov). Minor injuries include bruises or sprains, however, more serious injuries can include fractures and injury to the head, back, and/or hip (Alexander et al. 1992, Jager et al. 2000, Sterling et al. 2001, Scheffer et al. 2008). For falls requiring an emergency visit, the average cost per fall is $13,456 [adjusted for inflation, (Kochera 2002)]. Hospital stays due to fall-related injuries can ranges from 4 to 15 days (Roudsari et al. 2005), extending to 20 days for hip fractures (Lawrence et al. 2005). In 2015, an estimated 575,680 older adults (Figure 2) experienced an unintentional fall injury that required hospitalization. The average cost of fall related injury requiring hospitalization is $32,005 [adjusted for inflation, (Finkelstein et al. 2005)].

Beyond the physical consequences and/or financial burdens following a fall, psychological effects (e.g. fear for falling, depression) can also occur, due to loss of independence. Fear of falling and depression can lead to restriction of daily activities (including exercise) and social interactions (Howland et al. 1993, Cumming et al. 2001).

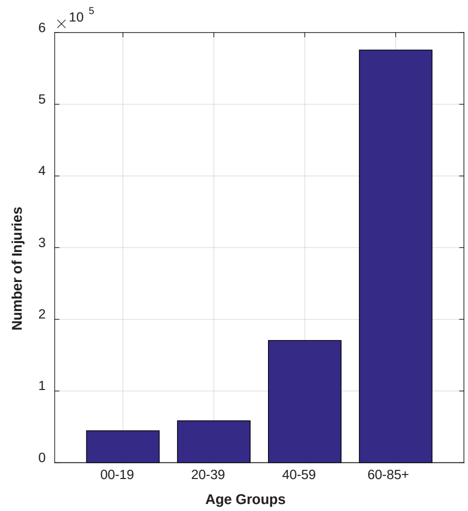


Figure 2. Estimated Non-fatal Unintentional Fall Injuries Requiring Hospitalization in 2015 (www.cdc.gov) across different age ranges. An estimated 575,680 older adults experienced an unintentional non-fatal fall injury that required hospitalization in 2015. This data was retrieved on May 31, 2017.

Although, unintentional falls impact all ages, development of comprehensive *evidence-based* prevention programs and interventions to reduce falls and fall-related injuries for older adults remains a substantial challenge. In fact, older adults (60+ years) as a group are growing faster than any other age group worldwide and are projected to increase to almost 2 billion by 2050 (currently estimated at 960 million). Moreover, proposed fall prevention frameworks must reflect the *interaction* of multiple risk factors.

In 2007, the World Health Organization published a comprehensive model that identified four conceivable framework dimensions: behavioral, socioeconomic, environmental, and biological factors. To start, (1) behavioral risk factors are potentially modifiable, and include sedentary behavior, excess alcohol or medication usage. (2) Socioeconomic risk factors include low income, limited education, inadequate access to healthcare or social services, or reduced community resources. (3) Environmental risk factors can include unsafe physical environments, such as slippery surfaces, tripping hazards (e.g. torn carpet), deficient illumination, absence of hand rails, in both and individual's home or their community. (4) Biological risk factors can include race, gender, chronic illnesses, and declines in physical or cognitive abilities. Although many studies have examined the contribution of deficiencies in physical mobility, unsafe environments, unhealthy behaviors, and socioeconomic influences, until the 1990s, the relationship between cognitive function and fall risk had significant less consideration.

COGNITIVE FUNCTION

Cognition is a comprehensive term used to represent all thought processes by which information or data is transformed, stored, extrapolated, retrieved, and applied. Cognitive abilities develop throughout young adulthood. However, in later life, these abilities stabilize and ultimately decline (Zelazo et al. 2004). Genetics, environment, health, and fitness influence the development, stability, and decline of cognition (Craik and Bialystok 2006). An evolving view within the fall risk literature is that, in scenarios where individuals must actively modify their stepping movements to appropriately respond to their varying environment, walking may not be simply automatic. Instead, walking in these complex environments may (to an unknown extent) rely on cognition.

Executive function (EF) is a domain of cognition often identified or examined in the fall risk literature. EF includes a set of skills necessary for deliberate, goal-directed thinking and behavior (Zelazo et al. 2004). Specifically, behavior that is focused on modifying an on-going plan when a scenario requires novel action (Norman and Shallice 1986). This review will focus on four behavioral outcomes of EF: working memory, attention, response inhibition, and cognitive flexibility (task- or set-shifting).

Working Memory. Working memory includes the processes of information acquisition, encoding, short-term storage, and recall (Atkinson and Shiffrin 1971, Unsworth 2010). The working memory system is necessary for both comprehension and learning (Baddeley 1992). During everyday walking, an individual may need to keep visual information (e.g. the structure of uneven ground a few steps ahead) in short-term memory and retrieve this information to avoid a collision or loss of balance.

Attention. Attention refers to the ability to recognize and attend to a stimulus (Parasuraman and Yantis 1998). Attention can be reflexive, as when and individual is walking on a sidewalk and turns toward a loud sound (e.g. a car alarm or fire truck siren). Attention can also be voluntary, as when an individual is standing at an intersection and must exert some level of effort to focus on a pedestrian walk signal.

Response Inhibition. Response inhibition refers to the ability to suppress automatic or dominant responses to a stimulus (Nigg 2000). Tasks that assess response inhibition often include congruent and incongruent conditions. In the congruent condition, the dominant response is the correct response; however, in the incongruent condition, the individual must suppress the dominant response to respond correctly. For example during walking, when an individual observes a change in terrain ahead (e.g. an unsteady flat rock), they may need to suppress an ongoing dominant step response (their preferred step length) for a more appropriate response. Moreover, due to the potential for distractors, everyday walking can depend on an ability to suppress irrelevant sensory information and respond selectively to important environment features (Yogev-Seligmann et al. 2008).

Cognitive flexibility. Cognitive flexibility (task- or set-shifting) refers to an awareness and ability to identify and exploit multiple alternative response options in any given situation (Martin and Anderson 1998). During walking, this may be necessary to switch between different sets of rules or task goals, generalize past knowledge to new situations (Zelazo et al. 2004), and to continuously evaluate task performance as circumstances may vary. Assessments of cognitive flexibility often examine the ability to alter a prevailing response, as task rules change, for a more appropriate response. During everyday walking, individuals must be both willing and able to implement alternative stepping responses when step goals or their environment change.

REVIEW OBJECTIVES (SUMMARY)

First, this review will examine retrospective and prospective studies that have linked declines in cognitive function and increased fall risk. As the work in this dissertation was focused on *early* changes in EF in high-functioning community dwelling older adults, studies that reported participants with significant cognitive impairments (e.g. dementia) or neurological disorders (e.g. Alzheimer's disease) were not directly examined. The review will highlight the multiple identified links reported between declines in memory, attention, response inhibition, cognitive flexibility and increased fall risk.

Secondly, cross-sectional and intervention studies that have included cognitively demanding stepping tasks will be examined. Studies that introduced a cognitive dual-tasks (separate from the walking task, e.g. perform Stroop Interference task or Serial Sevens) to the stepping task were not examined. This review sought to identify stepping scenarios or conditions that (1) have been used to understand or disentangle the reported link between declines in cognition and the stepping failures (i.e. errors) that potentially lead to falls, and (2) have been recognized as challenging for healthy older adults. In the latter aim, we sought to understand what aspects of cognition or physical capabilities (incorporated into these stepping tasks) could have contributed to more stepping failures.

RETROSPECTIVE AND PROSPECTIVE FALL RISK STUDIES

Immediate memory. A prospective 3-year study (van Schoor et al. 2002) reported a relationship between performance on an immediate memory task and recurrent falls. Recruited older adult participants (N = 1437, aged 75.6±6.6 years) were classified into three different categories: "recurrent fallers" (≥ 2 falls within 6 months), fallers (<2 falls within 6 months), and non-fallers. Each participant completed a cognitive battery. The 15WT assessment (abbreviated version of the Auditory Verbal Learning Test) was used to quantify *immediate memory*. Each participant was asked to remember as many words as possible from a list of 15 one-syllable nouns, immediately after the nouns are read aloud by an interviewer. Three trials were completed, and trial 3 was analyzed.

Recurrent fallers demonstrated poorer cognitive performance (multiple cognitive measures, including the MMSE, a standard assessment of general cognitive function) compared to non-fallers (van Schoor et al. 2002). A significant interaction was found between immediate memory and age. For the older adults 75+ years of age, *immediate memory* was identified as an independent risk factor for recurrent falls, but this relationship was not observed with the younger older adults. This study was the first study to report a significant association between immediate memory and fall risk in older adult populations.

Processing speed and immediate picture recall. A prospective 8-year study (Anstey et al. 2006), reported greater declines on *processing speed* and *immediate picture recall* were significantly associated with being a faller compared to a non-faller. Community dwelling adults (N = 539, aged > 70 years) were recruited to participate in three waves (1992, 1994, and 2000). The Digit Symbol Substitution (DSS) assessment was used to assess processing speed and symbol recall, and required each participant to code by hand an array of digits according to a key table of codes in 90 seconds. *Processing speed* was the time required to complete DSS. *Symbol recall* was the total number of symbols recalled from the DSS assessment. Each participant was given a recall sheet (numbered 1-9) and asked to draw the symbols they remembered. Additionally, a picture naming test (Luszcz et al. 1997) was used to assess immediate *picture recall* and included the recall of 15 pictures immediately after naming them.

Results indicated single fallers were more likely to have poorer *processing speed* and *symbol recall* compared to non-fallers (Anstey et al. 2006). Multiple fallers were more likely to have poorer performance on immediate *picture recall* (only) compared to non-fallers. More importantly, cognitive *change* was a stronger predictor of future falls than baseline cognitive performance (Anstey et al. 2006).

STRENGTHS AND LIMITATIONS. Both studies (related mostly to memory measures) examined large study populations (N = 1437 and 539) and included long durations of follow-up (3 and 8 years respectively). Also, an array of cognitive measures were examined. However, these studies were limited in that cognitive performance was only correlated to general fall risk. In fact, the different scenarios in which the reported falls occurred or the resulting fall injuries were not compared. Therefore, an understanding of walking scenarios that challenge (working) memory was still unknown.

Visual-spatial processing speed and attention. A retrospective 1-year study (Holtzer et al. 2007), reported visual-spatial processing speed and attention measures were significantly related to both single falls and recurrent falls, however memory was not associated to either single or recurrent falls. Recruited older adults (N = 172, aged 70+ years of age) self-reported falls within the last 12 months. Each participant also underwent a cognitive battery. The Trail Making Test (TMT) assessed cognitive flexibility. In the congruent condition (TMT-A), each participant was instructed to connect the numbers (1-25) in ascending order as fast and accurately as possible. In the incongruent condition (TMT-B), each participant was instructed to connect in alternate alphanumeric order, thus requiring higher cognitive demands. The Block Design (WAIS-R) assessment was primarily a measure of visual-spatial and organizational processing abilities, as well as nonverbal problem-solving skills. Each participant was presented with identical blocks with surfaces of solid red, surfaces of solid white, and surfaces that are half red and half white. The participant was required to replicate a pattern that the test administrator presented to them, the assessment was timed, and used an increasing number of blocks.

Factor Analysis revealed 3 factors: Verbal IQ, Speed/Executive Attention, and Memory. The Trail Making Test (TMT) Part A and B, Digit Symbol Substitution (DSS) and Block Design assessments all loaded on to the *Speed/Executive Attention* factor. The *Verbal IQ* were significantly related to recurrent falls, but *Memory* was not associated to either single falls or recurrent falls (Holtzer et al. 2007). Only the *Speed / Executive Attention* factor, related to processing speed and visual-spatial capacities, was significantly related to both single falls and recurrent falls (Holtzer et al. 2007).

Response inhibition and attention. A 1-year retrospective study (Hausdorff et al. 2006) reported fallers performed more poorly compared to healthy controls in executive function and attention measures, but did not differ on memory measures. Older adult fallers (N = 18, aged 77.1±4.9 years) and older adult controls (N = 25, aged 70.0±6.1 years) were recruited to participate. Fallers had fallen at least twice in the last 12 months (including at least once in last 6 months) and did not have a known balance impairment. Each participant completed a computerized cognitive battery (Dwolatzky et al. 2003). An *Executive Function* index was calculated based on computerized versions of the Go-No-Go and Stroop Interference tests, both related to response inhibition, and a "catch game" that assesses reaction time and errors in judgment on an eye-hand coordinated task. An *Attention* index was also quantified to mainly reflect reaction times for tasks that require focus or the ability to sustain attention. The computerized Go-No-Go assessment was a timed continuous performance test, responses were made to large colored stimuli that are any color but red. The computerized Stroop Interference Test was a timed test of response inhibition. In the congruent condition, the task was to choose the color named by a word presented in white letter-color. In the final incongruent condition, the task was to choose the letter-color of a word that names a different color. The computerized Catch Game examined motor planning and required both hand-eye coordination and rapid responses. Each participant was instructed to “catch” a “falling object” by moving a “paddle” horizontally so that it can be positioned directly in the path of the falling object.

Fallers performed more poorly than healthy controls in *Executive Function*, *Attention*, and motor skills (Hausdorff et al. 2006). However, these groups did not differ on Memory, information processing, or the Global Cognitive score. In 2012, this research group also reported a prospective 5-year study (Mirelman et al. 2012) in which community dwelling older adults (N = 256, aged 76.4±4.5 years) completed the same cognitive battery (Dwolatzky et al. 2003). Prior falls and prospective fall data were obtained by self-report. *Executive Function* and *Attention* indices both independently predicated future fall risk (after adjusting for age, gender, fall history, education, grip strength, BMI). Further, the participants with the lowest *Executive Function* scores were more likely to fall sooner and become multiple fallers (Mirelman et al. 2012). On the contrary, the MMSE (a measure of general cognition) and Memory did not predict future fall risk.

STRENGTHS AND LIMITATIONS. These studies (related to visual-spatial processing speed, response inhibition and attention measures) highlighted that overall cognitive measures may not discriminate higher risk individuals from lower risk individuals. This evidence suggests early changes in EF may predict future fall risk. Further, notably in contrast to earlier studies (van Schoor et al. 2002, Anstey et al. 2006), in these studies, memory did not predict future fall risk. A strength of these studies was that factor analyses were performed across many cognitive measures to combine highly correlated measures into distinct factors representing different constructs of EF. These analyses also required the researchers to qualitatively label each identified factor or index. However, these studies again only correlated cognitive performance to general fall risk. Therefore, an understanding of walking scenarios that specifically challenge response inhibition, attention, and/or visual-spatial processing speed abilities were still unknown.

Accuracy and response inhibition. A retrospective 1-year study (Anstey et al. 2009) reported that single fallers performed worse than non-fallers in choice reaction time (RT) tasks requiring response inhibition. Older adults (N = 658, aged 69+ years) were recruited and partitioned into three groups: non-fallers, single fallers, and recurrent fallers. Each participant underwent a cognitive battery. During the Simple Reaction Time (SRT) assessment, a red car appeared at random intervals on the screen and each participant was told to respond to the stimuli as quickly as possible by pressing a button using their dominant hand. During the Choice Reaction Time (CRT) assessment, a red car appeared randomly in 1 of 4 quadrants. For example, if car appeared in quadrant 1, a correct response would be to respond with the right hand; whereas if the car appeared in quadrant 3, a correct response would be to respond with the left foot. The Choice Reaction Time Location (CRT-L) assessment was the same as CRT, but the participant was told to not respond when the target stimuli (red car) appeared in the top right corner. The Choice Reaction Time Color (CRT-C) assessment was the same as CRT, but trials with blue cars were randomly presented within the red car trials. Each participant was told to not respond to the blue cars. The Choice Reaction Time Distractor (CRT-D) assessment was the same as CRT, but an unrelated target (a stop sign) was presented at random intervals on the screen throughout the trial, and each participant was required to respond by pressing an additional button.

Factor analysis revealed three factors: Reaction Time (the RT tasks and simple RT loaded), Accuracy/Inhibition (number correct on the CRT-C, CRT-L, CRT and CRT-D tests loaded), Visual Search (VS test, TMT A, TMT B-A, and Digit Symbol Matching loaded). The only cognitive measures on which the single fallers performed worse than non-fallers were the choice RT tasks requiring response inhibition (CRT-L and CRT-D), and they made more errors on the CRT task. Further, the *Accuracy/Inhibition* factor was a significant predictor of multiple falling after adjusting for demographic variables, MIS (memory impairment), and postural sway (Anstey et al. 2009).

STRENGTHS AND LIMITATIONS. These results indicate that early changes in attention and response inhibition in healthy older adults may potentially be associated with increased fall risk. Further, this study uniquely introduced cognitive assessments that incorporated both upper and lower body responses. Plus, a factor analysis was performed to combine highly correlated measures into distinct factors representing distinct constructs of EF. However, critically, this study only correlated performance on cognitive assessments to general fall risk in completely unrelated contexts. A critical missing gap remained to determine how declines in EF alter decision making within the task of walking itself. More recent research has sought to fill research gaps in understanding these links by developing stepping tasks that incorporate EF processes (Alexander et al. 2005, Yamada et al. 2011, Perrochon et al. 2015, Potocanac et al. 2015, Caetano et al. 2016, Pizano et al. 2017).

OVER-GROUND INHIBITORY STEPPING TASKS

Walking Trail-Making Test. The paper and pencil version of the Trail-Making Test (P-TMT) examines cognitive flexibility and visual scanning. Considering the importance of these processes during walking, an over-ground Walking Trail Making Test

(W-TMT) was developed (Alexander et al. 2005). Healthy young adults (N = 42, mean age 21 years) and older adults (N = 37, mean age 70 years) were recruited to walk in both W-TMT Parts A and B versions. The W-TMT Part A version included stepping on ascending sequential numbered stepping targets. The W-TMT Part B version included alternating between stepping on ascending numbers and letters (similar to the paper version). Distractors, additional targets (with letters and numbers on them) were included and required each participant to visually scan for the next suitable stepping target.

Healthy older took longer to walk in the W-TMT tasks compared to young adults, and most significantly they took disproportionally longer on the higher cognitively demanding W-TMT Part B. Additionally, for the older adults group, W-TMT Parts A and B times were significantly correlated with P-TMT B times (0.63 and 0.72 respectively).

STRENGTHS AND LIMITATIONS. This stepping task required (1) visual scanning for next suitable stepping targets, (2) switching between ascending number and letter stepping targets, and (3) ignoring multiple distractors (additional targets). The results identified performance differences between young and older adults. Notably, the older adults took disproportionally longer to walk on the higher cognitively demanding W-TMT Part B compared to young adults. Similarity between the paper and walking TMT versions was both sought and achieved, in that performance in both versions was highly correlated. However, considering everyday walking, the W-TMT was limited in that all the stepping targets were visible at the trial start (Alexander et al. 2005).

Multiple Stepping Accuracy Paradigm. An over-ground multi-target step task (MTST) was developed to examine stepping accuracy (Yamada et al. 2011). Participants (N = 118, mean age, 84.5 ± 6.5 years) were classified into low or high fall risk, with higher risk (HR) participants reporting at least one fall in the last year and exhibiting Timed Up and Go (TUG) times > than 13.5 seconds. Each participant completed the paper and pencil version of the Trail-Making Test (P-TMT) Part A version. The stepping task comprised of 45 squares arranged into three rows (Figure 3) and 15 lines where each line included one of three colors. Each participant was instructed to walk at a self-selected walking speed and to step on one color (i.e. the stepping target). The other colored squares were simply distractors. Each participant completed a *single* walking trial.

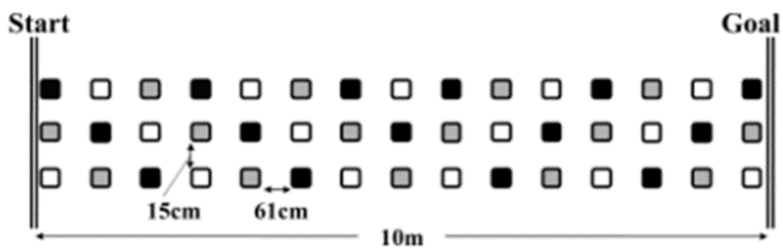


Figure 3. The over-ground multi-target step paradigm (Yamada et al. 2011) was developed to examine stepping accuracy. The walking path length was 10 meters. The stepping task comprised of 45 squares arranged into three rows and 15 lines where each line included one of three colors. Each participant was instructed to walk at a self-selected walking speed and to step on one color (i.e. the stepping target). The other colored squares were distractors.

No significant group differences were observed in performance of P-TMT Part A. However, HR older adults had longer TUG times compared to the LR older adults. In the MTST, HR older adults took more time to complete the MTST stepping paradigm compared to LR older adults. HR older adults also made more stepping failures (missing targets) and avoidance failures (failure to avoid a distractor, i.e. obstacle) compared to LR older adults. Performance on the P-TMT Part A was not significantly correlated with either (1) number of stepping failures, (2) number of avoidance failures, or (3) MTST performance times. However, both stepping failures (errors where participants missed targets) and TUG times were independently associated to high fall risk.

STRENGTHS AND LIMITATIONS. This stepping task (MTST) required (1) visual scanning of the ground for a specifically colored stepping target, and (2) ignoring multiple distractors (the other colored stepping targets). HR older adults took longer to complete the stepping paradigm, made more stepping failures (missing targets), and avoidance failures (failure to avoid a distractor, i.e. obstacle) compared to LR older adults. However, performance in the P-TMT Part A was not correlated with the three MTST performance measures. However, the MTST performance measures were significantly correlated with TUG time. A limitation of the MTST was that the stepping object placements were not modified based on an individual's stepping pattern (i.e. step length, Figure 3). This could have negatively impacted individuals with small or large step lengths. Moreover, similarly to the walking TMT, all the stepping squares were visible at the trial start. Lastly, each participant only completed a *single* walking trial. The latter was potentially necessary to minimize any task learning, however, compared to everyday walking, this assessment (Yamada et al. 2011) was a small sample of each participant's walking performance.

Gait Adaptability Test. An over-ground "gait adaptability test" (Caetano et al. 2016) was developed to introduce both targets and obstacles. Older adults (N = 50, aged 74±7 years) were recruited to participate. Each participant walked at a self-selected walking speed across a path (6 meter) under four conditions. Participants were required to (A) avoid stepping on a pink stimulus (i.e. obstacle) that appeared two steps ahead, (B) step onto a green stimulus shorter than two steps ahead (target), (C) step onto a green stimulus greater than two steps ahead (target), and (D) walk through with no stimuli on the path (Figure 4). Each participant completed 3 trials per experimental condition (and one practice trial). Stepping accuracy was computed as the distance between the foot center and *target* center or the distance between the edge of the foot and the edge of the *obstacle*.

No age group difference was identified in stepping accuracy in the (C) step on a target (two steps ahead), and (A) avoid stepping on an obstacle (two steps ahead) conditions. *However*, the older adult group demonstrated decreased stepping accuracy compared to the young adult group in the (B) step on a target shorter than two steps ahead condition. Eleven older adults (22%) made at least a single stepping error while none of the younger adults (21 participated) made any errors. Older adults took more steps while approaching obstacles in both the short and long target conditions. During the obstacle avoidance condition, older adults decreased the step length and velocity of the previous step as well as the obstacle step velocity, whereas as young adults decreased the step velocity of the previous step and increased the step length of the obstacle step.

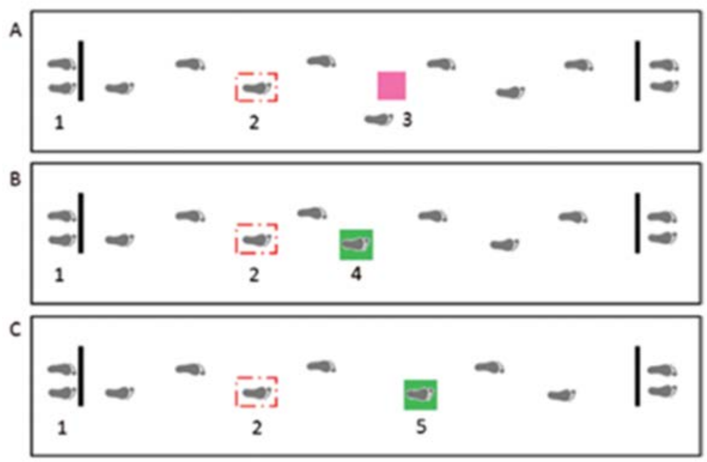


Figure 4. The over-ground "gait adaptability test" (Caetano et al. 2016) developed to introduce targets and obstacles. Each participant walked across a 6-meter path under four conditions in which participants were required to (A) avoid stepping on a pink stimulus (i.e. obstacle) two steps ahead, (B) step onto a green stimulus shorter than two steps ahead (target), (C) step onto a green stimulus greater than two steps ahead (target), and lastly (D, no picture) walk through with no stimuli on the path.

Stroop performance and simple reaction time discriminated participants who did and did not make stepping errors (Caetano et al. 2016). Poor TMT and Stroop predicted an increase in the number of preceding steps in the in the obstacle avoidance and long target conditions respectively, and reductions in step length as well.

STRENGTHS AND LIMITATIONS. This stepping task required each participant to (1) recognize and attend to the stepping objects, (2) recall the object color instructions (step on green, avoid pink), and (3) actively modify/inhibit an on-going step pattern to successfully step on a target or avoid an obstacle. No significant stepping accuracy differences were observed between older and younger adult groups in either obstacle or target conditions (in which the stepping objects appeared *at least* 2 steps ahead). However, eleven older adults (22%, out of 50 participants) made at least a single stepping error while none of the younger adults (21 participants) made any stepping errors. Considering each participant completed three walking trials in each experimental condition, this result suggests the stepping conditions may not have challenged most of the study participants.

Stroop interference performance and simple reaction times discriminated between participants that made and did not make stepping errors. That said, although detailed stepping strategy differences were provided for young and older adults across conditions, the experimental conditions in which the stepping errors occurred were not reported.

TREADMILL INHIBITORY STEPPING TASKS

Precision Step Inhibition Task. In a stepping assessment described as a precision step inhibition task (Potocanac et al. 2015), both young (N = 12, mean age 23) and older healthy adults (N = 12, mean age 72) walked on a C-Mill treadmill at a constant speed of 0.83 m/s (~1.86 mph). Stepping objects were projected onto the walking belt. The distance between objects was set to a constant, “comfortable” step length. Participants were instructed to step on the stepping objects (i.e. targets), unless the stepping object suddenly changed color as they approached it (i.e. the object became an obstacle). This scenario required a participant to inhibit their on-going stepping pattern and either step in front or past the stepping obstacle. The stepping object changed color ahead of the participant at a specified “available response distance” (ARD) plus a step length (Figure 5). The level of difficulty of the walking task was increased by reducing the ARD. The protocol consisted of a baseline walking condition (no stepping targets). Then, the “easiest” ARD was determined for each participant by starting at ARD = 0.600 meters, and decreased until the participant’s first two stepping failures. Following this, four walking conditions of increasing difficulty were completed, ARD decreased by 0.05 meters in each condition. Each of these four conditions consisted of 20 obstacles (~7 obstacles per minute).

During the process of determining the “easiest” ARD, older adults failed at shorter ARDs (0.655m ± 0.015 m) compared to young adults (0.521m ± 0.054 m). Even in the individualized “easiest” condition, a greater failure rate was observed in older adults (40±22%) compared to young adults (16±11%) for the stepping task only.

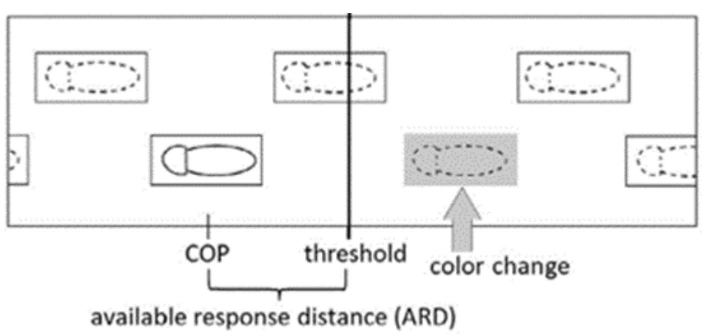


Figure 5. During the precision step inhibition task, the stepping object changed color ahead of the participant at a specified available response distance (ARD) plus a step length. The level of difficulty of the walking task was manipulated by reducing the ARD (Potocanac et al. 2015).

STRENGTHS AND LIMITATIONS. This stepping task introduced both targets and obstacles (a total of 80 obstacles). Interestingly, in this stepping paradigm, the older adult participants were observed failing at shorter ARDs compared to the young adult participants. That said, older adults also walked at shorter average step lengths (0.480±0.03 m) compared to the young adults (0.530±0.02 m). These results suggest the young adults required a visibility window on average of at least 1.98 step lengths ahead to successfully avoid the obstacle, aligning with obstacle avoidance research in young healthy adults (Matthis and Fajen 2013, Matthis and Fajen 2014). In contrast, the older adults required a larger visibility window, on average of at least 2.36 step lengths ahead to successfully avoid the obstacle (calculations below, units in meters).

Young Adults $$\frac{\text{“}Easiest\text{”}\ ARD\ +\ average\ Step\ Length}{average\ Step\ Length} = \frac{0.52083 + 0.53}{0.53} = 1.98\ step\ lengths$$

Older Adults $$\frac{\text{“}Easiest\text{”}\ ARD\ +\ average\ Step\ Length}{average\ Step\ Length} = \frac{0.65455 + 0.48}{0.48} = 2.36\ step\ lengths$$

However, this particular study focused on overall stepping failure rates, and the successful stepping strategies (e.g. step lengths modulations) used to avoid the stepping obstacles were not described. Therefore, it is not well understood *how* the older adult participants made more stepping errors compared to the younger participants.

Virtual Reality and Treadmill Intervention. In a randomized control trial (in five locations across Europe), high fall risk older adults (N = 282, aged 60-90 years) were recruited to participate in a 6 weeks intervention study (Mirelman et al. 2016). All participants reported 2+ falls in the 6 months before starting the intervention. The two intervention groups included Virtual Reality (VR) + treadmill training and Treadmill training only. Each group trained three times per week for six weeks. The VR/treadmill task included "obstacles, multiple pathways, and distractors that required continual adjustment of steps" to target *both* motor and cognitive functions. The VR intervention required active modification of step height and width to successfully navigate stepping targets, obstacles, and different pathways. Task complexity was manipulated by varying visibility and distractors in the environment. Moreover, both visual and auditory feedback was provided to allow participants to improve their stepping performance.

Figure 6. The virtual reality + treadmill training intervention experimental set-up (Mirelman et al. 2016). The VR/treadmill task included "obstacles, multiple pathways, and distractors that required continual adjustment of steps" to target both motor and cognitive functions.

Completed Training Sessions. The average number of completed training sessions was 16.62 (SD 1.78) and 16.82 (SD 1.81) for the VR + treadmill training and Treadmill only training groups respectively. Increased Walking Speed. Immediately after training and at the 6-month follow-up, both training groups demonstrated increased over-ground walking speed during an *obstacle negotiation* condition (measured on a 7-meter GaitRite walkway) compared to before the interventions. However, there were no gait speed improvement differences between the two training groups.

Improved Cognition Measures. Participants completed the same computerized cognitive battery (Dwolatzky et al. 2003) as in previous retrospective (Hausdorff et al. 2006) and prospective studies (Mirelman et al. 2012). Immediately after training and at the 6-month follow-up, both training groups demonstrated improvement on *Executive Function* index scores. For the *Attention* index scores, the Treadmill only training group demonstrated improvement both immediately after training and at the 6-month follow-up. However, the VR + treadmill training group only demonstrated an *Attention* index score improvement at the 6-month follow-up. However, these cognitive improvements were not different between the intervention training groups.

Reduced Fall Incident Rate: In the six months following training, the VR + treadmill training group's incident fall rate decreased (Figure 7), whereas no significant decrease was observed in the Treadmill only group. A few variables were identified as potential contributors to the observed fall incident reduction, including obstacle foot clearance and reduced gait speed variability (Mirelman et al. 2016).

Increased Obstacle Foot Clearance. Immediately following the intervention *and* at the 6-month follow-up, the VR + treadmill training group demonstrated increased obstacle foot clearance during an *obstacle negotiation* condition (measured on a 7-meter GaitRite walkway) compared to before the interventions. These obstacle foot clearance changes were not observed in the Treadmill only training group.

Reduced Gait Variability: Further, immediately following the training, the VR + treadmill training group demonstrated lower gait speed variability (reported as "better") during an *obstacle negotiation* condition compared to the Treadmill only group.

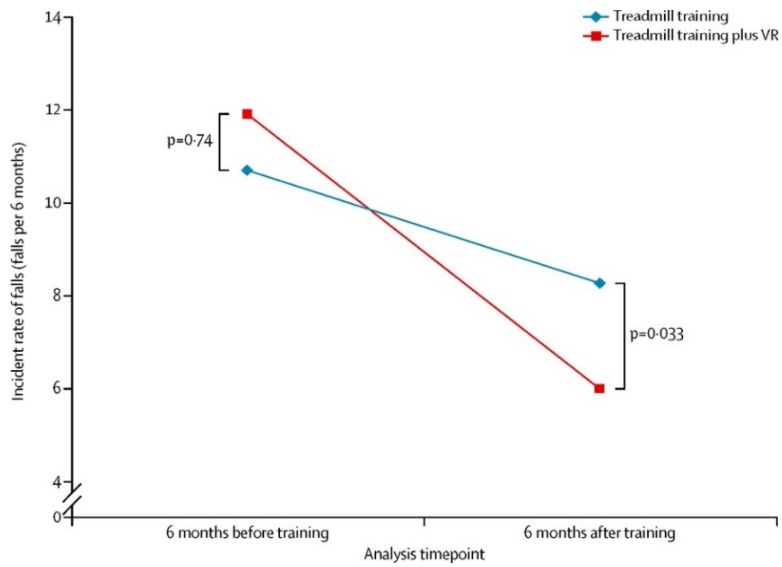


Figure 7. In the six months before training, there was no difference in fall incident rate between the two training groups. However, in the six months following training, the VR + treadmill training group's fall incident rate decreased, whereas no significant decrease was observed in the Treadmill only training group (Mirelman et al. 2016).

STRENGTHS AND LIMITATIONS. It is still not well understood which aspects of this VR training program were *most critical* to the study outcome measure of reduced fall incident rate. Secondly, these researchers contend that both attention and response inhibition abilities are important (required) during walking in complex environments, in particular when negotiating obstacles (Mirelman et al. 2016). However, although the VR component was suggested to have enhanced attention and executive function, similarly to (fall incident rate) it is not understood which specific aspects of the VR training could have improved cognition. In fact, the physical activity component only (without the VR component) in the Treadmill only training demonstrated improvement in both *Attention* and *Executive Function* scores as well. This was the same cognitive battery (Dwolatzky et al. 2003) that was linked to increased fall risk (Hausdorff et al. 2006, Mirelman et al. 2012).

This dilemma is central to research examining cognition within walking interventions. As it is well-established that physical activity improves cognition (Hillman et al. 2008).

What's Next

Multiple retrospective and prospective studies demonstrated significant links between declines in memory, attention, response inhibition, cognitive flexibility and increased fall risk. However, these studies only correlated cognitive performance to general fall risk. The different stepping scenarios or conditions in which falls occurred could not be compared. To fill this gap, an array of walking situations that challenge stepping have been explored. In fact, many of these have been recognized as challenging for older adults.

Stepping Tasks. However, there are still aspect of the stepping tasks which have not been explored. First, many of these past studies have included short-distances on over-ground walking pathways (Alexander et al. 2005, Yamada et al. 2011, Caetano et al. 2016). In some cases, scenarios where all the targets or distractors were visible from the trial start (Alexander et al. 2005, Yamada et al. 2011). In these cases, participants not only had a large visibility window, but were only required to attend to the stepping task for short periods of time. Filling the former gap, other studies have manipulated the visibility window of the targets and/or obstacles (Potocanac et al. 2015, Caetano et al. 2016). Smaller visibility windows allowed exploration of the circumstances in which healthy adults fail to make stepping adjustments. Additionally, only the treadmill inhibitory task (Potocanac et al. 2015) introduced a large number of *continuous* stepping targets and obstacles (20 per walking trial, 7 obstacle occurring per minute). Considering the older adult participants were walking at 0.833 m/s (with average step lengths of approximately 0.48 m), then an obstacle appeared approximately every 15 steps. Future research (1) should introduce stepping tasks that require participants to recognize and attend to a stepping task for continuous periods of time. Although, walking bouts during everyday walking are often short (Orendurff et al. 2008), this experimental manipulation would allow researchers to explore attentional limits and understand when these capabilities fail in stepping tasks. Similarly (2), stepping tasks that require participants to navigate continuous sequences of targets and obstacles would provide more information on how healthy adults actively modify their stepping and specifically the circumstances that stepping failures might occur. The knowledge would provide critical insights that can be used to help develop more effective evidence-based treatment strategies to improve walking function and reduce falls.

Cognitive Assessments. Considering how strongly cognitive and physical demands are intertwined during stepping in complex walking environments, a major challenge is to be able to provide a precise discussion on which cognitive abilities (and physical abilities) are most critical in the constructed stepping task(s). Mounting evidence highlights attention and response inhibition abilities as critical during walking in cognitively complex environments. However, stepping research that seeks to target specific EF behavioral outcomes (3) should also administer a cognitive battery (multiple measures), that is relevant to the constructed stepping task(s), to support these discussions.

Chapter 3: Study 1

Association of Cognition and Goal-Relevant Variability with Modification of Stepping Patterns in Young and Older Healthy Adults

Introduction

In everyday walking, our environment may expectedly or unexpectedly change. Humans thus need to modify their stepping strategies to negotiate such changes. Although many studies have examined the contribution of declines in physical mobility, until the 1990s, the relationship between cognitive function and fall risk had significant less consideration. Mounting evidence indicates that the significant declines in cognitive function (particularly executive function) experienced by older adults (Zelazo et al. 2004), affect motor performance (Ble et al. 2005, Yogev et al. 2005, Coppin et al. 2006, Holtzer et al. 2006, Springer et al. 2006), and are directly associated with increased fall risk (Anstey et al. 2006, Anstey et al. 2009, Herman et al. 2010, Mirelman et al. 2012).

Executive function (EF) is a domain of cognition that includes skills necessary for deliberate, goal-directed thinking and behavior (Zelazo et al. 2004). Behavior that is focused on modifying an on-going plan when a scenario requires novel action (Norman and Shallice 1986). However, the extent and under what types of circumstances, that walking in complex environments may rely on cognition is less understood.

As walking circumstances may vary, EF processes may be necessary to switch between different sets of rules or task goals, generalize past knowledge to new situations (Zelazo et al. 2004), continuously evaluate and modify task performance, suppress irrelevant sensory information, and respond selectively to environmental features (Yogev-Seligmann et al. 2008). Fallers performed more poorly on response inhibition and attention tasks compared to non-fallers (Hausdorff et al. 2006). Prospective studies also found similar cognitive deficits in attention (Mirelman et al. 2012), response inhibition (Anstey et al. 2009, Herman et al. 2010, Mirelman et al. 2012), and memory (van Schoor et al. 2002, Anstey et al. 2006) for fallers. These results imply that *early* changes in attention, memory, and inhibitory control in healthy older adults may potentially be associated with increased fall risk. However, these studies only examined how these EF behavior outcome measures were associated to general fall risk. The different situations in which the reported falls occurred could not be compared. Therefore, further understanding of stepping scenarios that challenge attention, memory, or response inhibition is necessary.

In this study, we sought to disrupt the normal walking pattern, with the intention to create situations where healthy adults are required to actively modify their stepping. We introduced new step goals constructed to *compete* with the stepping strategies both young and older adults choose during normal (unmodified) treadmill walking (Dingwell et al. 2010, Bohnsack-McLagan et al. 2015, Dingwell et al. 2017).

PRELIMINARY STUDIES

This work extends a theoretical framework developed to identify task goals and control strategies for repetitive movement tasks (Cusumano and Dingwell 2013, Dingwell et al. 2013, Cusumano et al. 2014), including walking (Dingwell and Cusumano 2010, Dingwell et al. 2010). For walking on a treadmill at constant belt speed, v_w, the primary requirement is to not walk off the treadmill. There are many strategies that can achieve this. Work from our lab (Dingwell et al. 2010) demonstrated that young healthy adults use the simple strategy of trying to maintain constant speed (v_w) at each stride. This can be written as the "goal function" $v_w = L_n/T_n$, where all combinations of stride length (L_n) and stride time (T_n) that satisfy the goal function successfully accomplish this task. Figure 8A shows example T_n and L_n data (cyan dots) from a single walking trial of many strides. Humans typically choose a "Preferred Operating Point" (POP, $[T^*, L^*]$ depicted as a yellow star in Figure 8A) within this space. We presume that people choose a POP that approximately minimizes energetic cost (Kuo 2001, Dingwell et al. 2010). During walking, from stride-to-stride, individual strides fluctuate around this POP (Figure 8A). Analyses of the how quickly these deviations from the POP are actively corrected at each stride provide information on the stepping strategies humans employ (Dingwell et al. 2010).

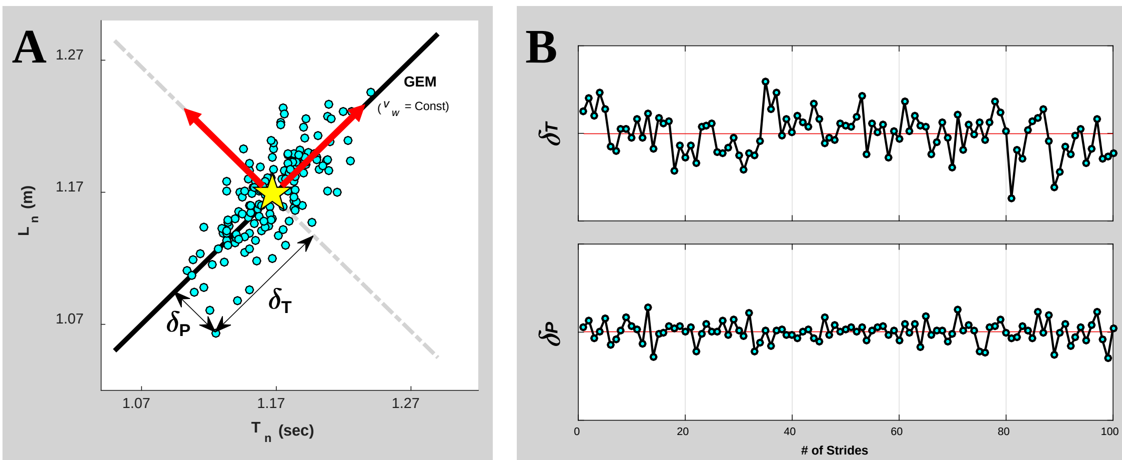


Figure 8. A) Definition of the speed "Goal Equivalent Manifold" (GEM) for walking at constant speed (L_n/T_n = Constant). B) Example time series of flucuations δ_T tangent and δ_P perpendicular to speed GEM in (A). Analyses of stride-to-stride fluctuation dynamics show healthy adults rapidly correct δ_P deviations (bottom plot) on subsequent strides, but do not correct deviations in δ_T (top plot), allowing them to persist across multiple strides.

The solid diagonal line represents all combinations of T_n and L_n that achieve the exact same speed v_w and defines the "Goal Equivalent Manifold" (GEM) for constant-speed walking. Time series of L_n and T_n are then transformed into times series of "Goal Equivalent" deviations tangent to the speed GEM (δ_T) that do not affect speed (v_w) and "Goal Relevant" deviations perpendicular to the speed GEM (δ_P) that do directly affect speed (v_w) (Dingwell et al. 2010). The time series data (for the walking trial in Figure 8A) of the speed GEM devations (δ_T and δ_P) are shown in Figure 8B.

Analyses of stride-to-stride fluctuation dynamics show healthy humans rapidly correct δ_P deviations on subsequent strides, but do not correct deviations in δ_T, allowing them to persist across multiple strides. Standard deviations analyses demonstrated healthy humans exhibit decreased within-trial variability in the δ_P deviations compared to δ_T deviations. The latter analyses also reveal how successful humans are at enacting the simple speed strategy with respect to the POP and speed GEM.

Older healthy adults (65+ years) exhibited greater within-trial variability during treadmill walking; however, no differences were observed in their stride-to-stride strategies compared to young healthy adults (Dingwell et al. 2017). Both younger and older healthy adults allowed deviations in L_n and T_n to persist across multiple consecutive strides, whereas deviations in S_n (equivalent to δ_P deviations) were rapidly corrected on subsequent strides. However, these results were only for normal (unmodified) treadmill walking.

More recently, secondary step goals of constant stride length (L_n) and time (T_n) were introduced during treadmill walking at a constant speed (Bohnsack-McLagan et al. 2015). Although, young healthy participants accommodated these multiple step goals, they still chose to prioritize the speed GEM ($v_w = L_n/T_n$) over the secondary goals (Bohnsack-McLagan et al. 2015). However, the secondary goals were designed to minimize conflict between them. Individuals did not have to specifically choose a single or a subset of these goals, because hypothetically they could accommodate all goals by choosing stride parameter [T_n, L_n] pairs near where all three goals intersected. Moreover, this work included only young healthy participants. No study had yet to investigate how healthy older adults would respond to similar secondary step goals or step goals constructed to conflict.

This experiment introduced new step goals specifically constructed to *compete* with the POP and the speed GEM. These step goals and experimental design not only required healthy adults to actively modify their stepping strategies, but *maintain* a new stepping pattern. However, importantly, participants were not told explicitly how modify their stepping to solve each step goal or subset of step goals.

We manipulated the step goals for both young and healthy older adults. We hypothesized that (1) across conditions, participants would exhibit stride-to-stride control strategies that sought to mediate the different competing step goals presented. Specifically, participants would modify their stride-to-stride strategies to accommodate the competing step goals. (2) Between groups, older adults would demonstrate higher prioritization of the implicit task goals (POP and speed GEM) over the competing step goals. Minimal or no change in stepping strategy to accommodate the competing step goals would indicate higher prioritization of the implicit task goals. Lastly, we sought to understand what aspects of EF (if any) might impact performance in a stepping task that required healthy adults to modify their preferred stepping pattern and maintain a new (novel) stepping strategy. Considering the links between EF declines and greater fall risk in older adult populations, we also hypothesized, (3) better EF abilities (inhibition, attention, and working memory) would be associated with superior stepping performance across study participants.

INSTRUMENTS AND METHODS

Selection of Participants

This study was approved by Institutional Review Board at The University of Texas at Austin and all participants provided written informed consent prior to participation.

Twenty-four young (21.9±3.4 years, YH) and twenty-four older (67.6±6.1 years, OH) healthy adults participated (Table 1). All participants were screened to ensure they had no history of serious cardiovascular, respiratory, visual, vestibular, neurological, or musculoskeletal problems that might directly interfere with their walking. Any individual who had experienced a fall in the previous year, or who was currently taking any medications that might adversely affect their walking were also excluded. Study participant characteristics (young and older healthy adult groups) are detailed in Table 1.

Table 1. Study 1 Participant Characteristics

		YH	**OH**	(two-tailed) p-value
Number of Participants		24	24	
Number of Females		15	15	
Age (years)	Mean	21.9	67.6	$p < .01$
	SD	3.4	6.1	
Body Mass (kg)	Mean	69.15	70.06	$p = 0.804$
	SD	13.56	11.66	
Height (m)	Mean	1.70	1.69	$p = 0.586$
	SD	0.09	0.08	
Resting HR (bpm)	Mean	71.7	66.5	$p = 0.120$
	SD	11.24	11.19	
MMSE	Mean	29.38	29.58	$p = 0.415$
	SD	0.875	0.881	
Icon-FES	Mean	13.92	12.79	$p = 0.163$
	SD	3.189	2.226	

Study Procedure

After (1) obtaining informed consent, each participant completed a series of assessments: (2) general assessments, (3) physical, and (4) EF assessments, before continuing to the (5) treadmill stepping task (as depicted in Figure 9).

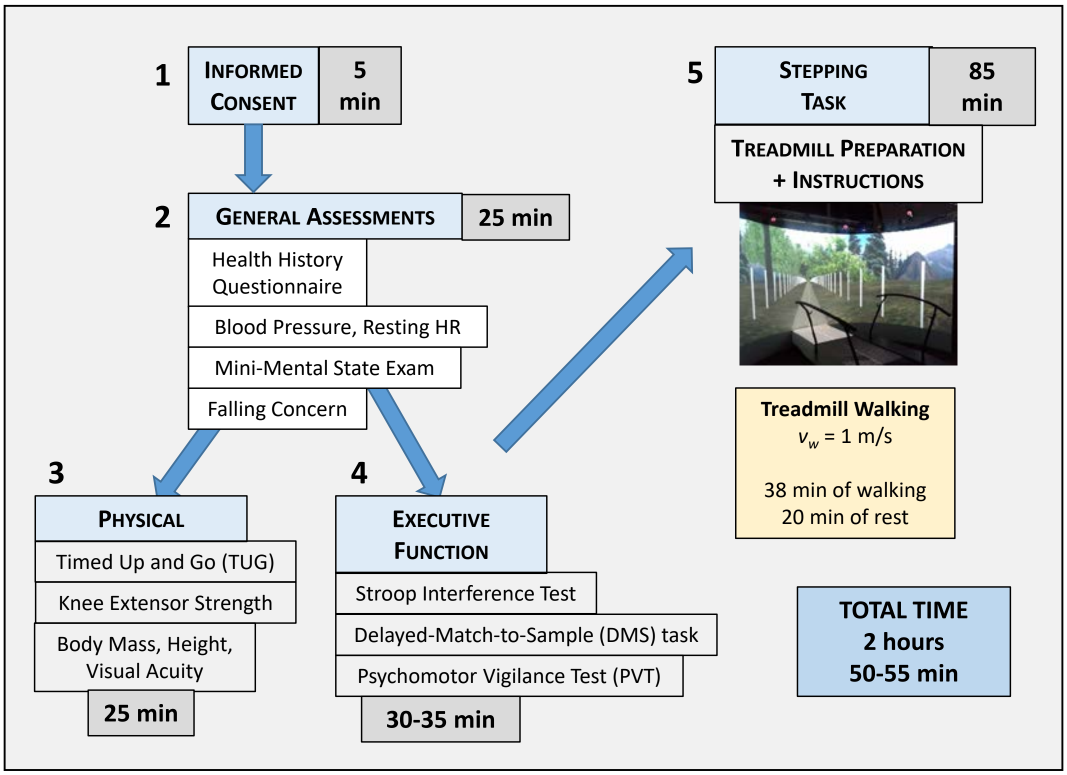


Figure 9. Study 1 Experimental Protocol. The study protocol included five section: Informed consent, general assessments, physical assessments, executive function assessments, and the treadmill stepping task. The protocol took approximately 2 hours and 50-55 minutes.

General Assessments

Each participant completed a Health History Questionnaire (Appendix A), and height, weight, and resting heart rate measurements were taken (Table 1).

MMSE. Following this, to screen for cognitive impairment and assess general cognitive function, the Mini-Mental State exam (MMSE) (Folstein et al. 1975) was administrated. MMSE is an established and prevalent screening tool in older adult studies. The MMSE consisted of eleven simple questions or tasks grouped into seven cognitive domains: orientation to time, orientation to place, registration of three words, attention and calculation, recall of three words, language, and visual construction (Appendix A). The final MMSE score was attained by summing the points for each question. The maximum possible score was 30 points. For this study, MMSE inclusion criteria score was > 24, as a score of 24 or less is suggestive of cognitive impairment (Luszcz et al. 1997). The MMSE screening took approximately 5 minutes.

Icon-FES. Concern of falling was assessed with the 10-item version of the Iconographical Falls Efficacy Scale (Icon-FES) (Delbaere et al. 2011). Icon-FES assessment was chosen for (a) its use of pictures to describe an array of daily activities and (b) validation on high-functioning community-dwelling older adults. In this assessment, participants were presented with ten pictures (one at a time, Appendix A) and instructed to imagine themselves performing each activity (e.g. getting dressed, taking a shower, walking down the stairs). For each picture, each participant was asked how concerned they were about the possibility of falling while doing the presented activity and to quantify their concern on a scale 1-4: (1) No at all concerned (1 point), (2) somewhat concerned (2 points), (3) fairly concerned (3 points), and (4) very concerned (4 points). The final score was attained by summing the points for each picture. The maximum possible Icon-FES score was 40 points. The Icon-FES took approximately 5 minutes.

Assessment of Physical Capacity

TUG. Functional mobility was assessed with a Timed Up and Go (TUG) (Podsiadlo and Richardson 1991) protocol. TUG is a well-established, reliable clinical measure often used to identify elevated fall-risk in older adults (Shumway-Cook et al. 2000). In this study, each participant sat on a standard armchair, and placed their back against the chair and rested their arms on the chair's arms. After the participant indicated they were "ready", the experimenter said "Go!" and the participant stood, walked to a line that was 3 meters away, turned around at the line, walked back to the chair, and sat down again. A stopwatch was used to time the test (in seconds). The stopwatch started at "Go!" and stopped when the participant's buttocks touched the chair seat. Participants were instructed to walk "at a comfortable and safe walking speed". Two trials were completed, the first trial was a familiarization trial and the second trial time was recorded. Better functional mobility was indicated by shorter TUG times. Although, specific TUG cut-off times identifying high fall risk vary greatly across studies (Beauchet et al. 2011), functioning community dwelling older adults (aged between 65 and 85 years) have been reported to have TUG times < 12 seconds (Bischoff et al. 2003). The TUG protocol took approximately 5 minutes.

Knee Extension Strength. Lower limb strength was assessed with an isometric knee extension test (Smidt 1984). Knee extension strength is a predictive marker of mobility limitation risk in high-functioning older adults (Manini et al. 2007). For each leg (left and right), the force measurement was performed 3 times, with a minimum of 30 seconds of rest in between each measurement (total six measurements). Each participant sat on table with their knees at 90 degrees. A dynamometer was fixed below the table and an ankle strap was secured on their shank. For each measurement, the participant was instructed to grip the table with their hands, remain seated, and push forward with their maximum effort (extending their knee) on "GO!" until the experimenter said "STOP" (~2 seconds). Participants received loud encouragement (e.g. "GO GO GO!!") during each measurement. Normalized knee extension strength was determined by averaging the maximum force measurement for both legs (lb) and dividing by body weight (lb) (see equation 1). Better lower limb strength performance was indicated by a larger ratio. The normalized knee extension strength assessment took approximately 10 minutes.

$$Normalized\ Knee\ Extension\ Strength = \frac{\left(\overline{force}_{left} + \overline{force}_{right}\right)/2}{BW} \qquad (1)$$

Measurement of Executive Function

Stroop Task. The Stroop Interference task, a standard measure of EF (Stroop 1935) and a prefrontal-based cognitive task assesses inhibiting ability through congruent conditions (i.e., Word and Color conditions) and a non-congruent condition (i.e., Color-Word condition). An advantage of the Stroop Interference task is also that it only entails participants to read out-loud verbally (no additional motor requirement). Each condition consisted of 100 items (5 by 20 matrix) printed on a white page (Figure 10). In the Word Condition (W), participants were instructed to read aloud color words ("red", "green", "blue") printed in black ink. In the Color Condition (C), to name the colors of XXXXs printed in different ink colors (red, yellow, blue). In the Color-Word condition (CW), participants were instructed to name the colors of incongruent color words presented in different ink color (e.g., the word "blue" written in red ink). For each condition, participants were instructed to read aloud as many items as possible in 45 seconds. Better response inhibition performance was indicated by a higher number of items read for the Color–Word (CW) condition. In a similar Stroop Interference protocol, young healthy adults (18 to 29 years) were reported to read on average 51 words (±11) in the incongruent CW condition (Hwang et al. 2016). The Stroop task took approximately 5 minutes.

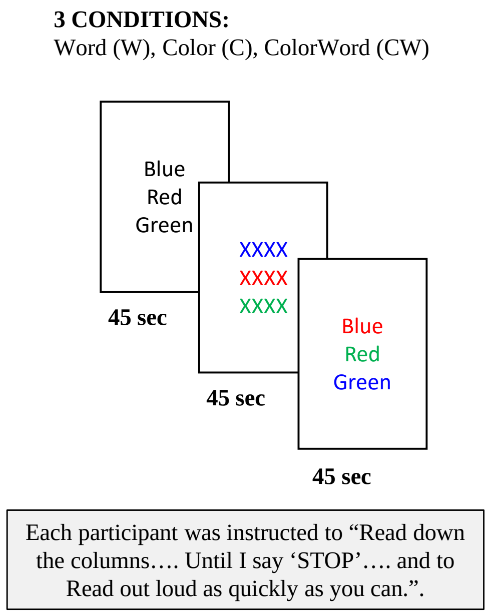


Figure 10. The Stroop Task included 3 condition: Word (W), Color (C), and ColorWord (CW). For each condition, participants were instructed to read aloud as many items as possible in 45 seconds. Better response inhibition performance was indicated by a higher number of items read in the non-congruent condition (i.e., Color-Word condition).

DMS. Working memory, also mediated by the frontal-parietal network (Nieder and Miller 2004), was assessed with the Delayed-Match-to-Sample Task (DMS) (Chudasama 2010). DMS measured the ability to hold visual information (short-term) and recall it. Further, DMS was chosen as alternatively to a verbal assessment due to the importance of identifying visual environmental features during everyday walking. In this assessment, participants viewed a 5x5 unique pattern of brightly colored yellow and red squares on a computer screen (Figure 11). The stimulus disappeared with a key press (however, each participant chose how long they studied each pattern), and the screen went blank through a 6 second delay period. Following this, two stimuli appeared on the computer screen (a "match" and "non-match"). Participants were instructed to indicate which stimulus was the correct "match" with a key press (right or left shift key) and move through the assessment as quickly and as accurately as possible. After their response, feedback was displayed as "correct" or "incorrect" on the computer screen. DMS resulted in three outcome measures: (1) number of correct match-to-sample trials (out of 30), during the correct "match" trials: (2) average study time (i.e. how long the participant studied the single pattern), and (3) average retrieval latency (msec) (i.e. how long the participant studied the two patterns).

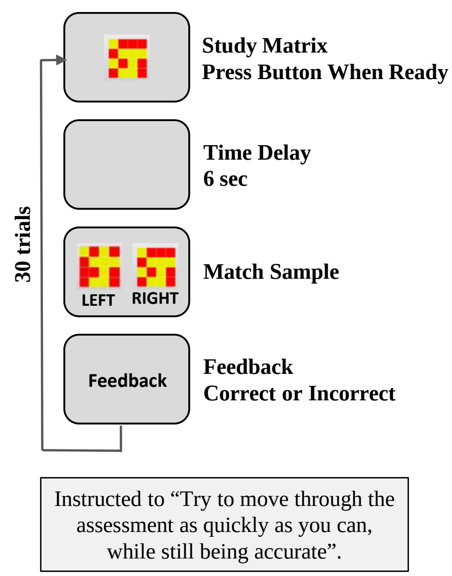


Figure 11. The DMS task consisted of viewed 30 unique patterns of brightly colored yellow and red squares on a computer screen, and after a 6 second time delay, had to then indicate which stimulus (from two different patterns) was the correct "match" to the initial stimuli. Better working memory performance was indicated by higher number of correct trials (response accuracy) and shorter memory retrieval latency (speed memory processing).

Better working memory performance was indicated by higher number of correct trials (response accuracy) and shorter memory retrieval latency (speed memory processing). In an identical DMS protocol, number of correct trials ranged from 26.50 (±1.98) to 28.00 (±1.15); and memory retrieval latencies from 1509 (±458) to 2175 (±634) msec for young adults (18 to 29 years) with "very poor" to "excellent" aerobic fitness levels respectively (Hwang et al. 2017). DMS consisted of 30 trials and took approximately 8-25 minutes.

PVT. Psychomotor Vigilance Task (PVT), an assessment suitable for both young and older adults (Dinges and Powell 1985), was used to assess sustained focus and attention. In this assessment, participants were instructed to pay attention to fixation point (+, "ready") at the center of a computer screen. Following the fixation point, at random time intervals, participants were instructed to respond via button press (space bar) as quickly as possible when they saw a counter stimulus (which was counting up, their response stopped the counter). Feedback was provided as the final counter value was displayed on the screen, representing to the participant's reaction time (RT). Better attention performance was indicated by a shorter (mean) RT (speed attentional processing). In an identical PVT protocol, mean RT ranged from 359 (±29) to 342 (±22) msec for young adults (18 to 29 years) with "very poor" to "excellent" aerobic fitness levels respectively (Hwang et al. 2017). Additionally, variability (standard deviation) of RT and number of lapse trials (reaction times > 500 sec) were quantified. Each participant completed a practice session (approximately one minute). Followed by the PVT actual session which consisted of 45 trials and took approximately five minutes.

The DMS and PVT were implemented with the Psychology Experiment Building Language (PEBL) program (Mueller and Piper 2014) and administered on a laptop.

Stepping Treadmill Task

Participants walked on an instrumented "V-Gait" treadmill (Motekforce Link, Amsterdam, Netherlands). The V-Gait system consists of an instrumented dual-belt treadmill (1 × 2 meter) and a virtual reality (VR) scene projected onto a 3 meter 180° semi-cylindrical screen in front of the treadmill. For all conditions and participants, the treadmill was set to a constant speed of v_w = 1 m/s (approximately 2.24 mph). A single fixed speed allowed us to directly examine stepping performance differences across participants. Further, as the stepping task conditions would require participants to modify their stepping, we chose a speed that was expected to be comfortable for both young and older adults.

Stepping Feedback: As each participant walked, we used the VR to provide each participant direct visual feedback of their stepping movements (Figure 12).

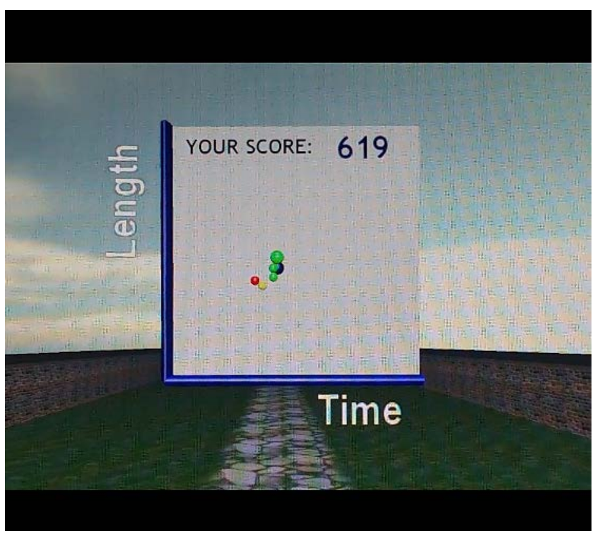


Figure 12. Visual Feedback during the Experiment Trials. As a participant walked, their last five strides were depicted as circle data points on the graph. Data points were color-coded proportional to the "error" magnitude (green, yellow, red).

The visual feedback of their stepping movements was explained to each participant as their stride length ("Length", L_n on the vertical axis) and stride time ("Time", T_n on the horizontal axis) at each stride. A stride was explained as "two consecutive steps". At each stride, the visual feedback updated (based on their stepping movements) and their most recent five strides ([T_n, L_n] pairs) were displayed as individual circles on the graph. The most recent stride was always the largest data point (i.e. circle, Figure 12).

Training Period: After the visual feedback was explained, each participant walked in a training period for approximately 5 minutes. The purpose of the training was to acclimate and familiarize each participant to the experimental set-up and visual feedback respectively. An example of the visual feedback is depicted in Figure 13. Each participant was instructed to "use this time to explore and try different stride lengths and times".

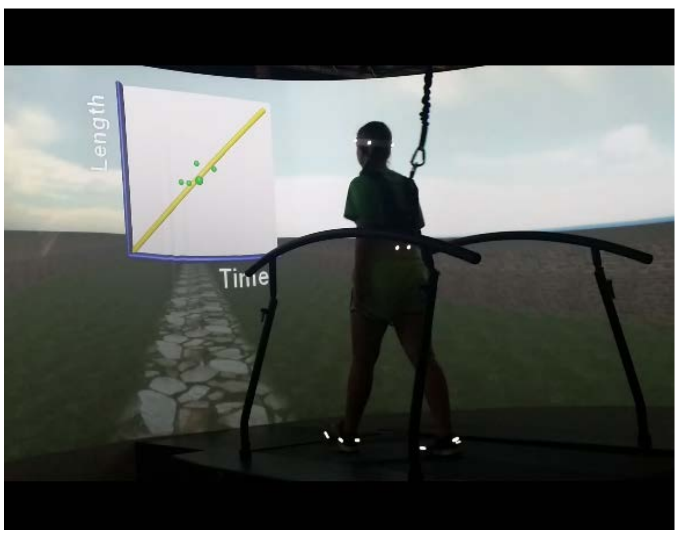


Figure 13. Visual Feedback during the Training Period. During the training period, each participant's last five strides were depicted as (only) green circle data points, also the constant speed GEM was displayed as a yellow diagonal line.

Experimental Conditions: Each participant completed four walking conditions. First, all participants (i) walked in a normal walking condition with no visual or auditory feedback ("NOF"). A designated POP (average stride length L_n and stride time T_n) was determined for each participant during normal walking at v_w = 1 m/s. Then, *competing* step goals were constructed by introducing alternative ([T_n, L_n] pairs in the [T, L] plane) that sought to move individuals *away* from their POP.

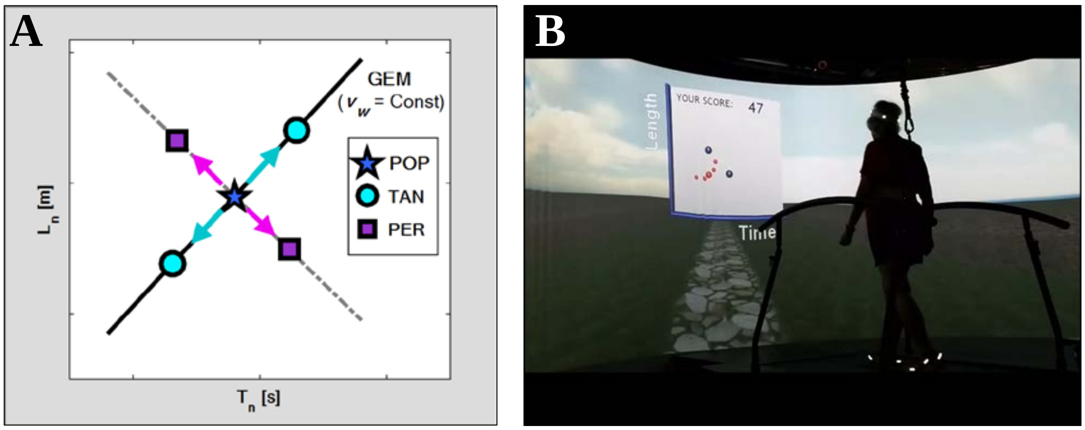


Figure 14. A) Schematic of the experimental conditions (ii-iv). B) Typical participant walks in an experimental condition. The step goal targets are displayed as navy blue circles (two in this condition), their last five strides are also displayed as circles (color-coded proportional to the magnitude of "error"), and their overall trial score is displayed near the top of the graph.

Following the NOF condition, each participant walked in three additional conditions (Figure 14A), in which step goals were introduced (using VR) to (ii) move to their own POP (Figure 14A: blue star, "POP"), (iii) move away from their POP *along* the speed GEM (Figure 14A: cyan circles, "TAN"), and (iv) move away from their POP *perpendicular* to the speed GEM (Figure 14A: purple squares, "PER"). To minimize order effects, the order of conditions (ii-iv) were counterbalanced across participants.

The TAN displacements from the POP were determined considering voluntary L_n modulations (Young and Dingwell 2012). We chose to displace our TAN step goals by ±0.14 meters or seconds with respect to L_n or T_n respectively. These displacements were ±7 SD (one SD greater than the voluntary L_n modulations) with respect to the average observed within-trial L_n variability (Salinas et al. 2017) during treadmill walking in a VR environment. The PER displacements from the POP were determined from piloting sessions of this condition. We chose to displace our PER step goals by ±0.05 meters or seconds with respect to L_n or T_n respectively. PER displacements were on average ±4 SD with respect to the observed within-trial S_n variability (Salinas et al. 2017) of which were approximately ± 0.02 m/s. An example of the step goals in conditions (ii-iv) is depicted in Figure 15. In the POP condition, the stepping goal (depicted as a navy-blue circle in Figure 15) were placed at the average [T_n, L_n] walked in the NOF trial. In the TAN and PER conditions, the two step goals were placed *along* and *perpendicular* to the speed GEM.

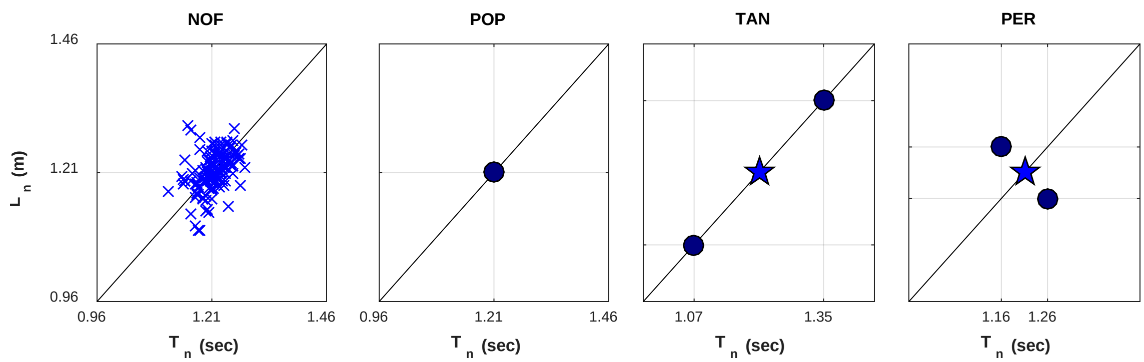


Figure 15. Example placement of the step goal(s) in experimental conditions (ii-iv) relative to the NOF condition for a typical participant. The speed GEM is depicted as a solid black diagonal line, however, it is important to note that, the speed GEM was not visible during the experimental condition trials.

These chosen displacements from the POP were made with the intention of introducing step goals that challenged normal treadmill walking, but also were in an achievable range.

Stepping Feedback (continued): As during the training period, visual feedback was provided and updated (based on each participant's most recent stepping movements) at each stride during conditions (ii-iv). Presented data points displayed the participant's most recent five strides (i.e., [T_n, L_n] pairs), color-coded proportional to the magnitude of "error" (green, yellow, red). The step goal radii for green and yellow strides were 0.02 and 0.04

meters (relative to stride length) respectively, and strides outside 0.04 radii were designated as red strides. These levels were determined from average variability observed in previous experiments. Specifically, the stride length L_n within-trial variability was approximately 0.02 m (Salinas et al. 2017) during treadmill walking in a VR environment.

Auditory feedback was also provided at each stride ("green" strides were accompanied by a "positive" sound, whereas "red" strides were accompanied with a "negative" sound). Lastly, (as a quantifiable feedback) a composite score was displayed and continuously updated on the screen (Figure 12) as the participant walked in each trial. Each green, yellow, and red stride received 10 points, 3 points, and zero points respectively.

The intention of condition (iii) TAN was to create conflict between the step goals specified and the implicit goal to stay at their POP (Figure 15). Condition (iv) PER created conflict between the step goals specified and the implicit goal to maintain speed (i.e., to stay on the constant-speed GEM, Figure 15).

Instructions: Participants were instructed to walk comfortably and to use the feedback to seek "green" strides. Participants were told they could take either longer or shorter strides (i.e., changing L_n) and/or faster or slower strides (i.e., changing T_n) to achieve the prescribed step goals. Importantly, participants were told their options, but were not be told explicitly how to solve each step goal.

Practice and Experimental Trials: For conditions (ii-iv), each participant completed one practice trial (with visual and auditory feedback) for 3 minutes. Then, they completed 2 trials of 3 minutes each for each condition. To avoid fatigue, each participant rested (seated) at least 2 minutes between each walking trial.

Stepping Data Analysis

An integrated 10-camera Vicon motion capture system (Oxford Metrics, Oxford, UK) was used to record movement kinematics. Kinematic data were recorded at 120 Hz using a 16-marker set marker data, including four markers on the head, four markers on the pelvis, and four markers on each foot. Raw kinematic data were processed using Vicon Nexus software (Oxford Metrics, Oxford, UK). Additional data reduction and analyses were performed using MATLAB (MathWorks, Inc., Natick, MA).

For the stepping data, three sequential sets of analyses were performed, each addressing different but relevant aspects of the questions addressed in this study.

Stepping Performance: This study's measure of overall performance was (1) percent of green strides (% Green strides) attained during each walking trial. Example stride data from the four experimental conditions are displayed in Figure 16.

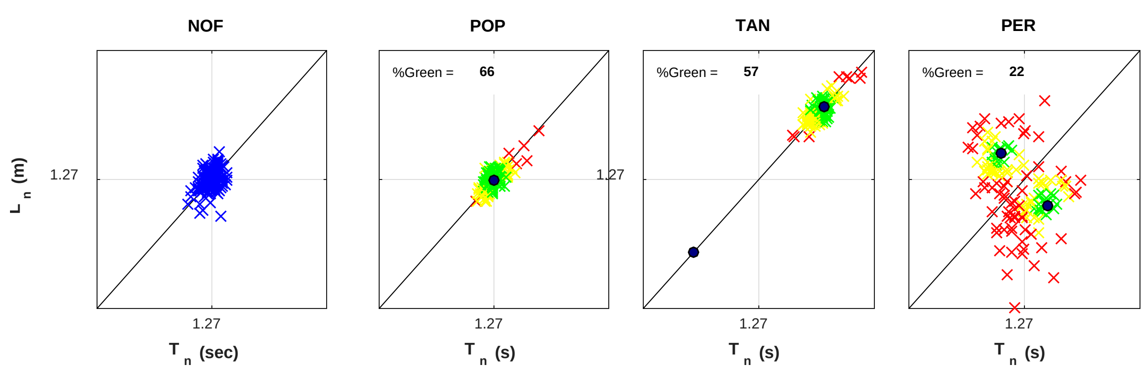


Figure 16. All stride data for a complete walking trial from four experimental conditions. Here, the stepping goals of the POP and alternative stepping goals ([T_n, L_n] pairs) in the [T, L] plane are depicted as navy blue circles. All the strides for the complete walking trial are color-coded proportional to the magnitude of "error" (green, yellow, red). Additionally, the percent of Green Strides is noted at the top of each subplot for conditions (ii-iv). All data for each study participant are displayed in Appendix C.

Here, the stepping goals of the POP and alternative stepping goals ([T_n, L_n] pairs) in the [T, L] plane are depicted as navy blue circles. All the strides for the complete walking trial are color-coded proportional to the magnitude of "error" (green, yellow, red).

Further, as we were interested in *how* healthy adults would modify their stepping to accommodate the competing step goals, we quantified the fluctuation characteristics of (2) the stride parameters (L_n, T_n, and S_n) and (3) deviations with respect of the speed GEM (δ_T and δ_P) across the different experimental conditions and between groups.

A stride was defined as the period between a right heel strike to the next right heel strike. individual heel strikes were determined by finding the local maxima of the distances between the pelvis and heel markers in the anterior-posterior direction (Zeni et al. 2008). Stride length (L_n) was calculated as the anterior-posterior displacement between two consecutive right heel strikes and using the heel marker data. Stride time (T_n) was calculated as the time between two consecutive right heel strikes. These data were used to extract time series of stride lengths (L_n), stride times (T_n), from which time series of stride speeds were then also computed ($S_n = L_n/T_n$).

We used the procedures developed in (Dingwell et al. 2010) to decompose these data into two new variables, tangent to (δ_T) and perpendicular to (δ_P) the speed GEM. The MATLAB script used to calculate these new variables (for Study 1) is included in Appendix D. First, the designated preferred operating point (POP) determined during the NOF condition (trial 2) was used to center the new coordinate system about this point $POP = [T^*, L^*]$, $T'_n = T_n - T^*$ and $L'_n = L_n - L^*$. The designated POP was used here, considering the *competing* step goals were constructed to move individuals away from this POP. Lastly, the following coordinate transformation was performed to acquire deviations tangent (δ_T) and perpendicular to the speed GEM (δ_P) (as depicted in Figure 8A).

$$\begin{bmatrix} \delta_T \\ \delta_P \end{bmatrix} = \frac{1}{\sqrt{1+v_w^2}} \begin{bmatrix} 1 & v_w \\ -v_w & 1 \end{bmatrix} \begin{bmatrix} T_n' \\ L_n' \end{bmatrix} \tag{2}$$

As tangent deviations do not affect walking speed, they are considered "goal-irrelevant". Alternatively, perpendicular deviations (δ_P) directly affect walking speed, and are thus considered "goal-relevant" (Figure 8A).

For each trial, means and standard deviations (σ) for each of these time series (T_n, L_n, S_n, δ_T, δ_P) were computed. We then used Detrended Fluctuation Analysis (DFA) (Peng et al. 1992, Peng et al. 1994, Hausdorff et al. 1995, Goldberger et al. 2002) to quantify the stride-to-stride fluctuation dynamics and to determine the extent of control for each variable, as we did previously (Dingwell et al. 2010). DFA scaling exponents, α, quantify the statistical persistence or anti-persistence in a scalar time series, independent of the magnitude of variability. Scaling exponents $\alpha > ½$ indicate statistical *persistence*: deviations in one direction are more likely to be followed by deviations in the same direction. Scaling exponents $\alpha < ½$ imply *anti-persistence*: deviations in one direction are more likely to be followed by deviations in the opposite direction (reversals). Scaling exponents $\alpha = ½$ indicate no correlation: all deviations are equally likely to be followed by deviations in either direction. In the context of control, variables that are *not* tightly controlled generally exhibit strong statistical persistence ($\alpha > ½$), while variables that *are* tightly controlled generally exhibit either uncorrelated or anti-persistent fluctuations ($\alpha \leq ½$) (Dingwell et al. 2010, Dingwell and Cusumano 2015, John et al. 2016). Thus, while standard deviations (σ) captured the average magnitude of fluctuations in these time series, these DFA exponents (α) captured how quickly participants actively corrected these fluctuations on subsequent strides (i.e. stride-to-stride strategy).

Statistical Analyses

Statistical analyses were performed using SPSS Statistical Package (SPSS Inc., Chicago, USA). Statistical analyses were divided into the following four sections.

Assessment Measures. To identify differences between YH and OH adult groups, age group mean differences of the physical measures (TUG, Normalized Knee Extensor Strength), and EF measures (Stroop, PVT, DMS) were compared using independent t-tests.

Overall Stepping Performance. A two-factor Age Group × (Condition) mixed factorial analysis of variance was employed to compare mean differences of overall stepping performance (% Green strides) between YH and OH adults and across the three experimental conditions (POP, TAN, PER).

Stepping Strategies. A two-factor Age Group × (Condition) mixed factorial analysis of variance was employed to compare mean difference of several stepping measures. These measures included within-trial variability (σ) and DFA exponents (α) of both stride parameters (L_n, T_n, S_n) and the speed GEM variables (δ_T, δ_P) across experimental conditions (NOF, POP, TAN, PER) and between OH and YH adults.

Correlation Analyses. Pearson correlations were conducted between both the assessment and stepping measures and overall stepping performance (% Green strides) in each experimental condition.

RESULTS

Physical Measures

OH adults exhibited no decrements in the physical measures (TUG, Normalized Knee Extension Strength) compared to YH adults (Figure 17). ***TUG.*** The mean TUG time (sec) for the OH adult group (M = 7.69; SD = 1.18) was not significantly different than the YH adult group (M = 7.07; SD = 0.98): $t(46) = -1.974$; p = 0.054 (two-tailed).

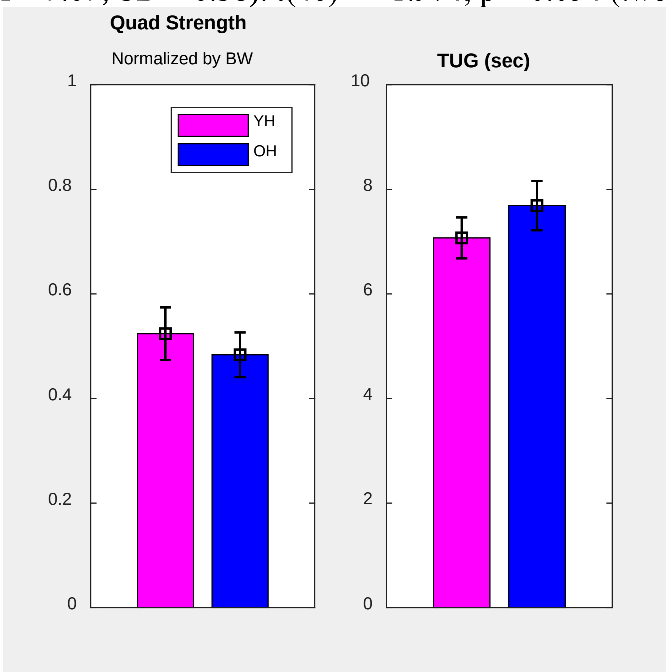


Figure 17. Physical Measures of TUG times (seconds) and normalized knee extension strength (non-dimensional). The group means for the YH and OH groups are depicted in magenta and blue bars respectively. Error bars are 95% Confidence Intervals for each mean. For TUG and Strength, group means were not significantly different between YH and OH.

Further, the TUG average times for both YH and OH adult groups were notably ≤12 seconds, the cut-off point for normal physical mobility (Bischoff et al. 2003, Bohannon 2006). ***Knee Extension Strength***. The mean normalized knee extension strength for the

OH adult group (M = 0.48; SD = 0.11) was not significantly different than that of the YH adult group (M = 0.52; SD = 0.13): $t(46) = -1.195$; $p = 0.238$ (two-tailed).

Cognitive Measures

Stroop Task. Older adults exhibited significant decrements in the EF Stroop measures compared to Young adults. The older adult group read significantly fewer words in all three Stroop Task (ST) conditions: Word (W), Color (C), and Color-Word (CW) conditions (Figure 18). The mean Stroop Word score for the OH adult group (M = 98.71; SD = 11.392) was significantly lower than that of the YH adult group (M = 112.17; SD = 15.339): $t(46) = 3.451$; $p < .01$ (two-tailed). The mean Stroop Color score for the OH adult group (M = 68.13; SD = 13.254) was significantly lower than that of the YH adult group (M = 83.25; SD = 13.342): $t(46) = 3.940$; $p < .01$ (two-tailed). The mean Stroop Color-Word score for the OH adult group (M = 36.17; SD = 8.686) was significantly lower than that of the YH adult group (M = 54.38; SD = 12.576): $t(46) = 5.836$; $p < .01$ (two-tailed).

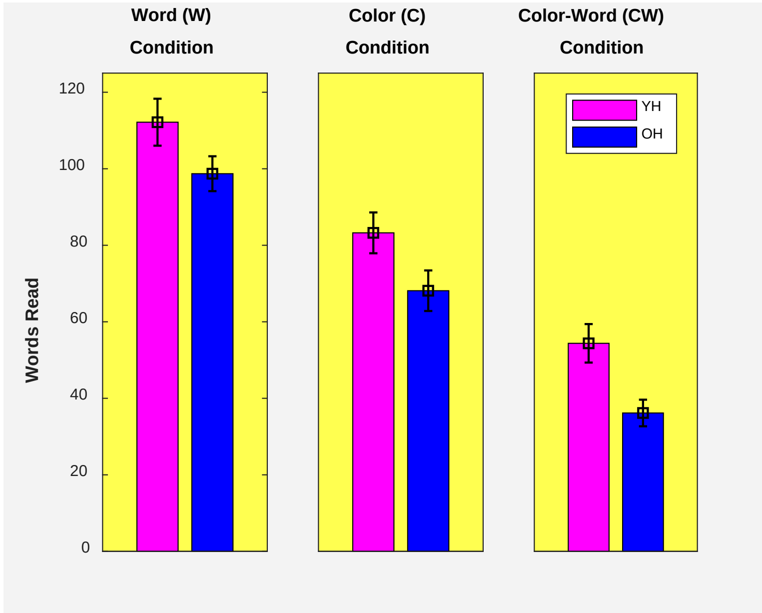


Figure 18. Words read during the Stroop interference conditions: Word (W), Color (C) and Color-Word (CW). The group means for the YH and OH groups are depicted in magenta and blue bars respectively. Error bars are 95% Confidence Intervals for each mean. Group means were significantly different between YH and OH across all three conditions. NOTE: The YELLOW backgrounds indicate significant group differences.

DMS. OH adults exhibited no performance differences in the DMS number of correct (match-to-sample) trials compared to YH adults, however significant longer Study Times and Retrieval Latencies were observed compared to YH adults (Figure 19). The mean number of correct DMS trials for the OH adult group (M = 26.63; SD = 2.700) was not significantly different than that of the YH adult group (M = 27.71; SD = 1.601): $t(46)$ =1.691; p = 0.099 (two-tailed).

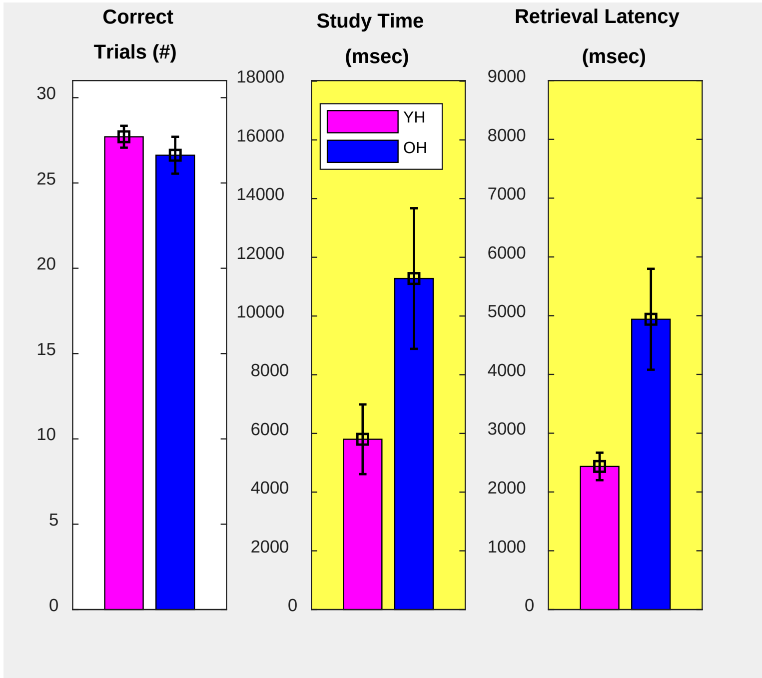


Figure 19. Number of correct (match-to-sample) trials, and the average Study Time and Retrieval Latency during these trials in the DMS task. The group means for the YH and OH groups are depicted in magenta and blue bars respectively. Error bars are 95% Confidence Intervals for each mean. Group means were significantly different between YH and OH for Study Time and Retrieval latency; however, no group mean difference was observed in Number of correct (match-to-sample) trials. NOTE: The YELLOW backgrounds indicate significant group differences.

However, the mean study time (msec) for the OH adult group (M = 11276.54; SD = 5988.29 msec) was significantly greater than that of the YH adult group (M = 5800.47; SD = 2966.99): $t(46) = -4.014$; $p < .01$ (two-tailed). Further, the mean Retrieval Latency (msec) for the OH adult group (M = 4938.70; SD = 2145.63) was significantly more than that of the YH adult group (M = 2434.88; SD = 583.88): $t(46) = -5.516$; $p < .01$ (two-tailed).

PVT. OH adults exhibited no performance differences in the attentional PVT measures compared to YH adults (data are not plotted). The mean PVT reaction time (msec) for the OH adult group (M = 405.46; SD = 43.1) was not significantly different than that of the YH adult group (M = 387.27; SD = 40.6): $t(46) = -1.505$; $p = 0.139$ (two-tailed). The standard deviation of PVT reaction time (msec) for the OH adult group (M = 82.68; SD = 58.8) was not significantly different than that of the YH adult group (M = 79.25; SD = 47.9): $t(46) = -0.221$; $p = 0.826$ (two-tailed). Further, the number of lapse PVT trials for the OH adult group (M = 2.8; SD = 4.4) was not significantly different than that of the YH adult group (M = 2.5; SD = 2.8): $t(46) = -0.274$; $p = 0.785$ (two-tailed).

Overall Stepping Performance

Stepping performance (% of Green, Yellow, and Red strides) varied across the three experimental conditions (POP, TAN, and PER; Figure 20).

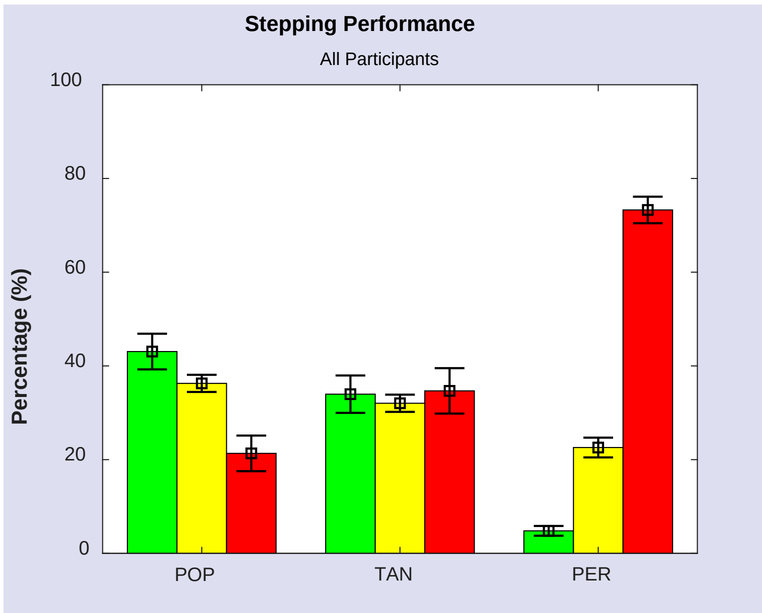


Figure 20. Descriptive statistics of stepping performance (of all participants) presenting percent of Green strides, Yellow strides, and Red strides. The green, yellow, and red bars represent the mean percent of Green, Yellow, and Red strides attained respectively in each experimental condition: POP, TAN, and PER. The error bars are 95% confidence intervals for each mean.

For Percentage of Green Strides, within-subject effects results from a 2-factor Age Group × (Condition) mixed factorial ANOVA indicated the Condition factor was significant: $F(2,92) = 143.282$; $p < .01$. Partial eta squared =.757. There was a significant interaction between Condition and Age Group: $F(2,92) = 7.193$; $p < .01$. Partial eta squared =.135. Additionally, the average Green Strides Percent for YH and OH Adult groups differed significantly: $F(1,46) = 31.234$; $p < .01$. Partial eta squared =.404.

The simple main effects of the between factor (Age Group) at each level of the within factor (Condition) indicated OH participants demonstrated decreased stepping performance compared to YH adults across all three conditions (Figure 21).

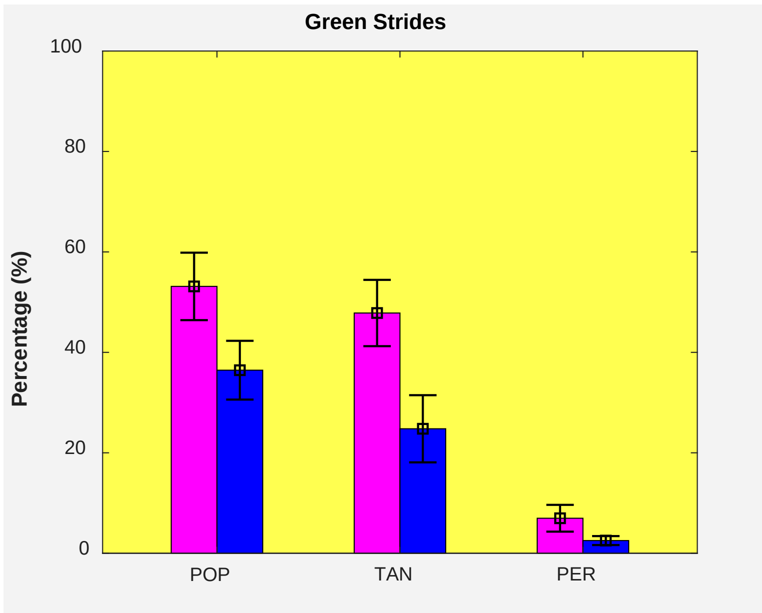


Figure 21. Percentage of Green Strides in Trial 2 for Young healthy adults (YH, the magenta bars) and Older healthy adults (OH, the blue bars). The average Green Strides (%) attained for Older Adult group was significantly less than Young Adult group across all three experimental conditions. NOTE: The YELLOW background indicates significant group differences.

Stride Parameters: L_n, T_n, S_n

The Age Group × (Condition) mixed factorial ANOVA results for L_n, T_n, and S_n (standard deviations and DFA scaling exponents) are described in Table 2.

Within-trial Variability. Standard deviations of L_n ($F_{(3,138)} = 20.447$; $p < 0.01$) and T_n ($F_{(4,76)} = 18.177$; $p < 0.01$) differed significantly across conditions. Post-hoc analyses indicated that during both TAN and PER, participants exhibited increased variability in L_n and T_n (Figure 22) compared to the NOF and POP conditions. Further, standard deviations of S_n ($F_{(3,138)} = 40.925$; $p < 0.01$) differed significantly across conditions. During PER, increased variability was observed in S_n (Figure 22) compared to NOF, POP and TAN. The simple main effect of Age Group in the NOF condition indicated no difference in standard deviations of S_n. However, significant differences in standard deviations of S_n were observed in POP, TAN, and PER between YH and OH adults (Figure 22).

DFA scaling exponents. DFA α's of L_n ($F_{(3,138)} = 7.793$; $p < 0.01$), T_n ($F_{(3,138)} = 6.495$; $p < 0.01$), and S_n ($F_{(3,138)} = 3.754$; $p < 0.05$) differed significantly across conditions. In the TAN condition, participants exhibited significantly greater statistical persistence in L_n, compared to the POP and PER conditions ($p < 0.05$); and significantly greater statistical persistence in T_n compared to POP ($p < 0.01$). For S_n, participants exhibited significantly greater statistical anti-persistence in PER compared to TAN ($p < 0.05$, Figure 22). DFA α's of L_n, T_n, and S_n did not differ significantly between YH and OH adults (Table 2).

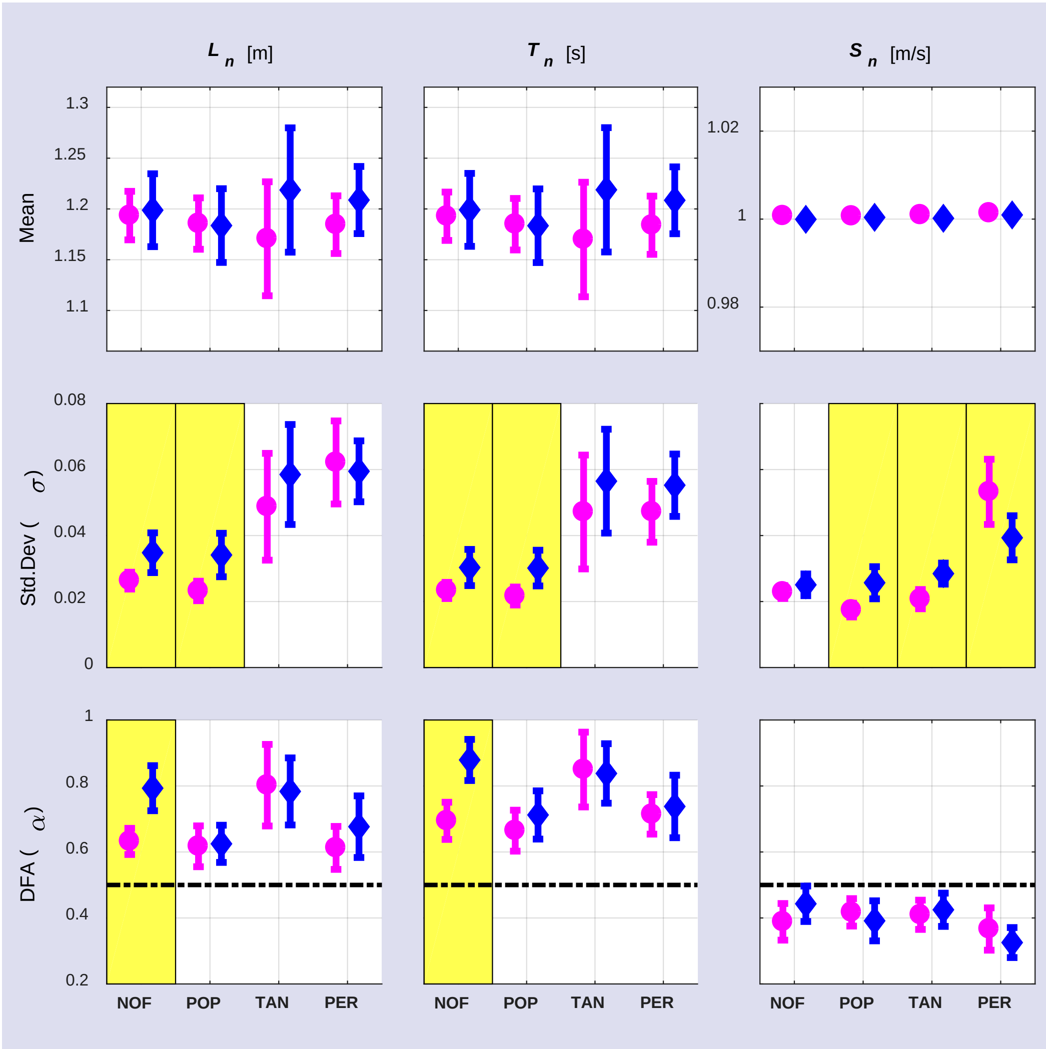


Figure 22. Means for stride lengths (L_n), times (T_n), and speeds (S_n) during each of the four conditions (NOF, POP, TAN and PER). Variability (within-trial standard deviations: σ) for L_n, T_n, and S_n during all conditions. DFA scaling exponents (α) for L_n, T_n, and S_n during all conditions. The group means for the YH and OH groups are depicted in magenta and blue symbols respectively. Error bars are 95% Confidence Intervals for each mean. NOTE: The YELLOW backgrounds indicate significant group differences. The SPSS outputs for these analyses are included in Appendix D.

Table 2. Statistical Results from Age Group × (Condition) Mixed Factorial ANOVA

Variable	Factor Type	Effect	F	p-value	Partial Eta Squared
VARIABILITY					
***L_n* (σ)**	**Within-Subject**	**Condition**	*F*(3,138) = 20.447	**p<.01**	.308
	Interaction		*F*(3,138) = .765	p = 0.515	.016
	Between-Subject	Age Group	*F*(1, 46) = 2.836	p = 0.099	.058
	Simple Main Effect of Group in **NOF**		*F*(1, 46) = 6.41	p = 0.015	
	Simple Main Effect of Group in **POP**		*F*(1, 46) = 8.74	p = 0.005	
	Simple Main Effect of Group in TAN		*F*(1, 46) = 0.75	p = 0.392	
	Simple Main Effect of Group in PER		*F*(1, 46) = 0.11	p = 0.737	
***T_n* (σ)**	**Within-Subject**	**Condition**	*F*(3,138) = 18.177	**p<.01**	.283
	Interaction		*F*(3,138) = .021	p = 0.996	.000
	Between-Subject	Age Group	*F*(1, 46) = 4.016	p = 0.051	.080
	Simple Main Effect of Group in **NOF**		*F*(1, 46) = 5.15	p = 0.028	
	Simple Main Effect of Group in **POP**		*F*(1, 46) = 7.49	p = 0.009	
	Simple Main Effect of Group in TAN		*F*(1, 46) = 0.62	p = 0.437	
	Simple Main Effect of Group in PER		*F*(1, 46) = 1.43	p = 0.238	
***S_n* (σ)**	**Within-Subject**	**Condition**	*F*(3,138) = 40.925	**p<.01**	.471
	Interaction		*F*(3,138) = 8.273	**p<.01**	.152
	Between-Subject	Age Group	*F*(1, 46) = .328	p = 0.569	.007
	Simple Main Effect of Group in NOF		*F*(1, 46) = 1.26	p = 0.268	
	Simple Main Effect of Group in **POP**		*F*(1, 46) = 9.37	p = 0.004	
	Simple Main Effect of Group in **TAN**		*F*(1, 46) = 12.31	p = 0.001	
	Simple Main Effect of Group in **PER**		*F*(1, 46) = 5.23	p = 0.027	
DFA					
***L_n* (α)**	**Within-Subject**	**Condition**	*F*(3,138) = 7.793	**p<.01**	.145
	Interaction		*F*(3,138) = 2.075	p = 0.106	.043
	Between-Subject	Age Group	*F*(1, 46) = 2.674	p =0 .109	.055
	Simple Main Effect of Group in **NOF**		*F*(1, 46) = 16.02	p = 0.000	
	Simple Main Effect of Group in POP		*F*(1, 46) = 0.03	p = 0.861	
	Simple Main Effect of Group in TAN		*F*(1, 46) = 0.05	p = 0.818	
	Simple Main Effect of Group in PER		*F*(1, 46) = 1.23	p = 0.274	
***T_n* (α)**	**Within-Subject**	**Condition**	*F*(3,138) = 6.495	**p<.01**	.124
	Interaction		*F*(3,138) = 2.558	p = 0.058	.053
	Between-Subject	Age Group	*F*(1, 46) = 3.452	p = 0.07	.070
	Simple Main Effect of Group in **NOF**		*F*(1, 46) = 18.51	p = 0.000	
	Simple Main Effect of Group in POP		*F*(1, 46) = 0.95	p = 0.336	
	Simple Main Effect of Group in TAN		*F*(1, 46) = 0.03	p = 0.874	
	Simple Main Effect of Group in PER		*F*(1, 46) = 0.18	p = 0.676	

Table 2 continued

DFA					
S_n (α)	**Within-Subject**	**Condition**	F(3,138) = 3.754	**p<.05**	.075
	Interaction		F(3,138) = 1.534	p = 0.208	.032
	Between-Subject	Age Group	F(1, 46) = 0.001	p = 0.973	.000
	Simple Main Effect of Group in NOF		F(1, 46) = 1.93	p = 0.172	
	Simple Main Effect of Group in **POP**		F(1, 46) = 0.47	p = 0.497	
	Simple Main Effect of Group in **TAN**		F(1, 46) = 0.20	p = 0.659	
	Simple Main Effect of Group in **PER**		F(1, 46) = 1.05	p = 0.312	

Speed GEM Variables: δ_T, δ_P

The Age Group × (Condition) mixed factorial ANOVA results for each Speed GEM variable are described in Table 3.

Within-trial Variability. Standard deviations of δ_T ($F_{(3,138)}$ = 17.166; p < 0.01) and δ_P ($F_{(3,138)}$ = 41.079; p < 0.01) differed significantly across conditions. However, for variability in δ_T, post-hoc analyses indicated that participants exhibited no difference in variability between the NOF and POP conditions (Figure 23). During PER, increased δ_P variability was observed compared to NOF, POP and TAN. The simple main effect of Age Group in the NOF and PER conditions indicated no difference in standard deviations of δ_P (p = 0.287 and p = 0.057). However, significant differences in standard deviations of δ_P were observed in POP and TAN between YH and OH adults (p <0.01, Figure 23).

DFA scaling exponents. DFA α's of δ_T ($F_{(3,138)}$ = 6.762; p < 0.01) and δ_P ($F_{(3,138)}$ = 4.036; p < 0.01) differed significantly across conditions. In the POP condition, participants exhibited significantly greater statistical anti-persistence in δ_T, compared to the NOF and TAN conditions (p < 0.05). For δ_P, participants exhibited significantly greater statistical anti-persistence in PER compared to TAN (p < 0.05, Figure 23). DFA α's of δ_T and δ_P did not differ significantly between YH and OH adults (Table 3).

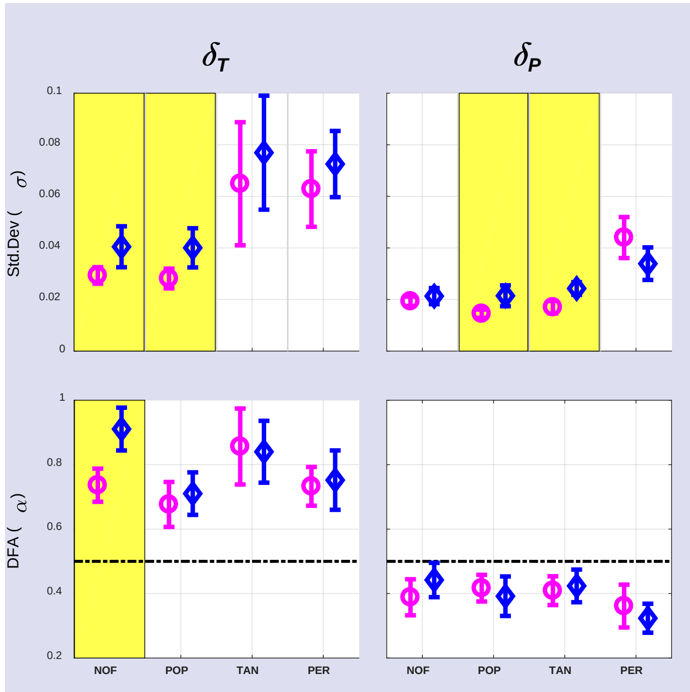


Figure 23. Variability (σ) and Statistical Persistence (α) of both δ_T and δ_P deviations. Within-trial stride-to-stride variability (standard deviations: σ) exhibited during each experimental condition (NOF, POP, TAN and PER). DFA scaling exponents (α) exhibited during each condition. Error bars are 95% Confidence Intervals of each mean. NOTE: The YELLOW backgrounds indicate significant group differences. The SPSS outputs for these analyses are included in Appendix D.

Table 3. Statistical Results from Age Group × (Condition) Mixed Factorial ANOVA

Variable	Factor Type	Effect	F	p-value	Partial Eta Squared
VARIABILITY					
δ_T (σ)	**Within-Subject**	**Condition**	*F*(3,138) = 17.17	**p<.01**	.272
	Interaction		*F*(3,138) = .012	p = 0.998	.000
	Between-Subject	Age Group	*F*(1, 46) = 3.904	p = 0.054	.078
	Simple Main Effect of Group in **NOF**		*F*(1, 46) = 6.48	p = 0.014	
	Simple Main Effect of Group in **POP**		*F*(1, 46) = 7.52	p = 0.009	
	Simple Main Effect of Group in TAN		*F*(1, 46) = 0.53	p = 0.472	
	Simple Main Effect of Group in PER		*F*(1, 46) = 0.95	p = 0.334	
δ_P (σ)	**Within-Subject**	**Condition**	*F*(3,138) = 41.08	**p<.01**	.472
	Interaction		*F*(3,138) = 7.167	**p<.01**	.135
	Between-Subject	Age Group	*F*(1, 46) = 0.875	p = 0.354	.019
	Simple Main Effect of Group in NOF		*F*(1, 46) = 1.16	p = 0.287	
	Simple Main Effect of Group in **POP**		*F*(1, 46) = 9.78	p = 0.003	
	Simple Main Effect of Group in **TAN**		*F*(1, 46) = 17.26	p = 0.000	
	Simple Main Effect of Group in PER		*F*(1, 46) = 3.82	p = 0.057	
DFA					
δ_T (α)	**Within-Subject**	**Condition**	*F*(3,138) = 6.762	**p<.01**	.128
	Interaction		*F*(3,138) = 2.307	p = 0.079	.048
	Between-Subject	Age Group	*F*(1, 46) = 2.599	p = 0.114	.053
	Simple Main Effect of Group in **NOF**		*F*(1, 46) = 16.55	p = 0.000	
	Simple Main Effect of Group in POP		*F*(1, 46) = 0.47	p = 0.496	
	Simple Main Effect of Group in TAN		*F*(1, 46) = 0.04	p = 0.834	
	Simple Main Effect of Group in PER		*F*(1, 46) = 0.12	p = 0.733	
δ_P (α)	**Within-Subject**	**Condition**	*F*(3,138) = 4.036	**p<.01**	.081
	Interaction		*F*(3,138) = 1.392	p = 0.248	.029
	Between-Subject	Age Group	*F*(1, 46) = 0.004	p = 0.951	.000
	Simple Main Effect of Group in NOF		*F*(1, 46) = 1.85	p = 0.180	
	Simple Main Effect of Group in POP		*F*(1, 46) = 0.44	p = 0.512	
	Simple Main Effect of Group in TAN		*F*(1, 46) = 0.18	p = 0.671	
	Simple Main Effect of Group in PER		*F*(1, 46) = 0.85	p = 0.361	

Correlational Analyses - *Assessment Measures*

No significant Pearson's correlation coefficients were found between Normalized Knee Extension Strength ("NStrength") with % Green strides during the POP, TAN, or PER conditions (Table 4). However, a significant correlation *r*(48) = -.310; p < .05 (effect size r^2 = .096, a Small effect) was found between TUG (Table 4) and % Green strides in the TAN condition ("Green Percent TAN2"). TUG and Normalized Knee Extension Strength ("NStrength") were not significantly correlated with each other and suggest these measures quantify different aspects of physical capacity of the healthy adult participants.

Table 4. Correlation Coefficients Between the Physical Assessments and Percent of Green Strides (Overall Stepping Performance)

		TUG	NStrength	Green Percent POP2	Green Percent TAN2	Green Percent PER2
TUG	Pearson Correlation	1	-.324*	-0.119	-.310*	-0.093
	Sig. (2-tailed)		0.025	0.422	0.032	0.531
	N	48	48	48	48	48
NStrength	Pearson Correlation	-.324*	1	0.070	0.165	0.197
	Sig. (2-tailed)	0.025		0.638	0.263	0.180
	N	48	48	48	48	48

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Significant correlations were found between the Stroop Word and Color conditions with % Green strides in POP, TAN, and PER (small to medium effect sizes, Table 5). For the Stroop Color-Word condition, significant correlations with % Green strides in POP and TAN (not PER) were found (medium effect sizes, Table 5).

Table 5. Correlation Coefficients Between Stroop Task Conditions and Percent of Green Strides (Overall Stepping Performance)

		Stroop Word	Stroop Color	Stroop ColorWord	Green Percent POP2	Green Percent TAN2	Green Percent PER2
Stroop Word	Pearson Correlation	1	.734**	.738**	.423**	.361*	.300*
	Sig. (2-tailed)		0.000	0.000	0.003	0.012	0.038
	N	48	48	48	48	48	48
Stroop Color	Pearson Correlation	.734**	1	.815**	.451**	.352*	.288*
	Sig. (2-tailed)	0.000		0.000	0.001	0.014	0.047
	N	48	48	48	48	48	48
Stroop ColorWord	Pearson Correlation	.738**	.815**	1	.438**	.513**	0.259
	Sig. (2-tailed)	0.000	0.000		0.002	0.000	0.075
	N	48	48	48	48	48	48

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Significant correlations were found between the DMS Correct Trials and DMS Retrieval Latency with % Green strides in TAN (medium effect sizes, Table 6).

Table 6. Correlation Coefficients Between DMS Measures and Percent of Green Strides (Overall Stepping Performance)

		DMS Correct	DMS Correct Study Time	DMS Correct Retrieval Latency	Green Percent POP2	Green Percent TAN2	Green Percent PER2
DMS Correct	Pearson Correlation	1	-0.024	-0.197	0.247	.381**	0.100
	Sig. (2-tailed)		0.871	0.180	0.091	0.008	0.499
	N	48	48	48	48	48	48
DMS Correct StudyTime	Pearson Correlation	-0.024	1	.828**	-0.119	-0.230	-0.165
	Sig. (2-tailed)	0.871		0.000	0.422	0.115	0.261
	N	48	48	48	48	48	48
DMS Correct Retrieval Latency	Pearson Correlation	-0.197	.828**	1	-0.199	-.442**	-0.214
	Sig. (2-tailed)	0.180	0.000		0.175	0.002	0.145
	N	48	48	48	48	48	48

**. Correlation is significant at the 0.01 level (2-tailed).

No significant Pearson's correlation coefficients were found between PVT Standard Deviation of Reaction Time or number of PVT Lapse trials with % Green strides during the POP, TAN, or PER conditions (Table not shown). However, a significant correlation $r(48) = -.299$; $p < .05$ (effect size $r^2 = .089$, a Small effect) was found between PVT Mean Reaction Time and % Green strides in the TAN condition.

<u>Correlational Analyses</u> – *Variability with respect to the Speed-GEM*

In the POP condition, better overall stepping performance (% Green strides) was associated with reduced δ_P variability: $r(48) = -0.659$; $p < .01$ (effect size $r^2 = .43$, a Large effect) and δ_T variability: $r(48) = -0.711$ $p < .01$ (effect size $r^2 = .51$, a Large effect). In the TAN condition, better overall stepping performance (% Green strides) was associated with reduced δ_P variability: $r(48) = -0.827$; $p < .01$ (effect size $r^2 = .68$, a Large effect) and δ_T variability: $r(48) = -0.499$ $p < .01$ (effect size $r^2 = .25$, a Medium effect). In the PER condition, better overall stepping performance (% Green strides) was associated with increased δ_P variability: $r(48) = +0.678$; $p < .01$ (effect size $r^2 = .46$, a Large effect) and increased statistical anti-persistence of δ_T: $r(48) = -0.295$ $p < .05$ (effect size $r^2 = .09$, a Small effect). Correlations between % Green strides and variability and statistical persistence of the speed GEM variables during the NOF condition are also presented (Table 7). The data for the within-trial δ_P variability and % Green strides attained during the TAN and PER conditions are depicted in Figure 24.

Table 7. Correlation Coefficients Between Percent of Green Strides (Overall Stepping Performance) and the variability and DFA exponents of the speed GEM variables during the particular condition and the NOF condition.

POP		SD δ_P POP2	SD δ_P NOF2	SD δ_T POP2	SD δ_T NOF2	DFA δP POP2	DFA δP NOF2	DFA δT POP2	DFA δT NOF2
Green Percent POP2	Pearson Correlation	-.659**	-0.269	-.711**	-.288*	0.230	0.051	-0.126	-0.068
	Sig. (2-tailed)	0.000	0.065	0.000	0.047	0.115	0.729	0.392	0.646
	N	48	48	48	48	48	48	48	48

TAN		SD δ_P TAN2	SD δ_P NOF2	SD δ_T TAN2	SD δ_T NOF2	DFA δP TAN2	DFA δP NOF2	DFA δT TAN2	DFA δT NOF2
Green Percent TAN2	Pearson Correlation	-.827**	-0.032	-.499**	-.419**	0.231	0.156	-0.173	-.301*
	Sig. (2-tailed)	0.000	0.827	0.000	0.003	0.114	0.290	0.240	0.037
	N	48	48	48	48	48	48	48	48

PER		SD δ_P PER2	SD δ_P NOF2	SD δ_T PER2	SD δ_T NOF2	DFA δP PER2	DFA δP NOF2	DFA δT PER2	DFA δT NOF2
Green Percent PER2	Pearson Correlation	.678**	-0.148	-0.096	-0.099	0.076	-0.107	-.295*	-0.155
	Sig. (2-tailed)	0.000	0.315	0.515	0.505	0.608	0.469	0.042	0.293
	N	48	48	48	48	48	48	48	48

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

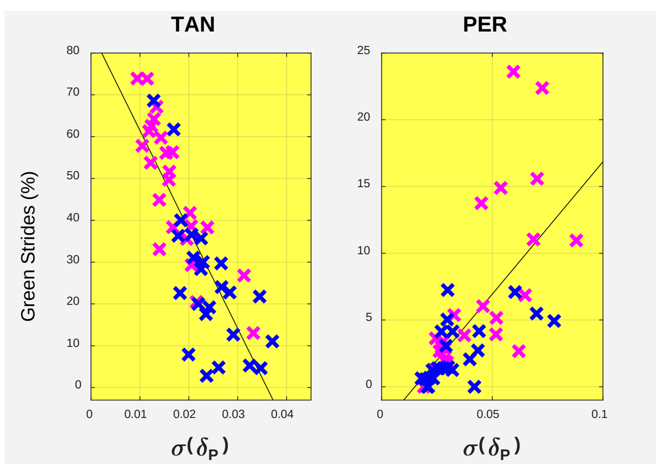


Figure 24. Variability of GEM-relevant direction δ_P and Percent of Green Strides in the TAN and PER conditions. The YH and OH data are depicted as magenta and blue x symbols respectively. NOTE: The YELLOW backgrounds indicate significant correlations.

DISCUSSION

No significant differences were observed in physical assessments of TUG times and normalized knee extension strength. For TUG times, both YH and OH groups exhibited mean TUG times < 10 seconds, indicating high-functional mobility (Bischoff et al. 2003). However, the OH adults exhibited decrements in EF measures of response inhibition and working memory compared to the YH adults. In the DMS (working memory) task, although no differences were observed in number of correct match-to-sample trials between YH and OH adults, OH adults exhibited longer study times of the original stimulus and retrieval latencies when choosing between the "match" and "not-match" stimuli respectively compared to YH adults. This suggests the OH adults required more time to potentially store the visual information *and* retrieve this information when prompted. In the Stroop Interference (response inhibition) task, OH adults read fewer words in the incongruent Color-Word condition compared to YH adults. This result indicated the OH adult group exhibited poorer response inhibition compared to the YH adult group. Altogether, these results suggest the OH adult group was physically high-functioning, but they exhibited EF decrements (Zelazo et al. 2004) compared to the YH group.

During the stepping task, we introduced *competing* step goals that directly competed with the implicit goals to maintain the preferred stepping pattern (stay at the POP) or maintain speed (stay on the speed GEM). The OH adult group demonstrated decreased stepping performance (% Green strides) compared to the young adult group across all three experimental conditions. Considering the stepping task required participants to (a) utilize visual and auditory feedback (of their last five strides) to modify their stepping movements, (b) stay focused on the step goals for three minutes per trial, and (c) inhibit an inclination to step at their POP and/or stay on the speed GEM, we anticipated working memory, attention, and response inhibition respectively would be significantly associated to better overall stepping performance (% Green strides). During the TAN condition, in which the step goals were introduced to move away from the POP along the speed GEM, better stepping performance was significantly associated to more words read during the incongruent Stroop Color-Word condition (r = +0.513) and faster DMS retrieval latencies (r = -0.442). Both EF measures that differentiated the OH and YH adult groups. However, in the PER condition, in which the step goals were introduced to move away from the POP perpendicular to the speed GEM, minimal associations were observed between better stepping performance and the EF measures.

Analyses of *how* participants modified their stepping to accommodate the competing step goals indicated within-trial variability (δ_T, δ_P) was a major contributor to overall stepping performance. During POP, better overall stepping performance (% Green strides) was significantly associated with decreased within-trial variability both *along* (r = -0.711) and *perpendicular* to the speed GEM (r = -0.659). Similarly, during TAN, better overall stepping performance (% Green strides) was significantly associated with decreased within-trial variability both *along* (r = -0.499) and *perpendicular* to the speed GEM (r = -0.827). Alternatively, during PER, better stepping performance (% Green strides) was significantly associated with greater within-trial variability *perpendicular* to the speed GEM (r = +0.678) and (to a small extent) greater statistical anti-persistence *along* the speed GEM (r = -0.295). Notably, these results indicate both decreased and greater within-trial "goal-relevant" (δ_P) variability was significantly associated with better stepping performance during TAN and PER respectively.

Between groups, the OH adult group demonstrated greater "goal-relevant" variability compared to YH adult group during POP and TAN. However, during PER, although there was a trend towards a group difference in "goal-relevant" variability between YH and OH (p = 0.057), this simple main effect did not reach significance. In comparison, during normal treadmill walking (the NOF condition), no difference in "goal-relevant" variability was observed between YH and OH adults. Altogether, the within-trial variability differences suggest YH adult group manipulated their variability to improve their stepping performance during POP and TAN, and the OH adult group did not. Future studies should consider whether ability to *manipulate* stepping variability in these type of contexts is a physical or cognitive decrement. Further, if this ability is a physical decrement, why is it not captured in TUG and knee extension strength measures.

Chapter 4: Study 2

HOW YOUNG AND OLDER HEALTHY ADULTS NEGOTIATE VIRTUAL TARGET AND OBSTACLE DURING A GO-NOGO STEPPING TASK

INTRODUCTION

Executive function (EF) is a domain of cognition that includes skills necessary for deliberate behavior (Zelazo et al. 2004). Behavior that is focused on modifying an on-going plan when a situation requires novel action (Norman and Shallice 1986). During everyday walking, humans often encounter constrained spaces, obstacles (fixed or moving), etc. (Helbing and Molnar 1998, Helbing et al. 2001) and must modify their stepping to negotiate these circumstances. Harmful physical consequences (e.g. collision, loss of balance) may occur when humans are unable to make rapid decisions in such complex environments. Mounting evidence indicates that the significant declines in cognitive function (particularly EF) experienced by older adults (Zelazo et al. 2004), affect motor performance (Ble et al. 2005, Yogev et al. 2005, Coppin et al. 2006, Holtzer et al. 2006, Springer et al. 2006), and are directly associated with increased fall risk (Anstey et al. 2006, Anstey et al. 2009, Herman et al. 2010, Mirelman et al. 2012).

Notably, early changes in *attention* and *response inhibition* have been linked to future fall risk (Anstey et al. 2009, Mirelman et al. 2012). Attention refers to the ability to recognize and attend to a stimulus (Parasuraman and Yantis 1998). Response inhibition refers to the ability to suppress automatic response to a stimulus (Nigg 2000). Fallers performed more poorly in both attention and response inhibition tasks than healthy controls (Hausdorff et al. 2006), and older adults with the lowest response inhibition scores were more likely to fall sooner and become multiple fallers (Mirelman et al. 2012).

Moreover, Study 1 (Chapter 3) identified significant decrements in response inhibition (quantified with the Stroop Interference task) between older adults (60+ years) and young adults (18-29 years) that were also significantly associated to overall stepping performance when step goals required active modification of their stepping.

In this study, we sought to challenge normal walking by introducing *virtual* targets and obstacles during treadmill walking. Our aim was to assess response inhibition abilities in the same way as a computer "Go-NoGo" (GNG) paradigm.

PRELIMINARY STUDIES

Considering the links between declines response inhibition and general fall risk, recent research has sought to develop stepping tasks that incorporate essential EF processes within the walking task itself (Alexander et al. 2005, Yamada et al. 2011, Perrochon et al. 2015, Potocanac et al. 2015, Caetano et al. 2016, Pizano et al. 2017). However, many of these past studies included relatively short over-ground walking distances and scenarios in which all the virtual stepping objects were visible from the trial start (Alexander et al. 2005, Yamada et al. 2011). Therefore, these stepping paradigms did not challenge either the limits of attention (i.e. sustained focus), or require participants to actively inhibit on-going step responses to respond to *unexpected* targets or obstacles.

Stroop interference performance (a standard measure of EF) and simple reaction time discriminated participants who did and did not make stepping errors (Caetano et al. 2016) in a 6-meter over-ground stepping paradigm. This stepping task required older adults to navigate virtual targets or obstacles that appeared ahead of them on the walking path. However, only a *single* virtual stepping object was introduced in each walking trial. Potentially due to this, only eleven older adults (out of 50 older adult participants) made a stepping error, while none of the younger adults (21 participants) made as stepping error. This suggests this stepping paradigm may not have challenged most of the participants. Further, due to the single virtual stepping object design, the impact of multiple target-to-obstacle, etc. sequences on quantity of stepping errors was not examined.

This experiment introduced both *virtual* stepping targets and obstacles during treadmill walking, specifically constructed to challenge young and older participants to actively modify their stepping. Our intention was to assess response inhibition in the same way as the standard "Go-NoGo" (GNG) paradigm (Bezdjian et al. 2009). In the standard GNG task, a specific motor response (e.g. press a key) is either executed or inhibited. In our stepping GNG task, an individual either stepped on or avoided a *virtual* stepping object. Two stepping conditions were implemented. Similar to previous inhibitory stepping tasks (Yamada et al. 2011, Potocanac et al. 2015, Caetano et al. 2016), we introduced a "stepping rule". The first condition was designed to accustom each participant to the specified stepping rule. The second condition was a reversal condition. In the reversal condition, the stepping rule was switched. This reversal condition is designed to challenge each participant's ability to inhibit the previously conditioned stepping response. In our GNG stepping task, this manipulation was focused on inhibiting a stepping response (i.e. avoiding a stepping object or "obstacle"). However, considering high fall risk older adults have exhibited decrements when avoiding obstacles *and* stepping on targets (Yamada et al. 2011), we examined both types of stepping errors across conditions.

Considering the previously observed Study 1 decrements in response inhibition, we hypothesized, (1) older adults would exhibit more stepping errors (inability to avoid an obstacle) compared to young adults in the reversal condition, as this condition would require the most inhibitory control. Further, as we were not simply interested in how an individual navigates a single virtual stepping object (target versus obstacle or "success" versus “failure”), but how they stepped from one target to another obstacle or vice versa (all while maintaining their balance), we also focused on Obstacle-to-Target and Target-to-Obstacle sequences. In these stepping sequences, we hypothesized (2) participants would exhibit more stepping errors while navigating the Obstacle-to-Target and Target-to-Obstacle transitions compared to Target-to-Target and Obstacle-to-Obstacle transitions respectively, as the former sequences would require active stepping *adjustments*. Lastly, we hypothesized, (3) better response inhibition capacities (in Stroop Interference task and a standard computer “Go-NoGo” paradigm) would be associated with fewer stepping errors during the GNG stepping task conditions across study participants.

INSTRUMENTS AND METHODS

Selection of Participants

This study was approved by Institutional Review Board at The University of Texas at Austin and all participants provided written informed consent prior to participation. Twenty-one young (19.9±2.6 years, YH) and twenty-one older (67.6±5.1 years, OH) healthy adults participated (Table 8). All participants were screened to ensure they have no history of serious cardiovascular, respiratory, visual, vestibular, neurological, or musculoskeletal problems that might directly interfere with their walking. Any individual who had experienced a fall in the previous year, or who is currently taking any medications that might adversely affect their walking were also excluded. Study participant characteristics (young and older healthy adult groups) are detailed in Table 8.

Table 8. Study 2 Participant Characteristics

		YH	OH	(two-tailed) p-value
Number of Participants		21	21	
Number of Females		12	15	
Age (years)	Mean	19.9	67.6	p < .01
	SD	2.6	5.1	
Body Mass (kg)	Mean	68.4	70.4	p = 0.592
	SD	12.3	12.0	
Height (m)	Mean	1.70	1.66	p = 0.091
	SD	0.10	0.06	
Resting HR (bpm)	Mean	65.6	69.1	p = 0.214
	SD	7.71	9.98	
MMSE	Mean	29.57	29.76	p = 0.349
	SD	0.746	0.539	
Icon-FES	Mean	12.57	13.10	p = 0.416
	SD	1.989	2.143	

Study Procedure

After (1) obtaining informed consent, each participant completed a series of assessments: (2) general assessments, (3) physical, and (4) executive function assessments, before continuing to the (5) treadmill stepping task (as depicted in Figure 25).

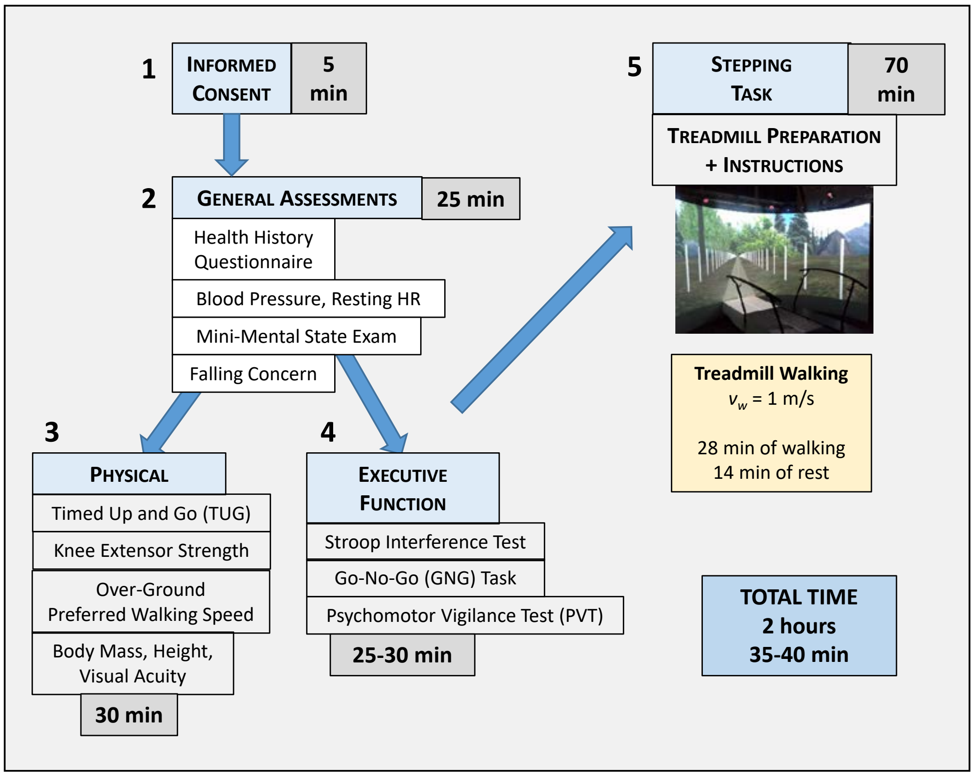


Figure 25. Study 2 Experimental Protocol. The study protocol included five section: Informed consent, general assessments, physical assessments, executive function assessments, and the treadmill stepping task. The protocol took approximately 2 hours and 35-40 minutes.

General Assessments

Each participant completed a Health History Questionnaire (Appendix B), and height, weight, and resting heart rate measurements were taken (Table 8). Following this, to screen assess general cognitive function and concern of falling the Mini-Mental State exam (MMSE) (Folstein et al. 1975) and the 10-item version of the Iconographical Falls Efficacy Scale (Icon-FES) (Delbaere et al. 2011) were administrated respectively. Descriptions of these two assessments were detailed in Chapter 3.

Assessment of Physical Capacity

Physical capacity was determined from three different assessments: Timed Up and Go (TUG), isometric knee extension strength test, and over-ground preferred walking speed (PWS). Descriptions of the TUG (Podsiadlo and Richardson 1991) and knee extension strength (Smidt 1984) assessments were detailed in Chapter 3.

Over-ground PWS. This test was used to assess the preferred walking speed of each participant, as walking speed is a measure of overall heath and associated to mortality (Studenski et al. 2011). A stopwatch was used to time the test (in seconds). Participants walked across 10 meters of level ground. The first three meters were given for acceleration, and the last three meters were given for deceleration. Only the middle four meters were timed. Each participant was instructed to walk to the other end of the course at their usual speed, just as if they were walking down the street to go to the store. Three trials were completed, and walking speed (meters per second) for each trial was recorded. The assessment outcome measure was the average walking speed across the three trials. The over-ground PWS assessment took less than 5 minutes.

Measurement of Executive Function

Executive function (in particular response inhibition) was quantified with three assessments: the Stroop Interference task, Go-NoGo (GNG) task, and Psychomotor Vigilance Task (PVT). Descriptions of the Stroop task (Stroop 1935) and PVT (Dinges and Powell 1985) were detailed in Chapter 3. The GNG and PVT were implemented with the Psychology Experiment Building Language (PEBL) program (Mueller and Piper 2014) and ran on a laptop. The PVT data were found to not be reliable as for practical reasons they had to be collected on two different laptops, which yielded somewhat different results for different participants. These data were therefore not analyzed further.

GNG. The Go-NoGo (GNG) task (Bezdjian et al. 2009) assesses response inhibition through a congruent condition (i.e., GoP condition) and a non-congruent or reversal condition (i.e., GoR condition). In both conditions, four squares were displayed (each with a star in the center) on the computer screen. A series of 'P's and 'R' appeared in one of the four squares. The instructions were displayed and indicated to the participant whether to respond to the letter 'P' or 'R'. The participant responded to a letter by pressing the right shift key. Specifically, in condition (1) GoP, the participant was instructed to hit the right shift key as quickly as possible when they saw the letter P in any one of the four squares on the screen and to not respond to the letter R. In condition (2) GoR, the participant was instructed to hit the right shift key as quickly as possible when they saw the letter R in any one of the four squares on the screen and to not respond to the letter P. In both conditions, the ratio of presentation of letter P to letter R was 3:1. Each condition began with a short practice period during which the participant was informed when they made an error. Outcome measures were Go Errors, NoGo Errors, mean and standard deviation of Response Times (RT) to the Go letter in each condition. During condition (1) GoP, Go Errors were response errors that occurred when the participant failed to respond to the letter P, and NoGo Errors were errors that occurred when the participant incorrectly responded to the letter R. During condition (2) GoR, Go Errors were errors that occurred when the participant failed to respond to the letter R, and NoGo Errors were errors that occurred when the participant incorrectly responded to the letter P. Fewer Go Errors represented better attentional ability and fewer NoGo Errors represented better inhibitory control. Shorter RTs (across both conditions) are typically representative of impulsivity. The GNG assessment took approximately 10 minutes.

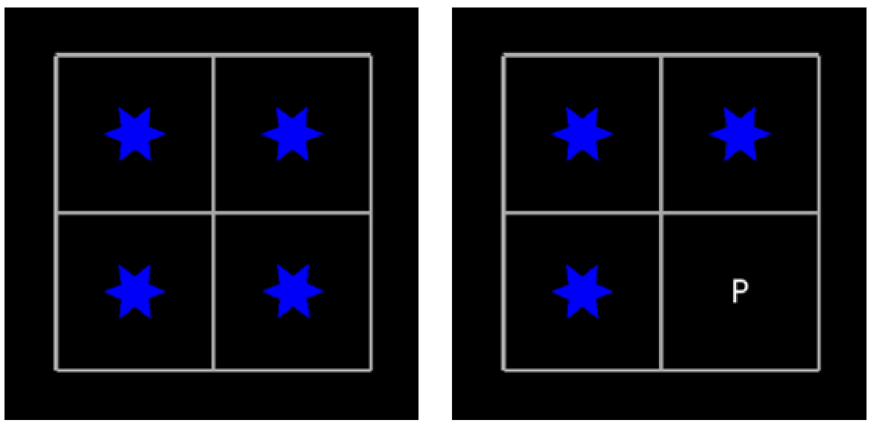


Figure 26. The GNG task consisted of a congruent condition (i.e., GoP condition) and a non-congruent condition (i.e., GoR condition). Four squares were displayed (each with a star in the center) on the computer screen. A series of ‘P’s and ‘R’ appeared in one of the four squares. The instructions were displayed and indicated to the participant whether to respond to the letter ‘P’ or ‘R’.

Stepping Treadmill Task

Participants walked on an instrumented “V-Gait” treadmill (Motekforce Link, Amsterdam, Netherlands). The V-Gait system consists of an instrumented dual-belt treadmill (1 × 2 meter) and a virtual reality (VR) scene projected onto a 3 meter tall 180° semi-cylindrical screen in front of the treadmill. During this study, *virtual* stepping objects were projected onto the treadmill walking surface. For all conditions and participants, the treadmill was set to a constant speed of v_w = 1 m/s (approximately 2.24 mph). A single fixed speed allowed us to directly examine stepping performance differences across participants. Further, as the stepping task conditions would require participants to modify their stepping to step on or avoid *virtual* stepping objects, we chose a walking speed that was expected to be comfortable during normal walking for both young and older adults.

Stepping Feedback: The auditory feedback was explained to each participant during the instructional period. To start, auditory feedback was provided at each virtual stepping object. Feedback included two positive auditory sounds. These positive sounds were played when a participant (i) successfully stepped on a “target” or (ii) cleared an “obstacle”. There was only one negative auditory sound. This sound was played either when a participant (iii) missed (stepping) on a “target”, or stepped on an “obstacle”. All three auditory sounds were played (as many times as requested) for each participant.

Training Period: After the auditory feedback was explained, each participant walked in a training period for approximately four minutes. This period included (a) one minute of normal walking (no virtual stepping objects were displayed), (b) two minutes of walking with *white* virtual stepping objects configured to be spaced at 0.6 meters apart (Figure 27), and (c) one minute of normal walking (no virtual stepping objects were displayed). Each participant was explained that virtual stepping objects would be projected onto the onto the treadmill walking surface during the acclimation period (so they could become comfortable with seeing them projected on the walking surface). However, that they were not required to step on or avoid these virtual stepping objects. No auditory stepping feedback was provided to the participant during the training period.

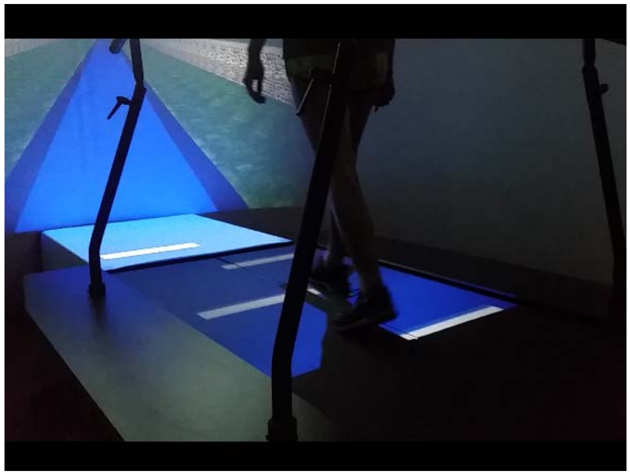


Figure 27. Virtual stepping objects during the Training Period. During the middle of the training period, white colored virtual objects were projected onto the walking surface. Participants were not required to step on or avoid these virtual stepping objects. The purpose of the training was to acclimate and familiarize each participant to the treadmill and the virtual stepping objects.

Experimental Conditions + Instructions: Each participant completed three walking conditions (Figure 28). During (1) condition NWalk (normal walking), no virtual projected objects were projected onto the treadmill walking space. Each virtual stepping object was 49 cm x 8 cm (length × width). Prior to this condition, each participant was instructed to "walk normally". This condition was used to determine their preferred step length (L_n /2) which was used as the distance between stepping objects in the next two conditions. During conditions (2-3), *virtual* stepping objects were projected onto the treadmill walking surface (Figure 28). During both conditions (2-3), 300 stepping objects were introduced in each walking trial. The distance between stepping objects was always fixed to their average step length (L_n /2). Therefore, the targets reinforced their preferred (average) step pattern, whereas the obstacles disrupted their preferred step pattern. Virtual stepping objects appeared approximately 2 steps ahead of the participant (Figure 28A). At the start of each condition, the instructions regarding the virtual objects were explained to each participant.

All participants completed the experimental conditions in the following order: (1) NWalk, (2) GoYel, and (3) GoRed.

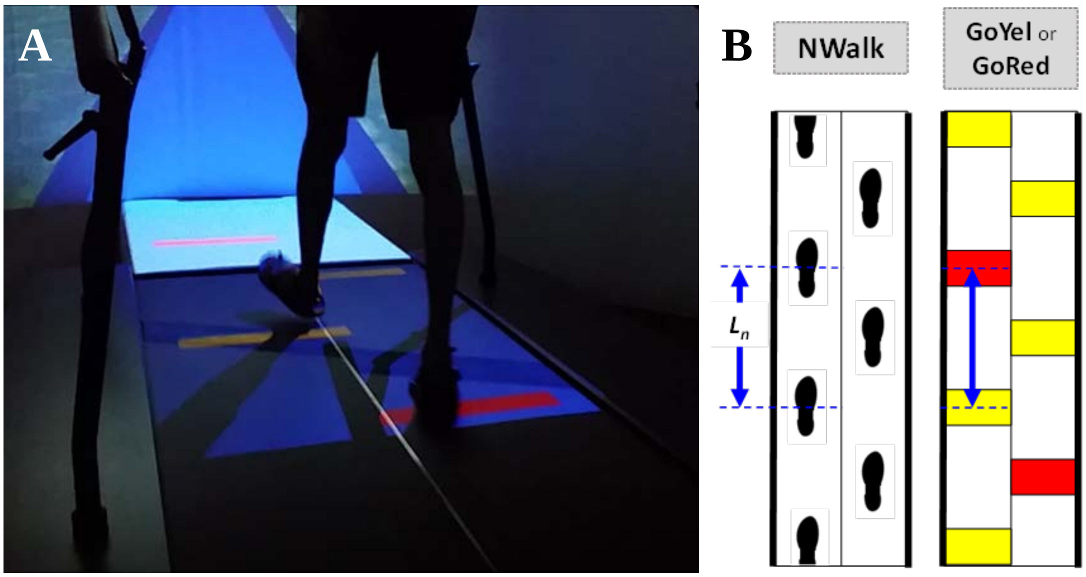


Figure 28. A) Participant walks in an experimental trial. Both yellow and red stepping objects are projected onto the treadmill walking space. B) Schematic of the experimental conditions (NWalk, GoYel and GoRed). In both GoYel and GoRed conditions, 80% of the stepping objects were yellow. Details about the order of obstacle-target objects can be found in Appendix E.

GoYel. During condition (2) GoYel, both *yellow* (targets) and *red* objects (obstacles) were projected onto the treadmill (Figure 28). Approximately 80% of the stepping objects were *yellow*. Each participant was instructed to "walk normally, (i) step on the *yellow* objects (targets), and (ii) avoid the *red* objects (obstacles)". The primary aim here was to accustom each participant to step on *yellow* objects (80% of the trial). The secondary aim was to examine how participants avoided the strategically placed fewer *red* objects (obstacles).

GoRed. The GoRed condition (reversal condition) switched the stepping rule (*red* objects became stepping targets and *yellow* objects became obstacles) to assess response inhibition as in a standardized "Go-NoGo" (GNG) paradigm. During (3) condition GoRed, both *yellow* (obstacles) and *red* (targets) objects were projected onto the treadmill walking space. Again, approximately 80% of the objects were *yellow*. Each participant was instructed to "walk normally, (i) step on the *red* objects (targets), and (ii) avoid the *yellow* objects (obstacles)". The primary aim was to examine how well participants inhibited the previously conditioned stepping response (step on *yellow* objects). The stepping rule required participants to inhibit this stepping response 80% of the trial. The secondary aim examined how participants stepped on the strategically placed fewer *red* objects (targets).

<u>Practice and Experimental Trials</u>: For (1) condition <u>NWalk</u>, each participant completed 2 trials of 3 minutes each at v_w = 1 m/s. For condition (2) <u>GoYel</u>, each participant completed 3 trials of 3 minutes each. Trial 1 was a speed-ramped trial in which the walking speed v_w was slowly increased from 0.5 m/s to 1 m/s over a period of 2 minutes. Both trials 2 and 3 were walked at a constant speed of v_w = 1 m/s. For condition (3) <u>GoRed</u>, each participant completed 2 trials of 3 minutes each at v_w = 1 m/s. Following condition (3), each participant repeated condition (1) <u>NWalk</u> trial for a single trial of 3 minutes. The sequence of targets and obstacles were different between trials 1 and 2 in each condition.

<u>Speed-Ramped GoYel Trial</u>: During early piloting, we found that although OH participants found the walking speed of 1 m/s to be comfortable for normal treadmill walking (NWalk), when the virtual stepping objects were introduced during GoYel, a majority of the older participants "stopped walking". As a result, the speed-ramped GoYel trial was introduced. This trial allowed for participants to slowly acclimate to the virtual stepping objects as the walking speed was slowly increased from 0.5 m/s to 1 m/s.

Stepping Data Analysis

An integrated 10-camera Vicon motion capture system (Oxford Metrics, Oxford, UK) was used to record movement kinematics. Kinematic data were recorded at 120 Hz using a 16-marker set marker data, including four markers on the head, four markers on the pelvis, and four markers on each foot. Raw kinematic data were processed using Vicon Nexus software (Oxford Metrics, Oxford, UK). Additional data reduction and analyses were performed using MATLAB (MathWorks, Inc., Natick, MA).

Three sequential sets of analyses were performed, each addressing different but relevant aspects of the questions addressed in this study.

Stepping Performance: This study's measures of overall performance were (1) stepping Go errors and NoGo errors exhibited in each walking trial. Stepping Go errors were stepping errors made when a participant did not step on a target. Stepping NoGo errors were stepping errors when a participant stepped on an obstacle. Further, these stepping error measures were converted into percentages dependent on the number of virtual stepping objects (targets or obstacles) that occurred during each trial.

As the GNG stepping task introduced targets and obstacles, we were not simply interested if a participant successfully navigated a single virtual stepping object (target or obstacle or simply success versus error), but *how* adults modify stepping with respect to the virtual stepping targets and obstacles. Therefore, the (2) anterior-posterior (AP) foot clearance at each virtual stepping object was quantified. To do this, two real markers on each foot, a *virtual* AP Foot center marker on each foot, and the AP center of the *virtual* stepping object were used (Figure 29A). First, the *virtual* AP Foot center (on each foot) was computed by averaging the two real markers on the foot, these markers were placed at the front and back of the foot (Figure 29A). Next, AP foot clearance was computed by subtracting the AP center of the *virtual* stepping object from the *virtual* AP Foot Center.

Lastly, this AP foot clearance was normalized by $C_N = \left[\frac{Object\ Width}{2} + \frac{Foot\ Length}{2}\right]$ (a unique distance for each participant, also depicted in Figure 29B).

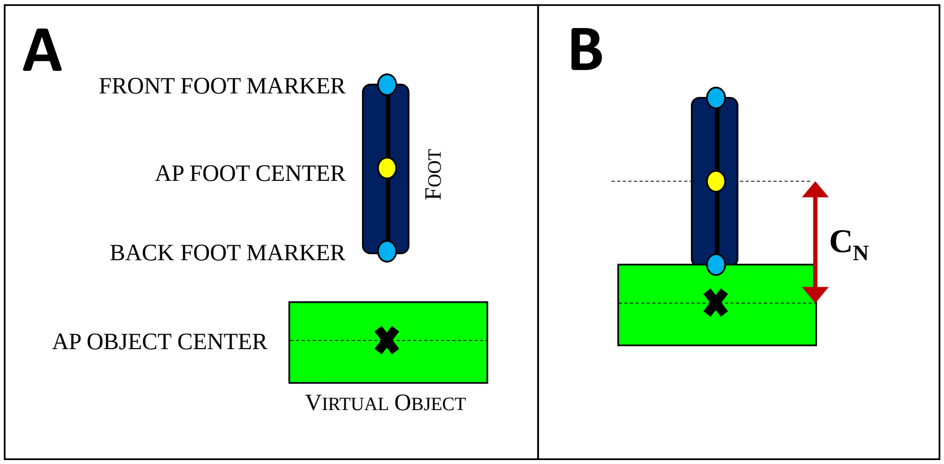


Figure 29. A) On each foot, two real markers (blue circles), a virtual AP Foot center marker (yellow circle), and the AP center of the virtual stepping object were used to compute AP Foot Clearance. B) The distance C_N was unique to each participant (dependent on their foot size) and was used to normalize the AP foot clearance data across participants.

This normalization is further depicted in Figure 30 in which three foot and *virtual* stepping object orientations for AP foot clearances of positive one (+1), zero (0), and negative one (-1), where the foot placement is at the anterior edge, center, and posterior edge of the *virtual* stepping object respectively. Positive (+) and negative (-) AP foot clearances indicated whether the foot was anterior and/or posterior to the virtual stepping object when the foot was on the ground (i.e. treadmill belt) respectively. Further, a normalized AP foot clearance > +1 or < -1 indicated the foot did not step on the virtual stepping object; but, an AP foot clearance ≤ +1 and ≥ -1 indicated the foot did step on the virtual stepping object (Figure 30).

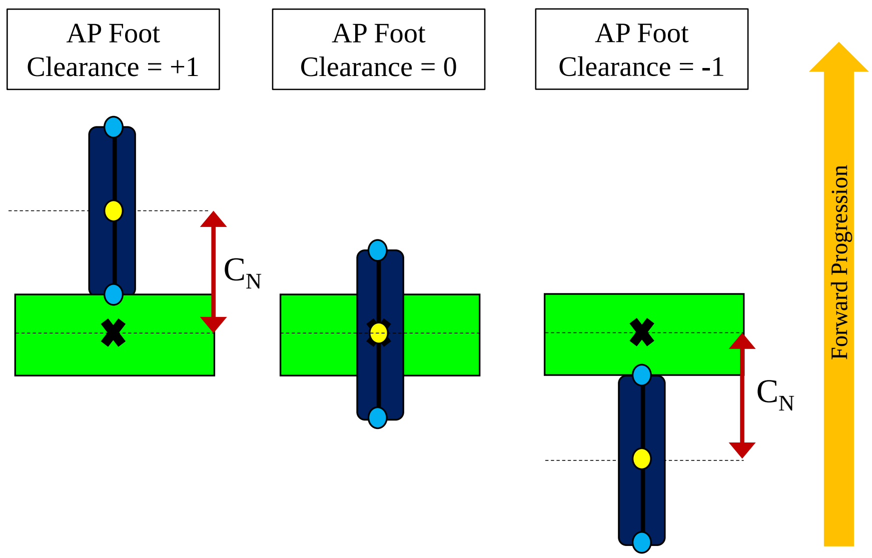


Figure 30. Example of Normalized AP Foot Clearance values where positive (+) and negative (-) values indicated the foot was anterior and posterior to the virtual stepping object when the foot was on the ground (i.e. treadmill belt). A value of zero indicated the AP foot center stepped on the AP object center. Further, a normalized AP foot clearance > +1 or < -1 indicated the foot did not step on the virtual stepping object; but, an AP foot clearance ≤ +1 and ≥ -1 indicated the foot did step on the virtual stepping object.

Example normalized AP Clearance data for GoYel and GoRed trials (a typical participant) are depicted in Figure 31. The AP foot clearances at object $_n$ and object $_{n+1}$ are depicted on the horizontal and vertical axes respectively. The different symbols indicate distinct consecutive object $_n$ -to- object $_{n+1}$ sequences: the blue circles are Target-to-Target, the magenta squares are Target-to-Obstacle, red diamonds are Obstacle-to-Targets, and the green triangles are Obstacle-to-Obstacle.

Particularly, the Obstacle-to-Target and Target-to-Obstacle sequences were identified as sequences of interest in our analyses, as they are sequences in which participants had to actively modify their stepping movement to successfully navigate targets and/or obstacles introduced to disrupt their normal walking pattern.

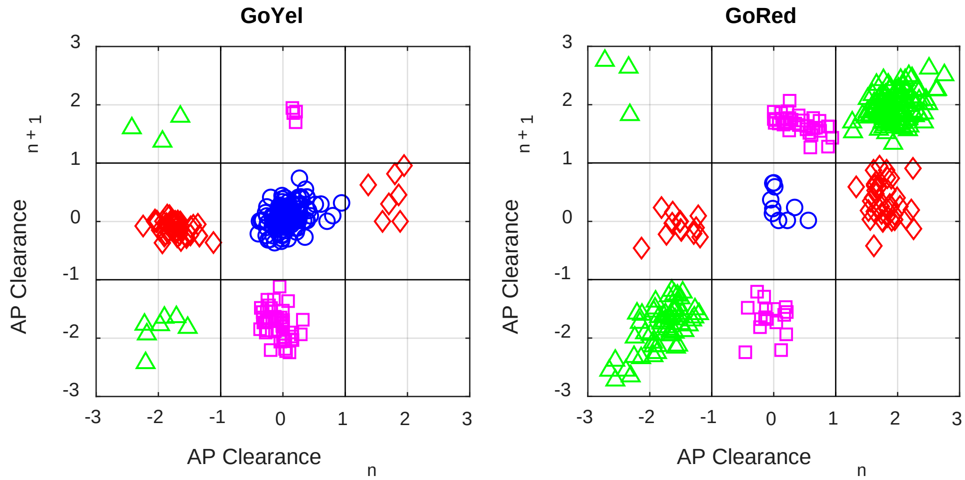


Figure 31. Example Participant of AP Clearance Data for a GoYel and GoRed trial. The AP foot clearances at object $_n$ and object $_{n+1}$ are depicted on the horizontal and vertical axes respectively. The different symbols indicate distinct consecutive object $_n$ -to- object $_{n+1}$ sequences: the blue circles are Target-to-Target, the magenta squares are Target-to-Obstacle, red diamonds are Obstacle-to-Targets, and the green triangles are Obstacle-to-Obstacle.

Last, (3) we quantified the fluctuation characteristics of the stride parameters L_n, T_n, and S_n for each walking trial. The purpose of this analysis was (i) characterize the overall stepping strategies participants used to accommodate the virtual stepping targets and obstacles across conditions, and to compare to previous studies. A stride was defined as the period between a right heel strike to the next right heel strike. individual heel strikes were determined by finding the local maxima of the distances between the pelvis and heel markers in the anterior-posterior direction (Zeni et al. 2008). Stride length (L_n) was calculated as the anterior-posterior displacement between two consecutive right heel strikes and using the heel marker data. Stride time (T_n) was calculated as the time between two consecutive right heel strikes. These data were used to extract time series of L_n and T_n, from which time series of stride speeds were then also computed ($S_n = L_n/T_n$).

For each trial, means and standard deviations (σ) for each of these time series (T_n, L_n, S_n) were computed. We also used Detrended Fluctuation Analysis (DFA) (Peng et al. 1992, Peng et al. 1994, Hausdorff et al. 1995, Goldberger et al. 2002) to quantify the stride-to-stride fluctuation dynamics and to determine the extent of control for each variable, as we did previously (Dingwell et al. 2010). While standard deviations (σ) captured the average magnitude of fluctuations in these time series, these DFA exponents (α) captured how quickly participants actively corrected these fluctuations on subsequent strides. Additional descriptions of these analyses were detailed in Chapter 3.

STATISTICAL ANALYSES

Statistical analyses were performed using SPSS Statistical Package (SPSS Inc., Chicago, USA). Statistical analyses were divided into the following five sections.

Assessment Measures. To identify differences between YH and OH adult groups, mean differences of the physical measures (TUG, Normalized Knee Extensor Strength, PWS), and EF measures (Stroop, GNG) were compared using independent t-tests.

Overall Stepping Performance. Age Group × (Trial) mixed factorial analysis of variance was employed to compare mean difference of overall stepping task performance (Percentage of Stepping Go and NoGo Errors) between OH and YH adults for each experimental condition (GoYel and GoRed).

Descriptive Properties of Stepping Errors. We reported the implemented success strategies, and both type and quantity of stepping errors that occurred in the Obstacle-to-Target and Target-to-Obstacle sequences across OH and YH adults.

Stepping Measures. A two-factor Age Group × (Condition) mixed factorial analysis of variance was employed to compare mean difference of several stepping measures (within-trial variability and statistical persistence of stride parameters L_n, T_n, and S_n) between OH and YH adults and across experimental conditions (GoYel, GoRed).

Correlational Analyses. Pearson correlations were conducted between the measures of physical capacity, executive function and overall stepping task performance (Percentage of Stepping Go and NoGo Errors) in each experimental condition.

RESULTS

Physical Measures

OH adults exhibited decrements in normalized knee extension strength compared to YH adults. No group differences were observed in TUG times. However, OH adults exhibited faster over-ground preferred walking speeds (PWS) compared to YH adults.

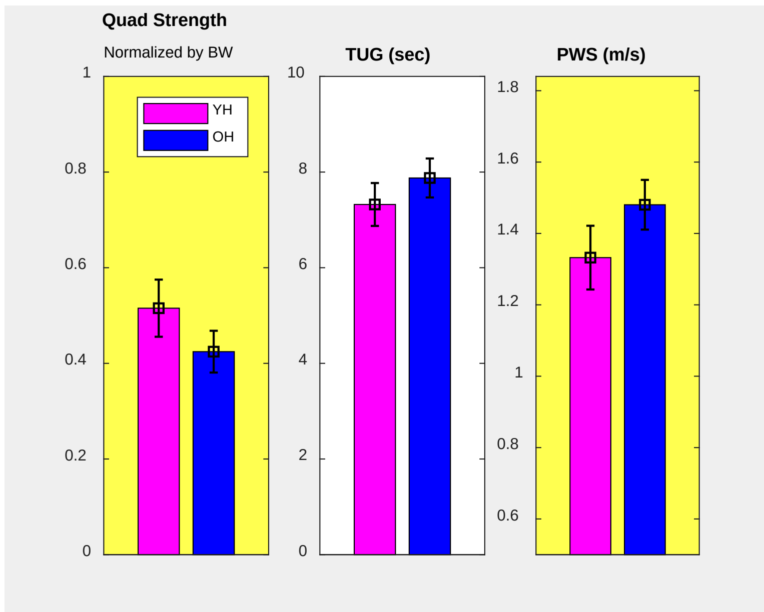


Figure 32. Physical Measures of TUG times (seconds), normalized knee extension strength (non-dimensional), and over-ground preferred walking speed (PWS). The group means for the YH and OH groups are depicted in magenta and blue bars respectively. Error bars are 95% Confidence Intervals for each mean. No significant age group differences were observed in TUG times. However, OH adults exhibited significantly decreased in Normalized Knee extension Strength compared to YH adults. OH adults exhibited significantly faster over-ground PWS compared to YH adults. NOTE: The YELLOW backgrounds indicate significant group differences.

TUG. The mean TUG time (seconds) for the OH adult group (M = 7.87; SD = 0.95) was not significantly different than that of the YH adult group (M = 7.32; SD = 1.05): $t(40) = -1.793$; p = 0.081 (two-tailed). Further, the TUG average times for both YH and OH adult groups were notably ≤12 seconds, the cut-off point for normal physical mobility (Bischoff et al. 2003, Bohannon 2006). ***Knee Extension Strength***. The mean normalized knee extension strength for the OH adult group (M = 0.42; SD = 0.10) was significantly less than that of the YH adult group (M = 0.52; SD = 0.14): $t(40) = 2.407$; $p < 0.05$ (two-tailed). ***PWS.*** The mean over-ground PWS for the OH adult group (M = 1.48; SD = 0.16) was significantly faster than that of the YH adult group (M = 1.33; SD = 0.21): $t(40) = -2.564$; $p < 0.05$ (two-tailed).

Cognitive Measures

Stroop Task. OH adults exhibited significant decrements in the EF Stroop measures compared to YH adults. The OH adult group read significantly fewer words in all three Stroop Task (ST) conditions: Word (W), Color (C), and Color-Word (CW) conditions (Figure 33). The mean Stroop Word score for the OH adult group (M = 101.19; SD = 17.342) was significantly lower than that of the YH adult group (M = 114.24; SD = 13.375): $t(40) = 2.730$; $p < .01$ (two-tailed). The mean Stroop Color score for the OH adult group (M = 71.05; SD = 11.200) was significantly lower than that of the YH adult group (M = 81.81; SD = 11.604): $t(40) = 3.058$; $p < .01$ (two-tailed). The mean Stroop Color-Word score for the OH adult group (M = 39.29; SD = 9.301) was significantly lower than that of the YH adult group (M = 53.62; SD = 9.463): $t(40) = 4.950$; $p < .01$ (two-tailed).

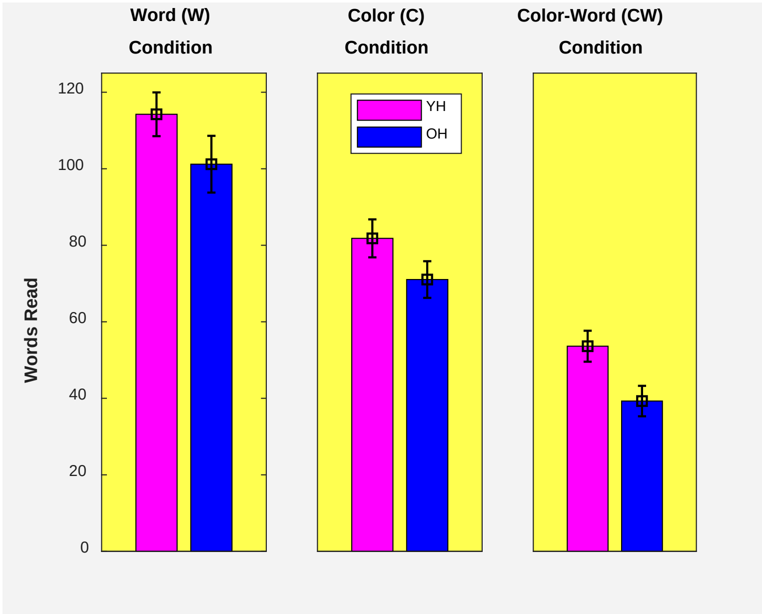


Figure 33. Words read during the Stroop interference conditions: Word (W), Color (C) and Color-Word (CW). The group means for the YH and OH groups are depicted in magenta and blue bars respectively. Error bars are 95% Confidence Intervals for each mean. Group means were significantly different between YH and OH across all three conditions. NOTE: The YELLOW backgrounds indicate significant group differences.

GNG. YH adults exhibited greater impulsivity compared to OH adults (indicated by more NoGo errors and faster response times in the GoP condition). No other differences were observed between YH and OH adults. The mean Go Errors (GoP condition) for the OH adult group (M = 0.76; SD = 1.578) was not significantly different than that of the YH adult group (M = 0.29; SD = 0.561): $t(40)$ =-1.303; p = 0.200 (two-tailed). The mean NoGo Errors (GoP condition) for the OH adult group (M = 4.05; SD = 2.397) was significantly less than that of the YH adult group (M = 10.38; SD = 5.113): $t(28.4)$ =5.139; $p < 0.01$ (two-tailed). The mean Go Errors (GoR condition) for the OH adult group (M = 0.24; SD = 0.539) was not significantly different than that of the YH adult group (M = 0.14; SD = 0.359): $t(40)$ =-0.674; p = 0.504 (two-tailed). The mean NoGo Errors (GoR condition) for the OH adult group (M = 1.14; SD = 2.128) was not significantly different than that of the YH adult group (M = 0.95; SD = 1.322): $t(40) = -0.348$; $p = 0.729$ (two-tailed).

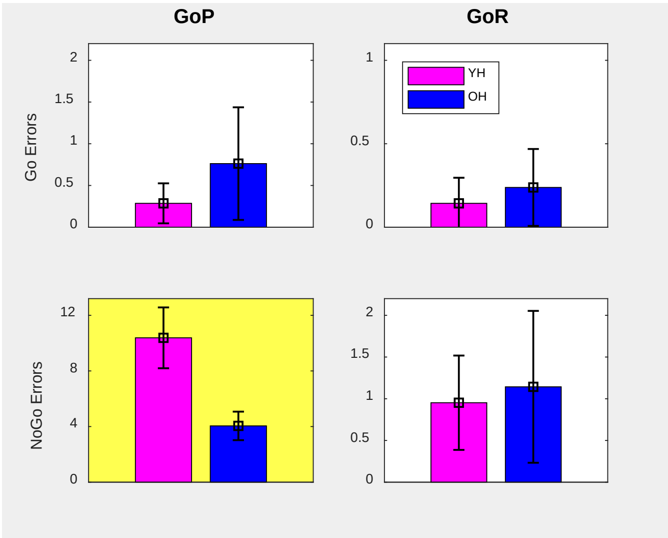


Figure 34. Go Errors and NoGo Errors during the Go-NoGo (GNG) task conditions (GoP and GoR). The group means for the YH and OH groups are depicted in magenta and blue bars respectively. Error bars are 95% Confidence Intervals for each mean. In the GoP condition, YH adults exhibited significantly greater number of NoGo Errors compared to OH adults. No groups differences were observed in Go Errors in either GoP or GoR conditions, or NoGo Errors in GoR (the reversal condition). NOTE: The YELLOW backgrounds indicate significant group differences.

The mean Response Time to the letter P (GoP condition) for the OH adult group (M = 587.7; SD = 92.5) was significantly longer than that of the YH adult group (M = 458.5; SD = 37.1): $t(26.3) = -5.944$; $p < 0.01$ (two-tailed). The standard deviation Response Time to the letter P (GoP condition) for the OH adult group (M = 106.4; SD = 39.6) was significantly greater than that of the YH adult group (M = 72.3; SD = 19.2): $t(28.9) = -3.548$; $p < 0.01$ (two-tailed). The mean Response Time to the letter R (GoR condition) for the OH adult group (M = 625.7; SD = 86.6) was significantly longer than that of the YH adult group (M = 542.4; SD = 53.2): *t*(40) =-3.754; p < 0.01 (two-tailed). The standard deviation Response Time to the letter R (GoR condition) for the OH adult group (M = 75.7; SD = 20.5) was not significantly different than that of the YH adult group (M = 78.1; SD = 26.7): *t*(40) =0.325; p = 0.747 (two-tailed).

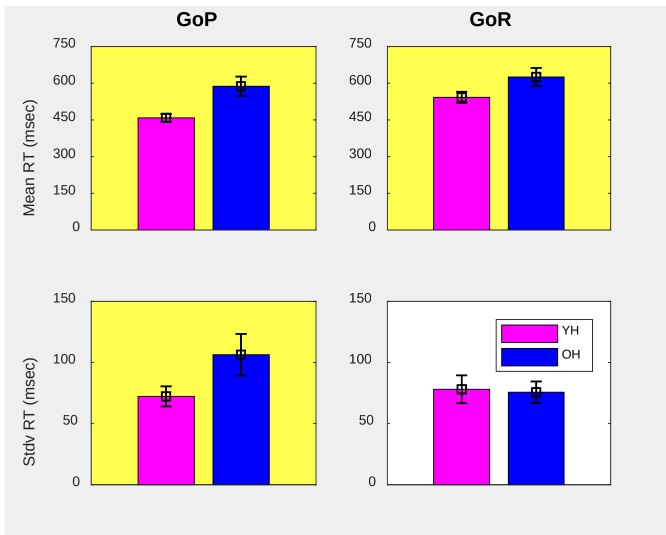


Figure 35. Mean and Standard Deviation of Correct Response Times during the Go-NoGo (GNG) task conditions (GoP and GoR). The group means for the YH and OH groups are depicted in magenta and blue bars respectively. Error bars are 95% Confidence Intervals for each mean. In the GoP condition, OH adults exhibited significantly longer and more variability Response Times compared to YH adults. In the GoR condition, OH adults exhibited significantly longer Response Times compared to YH adults; however no group differences were observed in variability of Response Times. NOTE: The YELLOW backgrounds indicate significant group differences.

Moreover, a significant correlation *r*(42) = -0.599; p < .01 (effect size r^2 = .359, a Large effect) was found between the mean NoGo Errors (GoP condition) and mean Response Time to the letter P (GoP condition).

Overall Stepping Performance

Stepping Go Errors (i.e. did not step on a target). In **GoYel**, the within-subject effects results from a 2-factor Age × (Trial) mixed factorial ANOVA indicated the Trial factor was not significant: F(1,40) =6.344; p <.05. Partial eta squared = 0.137. The average Percent of Go Errors for OH and YH adult groups did not differ significantly: $F(1,40) = 0.880$; $p = 0.354$. Partial eta squared =0.022 (Figure 36, Top Left). In **GoRed**, the within-subject effects results from a 2-factor Age × (Trial) mixed factorial ANOVA indicated the Trial factor was not significant: F(1,40) =0.258; p =0.614. Partial eta squared = 0.006. The average Percent of Go Errors for OH and YH adult groups did not differ significantly: $F(1,40) = 0.351$; $p = 0.557$. Partial eta squared =0.009 (Figure 36, Top Right).

Stepping NoGo Errors (i.e. stepped on an obstacle). In **GoYel**, the within-subject effects results from a 2-factor Age × (Trial) mixed factorial ANOVA indicated the Trial factor was not significant: F(1,40) =0.284; p =0.597. Partial eta squared = 0.007. However, the average Percent of NoGo Errors for OH and YH groups differed significantly: $F(1,40) = 8.900$; $p < .01$. Partial eta squared =0.182 (Figure 36, Bottom Left). In **GoRed**, the within-subject effects results from a 2-factor Age × (Trial) mixed factorial ANOVA indicated the Trial factor was not significant: F(1,40) =0.151; p =0.700. Partial eta squared = 0.004. However, the average Percent of NoGo Errors for the groups differed significantly: $F(1,40) = 9.898$; $p < .01$. Partial eta squared =0.198 (Figure 36, Bottom Right).

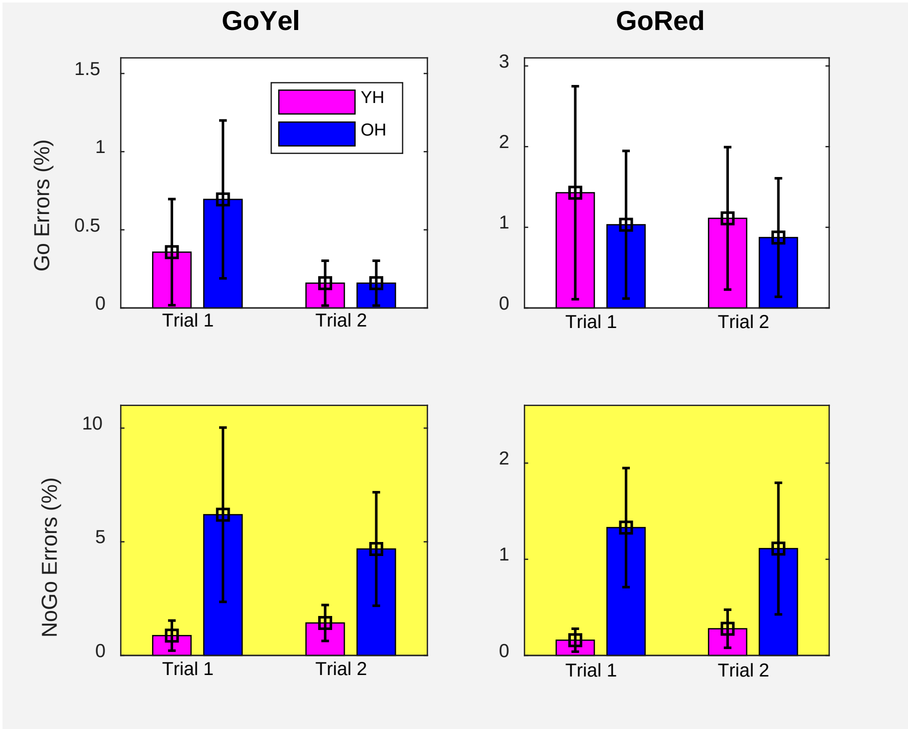


Figure 36. Percentage of Stepping Go and NoGo Errors in Trials 1 and 2 for Young healthy adults (YH, the magenta bars) and Older healthy adults (OH, the blue bars). Go Errors. The average Go Errors (%) attained for Older Adult group was not significantly different from the Young Adult group across the two experimental conditions. In both GoYel and GoRed, no group differences were observed stepping Go errors. NoGo Errors. The OH group made significantly more NoGo Errors (%) compared to the YH group across the two experimental conditions. In both GoYel and GoRed, the OH adults exhibited more stepping NoGo errors compared to YH adults. NOTE: The YELLOW backgrounds indicate significant group differences.

Descriptive Properties of Stepping Errors

This section will examine stepping strategies and errors in specific object $_{n}$-to-object $_{n+1}$ sequences (Obstacle-to-Target or Target-to-Obstacle). These stepping successes or errors occurred at the object $_{n+1}$ (which was either a target or an obstacle).

OBSTACLE-TO-TARGET

In the Obstacle-to-Target sequences, the successful object $_{n+1}$ AP Clearance data are $\leq +1$ and ≥ -1 (vertical axis in Figure 37, i.e. stepping on target) and illustrated by green space on the graph (Figure 37). Two different strategies were observed across participants. “Strategy 1” indicated that a participant stepped in front of the previous obstacle, and then onto the target; whereas, “Strategy 2” indicated that a participant stepped just past the previous obstacle, and then onto the target. Both YH (magenta x symbols, LEFT) and OH adult data (blue x symbols, RIGHT) are depicted in Figure 37.

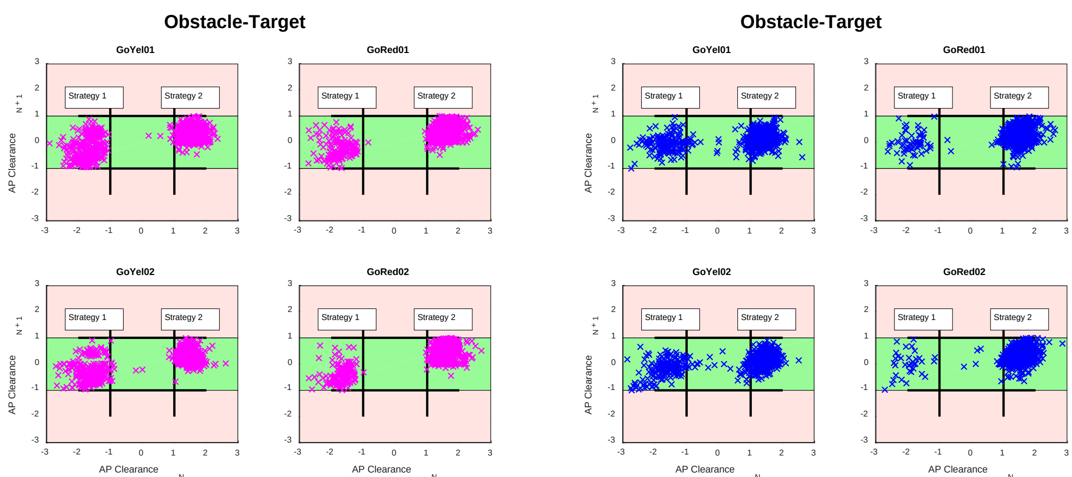


Figure 37. Obstacle-to-Target AP Clearance Data when participants successfully navigated object $_{n+1}$. Young adult AP clearance data are depicted as magenta x symbols (LEFT). Older adult AP clearance data are depicted with blue x symbols (RIGHT). For this sequence, participants successfully navigated object $_{n+1}$ (the vertical axis) with two different stepping strategies.

Total number of stepping Go errors (at object $_{n+1}$) made during the Target-to-Target and Obstacle-to-Target sequences by the YH and OH groups are depicted in Figure 38 across all four experimental trials (GoYel01, GoYel02, GoRed01 and GoRed02). Although the Obstacle-to-Target sequence (RIGHT) was identified as a sequence of interest, the Target-to-Target sequence (LEFT) data are also included in Figure 38.

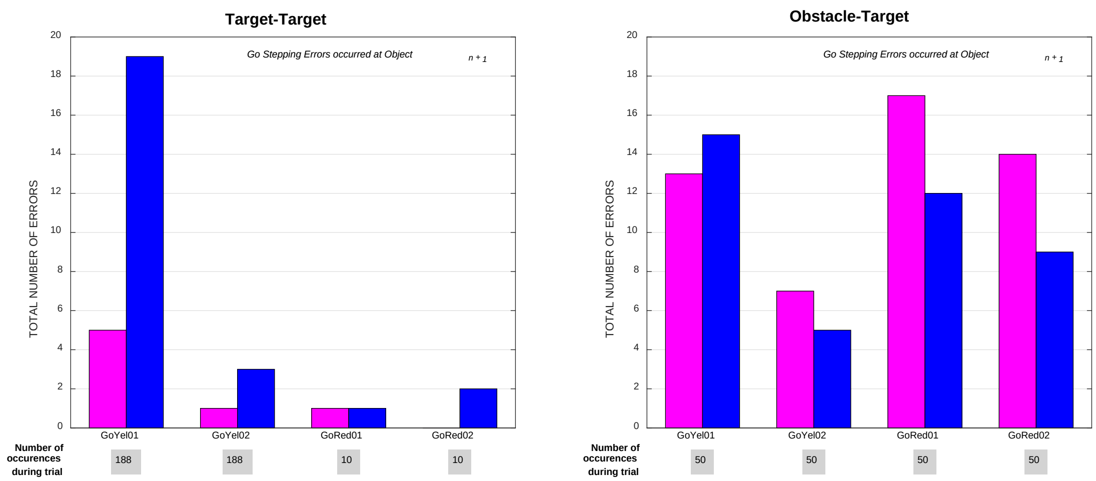


Figure 38. Total number of Go Stepping Errors across entire Age group (YH and OH) during the experimental trials (GoYel01, GoYel02, GoRed01 and GoRed02). The group means for the YH and OH groups are depicted in magenta and blue bars respectively. The number of Target-to-Target or Obstacle-to-Target occurrences during each experimental trial (for each participant) are noted below each experimental trial (e.g. GoYel01 and GoRed01 had 188 and 10 Target-to-Target occurrences respectively).

Obstacle-Target Sequences. In GoYel, 6 OH and 4 OH adults (29 and 19%) made at least one stepping Go error in trials 1 and 2 respectively; whereas 4 and 5 YH adults (19 and 24% of the group participants) made at least one stepping Go error in these trials. In GoRed, 6 OH adults (29%) made at least one stepping Go error in both trials 1 and 2; whereas 7 YH adults (33 %) made at least one stepping Go error in these trials.

AP foot clearance data from the object $_{n}$ (obstacle) and object $_{n+1}$ (target) encounters in which participants made stepping Go errors at object $_{n+1}$ (target) are depicted in Figure 39. Although, not distinctive in the GoYel trials, most of these stepping Go errors were "Stepped Long" (past the target) errors in the GoRed condition (Figure 39).

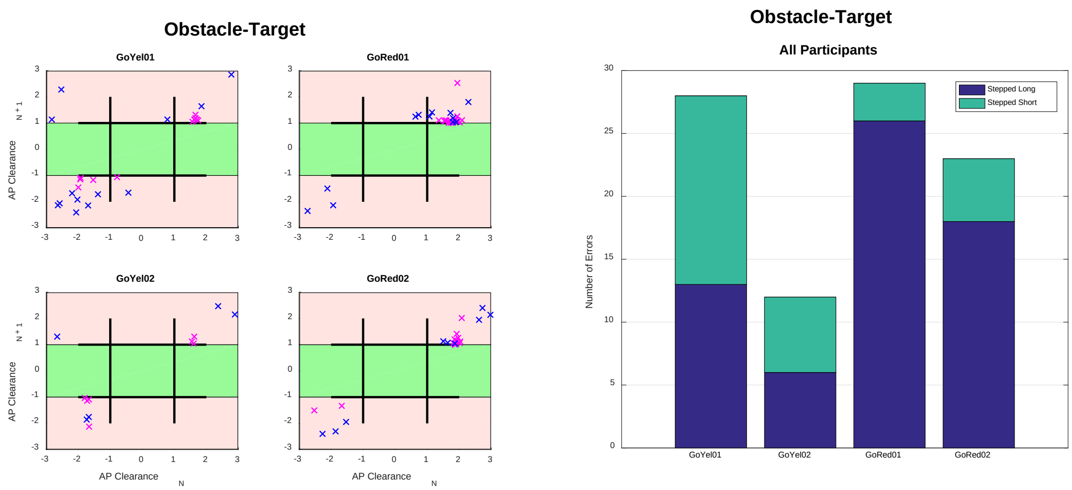


Figure 39. Left) Obstacle-to-Target AP Clearance Data when participants made stepping Go errors at object $_{n+1}$. The error and success spaces are presented as pink ("red") and green respectively. OH and YH AP clearance data are depicted with blue and magenta x symbols respectively. Right) These Target-to-Obstacle errors are separated into Stepped Long (Dark Blue data) and Stepped Short (Teal data) during the four different experimental trials (GoYel01, GoYel02, GoRed01 and GoRed02).

TARGET-TO-OBSTACLE

In the Target-to-Obstacle sequences, the successful AP Clearance data are >+ 1 and < -1 (vertical axis in Figure 40, i.e. not stepping on the obstacle) and illustrated by green space on the graph. "Strategy 1" indicated a participant stepped onto the previous target, and then just past the obstacle; whereas, "Strategy 2" indicates that a participant stepped onto the previous target, and then just in front of the obstacle. Both YH (magenta x symbols, LEFT) and OH adult data (blue x symbols, RIGHT) are depicted in Figure 40.

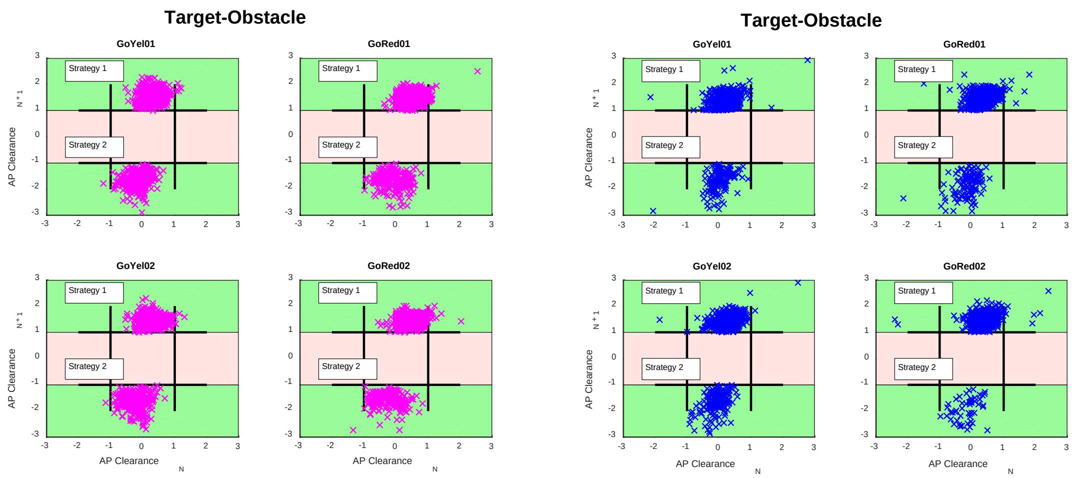


Figure 40. Target-to-Obstacle AP Clearance Data when participants successfully navigated object $_{n+1}$. Young adult AP clearance data are depicted as magenta x symbols (LEFT). Older adult AP clearance data are depicted with blue x symbols (RIGHT). For this sequence, participants successfully navigated object $_{n+1}$ (the vertical axis) with two different stepping strategies.

Total number of stepping NoGo errors (at object $_{n+1}$) made during the Obstacle-to-Obstacle and Target-to-Obstacle sequences by the YH and OH groups are depicted in Figure 41 across all four experimental trials (GoYel01, GoYel02, GoRed01 and GoRed02). Although the Target-to-Obstacle sequence was identified as a sequence of interest, the Obstacle-to-Obstacle sequence data are included in Figure 41 for completeness.

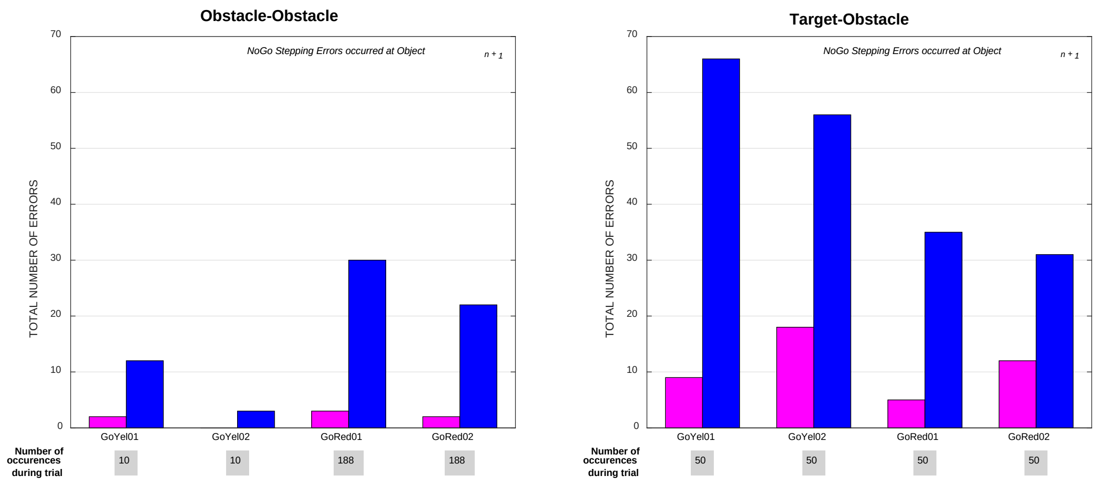


Figure 41. Total number of Stepping NoGo Errors across entire Age group (YH and OH) during the experimental trials (GoYel01, GoYel02, GoRed01 and GoRed02). The group means for the YH and OH groups are depicted in magenta and blue bars respectively. The number of Obstacle-to-Obstacle or Target-to-Obstacle occurrences during each experimental trial (for each participant) are noted below each experimental trial (e.g. GoYel01 and GoRed01 had 10 and 188 Obstacle-to-Obstacle occurrences respectively).

Target-to-Obstacle Sequences. In GoYel, 13 OH and 14 OH adults (62 and 67%) made at least one stepping NoGo error in trials 1 and 2 respectively; whereas 6 and 10 YH adults (29 and 48% of the group participants) made at least one stepping NoGo error in these trials. In GoRed, 15 OH and 11 OH adults (71 and 52%) made at least one stepping NoGo error in trials 1 and 2 respectively; whereas 4 and 7 YH adults (19 and 33%) made at least one stepping NoGo error in these trials.

AP foot clearance data from the object $_{n}$ (target) and object $_{n+1}$ (obstacle) encounters in which participants made stepping NoGo errors at object $_{n+1}$ (obstacle) are depicted in Figure 42. Most of these stepping NoGo errors were “Stepped Short” errors (Figure 42).

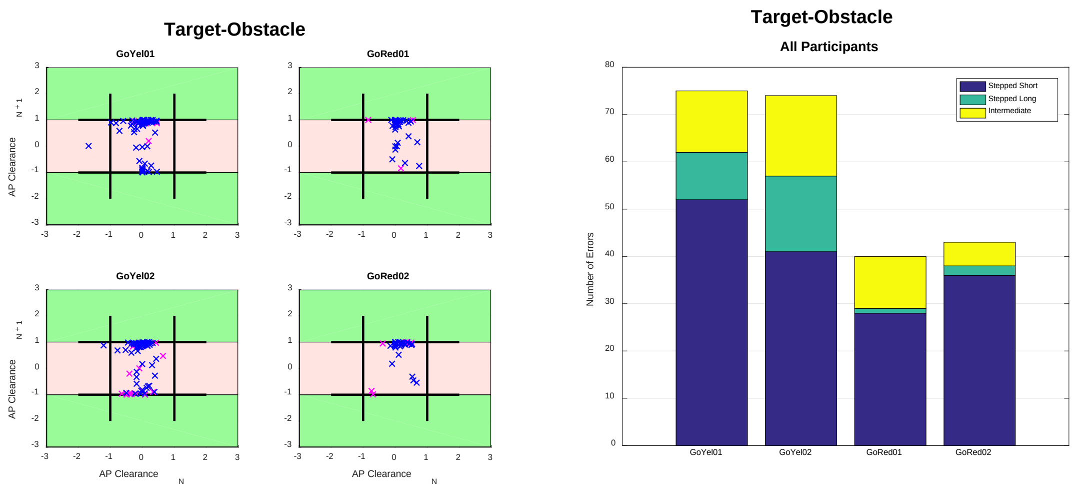


Figure 42. Left) Target-to-Obstacle AP Clearance Data when participants made errors at object $_{n+1}$. The error and success spaces are presented as pink ("red") and green respectively. OH and YH AP clearance data are depicted with blue and magenta x symbols respectively. Right) These Target-to-Obstacle errors are separated into Stepped Short (Dark Blue data), Stepped Long (Teal data), and Intermediate (yellow data) during the four different experimental trials (GoYel01, GoYel02, GoRed01 and GoRed02).

Stepping Measures: L_n, T_n, S_n

The results from the Age Group × (Condition) mixed factorial ANOVA for each stride parameter variable are described in Table 9. Introducing the virtual stepping targets and obstacles significantly altered both within-trial stepping variability and stride-to-stride error correction across conditions.

Within-trial Variability. Standard deviations of L_n ($F_{(2,80)} = 522.963$; $p < 0.01$), T_n ($F_{(2,80)} = 169.287$; $p < 0.01$), and S_n ($F_{(2,80)} = 520.701$; $p < 0.01$) differed significantly across conditions. Post-hoc analyses indicated that during both GoYel and GoRed, participants exhibited increased variability in L_n, T_n and S_n (Figure 43) compared to the NWalk condition. The simple main effects of Age Group (YH and OH adults) in the different experimental conditions are noted in Table 9 (in the circumstance in which the Between-Subject factor and/or Interaction were found to be significant).

DFA scaling exponents. DFA α's of L_n ($F_{(2,80)} = 112.033$; $p < 0.01$), T_n ($F_{(2,80)} = 76.567$; $p < 0.01$), and S_n ($F_{(2,80)} = 19.586$; $p < 0.01$) differed significantly across conditions. Post-hoc analyses indicated that during both GoYel and GoRed, participants exhibited significantly greater statistical anti-persistence in L_n, T_n and S_n (Figure 43) compared to the NWalk condition. The simple main effects of Age Group (YH and OH adults) in the different experimental conditions are noted in Table 9 (in the circumstance in which the Between-Subject factor and/or Interaction were found to be significant).

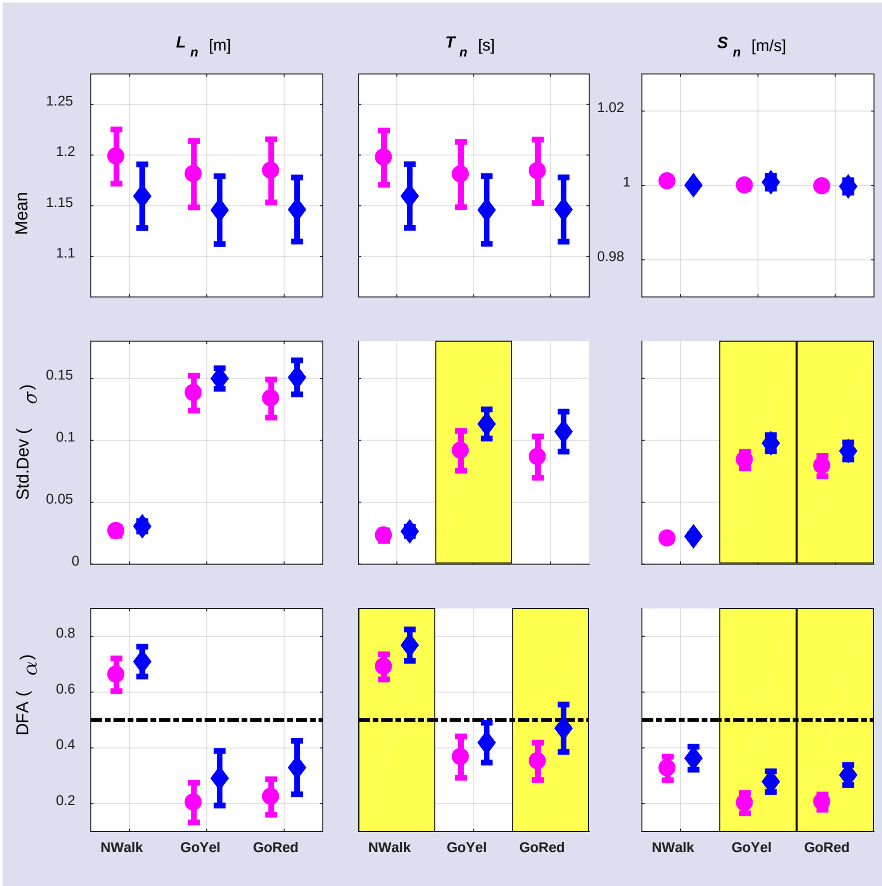


Figure 43. Means for stride lengths (L_n), times (T_n), and speeds (S_n) during each of the four conditions (NWalk, GoYel, GoRed). Variability (within-trial standard deviations: σ) for L_n, T_n, and S_n during all conditions. DFA scaling exponents (α) for L_n, T_n, and S_n during all conditions. The group means for the YH and OH groups are depicted in magenta and blue respectively. Error bars are 95% Confidence Intervals for each mean. NOTE: The YELLOW backgrounds indicate significant group differences. The SPSS outputs for these analyses are included in Appendix E.

Table 9. Statistical Results from Age Group × (Condition) Mixed Factorial ANOVA

Variable	Factor Type	Effect	F	p-value	Partial Eta Squared
VARIABILITY					
L_n (σ)	**Within-Subject**	**Condition**	F(2,80) = 522.963	**p<.01**	.929
	Interaction		F(2,80) = 1.300	p = 0.278	.031
	Between-Subject	Age Group	F(1, 40) = 2.987	p = 0.092	.069
	Simple Main Effect of Group in NWalk		F(1,40) = 1.99	p = 0.166	
	Simple Main Effect of Group in GoYel		F(1,40) = 2.01	p = 0.164	
	Simple Main Effect of Group in GoRed		F(1,40) = 2.65	p = 0.111	
T_n (σ)	**Within-Subject**	**Condition**	F(2,80) = 169.287	**p<.01**	.809
	Interaction		F(2,80) = 2.374	p = 0.100	.056
	Between-Subject	**Age Group**	F(1,40) = 4.270	p <.05	.096
	Simple Main Effect of Group in NWalk		F(1,40) = 1.40	p = 0.244	
	Simple Main Effect of Group in **GoYel**		F(1,40) = 4.57	**p = 0.039**	
	Simple Main Effect of Group in GoRed		F(1,40) = 3.03	p = 0.090	
S_n (σ)	**Within-Subject**	**Condition**	F(2,80) = 520.701	**p<.01**	.929
	Interaction		F(2,80) = 3.604	**p<.05**	.083
	Between-Subject	**Age Group**	F(1,40) = 7.862	**p < .01**	.164
	Simple Main Effect of Group in NWalk		F(1,40) = 1.39	p = 0.245	
	Simple Main Effect of Group in **GoYel**		F(1,40) = 8.15	**p = 0.007**	
	Simple Main Effect of Group in **GoRed**		F(1,40) = 4.92	**p = 0.032**	
DFA					
L_n (α)	**Within-Subject**	**Condition**	F(2,80) = 112.033	**p<.01**	.737
	Interaction		F(2,80) = 0.415	p = 0.662	.010
	Between-Subject	**Age Group**	F(1,40) = 4.172	**p = 0 .048**	.094
	Simple Main Effect of Group in NWalk		F(1,40) = 1.36	p = 0.250	
	Simple Main Effect of Group in GoYel		F(1,40) = 2.00	p = 0.165	
	Simple Main Effect of Group in GoRed		F(1,40) = 3.23	p = 0.080	
T_n (α)	**Within-Subject**	**Condition**	F(2,80) = 76.567	**p<.01**	.657
	Interaction		F(2,80) = 0.607	p = 0.547	.015
	Between-Subject	**Age Group**	F(1,40) = 6.025	**p < .05**	.131
	Simple Main Effect of Group in **NWalk**		F(1,40) = 4.45	**p = 0.041**	
	Simple Main Effect of Group in GoYel		F(1,40) = 0.98	p = 0.329	
	Simple Main Effect of Group in **GoRed**		F(1,40) = 4.64	**p = 0.037**	
S_n (α)	**Within-Subject**	**Condition**	F(2,80) = 19.586	**p<.01**	.329
	Interaction		F(2,80) = 1.456	p = 0.208	.035
	Between-Subject	**Age Group**	F(1,40) = 17.887	**p = < .01**	.309
	Simple Main Effect of Group in NWalk		F(1,40) = 1.49	p = 0.230	
	Simple Main Effect of Group in **GoYel**		F(1,40) = 8.43	**p = 0.006**	
	Simple Main Effect of Group in **GoRed**		F(1,40) = 17.85	**p < 0.01**	

Correlational Analyses - *Assessment Measures*

No significant Pearson's correlation coefficients were found between TUG times, Normalized Knee Extension Strength (NStrength), and PWS with Percent of NoGo (stepping) Errors during GoYel and GoRed (Table 10).

Table 10. Correlation Coefficients Between General and Physical Assessments and Percent of Go and NoGo Errors (Overall Stepping Performance)

		TUG	NStrength	PWS	NoGoErrors Perct GoYel2	NoGoErrors Perct GoRed2
TUG	Pearson Correlation	1	-0.204	-0.092	-0.164	0.007
	Sig. (2-tailed)		0.194	0.564	0.301	0.965
	N	42	42	42	42	42
NStrength	Pearson Correlation	-0.204	1	-0.016	-0.107	-0.225
	Sig. (2-tailed)	0.194		0.919	0.499	0.152
	N	42	42	42	42	42
PWS	Pearson Correlation	-0.092	-0.016	1	0.067	0.063
	Sig. (2-tailed)	0.564	0.919		0.673	0.692
	N	42	42	42	42	42

**. Correlation is significant at the 0.01 level (2-tailed).

A significant correlation *r*(42) = -0.330; $p < .05$ (effect size $r^2 = .109$, a Medium effect) was found between the Stroop Color-Word performance and Percent of NoGo (stepping) Errors in GoYel trial 2. Additionally, a significant correlation *r*(42) = -0.336; $p < .05$ (effect size $r^2 = .113$, a Medium effect) was found between the Stroop Color-Word performance and Percent of NoGo (stepping) Errors in GoRed trial 2 (Table 11).

Table 11. Correlation Coefficients Between Stroop Task Conditions and Percent of NoGo Errors (Overall Stepping Performance)

		Stroop Word	Stroop Color	Stroop ColorWord	NoGo Errors Perct GoYel2	NoGo Errors Perct GoRed2
Stroop Word	Pearson Correlation	1	.731**	.658**	-.101	-.074
	Sig. (2-tailed)		.000	.000	.526	.642
	N	42	42	42	42	42
Stroop Color	Pearson Correlation	.731**	1	.762**	-.183	-.273
	Sig. (2-tailed)	.000		.000	.246	.081
	N	42	42	42	42	42
Stroop ColorWord	Pearson Correlation	.658**	.762**	1	-.330*	-.336*
	Sig. (2-tailed)	.000	.000		.033	.030
	N	42	42	42	42	42

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

A significant correlation $r(42) = +0.442$; $p < .01$ (effect size $r^2 = .195$, a Medium effect) was found between GNG GoR NoGo Errors and Percent of NoGo (stepping) Errors in GoYel trial 2 (Table 12). No significantly correlations were found between the mean and standard deviations of GNG Response Times and the Percent of NoGo (stepping) Errors in GoRed or GoYel (trial 2 data).

Table 12. Correlation Coefficients Between Go-GoNo (GNG) Task Conditions and Percent of NoGo Errors (Overall Stepping Performance)

		GNG GoP GoErrors	GNG GoP NoGoErrors	GNG GoR GoErrors	GNG GoR NoGoErrors	NoGo Errors Perct GoYel2	NoGo Errors Perct GoRed2
GNG GoP GoErrors	Pearson Correlation	1	.013	.036	.151	-.106	-.094
	Sig. (2-tailed)		.934	.819	.340	.502	.554
	N	42	42	42	42	42	42
GNG GoP NoGoErrors	Pearson Correlation	.013	1	-.039	.366*	-.128	-.079
	Sig. (2-tailed)	.934		.805	.017	.418	.618
	N	42	42	42	42	42	42
GNG GoR GoErrors	Pearson Correlation	.036	-.039	1	-.042	-.072	-.096
	Sig. (2-tailed)	.819	.805		.790	.653	.544
	N	42	42	42	42	42	42
GNG GoR NoGoErrors	Pearson Correlation	.151	.366*	-.042	1	.442**	.153
	Sig. (2-tailed)	.340	.017	.790		.003	.333
	N	42	42	42	42	42	42

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Although not shown, none of the stepping measures of L_n, T_n, S_n (variability or DFA) or the computer GNG Response Times measures (means or standard deviations) were significantly associated with the Percent of NoGo (stepping) Errors in the GNG stepping task (GoYel or GoRed).

DISCUSSION

Although, the OH group exhibited decreased normalized knee extension strength, no significant group difference was observed in TUG times. For TUG times, both YH and OH groups exhibited mean TUG times < 10 seconds, indicating high-functional mobility (Bischoff et al. 2003). Further supporting this, the OH adult group exhibited faster over-ground preferred walking speeds (PWS) compared to the YH adult group, choosing to walk at an average 1.48 m/s. The Stroop Interference task indicated the OH adult group exhibited poorer response inhibition compared to the YH adult group. However, this decrement was not observed in the computer Go-NoGo (GNG) task. In fact, the YH adults group exhibited more NoGo errors and faster response times in the first condition (GoP), both suggestive of impulsivity (Bezdjian et al. 2009). These results suggest the OH group was physically high-functioning, but exhibited some EF decrements compared to the YH group.

Our aim was to assess response inhibition in the same way as the computer GNG task. In both GoYel and GoRed, the OH group exhibited more stepping NoGo errors compared to the YH group. Above all, this result suggests that the OH group was challenged when navigating *obstacles* in both conditions. However, in a walking context these conditions cannot be directly compared, as their physical demands are rather different. These results do lead us to question whether the quantity of the stepping NoGo errors were more due to cognitive or physical demands in GoYel and GoRed. The GoYel trials included fewer stepping obstacles placed within a majority of stepping targets. The GoRed trials included a majority of stepping obstacles and fewer stepping targets. Considering the step goal to avoid obstacles, these conditions might suggest that GoYel was a more physically challenging compared to GoRed. However, as by design, Go Red (the reversal condition) was more cognitively challenging compared to the GoYel. More stepping NoGo errors in the higher cognitive demand condition (GoRed) suggests the OH group was more challenged compared to the YH group when the stepping task required inhibition of the previously conditioned stepping response.

Considering, high fall risk older adults have been reported to make stepping errors when navigating targets and obstacles (Yamada et al. 2011), we also examined stepping Go errors. In this study, no differences were observed in number of stepping Go errors between OH and YH adult groups across both walking conditions.

We anticipated the computer GNG task (response inhibition) measures would be significantly associated to fewer errors in our stepping GNG task. However, no significant associations were found between the stepping NoGo errors (in GoRed, the reversal condition) and *any* of the computer GNG task measures. Surprisingly a significant association was found between the stepping NoGo errors (in GoYel) and the computer NoGo errors (in GoR, the reversal condition). However, overall we contend that the computer GNG and stepping GNG tasks cannot be easily compared. A notable difference between the two tasks was the physical demand involved in the stepping GNG task. For instance, during the computer GNG task, a participant could be more impulsive as a NoGo error had no consequence (beyond an error tally, not displayed). On the contrary, although the stepping GNG task introduced *virtual* obstacles and targets, the stepping task still required participants to maintain their balance while navigating these virtual objects.

That said, Stroop Interference performance ($r = -0.336$) was significantly associated with the stepping GNG performance. This aligns with past research that reported decrements in response inhibition may differentiate individuals that made stepping errors in an inhibitory stepping task (Caetano et al. 2016). One notable difference between computer GNG and Stroop Interference is that the latter task is perhaps more intuitive. All of the recruited participants were familiar with reading words and colors. However, both the computer and stepping GNG tasks required participants to learn to respond to letters with a key press or colored virtual stepping objects with a stepping response. Future research should consider introducing virtual stepping objects that are more intuitive during walking (i.e. what "objects" would participants intuitively step on or avoid).

Beyond overall stepping errors, we were also interested in the stepping strategies participants used to navigate consecutive sequences of targets and/or obstacles. Anterior-posterior (AP) foot clearance data demonstrated that study participants chose two different strategies when successfully navigating either the Obstacle-to-Target and Target-to-Obstacle sequences. Further, although some participants chose one strategy over the other for majority of these occurrences, other participants chose to alternate between strategies. Notably, no major distinction was observed between YH and OH participants with respect to strategy choice. The Target-to-Obstacle sequences were particularly challenging for the OH adult group, as they exhibited more stepping NoGo errors compared to the YH adult group during these transitions. Further partitioning these NoGo errors revealed that most of errors occurred when a participant stepped on the previous target and then "stepped short" of clearing the subsequent obstacle. In fact, fewer of observed stepping NoGo errors occurred in the Obstacle-to-Obstacle sequences. Altogether, these results demonstrate that it was, not simply a *single* target or obstacle that led to the observed stepping errors, but specific sequences of stepping targets and/or obstacles that challenged study participants in these contexts to make quick step adjustments and maintain their balance.

Chapter 5: Conclusions

In this dissertation, we investigated how younger and older healthy adults modify their stepping when new step goals are introduced that drive them away from their preferred walking patterns. We sought to identify stepping conditions that were cognitively and/or physically challenging for young and older healthy adults. Across both studies, physically high-functioning older adults exhibited executive function decrements that were significantly associated to overall poorer stepping performance in these contexts.

For Study 1, introducing *competing* step goals significantly altered both within-trial stepping variability and stride-to-stride error correction across conditions. Both healthy older and young healthy participants used the visual feedback of their stepping movements to actively modified their stepping and accommodate the *competing* step goals.

This was particularly evident in the condition in which participants were provided feedback to move to their POP compared to the normal (unmodified) treadmill walking condition. However, older adult participants demonstrated decreased overall stepping performance (% Green strides) compared to the young adults across all three feedback conditions suggesting decreased ability to *maintain* a new stepping pattern.

Results from the EF battery and physical assessments revealed the older adult group was physically high-functioning, but they exhibited EF decrements in both response inhibition and working memory compared to the YH group. EF performance was also significantly associated to decreased overall stepping performance (% Green strides).

However, analyses of how participants modified their stepping to accommodate the *competing* step goals revealed stepping variability was the primary contributor to better overall stepping performance. Across the different experimental conditions, group differences in variability suggested that the young adult group was more successful at manipulating the magnitude of their stepping variability compared to the older adult group.

Overall, Study 1 identified significant associations between better response inhibition (more words read in the Stroop Color-Word condition) and superior stepping performance in a stepping task that required participants to not only modify their preferred stepping pattern, but to *maintain* a new stepping strategy. Considering what we'd learned, we directly challenged response inhibition within our stepping task in Study 2.

For Study 2, introducing *virtual* stepping targets and obstacles significantly altered both within-trial stepping variability and stride-to-stride error correction across conditions. Specifically, both young and older participants made more rapid corrections of the stride-to-stride deviations of the stride length and time compared to the normal (unmodified) treadmill walking condition. This result aligns with past work that observed similar changes in young healthy adults when they were asked to step on evenly spaced stepping targets placed on the treadmill belt (Bohnsack-McLagan et al. 2015).

Similarly, to Study 1, our results from the EF battery and physical assessments revealed the older adult group was physically high-functioning, but demonstrated performance decrements in the Stroop Interference task (response inhibition) compared to the YH group. However, no group differences were observed in response inhibition measures assessed in the computer GNG task (not administered in Study 1).

Better Stroop Color-Word performance was significantly associated with the better stepping GNG performance. This aligns with past research that reported Stroop performance differentiated between individuals that made stepping errors in an inhibitory stepping task (Caetano et al. 2016). However, although we hypothesized significant associations between computer and stepping GNG task performances, specifically in the reversal conditions (GoR and GoRed respectively), none were found. Leading to an overall conclusion that the two GNG tasks perhaps quantified different cognitive constructs, primarily due to the *physical* demands within the stepping task.

That said, we contend the stepping GNG task allowed us to create stepping conditions that incorporated (varying) cognitive and physical demand that are relevant in walking contexts. In fact, the stepping Go-NoGo (GNG) task conditions revealed older adults made more stepping errors compared to the young adults when navigating *obstacles* but not *targets*. When considering target-to-obstacle and vice versa sequences, our analyses further revealed that study participants chose different strategies to successfully navigate these transitions. Notably, no major distinction was observed between young and older participants with respect to strategy choice. Furthermore, older adults made more stepping errors when navigating an *obstacle* that was preceded by a *target* (as opposed to a preceding *obstacle*). These results demonstrated that healthy adults are not simply challenged by a *single* target or obstacle in their path, but specific sequences of target and/or obstacles.

Study 1 **Appendix A**

HEALTH HISTORY QUESTIONNAIRE

"How Young and Older Healthy Adults Negotiate Competing Task Goals During Walking"

IRB # ***2015-02-0114*** ***Subject ID:*** ____________

Date of Birth (mm/dd/yy): _______________________ Age: __________________

MALE: ______ FEMALE: ______

Race: (please circle): Caucasian African American Latino Asian Other

1. Are you taking any medications on a regular basis? Y / N
   (Exclusions include: Psychotropics, Antihistamines, Asthma Meds, Aldomet, Clonidine, Anti-Depressants, Anti-Anxiety Meds)

2. Any over- the -counter meds? Y / N
   If yes, explain:

3. Do you have any disability or impairment that affects you when you walk? Y / N
   (If yes, excludes.)

4. Have you had any broken bones, surgery, or injury to lower extremities? Y / N
   If yes, explain:

5. Do you have arthritis? Does it cause pain or discomfort when you stand or walk? Y / N
   If yes to discomfort, excludes.

6. Have you had any significant medical problems within the last 10 years? Y / N
   If yes, explain:

7. Do you have a history of neurological diseases likely to affect your ability to stand or walk, including CVA (stroke), disc disease, peripheral neuropathy, or lower extremity weakness? Y / N
If yes, exclude.

8. Do you have any history of back problems, such as low back pain? Y / N
If yes, explain.

9. Do you have any problems with standing balance? Y / N
If yes, excludes.

10. Do you have any drug and/or alcohol dependence? Y / N
If yes, excludes.

11. Do you have any significant visual impairments? Y / N
Examples: loss of binocular vision or the presence of double vision
If yes, excludes.

12. Do you have any heart problems or coronary artery disease? Y / N
If yes, excludes.

13. Do you have hypertension? Y / N
If yes, excludes.

15. Do you have any lung or respiratory problems? Y / N
If yes, excludes.

16. Do you smoke? Y / N
Pattern?

17. Do you use alcohol? Y / N
Pattern?

18. Do you use caffeine (cola, coffee, etc.)? Y / N
Pattern?

19. Do you have any allergies that require medication? Y / N
If yes, explain.

20. Have you fallen during the past year? Y / N
If yes, explain how the fall occurred and what injuries (if any) resulted.

Educational Background

Primary/First Language: _________________________ Secondary Language: ______________________

Years of Education: ______ Highest Academic Degree: _______________________________________

Occupation: ____

(if retired, please indicate your occupation before retirement)

If you were not born in the USA, please indicate what year you moved to the USA ________

Study 1 Appendix A

Below is a list of the ways you might have felt or behaved. Please tell me how often you have felt this way during the past week.

During the past week:	**Rarely or None of the Time (Less than 1 Day)**	**Some or a Little of the Time (1-2 Days)**	**Occasionally or a Moderate Amount of Time (3-4 Days)**	**Most or All of the Time (5-7 Days)**
1. I was bothered by things that usually don't bother me.	☐	☐	☐	☐
2. I did not feel like eating; my appetite was poor.	☐	☐	☐	☐
3. I felt that I could not shake off the blues even with help from my family or friends.	☐	☐	☐	☐
4. I felt that I was just as good as other people.	☐	☐	☐	☐
5. I had trouble keeping my mind on what I was doing.	☐	☐	☐	☐
6. I felt depressed.	☐	☐	☐	☐
7. I felt that everything I did was an effort.	☐	☐	☐	☐
8. I felt hopeful about the future.	☐	☐	☐	☐
9. I thought my life had been a failure.	☐	☐	☐	☐
10. I felt fearful.	☐	☐	☐	☐
11. My sleep was restless.	☐	☐	☐	☐
12. I was happy.	☐	☐	☐	☐
13. I talked less than usual.	☐	☐	☐	☐
14. I felt lonely.	☐	☐	☐	☐
15. People were unfriendly.	☐	☐	☐	☐
16. I enjoyed life.	☐	☐	☐	☐
17. I had crying spells.	☐	☐	☐	☐
18. I felt sad.	☐	☐	☐	☐
19. I felt that people dislike me.	☐	☐	☐	☐
20. I could not get "going".	☐	☐	☐	☐

Exercise Information:
These questions are about your physical activity in the last 7 days. These can be activities you do at work, at home or in your yard, to get from place to place, and in your spare time for recreation, exercise, or sport.

vigorous activities refer to activities that take hard physical effort and make you breathe much harder than normal.

moderate activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal.

1. During the last 7 days, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling?
   _____ days per week

   ☐ No vigorous physical activities ⟶ Skip to question 3

2. How much time did you usually spend doing vigorous physical activities on one of those days?
   _____ hours _____ minutes per day

   ☐ None

3. During the last 7 days, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Think only about those physical activities you did for at least 10 minutes at a time. Do not include walking.
   _____ days per week

   ☐ No moderate physical activities ⟶ Skip to question 5

4. How much time did you usually spend doing moderate physical activities on one of those days?
   _____ hours _____ minutes per day

5. During the last 7 days, on how many days did you walk for at least 10 minutes at a time? This includes at work and at home, walking to travel from place to place, and any other walking that you might do solely for recreation, sport, exercise, or leisure.
   _____ days per week

   ☐ No walking ⟶ Skip to question 7

6. How much time did you usually spend walking on one of those days?
_____ hours _____ minutes per day

7. During the last 7 days, how much time did you spend sitting on a week day? Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.
_____ hours _____ minutes per day

Appendix A

Think of this ladder as representing where people stand in the United States.

At the **top** of the ladder are the people who are the best off – those who have the most money, the most education and the most respected jobs. At the **bottom** are the people who are the worst off – who have the least money, least education, and the least respected jobs or no job. The higher up you are on this ladder, the closer you are to the people at the very top; the lower you are, the closer you are to the people at the very bottom.

Where would you place yourself on this ladder?

Please place a large **"X"** on the rung where you think you stand at this time in your life, relative to other people in the United States.

Appendix A

Think of this ladder as representing where people stand in their communities.

People define community in different ways; please define it in whatever way is most meaningful to you. At the **top** of the ladder are the people who have the highest standing in their community. At the **bottom** are the people who have the lowest standing in their community.

Where would you place yourself on this ladder?

Please place a large **"X"** on the rung where you think you stand at this time in your life, relative to other people in your community.

SUBJECT DATA FORM

"How Young and Older Healthy Adults Negotiate Competing Task Goals During Walking"

Obtain Consent		Check
1	Participant reads and signs consent form.	☐
2	Participant fills out health history questionnaire	☐

General Measures		Measurement / Score
3	Age	years
4	Gender	F or M
5	Handedness: *Which hand do you prefer when writing?* *Which hand do you prefer when throwing?*	L or R L or R
	Dominant leg: *Which foot do you kick a soccer ball with?*	L or R
6	Blood Pressure (SYS / DIA) Inclusion Criteria [1]: systolic <140 and diastolic <90.	/ mmHg
	Resting Heart Rate	bpm

____
____
____
____
____
____

Cognitive / Psych. Assessment		Measurement / Score
7	Mini-Mental State exam (MMSE) [2] Inclusion Criteria: > 23	/ 30
	→ Use MMSE form.	

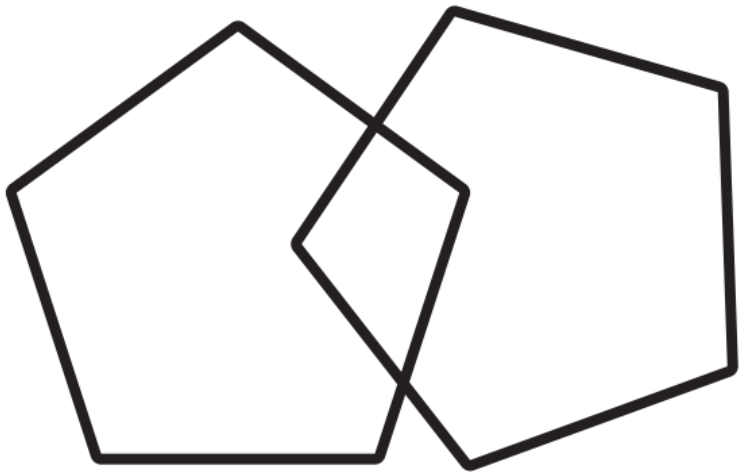
1. Orientation	Record Each Answer:	Maximum Score = 10
What is today's year?	2015	1 ☐
What is today's month?	Month	1 ☐
What is the date?	e.g. 1st	1 ☐
What is weekday is today?	Day (e.g. Monday)	1 ☐
Can you tell me what season it is?	Season	1 ☐
Can you tell the name of this educational institution?	UT Austin	1 ☐
What floor are we on?	Floor - 5th	1 ☐
What city are we in?	City - Austin	1 ☐
What county are in?	County - Travis	1 ☐
What state are we in?	State - TX	1 ☐
2. Immediate Recall		Maximum Score = 3
I will name three objects, repeat after me. ball, flag, tree (speak clearly & slowly, about 1 sec each). *Just try to remember them, I will ask later*. Check box for each correct response. The first repetition determines the score. If he/she does not repeat all three correctly, keep saying them up to six tries until he/she can repeat the.	Ball	1 ☐
	Flag	1 ☐
	Tree	1 ☐
		Number of Trials: ___________
3. Attention and Calculation		
A. Counting Backwards Test		Maximum Score = 5
Begin with the number 100 and count backwards by 7. Record each response. Check one box at the right for each correct response. Any response 7 or less than the previous response is a correct response. The score is the number of correct subtractions	93	1 ☐
	86	1 ☐
	79	1 ☐
	72	1 ☐
	65	1 ☐
B. Spelling Backwards Test		Maximum Score = 5
Next, spell the word "WORLD" backwards. Record each response.	D	1 ☐
	L	1 ☐
	R	1 ☐
	O	1 ☐
	W	1 ☐
C. Final Score		
Compare the scores of the Counting Backwards and Spelling Backwards tests. Write the greater of the two scores in the box labeled FINAL SCORE, and use it in deriving the TOTAL SCORE.		FINAL SCORE ________

4. Recall		Maximum Score = 3
Do you recall the three objects I previously asked you to remember? Record each correct response.	Ball	1 □
	Flag	1 □
	Tree	1 □
5. Language		Maximum Score = 9
NAMING		
Show the participant a wrist watch. Ask: *What is this?*	Watch	1 □
Show the participant a pencil. Ask: *What is this?*	Pencil	1 □
REPETITION		
Repeat the following statement: 'No, ifs, ands, or buts'.		1 □
THREE-STAGE COMMAND		
Give the participant a sheet of blank paper in their dominant hand and say: *Take this piece of paper, fold it in half, and put it on the floor.*	Takes paper	1 □
	Folds paper in half	1 □
	Puts paper on floor	1 □
READING		
Hold up the card/paper that reads, "Close your eyes" and say: *Read this and do what it says.* Check the box at the right only if he/she actually closes his/her eyes.	Closes Eyes.	1 □
WRITING		
Give the subject a sheet of paper and ask: *Write a sentence*. It is to be written spontaneously. If the sentence contains a subject and a verb, and is sensible, check the box at the right. Correct grammar or punctuation are not necessary.	Writes a sentence.	1 □
COPYING		
Show the participant the drawing of the intersecting pentagons and ask: *Copy this design below on this paper.* If ten angles are present and two intersect, check the box at the right. Ignore tremor and rotation.	Copies pentagons.	1 □
DERIVING THE TOTAL SCORE		
Add the number of correct responses. The maximum is 30.		TOTAL SCORE _________

Folstein, M. F., Folstein, S. E., & McHugh, P. R. (1975). "Mini-mental state": a practical method for grading the cognitive state of patients for the clinician.*Journal of psychiatric research*, *12*(3), 189-198.

Close your eyes.

Appendix A



Cognitive / Psych. Assessment		Measurement / Score
8	Iconographical Falls Efficacy Scale (Icon-FES) [3]	/ 40

- *Please look at each picture carefully, and try to imagine yourself performing the activity.*
- *We would like to know how concerned you are about the possibility of falling while doing any of the following activities, as pictured on the drawings. For each of the following activities, please show the level of concern which is closest to your own opinion to show how concerned you are that you might fall if you did this activity.*
- *According to the following SCALE* (show scale): *not at all concerned, somewhat concerned, fairly concerned, very concerned.*

		Not at all concerned	Somewhat concerned	Fairly concerned	Very concerned
		1	2	3	4
	Getting dressed.	☐	☐	☐	☐
	Taking a bath.	☐	☐	☐	☐
	Taking a shower.	☐	☐	☐	☐
	Reaching for something above your head (chair).	☐	☐	☐	☐
	Reaching for something above your head (stepping stool).	☐	☐	☐	☐
	Cleaning the gutter.	☐	☐	☐	☐
	Going down the stairs.	☐	☐	☐	☐
	Going to the shop (grocery store).	☐	☐	☐	☐
	Walking around in the neighborhood.	☐	☐	☐	☐
	Going out to a social event.	☐	☐	☐	☐

____

____

Iconographical Falls Efficacy Scale

Icon-FES

developed by

Kim Delbaere
Stuart T Smith
Stephen R Lord

Neuroscience Research Australia
Discover. Conquer. Cure.

Appendix A

"Please look at each picture carefully, and try to imagine yourself performing the activity."

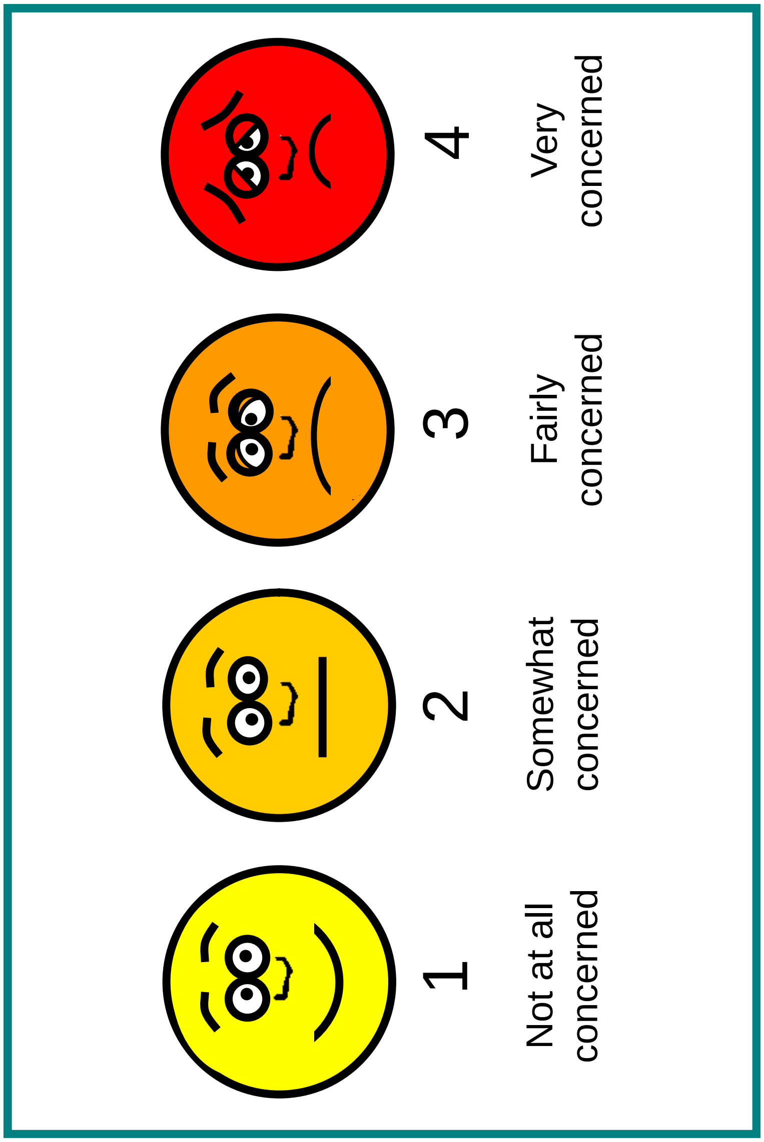
If you currently don't do the activity (e.g. if someone does your shopping for you), please answer to indicate whether you think you would be concerned about falling IF you did the activity.

Imagine that you are using your normal walking aid.

"We would like to know how concerned you are about the possibility of falling while doing any of the following activities, as pictured on the drawings. For each of the following activities, please show the level of concern which is closest to your own opinion to show how concerned you are that you might fall if you did this activity."

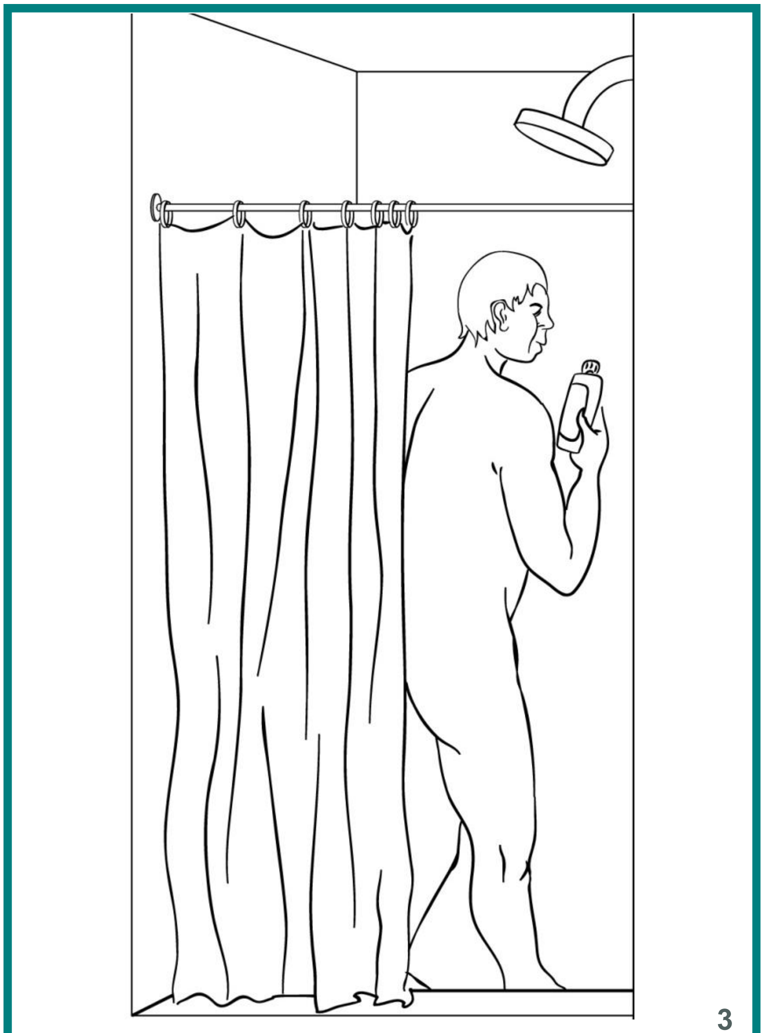
"According to the following SCALE (show scale)*: not at all concerned, somewhat concerned, fairly concerned, very concerned."*

Study 1 **Appendix A**

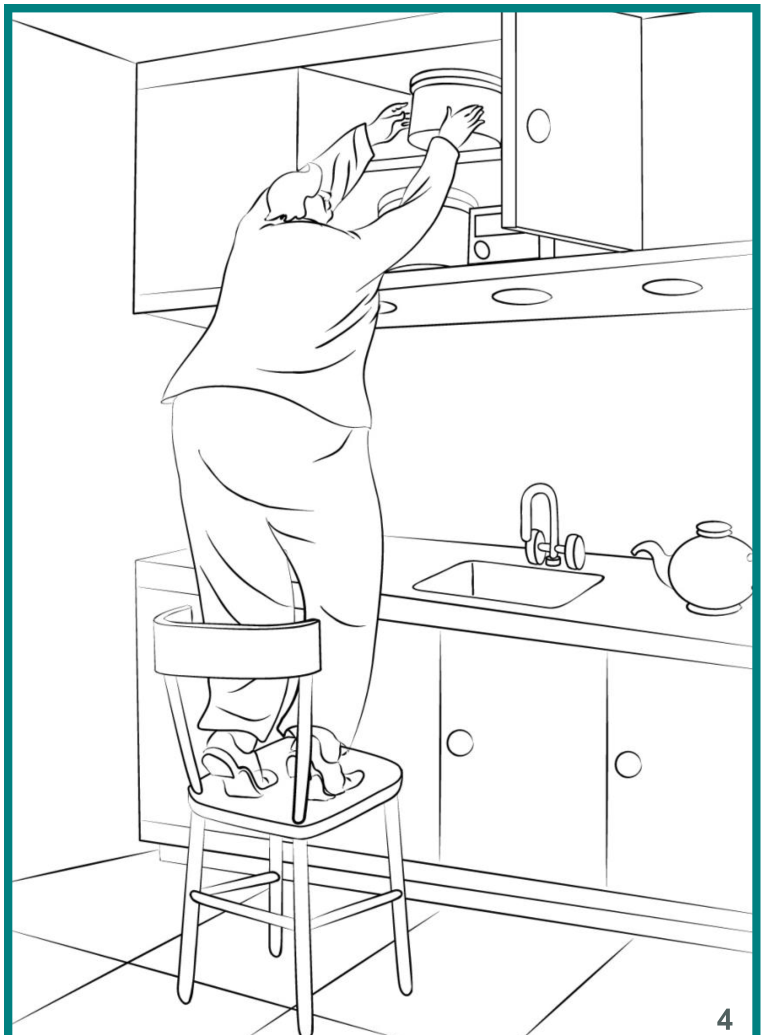


Getting dressed

Taking a bath



Taking a shower



Reaching for something above your head

Reaching for something above your head

Cleaning the gutter

Going down the stairs

Going to the shop

Walking around in the neighbourhood

Going out to a social event

Cognitive / Psych. Assessment		Measurement / Score
9	Stroop Interference Test [4, 5]	
▪ Color Blindness		Pass: ☐

At the start, screen the participant for color-blindness (use Task B page). *Ok, to begin, please name the colors in this first column until the marked line.*

▪ Word Condition (Task A) - color words in black ink	Check: ☐	

For the first task we are going to see how fast you can read the words on this page. After I say begin, you are to read down the columns starting with the first one (point to the left-most column) *until you complete it* (run your hand down the remaining columns) *and then continue without stopping down the remaining columns in order* (run your hand down the next columns in order). *If you finish all the columns before I say 'STOP', then return to the first column and begin again* (point to the first column). *Remember, do not stop reading until I tell you to 'STOP' and read out loud as quickly as you can. If you make a mistake, I will say 'incorrect' to you. Correct your error and continue without stopping. Do you have any questions?* (Pause).

During the trial, say: *Ready?* (wait for response) *Then begin…* [*Start stopwatch*]. After 45 seconds say: *Stop. Circle the item you are on. If you finished the entire page and began again, put the number 1 by your circle.*

▪ Color Condition (Task B) - colored XXX, in colored ink	Check: ☐	

This time we want to see how fast you can name the colors on this page. You will complete this page just as you did the previous page, starting with the first column. Remember to name the colors out loud as quickly as you can. Do you have any questions? (Pause).

During the trial, say: *Ready?* (wait for response) *Then begin…* [*Start stopwatch*]. After 45 seconds say: *Stop. Circle the item you are on. If you finished the entire page and began again, put the number 1 by your circle.*

▪ Color-Word Condition (Task C) - color word in different color ink	Check: ☐	

This last page is like the page you just finished. I want you to name the color of the ink the words are printed in ignoring the word. For example, [point to the first item of the first column], *this is the first item: what would you say?* If response is incorrect, say: *No. That is the word that is spelled there. I want you to name the color of the ink the word is printed in. Now, try again.* If response is correct say, *Good. You will do this page just like the others, starting with the first column and then going on to as many columns as possible. Remember, if you make a mistake, just correct it and go on.* (Pause).

During the trial, say: *Ready?* (wait for response) *Then begin…* [*Start stopwatch*]. After 45 seconds say: *Stop. Circle the item you are on. If you finished the entire page and began again, put the number 1 by your circle.*

To be calculated later:

$$\boldsymbol{Interference\ score = Task\ C - [(Task\ A \times Task\ B) \div (Task\ A + Task\ C)]}$$

Interference Score = ________________________

Physical Assessment

10

Timed Up and Go (TUG) [6]

GENERAL:

- The participant will sit on a standard armchair, placing his/her back against the chair and resting his/her arms on the chair's arms.
- Regular footwear should be used.
- The participant will walk to a line that is 3 meters away, turn around at the line, walk back to the chair, and sit down.
- Participants should be instructed to use a comfortable and safe walking speed.
- A stopwatch is used to time the test (in seconds).

INSTRUCTIONS:

- *You will sit on this chair.* (Demonstrate) *You will place your back against the chair and rest your arms on the chair's arms. When you are ready (let me know verbally), I will say 'Go'. At a comfortable and safe walking speed, walk to the line, turn around at the line, walk back to the chair, and sit down.*
- [Demonstrate the entire test to the participant.]
- *We will begin with a practice trial. When you are ready (let me know verbally and), I will say 'Go'.*
- Participant will indicate they are "Ready" (verbally).
- Then, experimenter will say "GO". The stopwatch will start when the experimenter says go, and will be stopped with the participant's buttocks touch the seat.

For the recorded trial:

- *We will collect the real trial now. You will sit on this chair. You will place your back against the chair and rest your arms on the chair's arms. When you are ready (let me know verbally and), I will say 'Go'.*
- Participant will indicate they are "Ready" (verbally).
- Then, experimenter will say "GO". The stopwatch will start when the experimenter say go, and will be stopped with the participant's buttocks touch the seat.

TUG Time Inclusion Criteria [7, 8]: ≤ 12 sec	sec

____
____
____
____

Cognitive / Psych. Assessment

NOTE: Turn lab lights out.

11	Delayed-Match-to-Sample task (DMS)	Check: ☐

- *During this assessment, you will see a single matrix filled with red and yellow squares* (show example).
- *Study it and try to remember it.*
- *When you are ready, press any key to move to the test.*
- *After a short time delay, you will see two matrices.*
- *One of these is identical to the matrix you saw before. The other is slightly different.*
- *Press the shift key (LEFT or RIGHT) which corresponds to the correct matrix.*
- *Try to move through the assessment as quickly as you can, while still being accurate.*
- *You will begin with a short (1-minute) practice trial.*
- *Please let me know when you are done & I will come back in* (set-up practice trials).
- *When you are ready to begin, press the spacebar.*

---------- After the practice trial ---

- *Do you have any questions?* (Pause, set-up real trials). *Ok, you will start the real trials now. When you are ready to begin, press the spacebar.*

General note: The actual DMS trials will be approximately 5-6 minutes long.

NOTE: Give 2 minutes of rest.

12	Psychomotor Vigilance Test (PVT)	Check: ☐

- *During this assessment, please pay attention to the stimuli on the screen.*
- *Do not respond to the fixation cross: "+".*
- *At random time intervals, a bright millisecond timer (counting up) will appear in the center of the screen.*
- *Press the spacebar as quickly as possible whenever you see the counter appear (your response will stop counter).*
- *You will begin with a short (1-minute) practice trial.*
- *Please let me know when you are done & I will come back in* (set-up practice trials).
- *When you are ready to begin, press the spacebar.*

---------- After the practice trial ---

- *Do you have any questions?* (Pause, set-up real trials). *Ok, you will start the real trials now. When you are ready to begin, press the spacebar.*

General note: The actual PVT trials will be approximately 5 minutes long.

Physical Assessment

13

Lower Limb Strength (Knee Extensors) [9] - *Measure 3X*

Participant sits on table with knee at 90 degrees. The dynamometer is fixed below the table. An ankle strap will be secured on their shank (just proximal to lateral and medial malleoli). The participant is instructed to grip the table. Each force measurement is performed 3 times, with a minimum of 30 seconds of rest in between. The moment-arm length is measured from the lateral epicondyle of the femur to the point of force measurement. Participant receives loud encouragement (e.g. "GO GO GO!!") during the measurement.

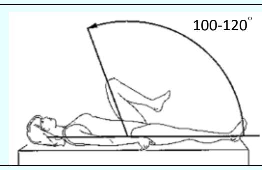
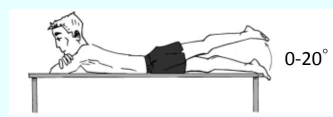
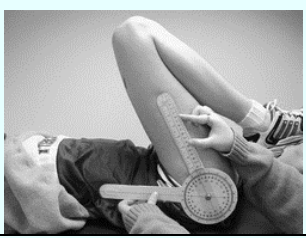
I will be measuring your quad strength here. Grip the table with your hands, and stay seated. On 'GO', you will push forward with maximum effort, extending your knee until I say 'STOP' (~2 seconds).

LEFT		1	2	3	MAX
	FORCE PRODUCED				lb
	MOMENT-ARM LENGTH				m

RIGHT		1	2	3	MAX
	FORCE PRODUCED				lb
	MOMENT-ARM LENGTH				m

Physical Assessment

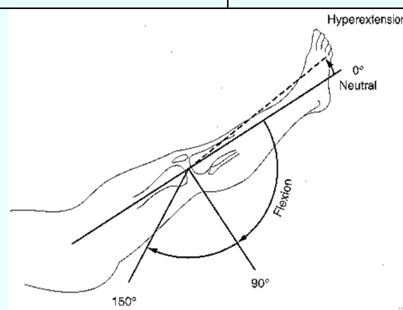
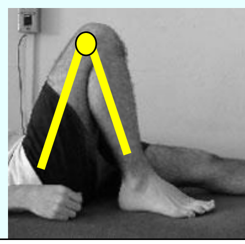
14	Passive Range of Motion (ROM) – *Measure Each Once* - **NOTE: Remove shoes.**

HIP		
Goniometer Axis	Femoral greater trochanter	
Proximal Arm	Parallel to mid-axillary line of the trunk	
Distal Arm	Parallel to longitudinal axis of the femur in line with lateral femoral condyle	
	HIP FLEXION	**HIP EXTENSION**
Testing Position	Participant lays supine with arms at their sides on the table. The participant starts with the knee extended. The experimenter is standing on the same side as the examined hip. The contralateral leg is kept straight. Both the contralateral and pelvis are belted for stabilization.	Participant lays prone on the table. Experimenter may stabilize at the iliac crest. A pillow may be placed under the participant's stomach/pelvis for support and to ensure ASIS and PS remain on table. The lower back is belted to the table for stabilization.
Movement	**The experimenter flexes the examined hip as far as it can go without the participant being uncomfortable.** Important: Be sure examined leg is completely in the sagittal plane.	**The experimenter extends the examined hip as far as it can go without the participant being uncomfortable.** Important: Be sure lower back is not arching during the movement.
		
		
Expected ROM	100-120°	0-20°

L HIP	Maximum				**Left Hip ROM**
	Flexion Angle		Extension Angle		
		-		**=**	°

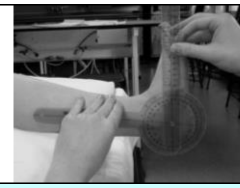
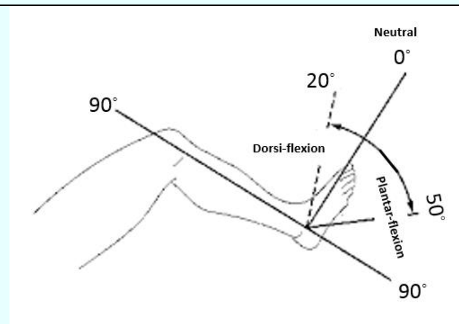
R HIP	Maximum				**Right Hip ROM**
	Flexion Angle		Extension Angle		
		-		**=**	°

Study 1 Appendix A

KNEE		
Goniometer Axis	Lateral epicondyle of the femur	
Proximal Arm	Parallel to the long axis of the femur and pointing at the greater trochanter	
Distal Arm	Parallel to the long axis of the fibula and pointing at the lateral malleolus	
	KNEE FLEXION	**KNEE EXTENSION**
Testing Position	Participant lays supine on the table. The participant starts with their leg extended, and is asked to bring their heel toward the buttock.	Participant lays supine on the table. Place a towel under ankle. The shank should not be touching the table.
Movement	**The experimenter flexes the leg at the knee as far as it would go without causing the participant discomfort.**	**The experimenter gently applies a small amount of force down on the knee to straighten the knee (and identify any hyperextension).**
		
		
Expected ROM	120-135°	0°. Hyperextension may be present up to 10-15°

L KNEE	Maximum				
	Flexion Angle		Extension Angle		**Left Knee ROM**
		-		=	°

R KNEE	Maximum				
	Flexion Angle		Extension Angle		**Right Knee ROM**
		-		=	°

ANKLE		
Goniometer Axis	Approximately 1.5 cm inferior (lower) to the lateral malleolus	
Proximal Arm	Parallel to the longitudinal axis of the fibula, lining up with the fibula head	
Distal Arm	Parallel to the longitudinal axis of the 5th metatarsal (styloid process)	
	ANKLE PLANTARFLEXION	**ANKLE DORSIFLEXION**
Testing Position	Participant lays prone with knee at a 90 degree with respect to the upper leg. The participant starts with their foot neutral (should be an "L").	
Movement	**The experimenter presses the foot *away* from the shin as far as it will go without causing the participant discomfort.**	**The experimenter presses the foot *toward* the shin as far as it will go without causing the participant discomfort.**
	Important: Be sure Achilles /calcaneus is straight (to eliminate any foot inversion or eversion) during the movement.	
		
		
Expected ROM	0-45°	0-20°

L ANKLE	Maximum				
	Plantarflexion Angle		Dorsiflexion Angle		**Left Ankle ROM**
		-		=	°

R ANKLE	Maximum				
	Plantarflexion Angle		Dorsiflexion Angle		**Right Ankle ROM**
		-		=	°

Prepare Participant for Data Collection			Check	
15	Body Weight	Inclusion Criteria: BMI <30	kg	
	Height		m	
16	Vision Acuity Participant stands 2.8 meters from Snellen chart. Test one eye at a time. Read the letters from left to right. Guide participant by pointing at the particular line to read. Inclusion Criteria: 20/20 ± 5.		LEFT EYE 20 / ____	RIGHT EYE 20 / ____
17	→ Participant stands on treadmill to identify any reflective issues on clothing. Place <u>HARNESS</u> and (16) reflective markers on Participant.		☐	
18	Trace shoe prints+ note ML position of TOE + HEEL markers!		☐	
19	Leg Length Measure from greater trochanter to the floor.		m	
20	Collect STATIC trial of participant on treadmill. Create VICON Model.		☐	
21	Provide participant with experimental INSTRUCTIONS.		☐	
General	▪ *You will walk for ~45 minutes. You will receive seated rest breaks throughout.* ▪ *During all the conditions, you will walk at a constant speed [if they ask: 1 m/s ~2.2 mph].*			
#1	▪ *During some of the conditions, a graph of your stride lengths (on the vertical axis) versus your stride times (on the horizontal axis) will be displayed.* ▪ *A "stride" is two consecutive steps* (demonstrate). ▪ *The yellow line (shown here) represents the treadmill belt speed.* ▪ *This line will only be visible during the training period (~5 minutes).* ▪ *As you walk, your most recent 5 strides will be displayed on the graph as spheres. Your last stride will be easy to distinguish b/c it will be the largest sphere.*			
#2	▪ *A sphere <u>above</u> the yellow line represents a "Fast Stride" where you are walking faster than the treadmill speed.* ▪ *A sphere <u>below</u> the yellow line represents a "Slow Stride" where you are walking slower than the treadmill speed.* ▪ *A sphere ~ <u>ON</u> the yellow line represents a stride where you are walking at the treadmill speed.*			
#3	▪ *If you move <u>up</u> the yellow line, this represents a "Longer Slower" stride.* ▪ *If you move <u>down</u> the yellow line, this represents a "Shorter Faster" stride.*			

#4 - TASK GOALS	▪ *During some of the conditions (not all), there will be 1-2 fixed "targets" visible on the graph (they will be displayed as navy blue spheres).* ▪ *During these conditions, your strides (also represented by spheres) will be color-coded depending on how close you are to these fixed "targets". The color green is "good". Yellow is "ok". Red is "bad" (meaning far). There will also be auditory feedback.* ▪ *We will begin with a 5 minute training period. The yellow line representing the treadmill belt speed will be visible. There will be no "targets" during this training period.* ▪ *Use this time to explore and try different stride lengths and times.*
	▪ Enter treadmill speed = 1 m/s ▪ Enter participant's leg length into D-Flow / Type the "Predicted L_n" value into "Experiment L_n" input. ▪ Set D-Flow computer volume to Maximum
22	Participant walks on Treadmill for acclimation (5 min). ☐
23	**After Training (seated):** ▪ *Now you will walk in four different conditions. Do your best to walk in the center of the treadmill.* ▪ *As mentioned, during some of the conditions (not all), there will be 1-2 fixed "targets" visible on the graph (they will be displayed as navy blue spheres).* ▪ *During these conditions, your strides (also represented by spheres) will be color-coded depending on how close you are to these fixed "targets". The color green is "good". Yellow is "ok". Red is "bad" (meaning far). There will also be auditory feedback.* ▪ *During all trials with targets, a score on the screen will continuously update. You will receive 10 points for green strides, 3 points for yellow strides, and zero points for red strides.* ▪ ***During these conditions, your goal is to walk normally, seek green-colored strides, and maximize your score.*** *Do you have any questions?* (Pause) ▪ *Ok, each condition will include a 3 minute PRACTICE trial, followed by 2 real trials of 3 minutes each. Seated rest will be provided between trials.* ▪ *During the practice trials, feel free to explore different strategies. In the real trials, choose a strategy that worked during the practice trial.*

24 Walk in the NOF (No Feedback) Condition

Description	Time	Completed	Comments
Trial 1	3 min	☐	
Seated Rest	2 min	☐	
Trial 2	3 min	☐	
Seated Rest	2 min	☐	

Average L_n during NOF (Trial 2, last 20 strides): at 1 min remaining ______ at 1-2 sec remaining ______†	________________ m Average L_n (last 20 strides) at 3 min mark†

▪ Enter participant's average L_n (m) into D-Flow's "Experiment L_n" input

Study 1 Appendix A

Data Collection		
1st Condition	2nd Condition	3rd Condition

<u>During the 2 target conditions:</u> *There will be two targets during this conditions, free to choose a single target or move back and forth between 2 targets.*

	Description	Time	Completed	Comments	
1st Condition	____________				
	Practice Trial	3 min	☐	**Score:**	
	Seated Rest	2 min	☐		
	Trial 1	3 min	☐	**Score:**	
	Seated Rest	2 min	☐		
	Trial 2	3 min	☐	**Score:**	
	Seated Rest	2 min	☐		

	Description	Time	Completed	Comments	
2nd Condition	____________				
	Practice Trial	3 min	☐	**Score:**	
	Seated Rest	2 min	☐		
	Trial 1	3 min	☐	**Score:**	
	Seated Rest	2 min	☐		
	Trial 2	3 min	☐	**Score:**	
	Seated Rest	2 min	☐		

	Description	Time	Completed	Comments	
3rd Condition	___________				
	Practice Trial	3 min	☐	**Score:**	
	Seated Rest	2 min	☐		
	Trial 1	3 min	☐	**Score:**	
	Seated Rest	2 min	☐		
	Trial 2	3 min	☐	**Score:**	
	Seated Rest	2 min	☐		

EXIT QUESTIONS:

1. How did you use the visual feedback provided to you during the experiment?

2. During the different experimental conditions, what motivated your stepping decisions or strategy (i.e. game plan)?

3. Did you find any of the experimental conditions challenging? If yes, please explain?

4. Do you play any video games on either a game console, computer, or cell phone? If yes, which games (e.g. Sudoku) and how often (hours per week)?

	Final Payment to Participant	Check
	Have participant sign accounting document.	☐

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Study 2 **Appendix B**

HEALTH HISTORY QUESTIONNAIRE

"How Young and Older Healthy Adults Negotiate Competing Task Goals During Walking"

IRB # *2015-02-0114* ***Subject ID:*** ____________

Date of Birth (mm/dd/yy): ______________________ Age: __________________

MALE: ______ FEMALE: ______

Race: (please circle): Caucasian African American Latino Asian Other

Educational Background

Primary/First Language: ______________________ Secondary Language: ____________________

Years of Education: ______ Highest Academic Degree: ___________________________________

Occupation: ____

(if retired, please indicate your occupation before retirement)

If you were not born in the USA, please indicate what year you moved to the USA ________

Think of this ladder as representing where people stand in the United States

At the **top** of the ladder are the people who are the best off – those who have the most money, the most education, and the most respected jobs. At the **bottom** are the people who are the worst off – those who have the least money, the least education, and the least respected jobs or no job. The higher up you are on this ladder, the closer you are to the people at the very top; the lower you are, the closer you are to the people at the very bottom.

Where would you place yourself on this ladder?
Please place a large 'X' on the rung where you think you stand at this time in your life, relative to other people in the United States.

Think of this ladder as representing where people stand in their communities

People define community in different ways; please define it in whatever way is most meaningful to you. At the **top** of the ladder are the people who have the highest standing in their community. At the **bottom** are the people who have the lowest standing in their community.

Where would you place yourself on this ladder?
Please place a large 'X' on the rung where you think you stand at this time in your life, relative to other people in your community.

[Source: http://www.macses.ucsf.edu/research/socialenviron/sociodemographic.php]

Study 2 Appendix B

Health History Information

1. Are you taking any medications on a regular basis? Y / N
(Exclusions include: Psychotropics, Antihistamines, Asthma Meds, Aldomet, Clonidine, Anti-Depressants, Anti-Anxiety Meds)

2. Any over- the -counter meds? Y / N
If yes, explain:

3. Do you have any disability or impairment that affects you when you walk? Y / N
(If yes, excludes.)

4. Have you had any broken bones, surgery, or injury to lower extremities? Y / N
If yes, explain:

5. Do you have arthritis? Does it cause pain or discomfort when you stand or walk? Y / N
If yes to discomfort, excludes.

6. Have you had any significant medical problems within the last 10 years? Y / N
If yes, explain:

7. Do you have a history of neurological diseases likely to affect your ability to stand or walk, including CVA (stroke), disc disease, peripheral neuropathy, or lower extremity weakness? Y / N
If yes, exclude.

8. Do you have any history of back problems, such as low back pain? Y / N
If yes, explain.

9. Do you have any problems with standing balance? Y / N
If yes, excludes.

10. Do you have any drug and/or alcohol dependence? Y / N
If yes, excludes.

11. Do you have any significant visual impairments? Y / N
Examples: loss of binocular vision or the presence of double vision
If yes, excludes.

12. Do you have any heart problems or coronary artery disease? Y / N
If yes, excludes.

13. Do you have hypertension? Y / N
If yes, excludes.

14. Do you have any lung or respiratory problems? Y / N
If yes, excludes.

15. Do you smoke? Y / N
Pattern?

16. Do you use alcohol? Y / N
Pattern?

17. Do you use caffeine (cola, coffee, etc.)? Y / N
Pattern?

18. Do you have any allergies that require medication? Y / N
If yes, explain.

19. Have you fallen during the past year? Y / N
If yes, explain how the fall occurred and what injuries (if any) resulted.

20. Many people feel older or younger than they actually are.
What age do you feel most of the time? ____________ yrs

Sleep Information

Last Night: Approximately how many hours of sleep did you receive? __________________________

During a typical week, how many hours of sleep do you receive per night? ______________________

Study 2 **Appendix B**

Below is a list of the ways you might have felt or behaved. Please tell me how often you have felt this way during the past week.

During the past week:	**Rarely or None of the Time (Less than 1 Day)**	**Some or a Little of the Time (1-2 Days)**	**Occasionally or a Moderate Amount of Time (3-4 Days)**	**Most or All of the Time (5-7 Days)**
1. I was bothered by things that usually don't bother me.	☐	☐	☐	☐
2. I did not feel like eating; my appetite was poor.	☐	☐	☐	☐
3. I felt that I could not shake off the blues even with help from my family or friends.	☐	☐	☐	☐
4. I felt that I was just as good as other people.	☐	☐	☐	☐
5. I had trouble keeping my mind on what I was doing.	☐	☐	☐	☐
6. I felt depressed.	☐	☐	☐	☐
7. I felt that everything I did was an effort.	☐	☐	☐	☐
8. I felt hopeful about the future.	☐	☐	☐	☐
9. I thought my life had been a failure.	☐	☐	☐	☐
10. I felt fearful.	☐	☐	☐	☐
11. My sleep was restless.	☐	☐	☐	☐
12. I was happy.	☐	☐	☐	☐
13. I talked less than usual.	☐	☐	☐	☐
14. I felt lonely.	☐	☐	☐	☐
15. People were unfriendly.	☐	☐	☐	☐
16. I enjoyed life.	☐	☐	☐	☐
17. I had crying spells.	☐	☐	☐	☐
18. I felt sad.	☐	☐	☐	☐
19. I felt that people dislike me.	☐	☐	☐	☐
20. I could not get "going".	☐	☐	☐	☐

Exercise Information:

These questions are about your physical activity in the last 7 days. These can be activities you do at work, at home or in your yard, to get from place to place, and in your spare time for recreation, exercise, or sport.

vigorous activities refer to activities that take hard physical effort and make you breathe much harder than normal.

moderate activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal.

1. During the last 7 days, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling?
   _____ days per week
   ☐ No vigorous physical activities → Skip to question 3

2. How much time did you usually spend doing vigorous physical activities on one of those days?
   _____ hours _____ minutes per day
   ☐ None

3. During the last 7 days, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Think only about those physical activities you did for at least 10 minutes at a time. Do not include walking.
   _____ days per week
   ☐ No moderate physical activities → Skip to question 5

4. How much time did you usually spend doing moderate physical activities on one of those days?
   _____ hours _____ minutes per day

5. During the last 7 days, on how many days did you walk for at least 10 minutes at a time? This includes at work and at home, walking to travel from place to place, and any other walking that you might do solely for recreation, sport, exercise, or leisure.
   _____ days per week
   ☐ No walking → Skip to question 7

6. How much time did you usually spend walking on one of those days?
   _____ hours _____ minutes per day

7. During the last 7 days, how much time did you spend sitting on a week day? Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.
   _____ hours _____ minutes per day

Study 2 **Appendix B**

Title	Leisure and Social Activities Survey
Creator	Mandy Salinas
Laboratory	Nonlinear Biodynamics Laboratory (NBL)
Date Created	04/26/2016
Last Modified	05/06/2016 by M. Salinas
Purpose + Background	To assess intrapersonal (i.e. activity preferences) and interpersonal (i.e. social support) level factors of both young and older adults (for project P0047). A published systematic review [1] examining the relationship between leisure activity (its definition, categorization, and operationalization) and prevention of later-life cognitive decline was used as a guide. This systematic review reported: "About 39% of all the studies (n=20) reported cognitively stimulating activities as most important and significantly associated with a preventive effect outcome. About 29% of the studies (n=15) found physical activity as most important and significantly associated with preventive effect. Finally, about 19% (n=10) found social activity as most important and significantly associated with the preventive effect." ▪ At the time this survey was created, physical activity was recorded in a separate NBL survey (IPAQ survey, therefore it was not surveyed here). Only cognitive activities (described as "Leisure Activities" to participants) and social activities are surveyed. ▪ Cognitive Activity Questions (pages 1-5) were modified from [2-8]. ▪ Social Activity Questions (pages 6-8) were modified from [9-11].

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On the following pages, we will ask you to reflect on your **employment, leisure and social activities** over the last year.

Begin Here ↓

Employment is an occupation that you do regularly by which you earn a wage; job, trade, profession.

Do you currently hold employment?	☐ YES ☐ NO	
	IF YES, PLEASE ANSWER BELOW.	
	Job Title (s): ____________________________ ____________________________	______________ Hours / Week ______________

Are you a full-time student?	☐ YES ☐ NO

<u>Leisure time</u> is time free from the demands of work, when you can rest, enjoy hobbies, etc.

BELOW IS A LIST OF LEISURE ACTIVITIES.

Directions: Each box has 3 parts

(i) Place a **CHECK √** in the box corresponding to <u>how often</u> you perform the leisure activity.
(ii) (ii) Then, if applicable, fill in <u>how long</u> (on average) you perform the leisure activity.
(iii) Finally, place a **CHECK √** in the box corresponding to <u>how you feel</u> your leisure would be if you spent more time on the given activity.

1. Participate in recreational classes	**HOW OFTEN?**	NEVER	AT LEAST ONCE A YEAR	AT LEAST ONCE A MONTH	AT LEAST ONCE PER WEEK	FEW TIMES PER WEEK	EVERYDAY
Recreational – meaning for enjoyment, amusement, or pleasure.	**HOW LONG?**	N/A	AVERAGE TIME:				
			____________ Minutes ____________ Hours				
Do you feel that your leisure would be *better* (i.e. more enjoyable), about the *same*, or *worse* if you spent more time on this activity?		BETTER	SAME	WORSE	UNSURE		

2. Participate in unpaid volunteer work	**HOW OFTEN?**	NEVER	AT LEAST ONCE A YEAR	AT LEAST ONCE A MONTH	AT LEAST ONCE PER WEEK	FEW TIMES PER WEEK	EVERYDAY
	HOW LONG?	N/A	AVERAGE TIME:				
			____________ Minutes ____________ Hours				
Do you feel that your leisure would be *better* (i.e. more enjoyable), about the *same*, or *worse* if you spent more time on this activity?		BETTER	SAME	WORSE	UNSURE		

3. **Read for pleasure**	How Often?	Never	At Least Once A Year	At Least Once A Month	At Least Once Per Week	Few Times Per Week	Everyday
	How Long?	N/A	Average Time:				
			____________ Minutes ____________ Hours				
Do you feel that your leisure would be *better* (i.e. more enjoyable), about the *same*, or *worse* if you spent more time on this activity?		Better		Same	Worse		Unsure

4. **Write for pleasure** (e.g. journal, diary, fiction)	How Often?	Never	At Least Once A Year	At Least Once A Month	At Least Once Per Week	Few Times Per Week	Everyday
	How Long?	N/A	Average Time:				
			____________ Minutes ____________ Hours				
Do you feel that your leisure would be *better* (i.e. more enjoyable), about the *same*, or *worse* if you spent more time on this activity?		Better		Same	Worse		Unsure

5. **Work on puzzles** (e.g. crossword, jigsaw, word search, Sudoku)	How Often?	Never	At Least Once A Year	At Least Once A Month	At Least Once Per Week	Few Times Per Week	Everyday
	How Long?	N/A	Average Time:				
			____________ Minutes ____________ Hours				
Do you feel that your leisure would be *better* (i.e. more enjoyable), about the *same*, or *worse* if you spent more time on this activity?		Better		Same	Worse		Unsure

Study 2 Appendix B

6. Watch television, listen to radio (also consider podcasts, Hulu, Netflix, etc.)	**How Often?**	Never	At Least Once A Year	At Least Once A Month	At Least Once Per Week	Few Times Per Week	Everyday
	How Long?	N/A	Average Time:				
			________________ Minutes ________________ Hours				
Do you feel that your leisure would be *better* (i.e. more enjoyable), about the *same*, or *worse* if you spent more time on this activity?	Better		Same		Worse		Unsure

7. Play a musical instrument	**How Often?**	Never	At Least Once A Year	At Least Once A Month	At Least Once Per Week	Few Times Per Week	Everyday
	How Long?	N/A	Average Time:				
			________________ Minutes ________________ Hours				
Do you feel that your leisure would be *better* (i.e. more enjoyable), about the *same*, or *worse* if you spent more time on this activity?	Better		Same		Worse		Unsure

8. Play video games (on game consoles, computers, or apps on phones)	**How Often?**	Never	At Least Once A Year	At Least Once A Month	At Least Once Per Week	Few Times Per Week	Everyday
	How Long?	N/A	Average Time:				
			________________ Minutes ________________ Hours				
Do you feel that your leisure would be *better* (i.e. more enjoyable), about the *same*, or *worse* if you spent more time on this activity?	Better		Same		Worse		Unsure

9. **Play board or card games** (e.g. checkers, chess, scrabble)	How Often?	Never	At Least Once A Year	At Least Once A Month	At Least Once Per Week	Few Times Per Week	Everyday
	How Long?	N/A	Average Time:				
			________________ Minutes ________________ Hours				

Do you feel that your leisure would be *better* (i.e. more enjoyable), about the *same*, or *worse* if you spent more time on this activity?	Better	Same	Worse	Unsure

10. **Go to movies, theater, art, music, or sporting events**	How Often?	Never	At Least Once A Year	At Least Once A Month	At Least Once Per Week	Few Times Per Week	Everyday
	How Long?	N/A	Average Time:				
			________________ Minutes ________________ Hours				

Do you feel that your leisure would be *better* (i.e. more enjoyable), about the *same*, or *worse* if you spent more time on this activity?	Better	Same	Worse	Unsure

11. **Go to a recreational or community center**	How Often?	Never	At Least Once A Year	At Least Once A Month	At Least Once Per Week	Few Times Per Week	Everyday
	How Long?	N/A	Average Time:				
			________________ Minutes ________________ Hours				

Do you feel that your leisure would be *better* (i.e. more enjoyable), about the *same*, or *worse* if you spent more time on this activity?	Better	Same	Worse	Unsure

12. Attend meetings of clubs or community groups (including religious services)	**How Often?**	Never	At Least Once A Year	At Least Once A Month	At Least Once Per Week	Few Times Per Week	Everyday
	How Long?	N/A	Average Time:				
			____________________ Minutes ____________________ Hours				

Do you feel that your leisure would be *better* (i.e. more enjoyable), about the *same*, or *worse* if you spent more time on this activity?	Better	Same	Worse	Unsure

13. Is there another personal hobby (not yet mentioned) you enjoy greatly and/or do often?	Place a **CHECK √** in the corresponding boxes:		
	Enjoy Greatly	Do Often	N/A
			Move to next page.

If applicable, list (or describe) your personal hobby below (Please limit to 1 hobby)?

____

____

How Often?	Never	At Least Once A Year	At Least Once A Month	At Least Once Per Week	Few Times Per Week	Everyday
How Long?	N/A	Average Time:				
		____________________ Minutes ____________________ Hours				

Do you feel that your leisure would be *better* (i.e. more enjoyable), about the *same*, or *worse* if you spent more time on this activity?	Better	Same	Worse	Unsure

Study 2 Appendix B

Social Network or Interactions

Social time is time involving activities in which you spend time with friends or family relatives, communicating and/or doing things together, etc.

Place a **CHECK √** in the corresponding box.						
	0	**1**	**2-3**	**4-5**	**6-10**	**11+**
1. How many **family relatives** do you keep in touch by phone, text (all messaging applications), or visits?						
2. How many **friends and neighbors** do you keep in touch by phone, text (all messaging applications), or visits?						
3. How many close friends/family relatives do you have that you feel at ease with, can talk to about private matters, and can call for help?						

4. How often do you feel you play an important role in the lives of your friends and family relatives?	PLACE A **CHECK √** IN THE CORRESPONDING BOX.			
	NEVER	SOMETIMES	FREQUENTLY	ALWAYS
Do you feel that your social interactions would be *better* (i.e. more enjoyable), about the *same*, or *worse* if you were needed more by your friends and family relatives?	BETTER	SAME	WORSE	UNSURE

Directions: Each box has 3 parts

(iv) Place a **CHECK √** in the box corresponding to how often you perform these activities.

(v) (ii) Then, if applicable, fill in how long (on average) you perform these activities.

(vi) Finally, place a **CHECK √** in the box corresponding to how you feel your social time would be if you spent more time on the activity.

5. Describe how often you are in contact by phone, text, or "getting together" with your **family relatives**?							
	How Often?	Never	At Least Once A Year	At Least Once A Month	At Least Once Per Week	Few Times Per Week	Everyday
	How Long?	N/A	Average Time:				
			________________ Minutes ________________ Hours				

Do you feel that your social time would be *better* (i.e. more enjoyable), about the *same*, or *worse* if you spent more time on this activity?	Better	Same	Worse	Unsure

6. Describe how often you are in contact by phone, text, or "getting together" with your **friends & neighbors**?							
	How Often?	Never	At Least Once A Year	At Least Once A Month	At Least Once Per Week	Few Times Per Week	Everyday
	How Long?	N/A	Average Time:				
			________________ Minutes ________________ Hours				

Do you feel that your social time would be *better* (i.e. more enjoyable), about the *same*, or *worse* if you spent more time on this activity?	Better	Same	Worse	Unsure

SUBJECT DATA FORM

"How Young and Older Healthy Adults Negotiate Competing Task Goals During Walking"

Obtain Consent		Check
1	Participant reads and signs consent form.	☐
2	Participant fills out health history questionnaire	☐

General Measures		Measurement / Score
3	Age	years
4	Gender	F or M
5	Handedness: *Which hand do you prefer when writing?* *Which hand do you prefer when throwing?*	L or R L or R
	Dominant leg: *Which foot do you kick a soccer ball with?*	L or R
6	Blood Pressure (SYS / DIA) Inclusion Criteria [1]: systolic <140 and diastolic <90.	/ mmHg
	Resting Heart Rate	bpm

____
____
____
____
____
____

Cognitive / Psych. Assessment		Measurement / Score
7	Mini-Mental State exam (MMSE) [2] Inclusion Criteria: > 23	/ 30
	→ Use MMSE form.	

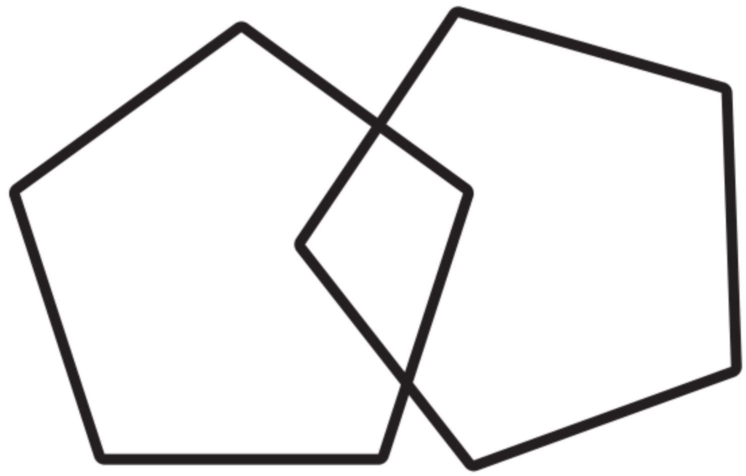
1. **Orientation**	Record Each Answer:	Maximum Score = 10
What is today's year?	2016	1 ☐
What is today's month?	Month	1 ☐
What is the date?	e.g. 1st	1 ☐
What is weekday is today?	Day (e.g. Monday)	1 ☐
Can you tell me what season it is?	Season	1 ☐
Can you tell the name of this educational institution?	UT Austin	1 ☐
What floor are we on?	Floor - 5th	1 ☐
What city are we in?	City - Austin	1 ☐
What county are we in?	County - Travis	1 ☐
What state are we in?	State - TX	1 ☐
2. **Immediate Recall**		Maximum Score = 3
I will name three objects, repeat after me. ball, flag, tree (speak clearly & slowly, about 1 sec each). *Just try to remember them, I will ask later*. Check box for each correct response. The first repetition determines the score. If he/she does not repeat all three correctly, keep saying them up to six tries until he/she can repeat the.	Ball	1 ☐
	Flag	1 ☐
	Tree	1 ☐
		Number of Trials: ___________
3. **Attention and Calculation**		
A. COUNTING BACKWARDS TEST		Maximum Score = 5
Begin with the number 100 and count backwards by 7. Record each response. Check one box at the right for each correct response. Any response 7 or less than the previous response is a correct response. The score is the number of correct subtractions	93	1 ☐
	86	1 ☐
	79	1 ☐
	72	1 ☐
	65	1 ☐
B. SPELLING BACKWARDS TEST		Maximum Score = 5
Next, spell the word "WORLD" backwards. Record each response.	D	1 ☐
	L	1 ☐
	R	1 ☐
	O	1 ☐
	W	1 ☐
C. Final Score		
Compare the scores of the Counting Backwards and Spelling Backwards tests. Write the greater of the two scores in the box labeled FINAL SCORE, and use it in deriving the TOTAL SCORE.		FINAL SCORE ________

4. Recall		Maximum Score = 3
Do you recall the three objects I previously asked you to remember? Record each correct response.	Ball	1 □
	Flag	1 □
	Tree	1 □
5. Language		Maximum Score = 9
NAMING		
Show the participant a wrist watch. Ask: *What is this?* Show the participant a pencil. Ask: *What is this?*	Watch	1 □
	Pencil	1 □
REPETITION		
Repeat the following statement: 'No, ifs, ands, or buts'.		1 □
THREE-STAGE COMMAND		
Give the participant a sheet of blank paper in their dominant hand and say: *Take this piece of paper, fold it in half, and put it on the floor.*	Takes paper	1 □
	Folds paper in half	1 □
	Puts paper on floor	1 □
READING		
Hold up the card/paper that reads, "Close your eyes" and say: *Read this and do what it says.* Check the box at the right only if he/she actually closes his/her eyes.	Closes Eyes.	1 □
WRITING		
Give the subject a sheet of paper and ask: *Write a sentence*. It is to be written spontaneously. If the sentence contains a subject and a verb, and is sensible, check the box at the right. Correct grammar or punctuation are not necessary.	Writes a sentence.	1 □
COPYING		
Show the participant the drawing of the intersecting pentagons and ask: *Copy this design below on this paper.* If ten angles are present and two intersect, check the box at the right. Ignore tremor and rotation.	Copies pentagons.	1 □
DERIVING THE TOTAL SCORE		
Add the number of correct responses. The maximum is 30.		TOTAL SCORE __________

Folstein, M. F., Folstein, S. E., & McHugh, P. R. (1975). "Mini-mental state": a practical method for grading the cognitive state of patients for the clinician.*Journal of psychiatric research*, *12*(3), 189-198.

Close your eyes.

Appendix B



Cognitive / Psych. Assessment		Measurement / Score
8	Iconographical Falls Efficacy Scale (Icon-FES) [3]	/ 40

- *Please look at each picture carefully, and try to imagine yourself performing the activity.*
- *We would like to know how concerned you are about the possibility of falling while doing any of the following activities, as pictured on the drawings. For each of the following activities, please show the level of concern which is closest to your own opinion to show how concerned you are that you might fall if you did this activity.*
- *According to the following SCALE* (show scale): *not at all concerned, somewhat concerned, fairly concerned, very concerned.*

		Not at all concerned	**Somewhat concerned**	**Fairly concerned**	**Very concerned**
		1	**2**	**3**	**4**
	Getting dressed.	☐	☐	☐	☐
	Taking a bath.	☐	☐	☐	☐
	Taking a shower.	☐	☐	☐	☐
	Reaching for something above your head (chair).	☐	☐	☐	☐
	Reaching for something above your head (stepping stool).	☐	☐	☐	☐
	Cleaning the gutter.	☐	☐	☐	☐
	Going down the stairs.	☐	☐	☐	☐
	Going to the shop (grocery store).	☐	☐	☐	☐
	Walking around in the neighborhood.	☐	☐	☐	☐
	Going out to a social event.	☐	☐	☐	☐

____
____

Cognitive / Psych. Assessment		Measurement / Score	
9	Stroop Interference Test [4, 5]		
▪ Word Condition (Task A) - color words in black ink		Check: ☐	

For the first task we are going to see how fast you can read the words on this page. After I say begin, you are to read down the columns starting with the first one (point to the left-most column) *until you complete it* (run your hand down the remaining columns) *and then continue without stopping down the remaining columns in order* (run your hand down the next columns in order). *If you finish all the columns before I say 'STOP', then return to the first column and begin again* (point to the first column). *Remember, do not stop reading until I tell you to 'STOP' and read out loud as quickly as you can. If you make a mistake, I will say 'incorrect' to you. Correct your error and continue without stopping. Do you have any questions?* (Pause).

During the trial, say: *Ready?* (wait for response) *Then begin…* [*Start stopwatch*]. After 45 seconds say: *Stop. Circle the item you are on. If you finished the entire page and began again, put the number 1 by your circle.*

▪ Color Condition (Task B) - colored XXX, in colored ink	Check: ☐	

This time we want to see how fast you can name the colors on this page. You will complete this page just as you did the previous page, starting with the first column. Remember to name the colors out loud as quickly as you can. Do you have any questions? (Pause).

During the trial, say: *Ready?* (wait for response) *Then begin…* [*Start stopwatch*]. After 45 seconds say: *Stop. Circle the item you are on. If you finished the entire page and began again, put the number 1 by your circle.*

▪ Color-Word Condition (Task C) - color word in different color ink	Check: ☐	

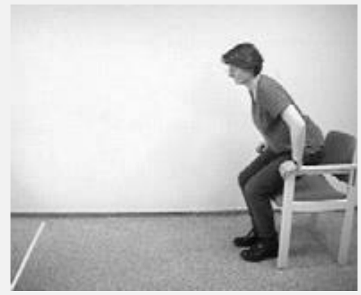
This last page is like the page you just finished. I want you to name the color of the ink the words are printed in ignoring the word. For example, [point to the first item of the first column], *this is the first item: what would you say?* If response is incorrect, say: *No. That is the word that is spelled there. I want you to name the color of the ink the word is printed in. Now, try again.* If response is correct say, *Good. You will do this page just like the others, starting with the first column and then going on to as many columns as possible. Remember, if you make a mistake, just correct it and go on.* (Pause).

During the trial, say: *Ready?* (wait for response) *Then begin…* [*Start stopwatch*]. After 45 seconds say: *Stop. Circle the item you are on. If you finished the entire page and began again, put the number 1 by your circle.*

Physical Assessment

10	Timed Up and Go (TUG) [6]

General:



- The participant will sit on a standard armchair, placing his/her back against the chair and resting his/her arms on the chair's arms.
- Regular footwear should be used.
- The participant will walk to a line that is 3 meters away, turn around at the line, walk back to the chair, and sit down.
- Participants should be instructed to use a comfortable and safe walking speed.
- A stopwatch is used to time the test (in seconds).

Instructions:

- *You will sit on this chair.* (Demonstrate) *You will place your back against the chair and rest your arms on the chair's arms. When you are ready (let me know verbally), I will say 'Go'. At a comfortable and safe walking speed, walk to the line, turn around at the line, walk back to the chair, and sit down.*
- [Demonstrate the entire test to the participant.]
- *We will begin with a practice trial. When you are ready (let me know verbally and), I will say 'Go'.*
- Participant will indicate they are "Ready" (verbally).
- Then, experimenter will say "GO". The stopwatch will start when the experimenter says go, and will be stopped with the participant's buttocks touch the seat.

For the recorded trial:

- *We will collect the real trial now. You will sit on this chair. You will place your back against the chair and rest your arms on the chair's arms. When you are ready (let me know verbally and), I will say 'Go'.*
- Participant will indicate they are "Ready" (verbally).
- Then, experimenter will say "GO". The stopwatch will start when the experimenter say go, and will be stopped with the participant's buttocks touch the seat.

TUG Time Inclusion Criteria [7, 8]: ≤ 12 sec	sec

____
____
____
____

Cognitive Assessment Turn lab lights out.

11	Go-No-Go Task (GNG) (PEBL reference [9])	Check: ☐

- *During this assessment, you will see a square with 4 stars (show example).*
- *A series of 'P's and 'R's will appear on the screen in 1 of the 4 squares.*
- *For each part, the instructions will explain whether to you respond to the letter 'P' or 'R'.*
- *You will always responds to a letter by pressing the right shift key.*

- *There are two parts to this assessment.*
- *Do not stress about remembering the instructions now, just make sure you read the instructions on the computer screen as you move through the assessment.*
- *In the first part, you will hit the right shift key as quickly as possible when you see the letter P in any one of the four squares on the screen. Do not respond to the letter R.*
- *In the second part, you will hit the right shift key as quickly as possible when you see the letter R on any one of the four squares on the screen. Do not respond to the letter P.*

- *Each parts will begin with a short practice in which you will be told when you make an error.*
- *Following each practice, the computer will let you know that the real trials will begin.*
- *Do you have any questions?*
- *In between the two parts, you will be allowed to take a short break before continuing, feel free to rest a minute or two.*

- *When you are ready to begin, press the right shift key.*

Physical Assessment

12	Preferred Walking Speed (PWS) [10] – *Measure Three Times*

This test is conducted over even ground. We used 10 meters (of space) and a stopwatch. Three meters will be given for acceleration. Only the middle **four meters** are timed. Three meters will be given for deceleration.
A stopwatch is used to time the test (in seconds).

PWS: *Now I am going to observe how you normally walk. This is our walking course. I want you to walk to the other end of the course at your usual speed, just as if you were walking down the street to go to the store. Walk all the way to the last orange cone. When you are ready (let me know verbally and), I will say 'Go'.*

PWS		Practice	1	2	Walking Speed Calculation	
	TIME4meters	s	s	s	$v = \frac{4\ meters}{Time_{max}}$	m/s

Cognitive Assessment Turn lab lights out.

13	Psychomotor Vigilance Test (PVT) [11]	Check: ☐

- *During this assessment, please pay attention to the stimuli on the screen.*
- *Do not respond to the fixation cross: "+".*
- *At random time intervals, a bright millisecond timer (counting up) will appear in the center of the screen.*
- *Press the spacebar as quickly as possible whenever you see the counter appear (your response will stop counter).*
- *You will begin with a short (1-minute) practice trial.*
- *Please let me know when you are done & I will come back in* (set-up practice trials).
- *When you are ready to begin, press the spacebar.*

---------- After the practice trial --

- *Do you have any questions?* (Pause, set-up real trials). *Ok, you will start the real trials now. When you are ready to begin, press the spacebar.*

General note: The actual PVT trials will be approximately 5 minutes long.

Physical Assessment

14	Lower Limb Strength (Knee Extensors) [12] - *Measure 3X*

Participant sits on table with knee at 90 degrees. The dynamometer is fixed below the table. An ankle strap will be secured on their shank (just proximal to lateral and medial malleoli). The participant is instructed to grip the table. Each force measurement is performed 3 times, with a minimum of 30 seconds of rest in between. The moment-arm length is measured from the lateral epicondyle of the femur to the point of force measurement. Participant receives loud encouragement (e.g. "GO GO GO!!") during the measurement.

I will be measuring your quad strength here. Grip the table with your hands, and stay seated. On 'GO', you will push forward with maximum effort, extending your knee until I say 'STOP' (~2 seconds).

LEFT		1	2	3	MAX
	Force Produced				lb
	Moment-arm Length				m

RIGHT		1	2	3	MAX
	Force Produced				lb
	Moment-arm Length				m

Prepare Participant for Data Collection		Check	
15	Body Weight	kg	
	Height	m	
16	Vision Acuity Participant stands 2.8 meters from Snellen chart. Test one eye at a time. Read the letters from left to right. Guide participant by pointing at the particular line to read. Inclusion Criteria: 20/40 ± 5.	**LEFT EYE** 20 / ____	**RIGHT EYE** 20 / ____
17	Place HARNESS and (16) reflective markers on Participant.	☐	
18	Collect STATIC trial of participant on treadmill. Create VICON Model.	☐	
	▪ Enter treadmill speed = 1 m/s ▪ Set D-Flow computer volume to Maximum ▪ In Training tab, show projected object examples.		
19	Provide participant with experimental INSTRUCTIONS.	☐	
General	▪ *You will walk for ~25 minutes. You will receive seated rest breaks between all trials.* ▪ *During all the conditions, you will walk at a constant speed* [if they ask: 1 m/s ~2.2 mph]. ▪ *Because we are investigating balance and stepping, we will ask you to not use the arm rails during the actual experimental trials, however you can use them during the acclimation period.*		
Objects	▪ *During some of the conditions, stepping objects will appear on the treadmill.* ▪ *The stepping objects will be either **yellow or red** in color.* (point at projected examples) ▪ *You can only step on left objects with your left foot & right objects with your right foot.* ▪ *Before each walking trial, I will let you know which color to step on (those are the "targets"….) and which color to avoid (those are the "obstacles"…..).*		
SOUNDS	Note: sounds played from cell phone. *As you walk, you will hear SOUNDS indicating you've stepped on a "target" or avoided an "obstacle".* ▪ *If you step on a "target", this is the sound* (sound plays) *you will hear.* ▪ *If you avoid an "obstacle", this is the sound* (sound plays) *you will hear.* *As you walk, you will hear sounds indicating you've missed a "target" or stepped on an "obstacle".* ▪ *If you miss a "target", this is the sound* (sound plays) *you will hear.* ▪ *If you step on an "obstacle", this is the sound* (sound plays) *you will hear.* • *Do you have any questions?* • *We will begin with a short acclimation period. You will walk for ~ 4 minutes. There will be some stepping objects during the middle of this acclimation period. However, no stepping feedback will be provided during this time.*		
20	Participant walks on Treadmill for acclimation (4 min).	☐	

21	**After Training (seated):** ▪ *Now we will begin the experiment. Do your best to walk in the center of the treadmill.* ▪ *As mentioned, during some of the conditions, stepping objects will appear on the treadmill.* ▪ *The stepping objects will be either **yellow** or **red** in color.* ▪ *Before each walking trial, I will let you know which color to step on (those are the "targets") and which color to avoid (those are the "obstacles").* ▪ *As you walk, you will hear sounds indicating if you've stepped on or missed a "target" or "obstacle".* ▪ *Remember: you can only step on left objects with your left foot & right objects with your right foot.* ▪ ***During these conditions, your goal is to walk normally, step on the "targets" and avoid (do not step on) the "obstacles".*** *Do you have any questions?* (Pause)

Data Collection – let's do this.

Instructions:
In this condition, your goal is to walk normally.

	Description	Time	Completed	Comments
1st Condition	Normal Walking			
	Trial 1	3 min	☐	
	Seated Rest	2 min	☐	
	Trial 2	3 min	☐	
	Seated Rest	2 min	☐	

Average L_n during NW (Trial 2, last 20 strides):
at 1 min remaining ______
at 1-2 sec remaining ______†

________________ m
Average L_n (last 20 strides) at 3 min mark†

- Enter participant's average L_n (m) into D-Flow's "Experiment L_n" input

Instructions:
For Trial 0 (only): *For the first trial only, the treadmill speed will start slower than 1 m/s and will slowly increase to 1 m/s. Your goal is to walk normally,* ***step on*** ***Yellow objects*** *and* ***avoid*** ***Red objects****.*

For Trial 1-2: *In this condition, your goal is to walk normally,* ***step on*** ***Yellow objects*** *and* ***avoid*** ***Red objects****.*

	Description	Time	Completed	Comments
2nd Condition	Step on Yellow Objects, Avoid Red			
	Trial 0	~3 min	☐	
	Seated Rest	2 min	☐	
	Trial 1	~3 min	☐	
	Seated Rest	2 min	☐	
	Trial 2	~3 min	☐	
	Seated Rest	2 min	☐	

Instructions: *In this condition, your goal is to walk normally, **step on** **Red objects** and **avoid** **Yellow objects**.*				
	Description	**Time**	**Completed**	**Comments**
3rd Condition	Step on Red Objects, Avoid Yellow			
	Trial 1	~3 min	☐	
	Seated Rest	2 min	☐	
	Trial 2	~3 min	☐	
	Seated Rest	2 min	☐	

Instructions: *In this condition, your goal is to walk normally.*				
	Description	**Time**	**Completed**	**Comments**
Return to 1st Condition	Normal Walking			
	Trial 1	3 min	☐	
	Seated Rest	2 min	☐	

EXIT QUESTIONS:

1. Did you find any of the experiment challenging? If yes, please explain?

   How did the walking speed feel?

2. Do you play any video games on either a game console, computer, or cell phone? If yes, which games (e.g. Sudoku) and how often (hours per week)?

Other Forms		Check
1	Leisure and Social Activities Survey	☐
2	Participant Information Form (optional)	☐

Final Payment to Participant		Check
	Have participant sign accounting document.	☐

References:

1. Frese, E.M., A. Fick, and H.S. Sadowsky, *Blood pressure measurement guidelines for physical therapists.* Cardiopulmonary physical therapy journal, 2011. **22**(2): p. 5.
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6. Podsiadlo, D. and S. Richardson, *The timed" Up & Go": a test of basic functional mobility for frail elderly persons.* Journal of the American Geriatrics Society, 1991. **39**(2): p. 142-148.
7. Bischoff, H.A., et al., *Identifying a cut-off point for normal mobility: a comparison of the timed 'up and go'test in community-dwelling and institutionalised elderly women.* Age and ageing, 2003. **32**(3): p. 315-320.
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9. Bezdjian, S., et al., *Assessing inattention and impulsivity in children during the Go/NoGo task.* British Journal of Developmental Psychology, 2009. **27**(2): p. 365-383.
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11. Dinges, D.F. and J.W. Powell, *Microcomputer analyses of performance on a portable, simple visual RT task during sustained operations.* Behavior Research Methods, Instruments, & Computers, 1985. **17**(6): p. 652-655.
12. Smidt, G.L., *Muscle strength testing: a system based on mechanics*. 1984: Spark Instruments and Academics.

PARTICIPANT INFORMATION FORM

"How Young and Older Healthy Adults Negotiate Competing Task Goals During Walking"

IRB # ***__2015-02-0114__*** ***Subject ID:*** _____________

NOTE: FILLING OUT THIS FORM IS COMPLETELY OPTIONAL

We request this information in case you may be interested in being contacted in the future regarding the outcomes of this study and/or possible participation in future studies. Completing this form is not required.

This form and this information will be kept strictly confidential.

Name: ____

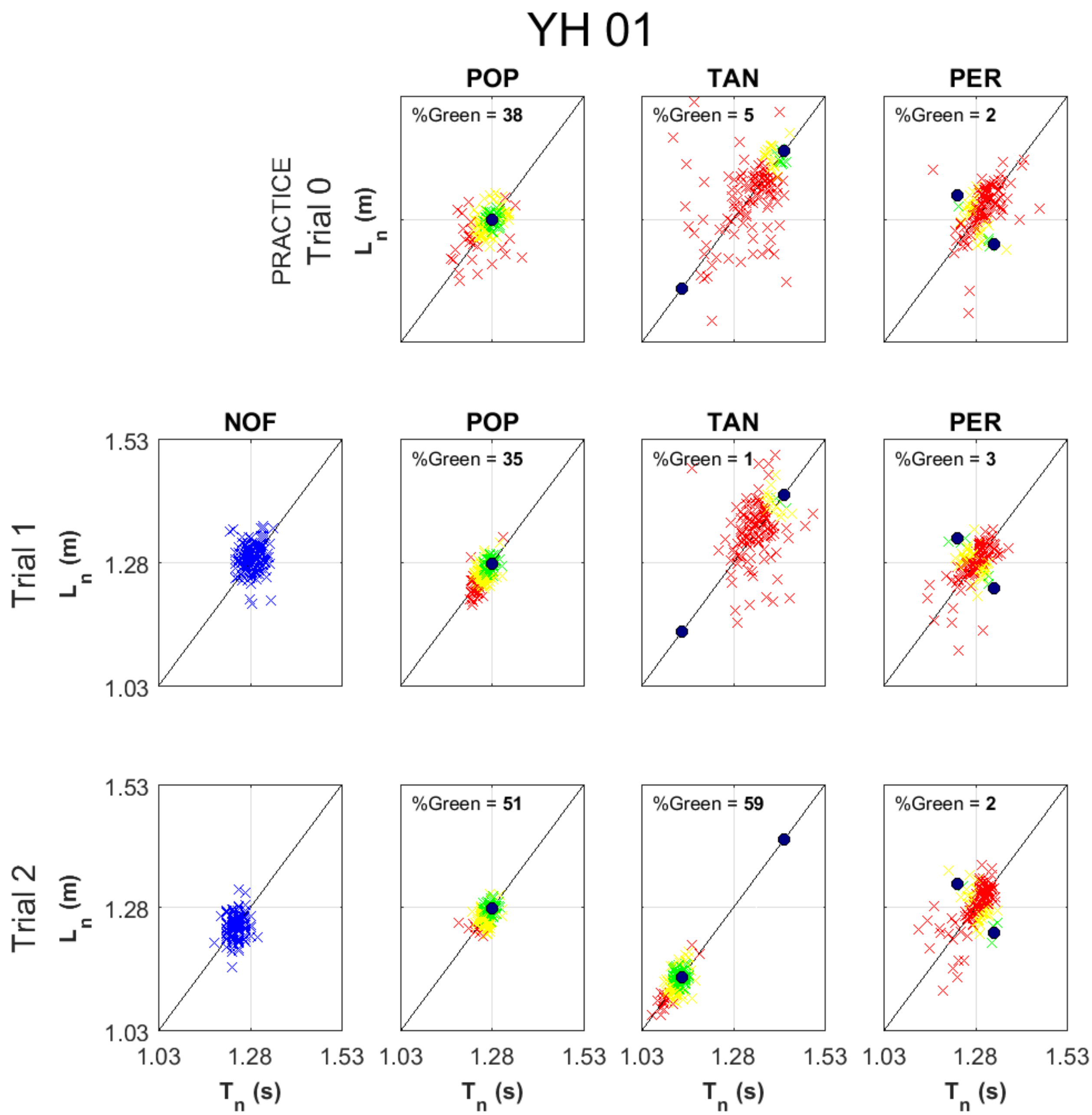
Postal Address: ____

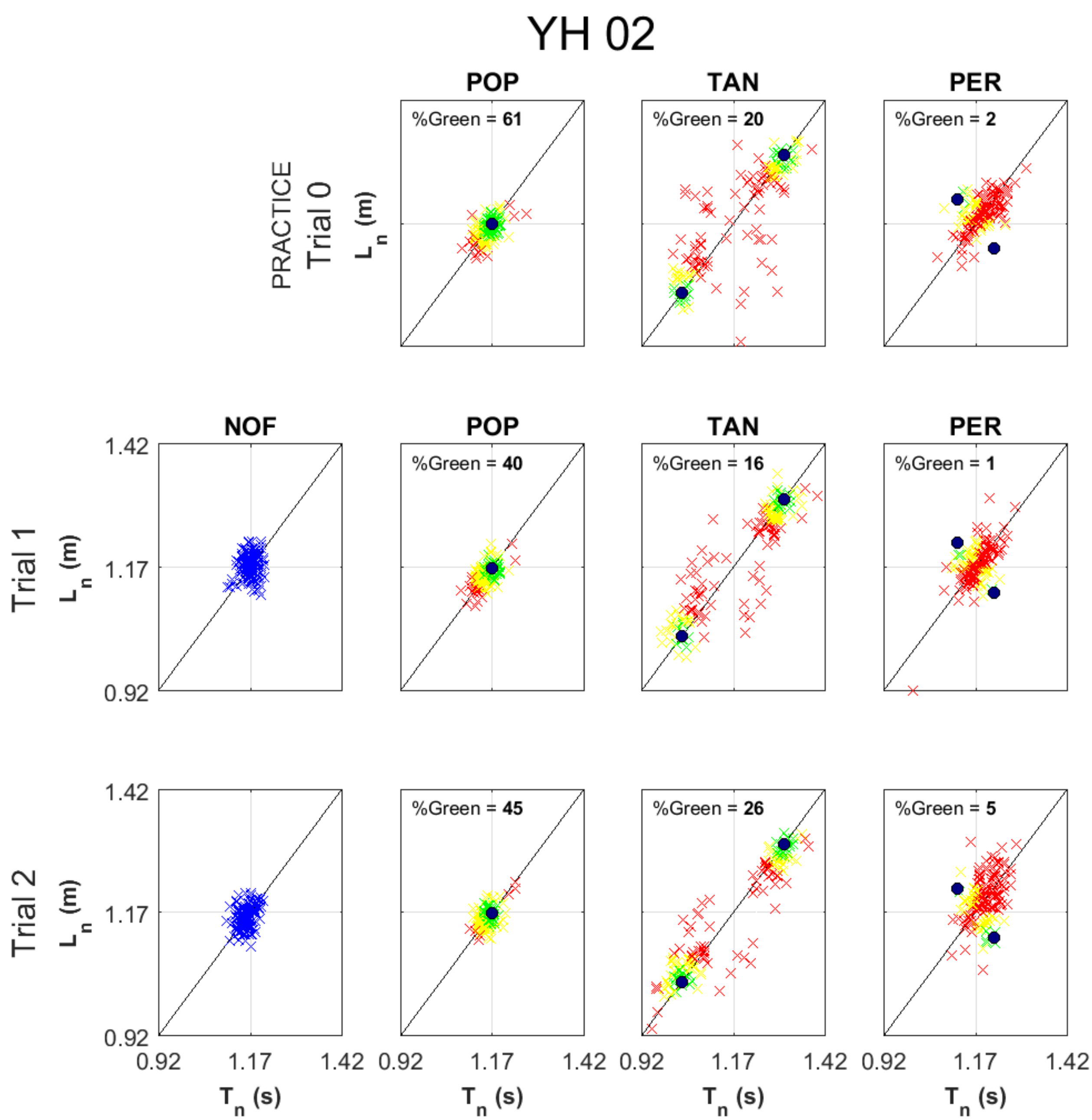
____

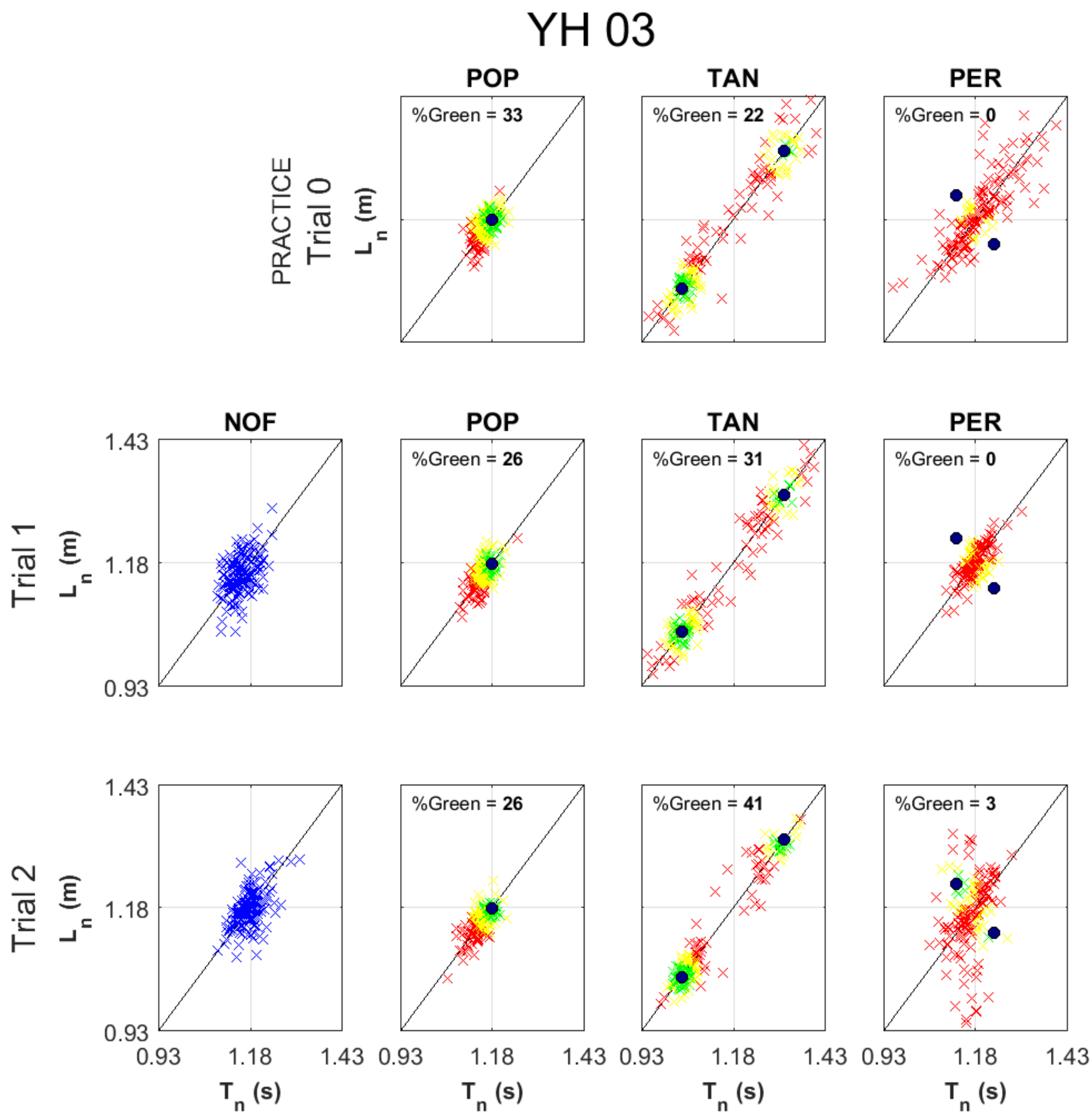
____

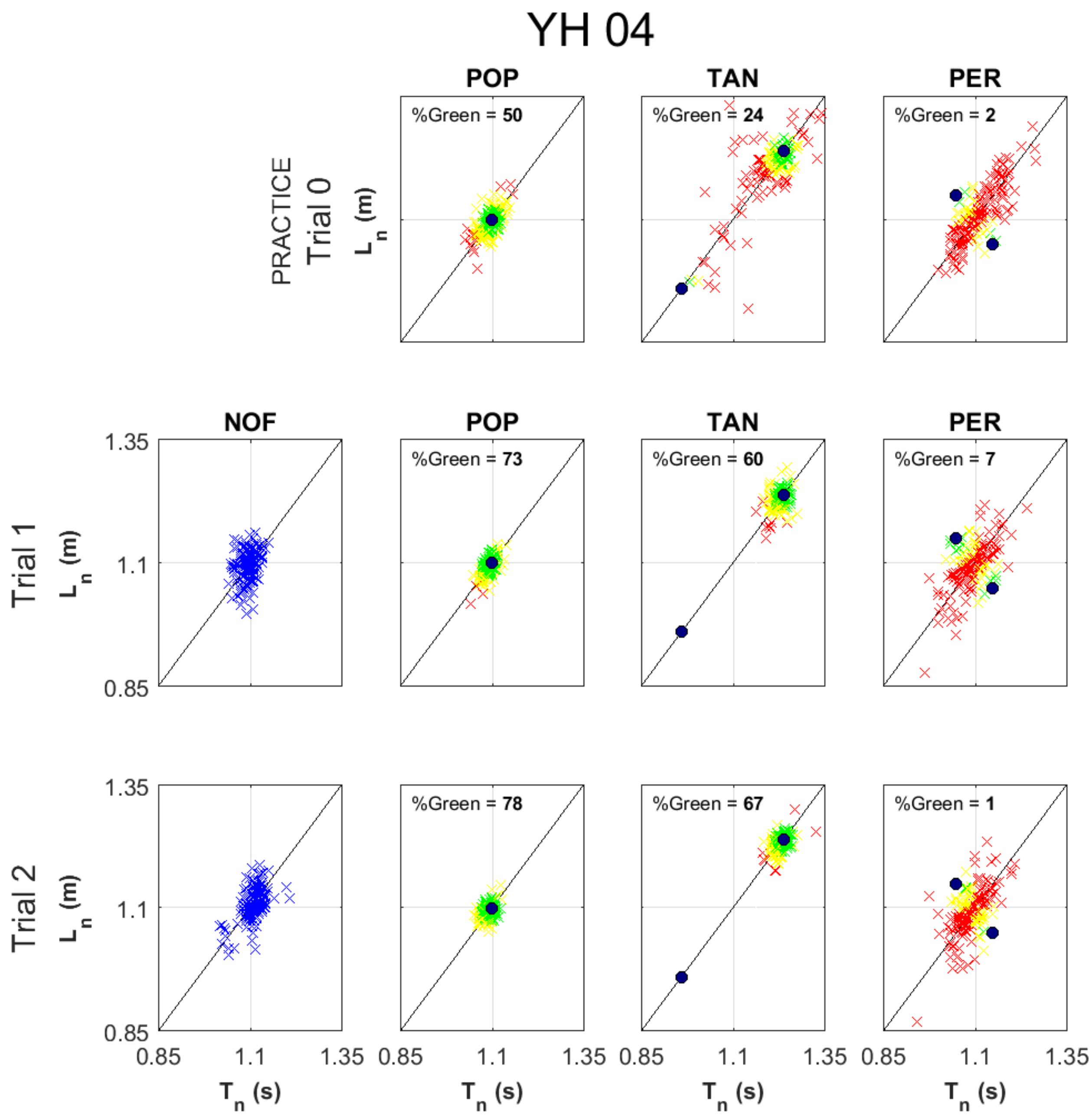
Telephone Number: (__________) ____________________________

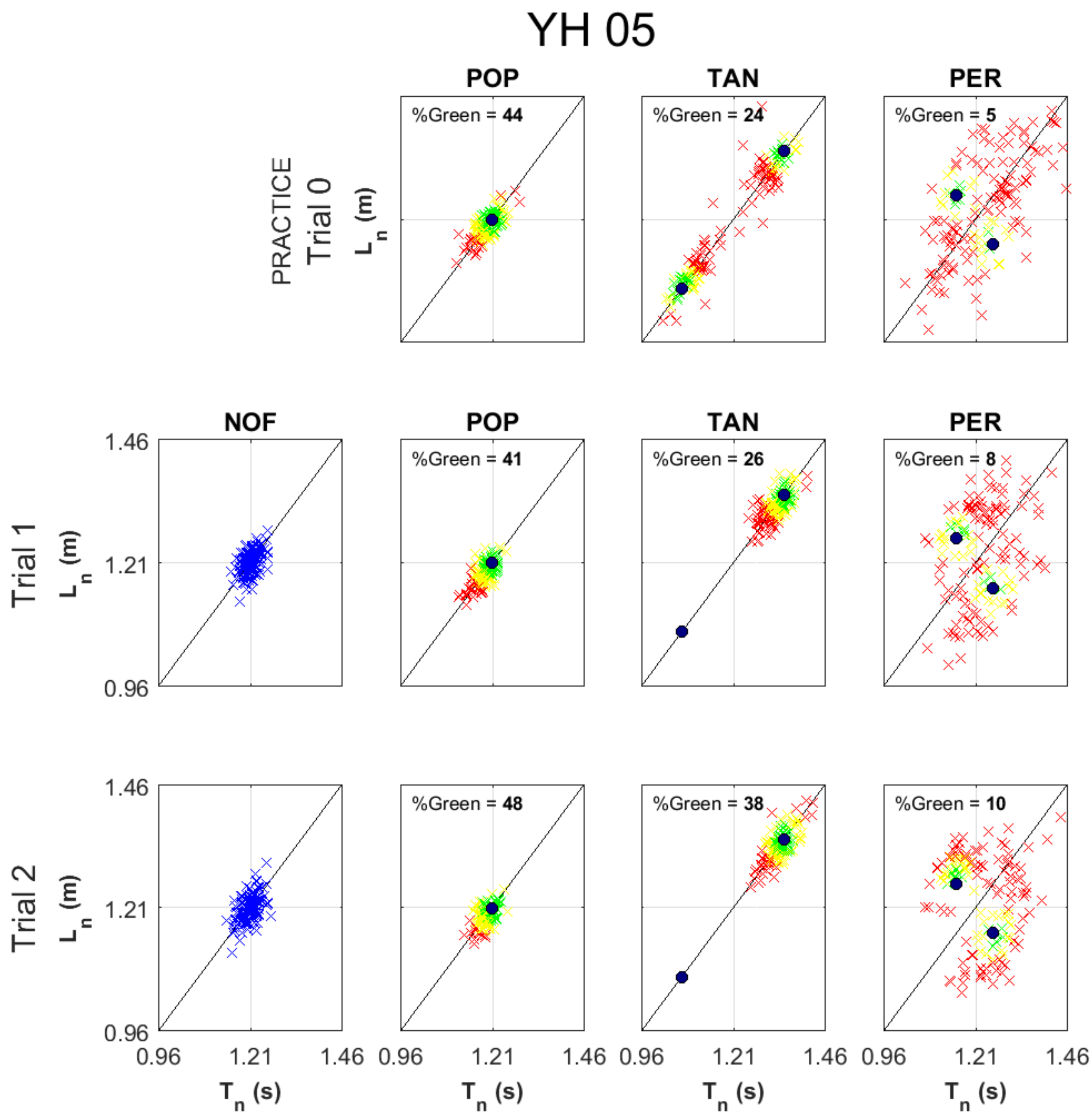
E-Mail Address: ____

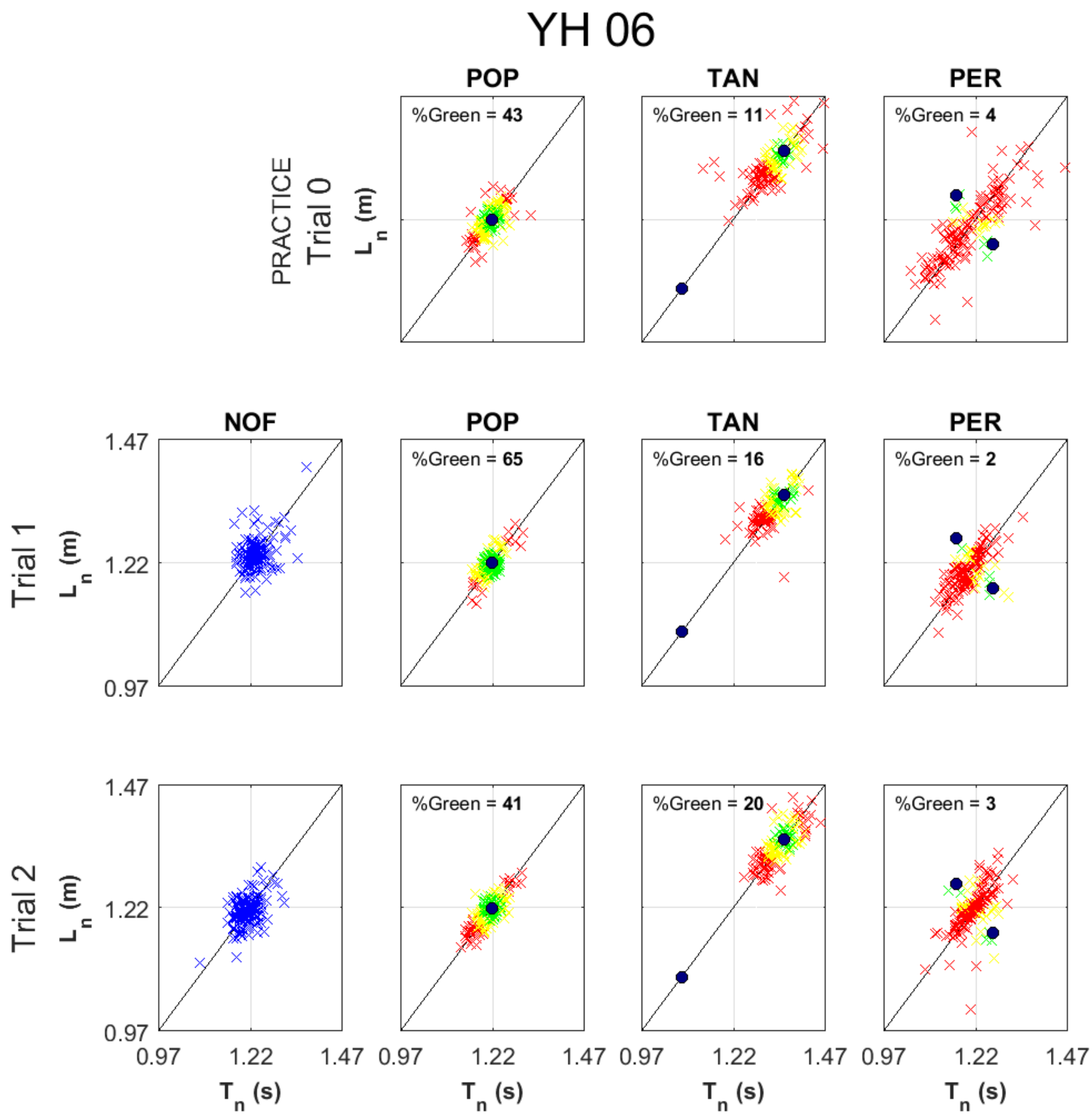

YH 01
POP
TAN
PER
PRACTICE
Trial 0
L_n (m)
%Green = 38
%Green = 5
%Green = 2
NOF
POP
TAN
PER
Trial 1
L_n (m)
1.53
1.28
1.03
%Green = 35
%Green = 1
%Green = 3
Trial 2
L_n (m)
1.53
1.28
1.03
%Green = 51
%Green = 59
%Green = 2
1.03
1.28
1.53
T_n (s)

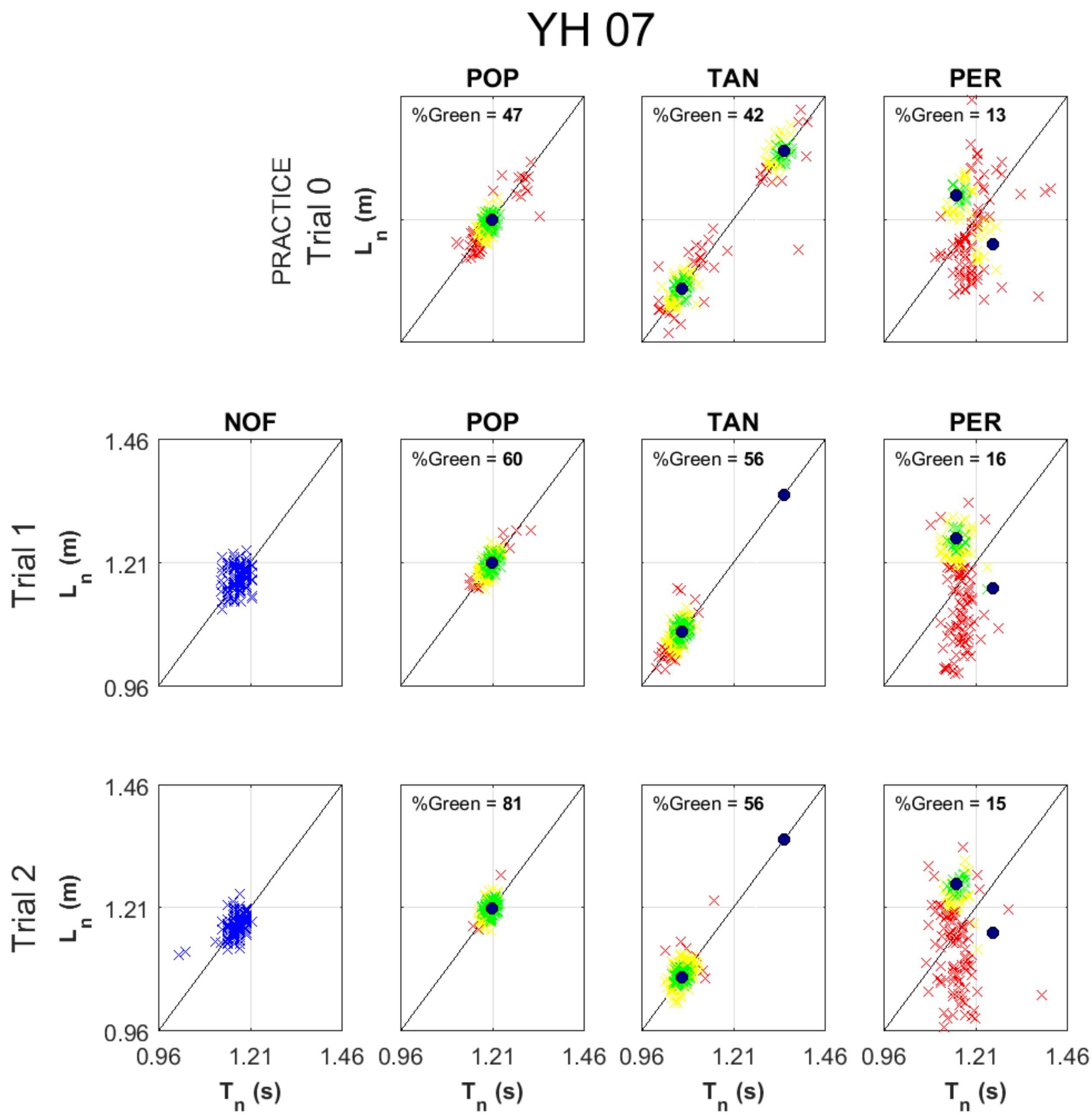

YH 02
POP
TAN
PER
%Green = 61
%Green = 20
%Green = 2
PRACTICE
Trial 0
L_n (m)
NOF
%Green = 40
%Green = 16
%Green = 1
Trial 1
Trial 2
%Green = 45
%Green = 26
%Green = 5
1.42
1.17
0.92
T_n (s)

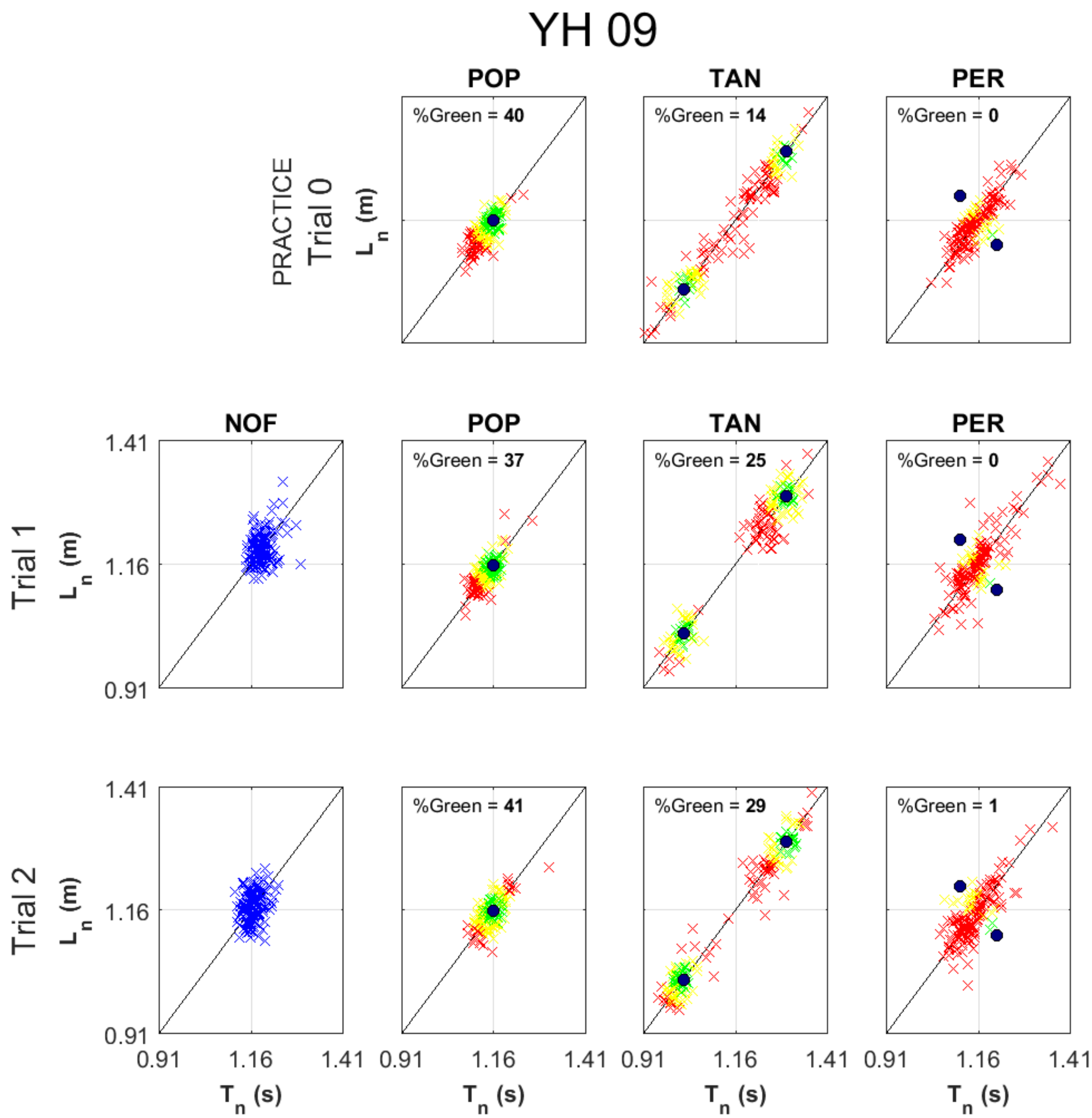

YH 03
POP
TAN
PER
PRACTICE
Trial 0
L_n (m)
%Green = 33
%Green = 22
%Green = 0
NOF
POP
TAN
PER
Trial 1
L_n (m)
1.43
1.18
0.93
%Green = 26
%Green = 31
%Green = 0
Trial 2
L_n (m)
1.43
1.18
0.93
%Green = 26
%Green = 41
%Green = 3
0.93
1.18
1.43
T_n (s)

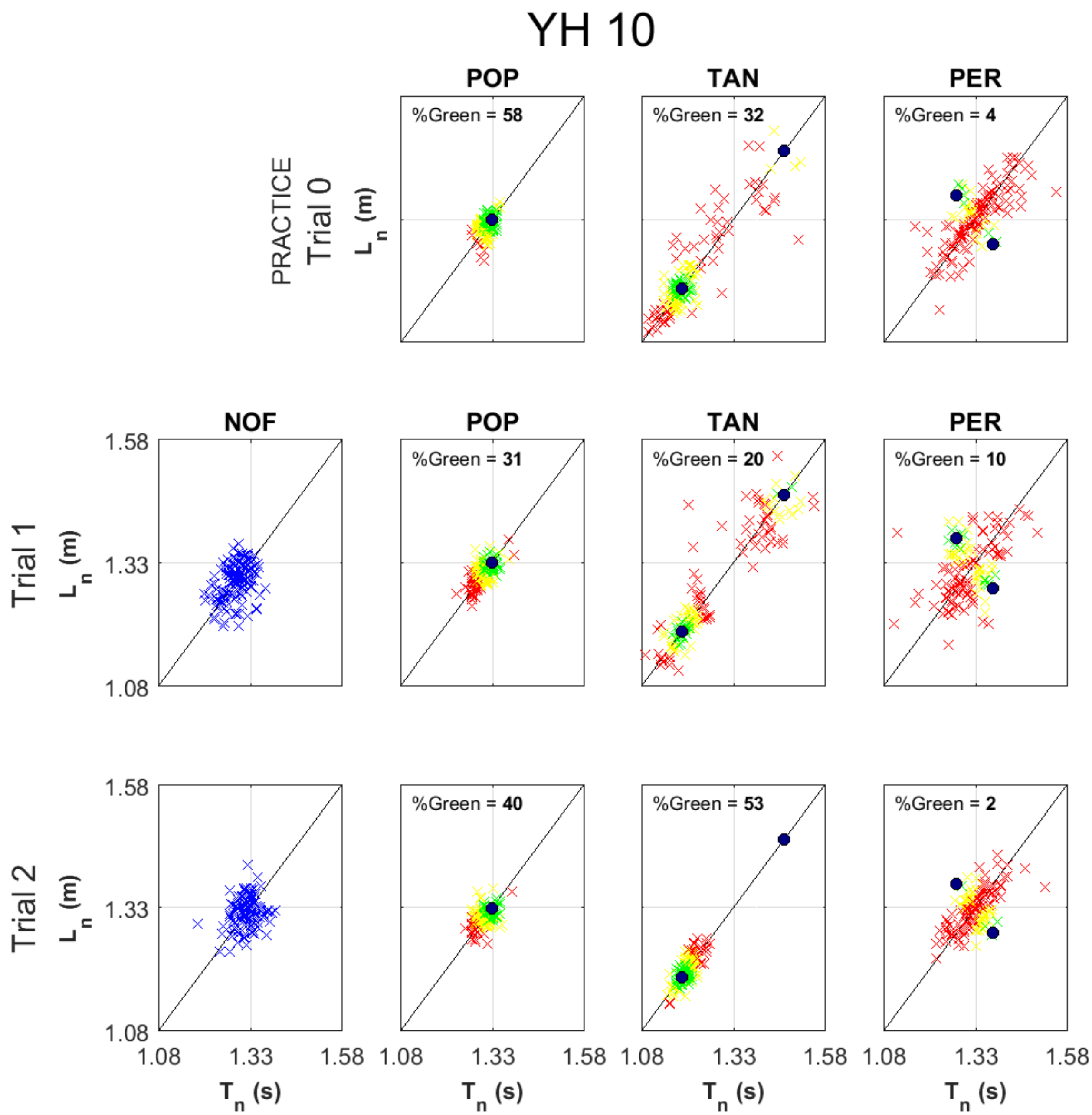

YH 04
POP
TAN
PER
PRACTICE
Trial 0
L_n (m)
%Green = 50
%Green = 24
%Green = 2
NOF
POP
TAN
PER
Trial 1
%Green = 73
%Green = 60
%Green = 7
Trial 2
%Green = 78
%Green = 67
%Green = 1
1.35
1.1
0.85
T_n (s)

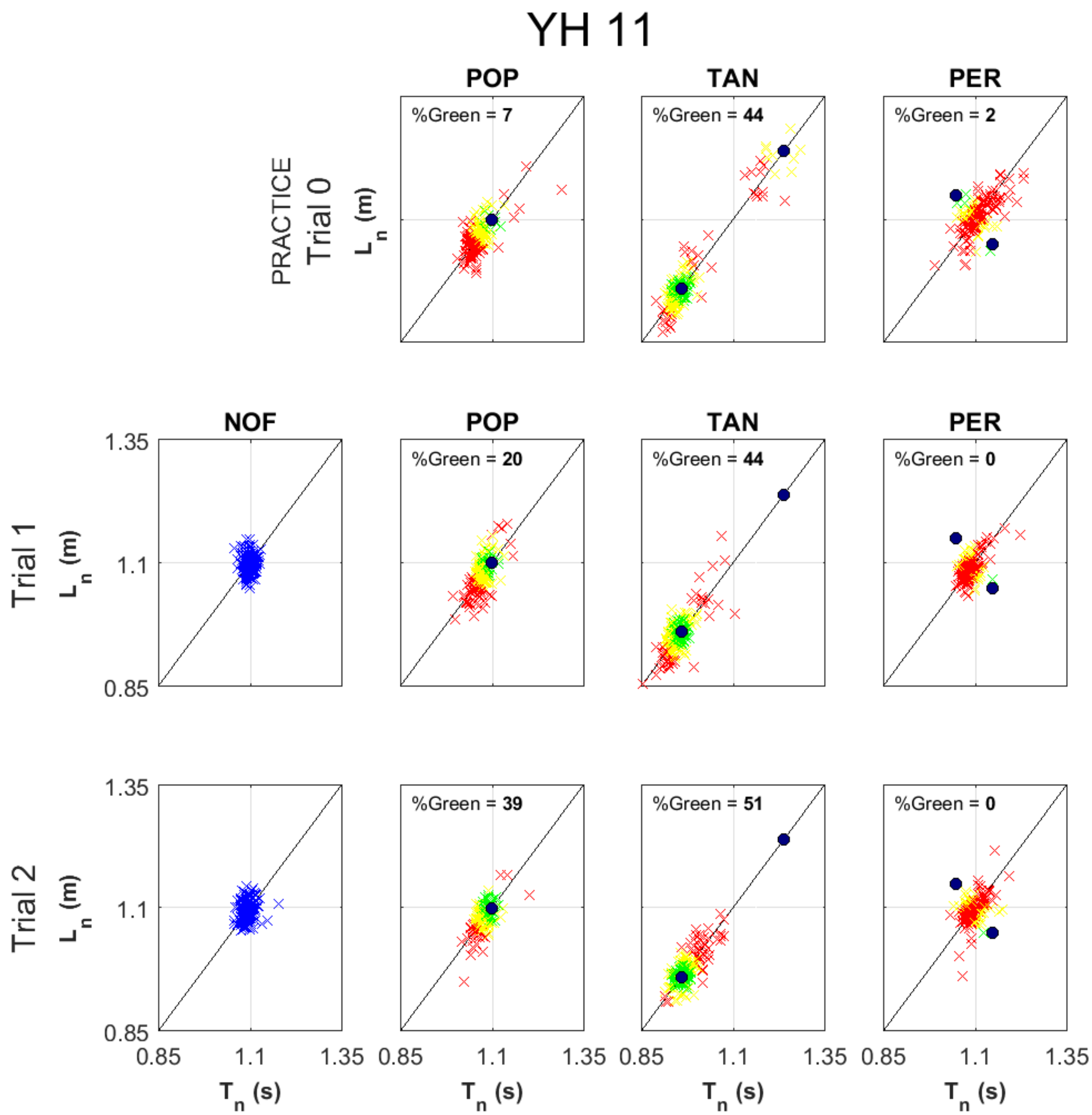

YH 05
POP
TAN
PER
PRACTICE
Trial 0
L_n (m)
%Green = 44
%Green = 24
%Green = 5
NOF
POP
TAN
PER
Trial 1
L_n (m)
1.46
1.21
0.96
%Green = 41
%Green = 26
%Green = 8
Trial 2
L_n (m)
1.46
1.21
0.96
%Green = 48
%Green = 38
%Green = 10
0.96
1.21
1.46
0.96
1.21
1.46
0.96
1.21
1.46
0.96
1.21
1.46
T_n (s)
T_n (s)
T_n (s)
T_n (s)

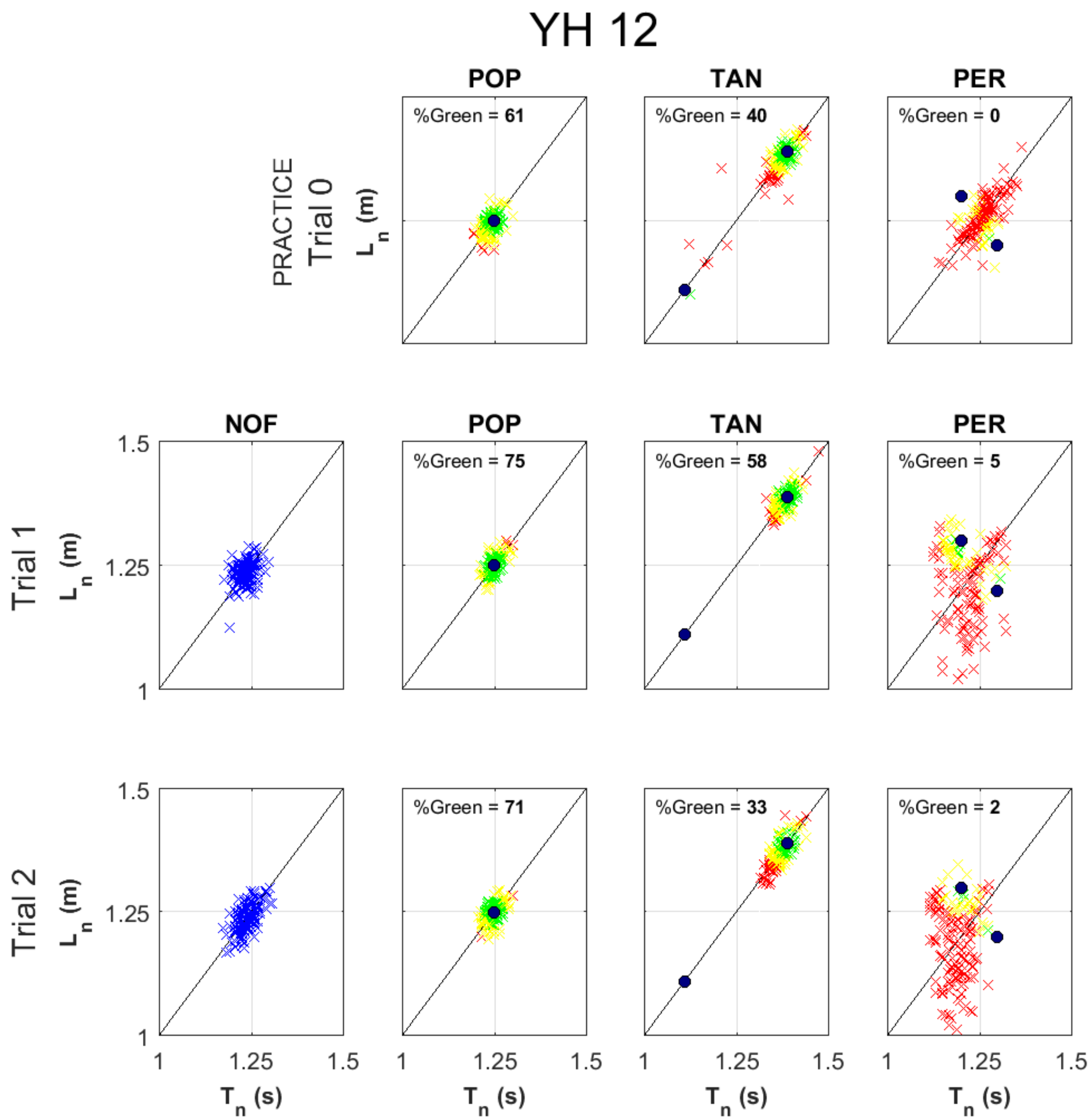

YH 06
POP
TAN
PER
PRACTICE
Trial 0
L_n (m)
%Green = 43
%Green = 11
%Green = 4
NOF
POP
TAN
PER
1.47
1.22
0.97
Trial 1
L_n (m)
%Green = 65
%Green = 16
%Green = 2
1.47
1.22
0.97
Trial 2
L_n (m)
%Green = 41
%Green = 20
%Green = 3
0.97 1.22 1.47
T_n (s)
0.97 1.22 1.47
T_n (s)
0.97 1.22 1.47
T_n (s)
0.97 1.22 1.47
T_n (s)

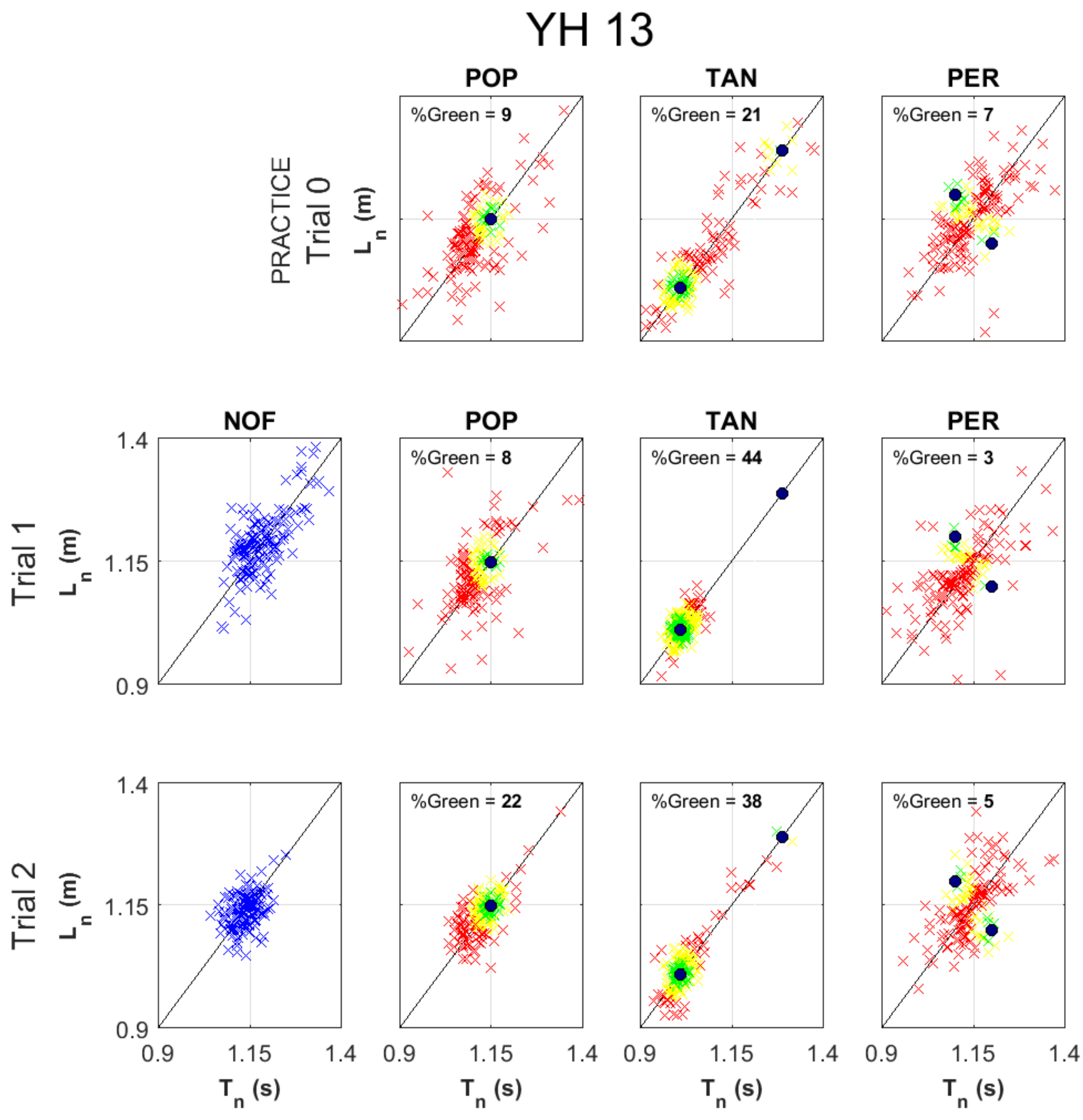

YH 07
POP
TAN
PER
%Green = 47
%Green = 42
%Green = 13
PRACTICE
Trial 0
L_n (m)
NOF
POP
TAN
PER
%Green = 60
%Green = 56
%Green = 16
Trial 1
L_n (m)
1.46
1.21
0.96
%Green = 81
%Green = 56
%Green = 15
Trial 2
L_n (m)
1.46
1.21
0.96
0.96
1.21
1.46
T_n (s)

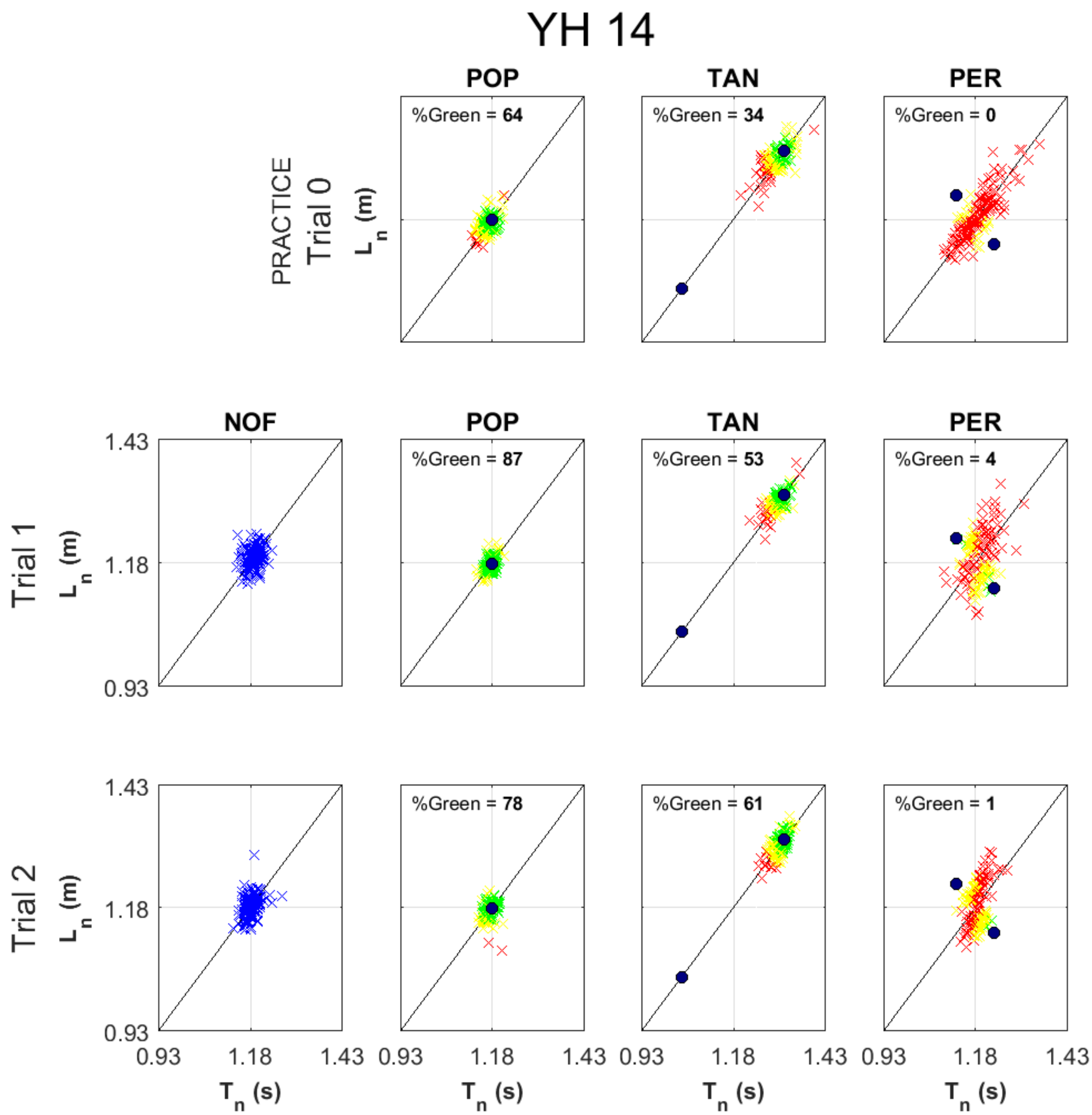

YH 09
POP
TAN
PER
PRACTICE
Trial 0
L n (m)
%Green = 40
%Green = 14
%Green = 0
NOF
Trial 1
%Green = 37
%Green = 25
%Green = 0
Trial 2
%Green = 41
%Green = 29
%Green = 1
1.41
1.16
0.91
T n (s)

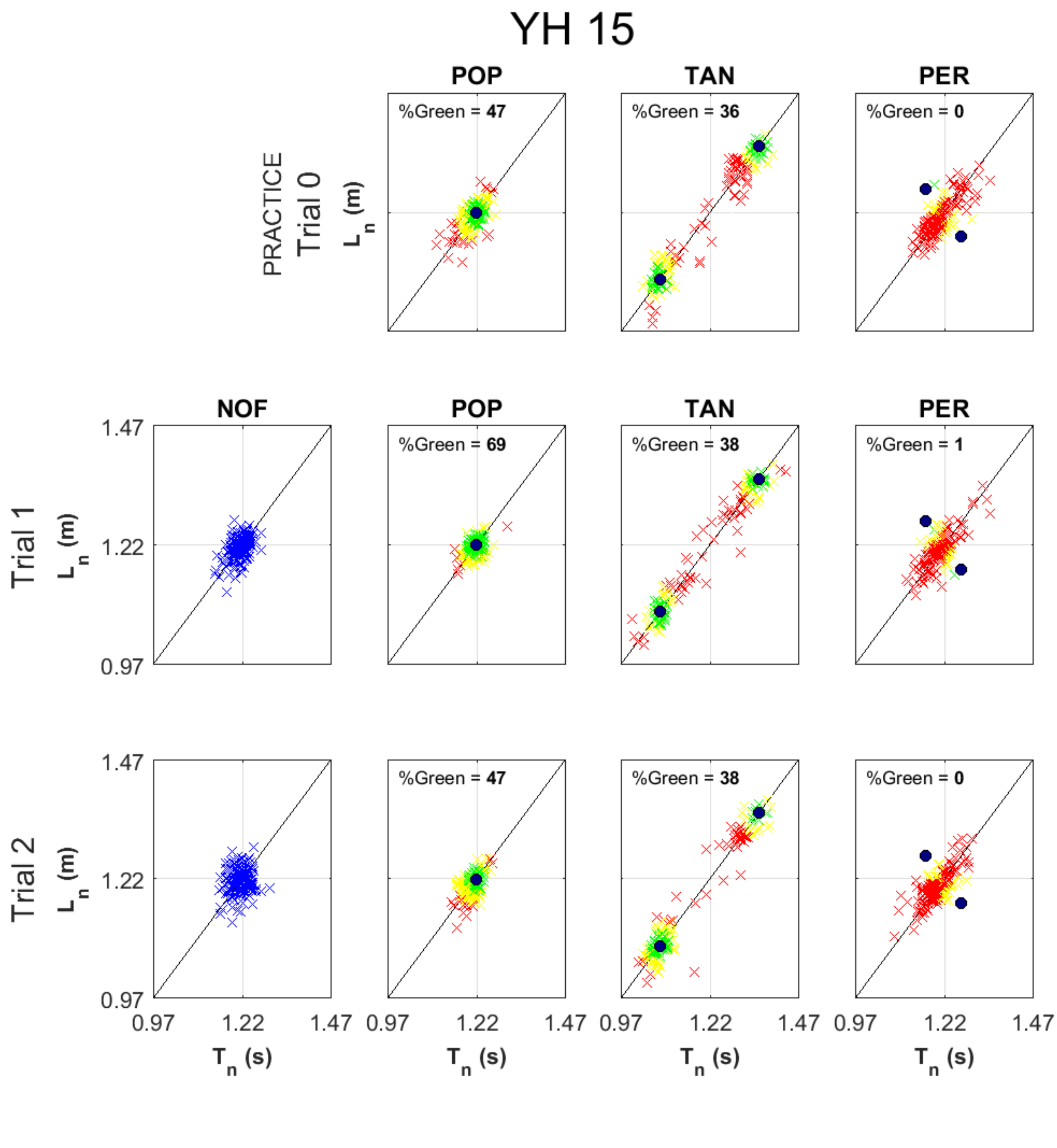

YH 10
POP
TAN
PER
%Green = 58
%Green = 32
%Green = 4
PRACTICE
Trial 0
L n (m)
NOF
POP
TAN
PER
%Green = 31
%Green = 20
%Green = 10
Trial 1
L n (m)
1.58
1.33
1.08
Trial 2
L n (m)
%Green = 40
%Green = 53
%Green = 2
1.58
1.33
1.08
1.08
1.33
1.58
T n (s)

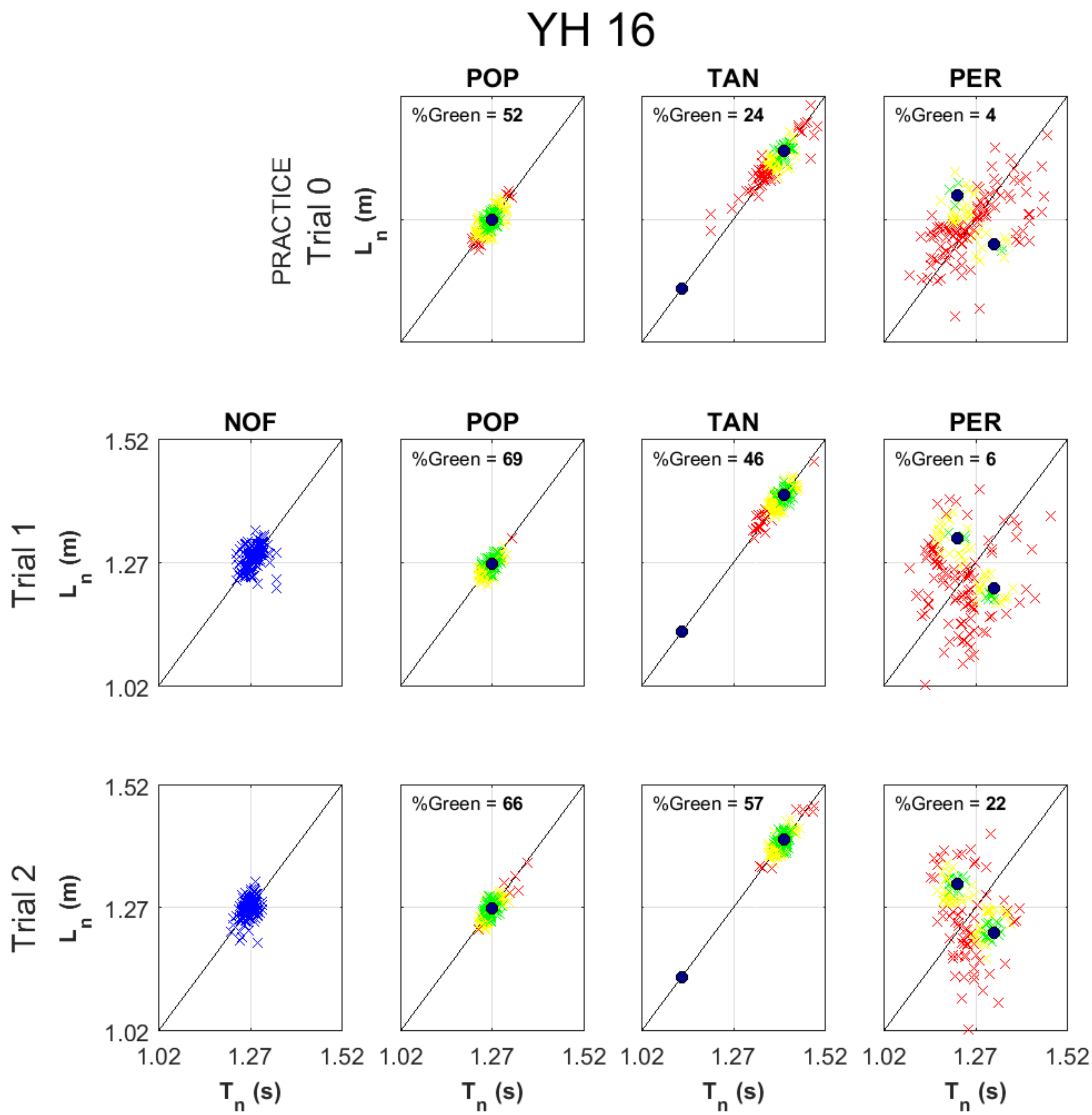

YH 11
POP
TAN
PER
%Green = 7
%Green = 44
%Green = 2
PRACTICE
Trial 0
L_n (m)
NOF
POP
TAN
PER
1.35
%Green = 20
%Green = 44
%Green = 0
Trial 1
L_n (m)
1.1
0.85
1.35
%Green = 39
%Green = 51
%Green = 0
Trial 2
L_n (m)
1.1
0.85
0.85
1.1
1.35
0.85
1.1
1.35
0.85
1.1
1.35
0.85
1.1
1.35
T_n (s)
T_n (s)
T_n (s)
T_n (s)


YH 12
POP
TAN
PER
NOF
%Green = 61
%Green = 40
%Green = 0
%Green = 75
%Green = 58
%Green = 5
%Green = 71
%Green = 33
%Green = 2
PRACTICE
Trial 0
Trial 1
Trial 2
Ln (m)
Tn (s)
1
1.25
1.5

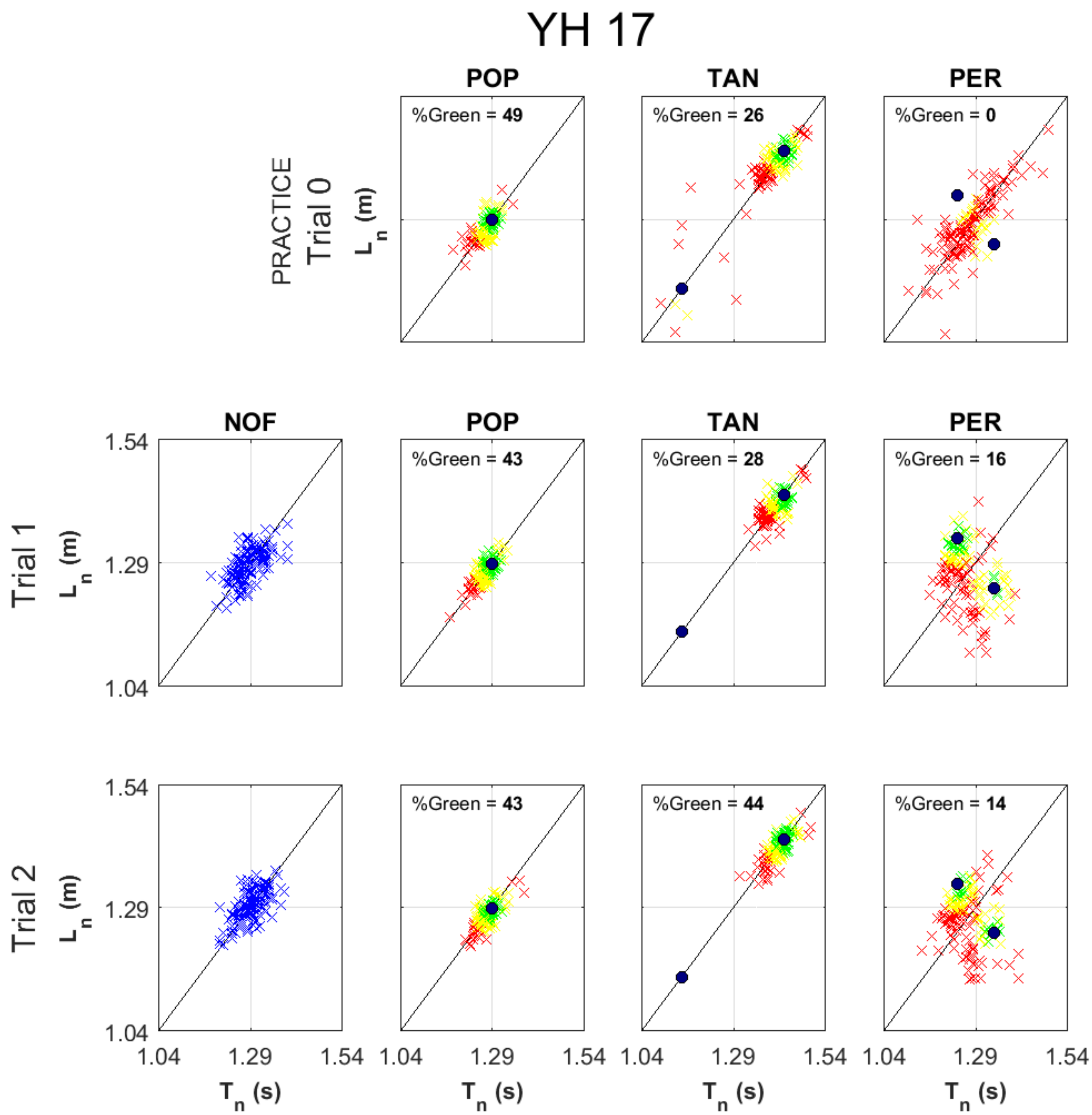

YH 13
POP
TAN
PER
%Green = 9
%Green = 21
%Green = 7
PRACTICE
Trial 0
L_n (m)
NOF
POP
TAN
PER
%Green = 8
%Green = 44
%Green = 3
Trial 1
L_n (m)
1.4
1.15
0.9
%Green = 22
%Green = 38
%Green = 5
Trial 2
L_n (m)
1.4
1.15
0.9
0.9 1.15 1.4
T_n (s)

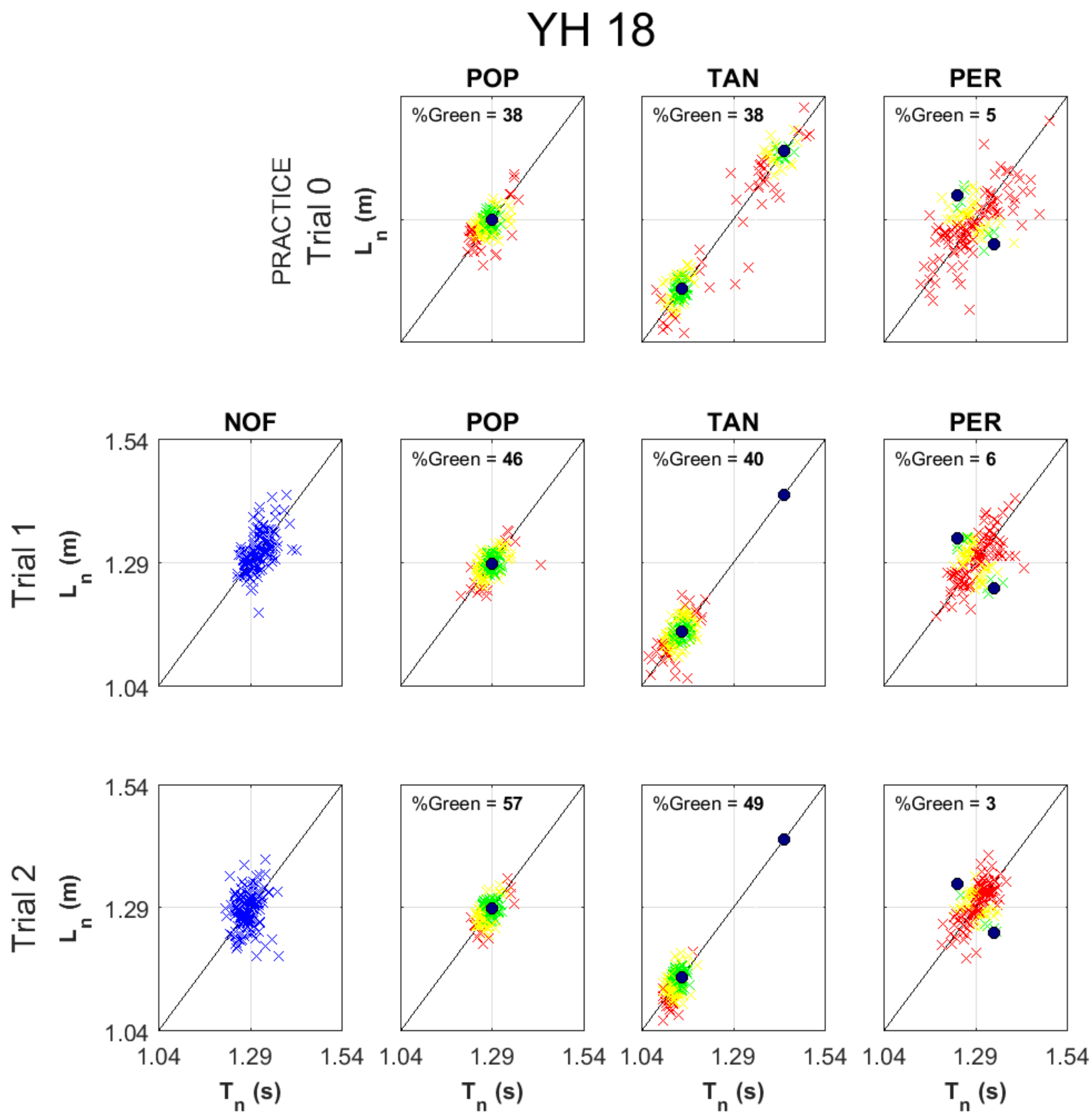

YH 14
POP
TAN
PER
%Green = 64
%Green = 34
%Green = 0
PRACTICE
Trial 0
L_n (m)
NOF
POP
TAN
PER
%Green = 87
%Green = 53
%Green = 4
Trial 1
L_n (m)
1.43
1.18
0.93
%Green = 78
%Green = 61
%Green = 1
Trial 2
L_n (m)
1.43
1.18
0.93
0.93 1.18 1.43
T_n (s)

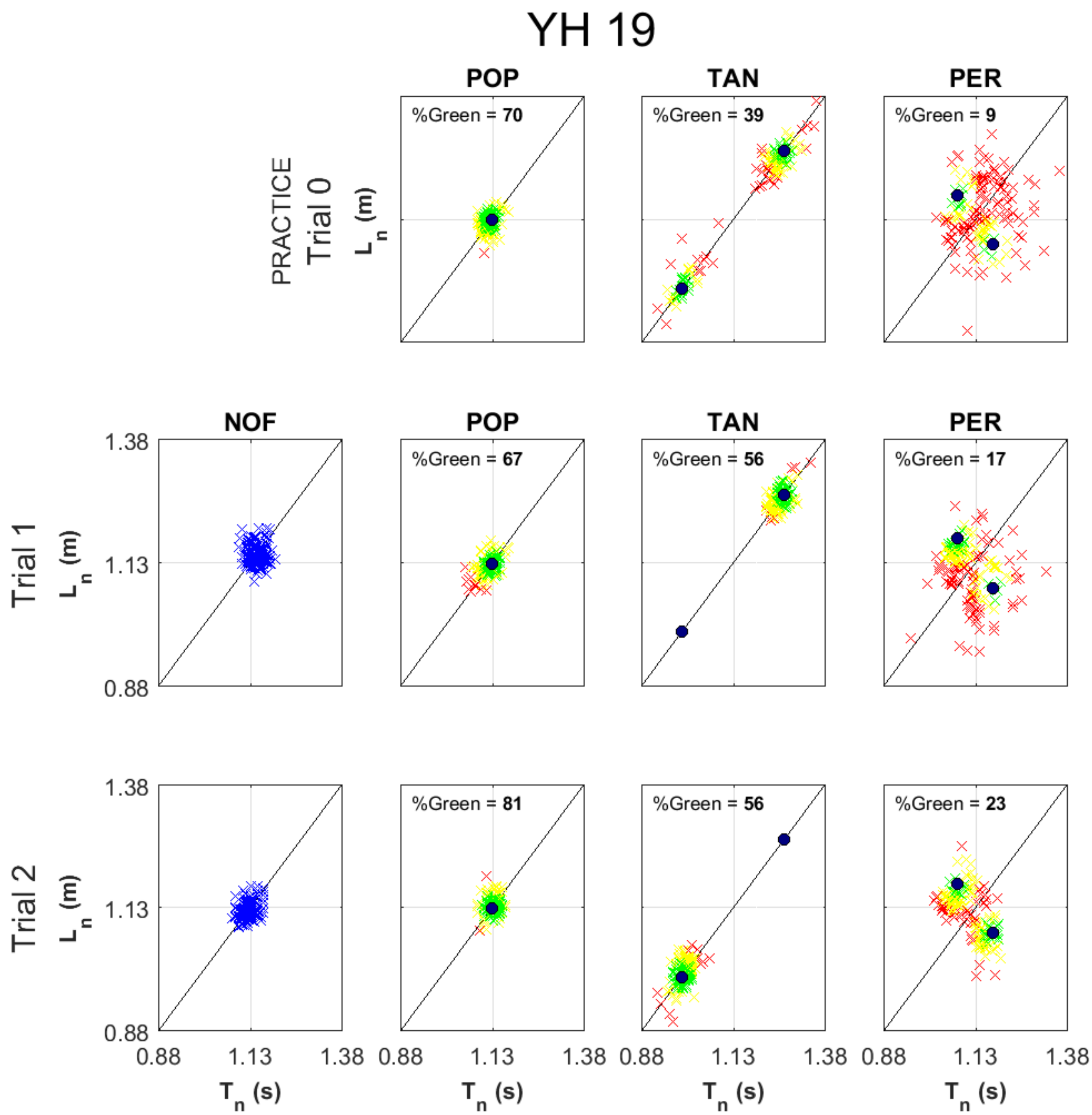

YH 15
POP
TAN
PER
%Green = 47
%Green = 36
%Green = 0
PRACTICE
Trial 0
L_n (m)
NOF
POP
TAN
PER
%Green = 69
%Green = 38
%Green = 1
Trial 1
L_n (m)
1.47
1.22
0.97
%Green = 47
%Green = 38
%Green = 0
Trial 2
L_n (m)
1.47
1.22
0.97
0.97 1.22 1.47
T_n (s)

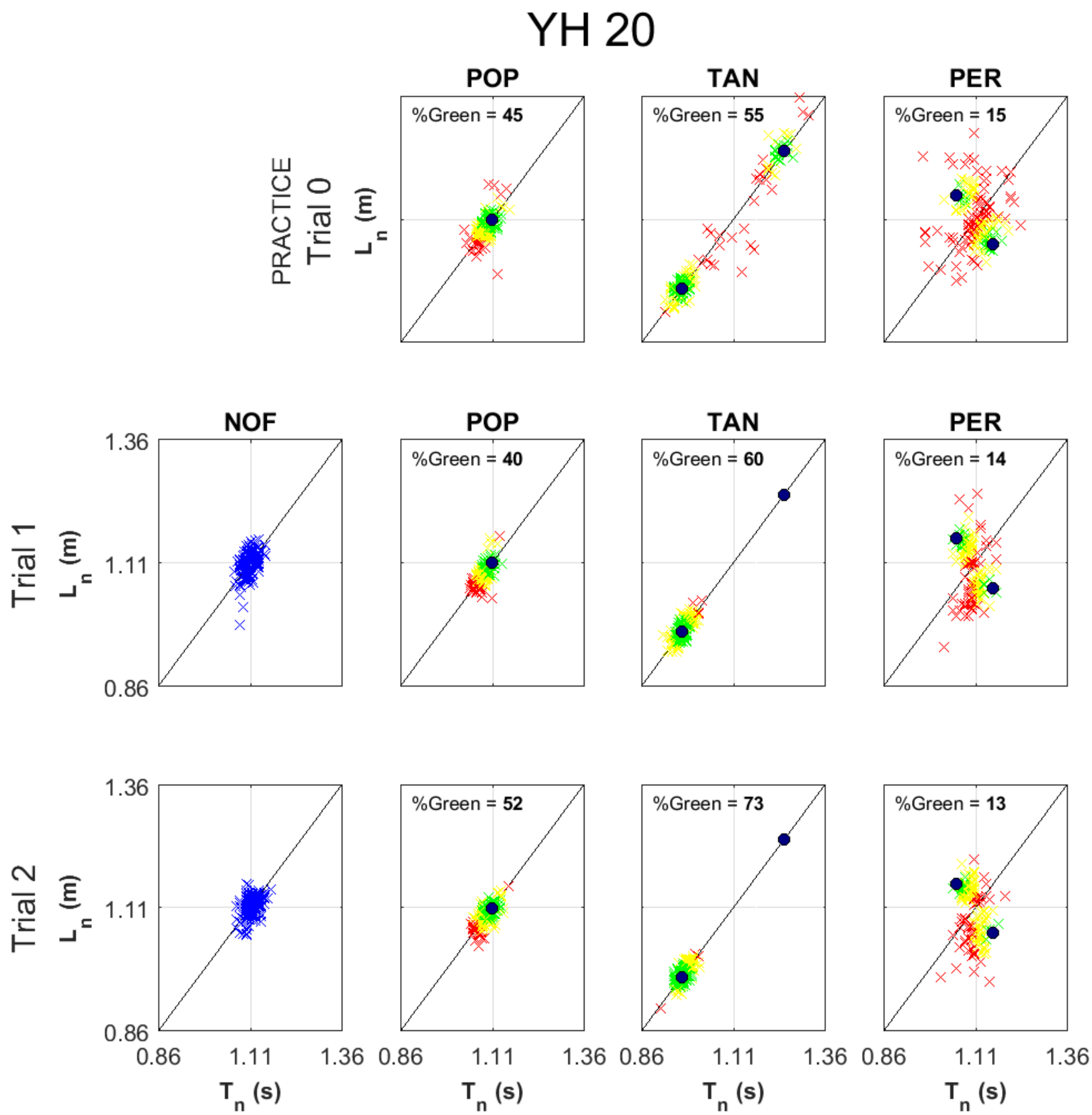


YH 16
POP
TAN
PER
%Green = 52
%Green = 24
%Green = 4
PRACTICE
Trial 0
L_n (m)
NOF
POP
TAN
PER
%Green = 69
%Green = 46
%Green = 6
Trial 1
L_n (m)
1.52
1.27
1.02
%Green = 66
%Green = 57
%Green = 22
Trial 2
L_n (m)
1.52
1.27
1.02
1.02
1.27
1.52
T_n (s)

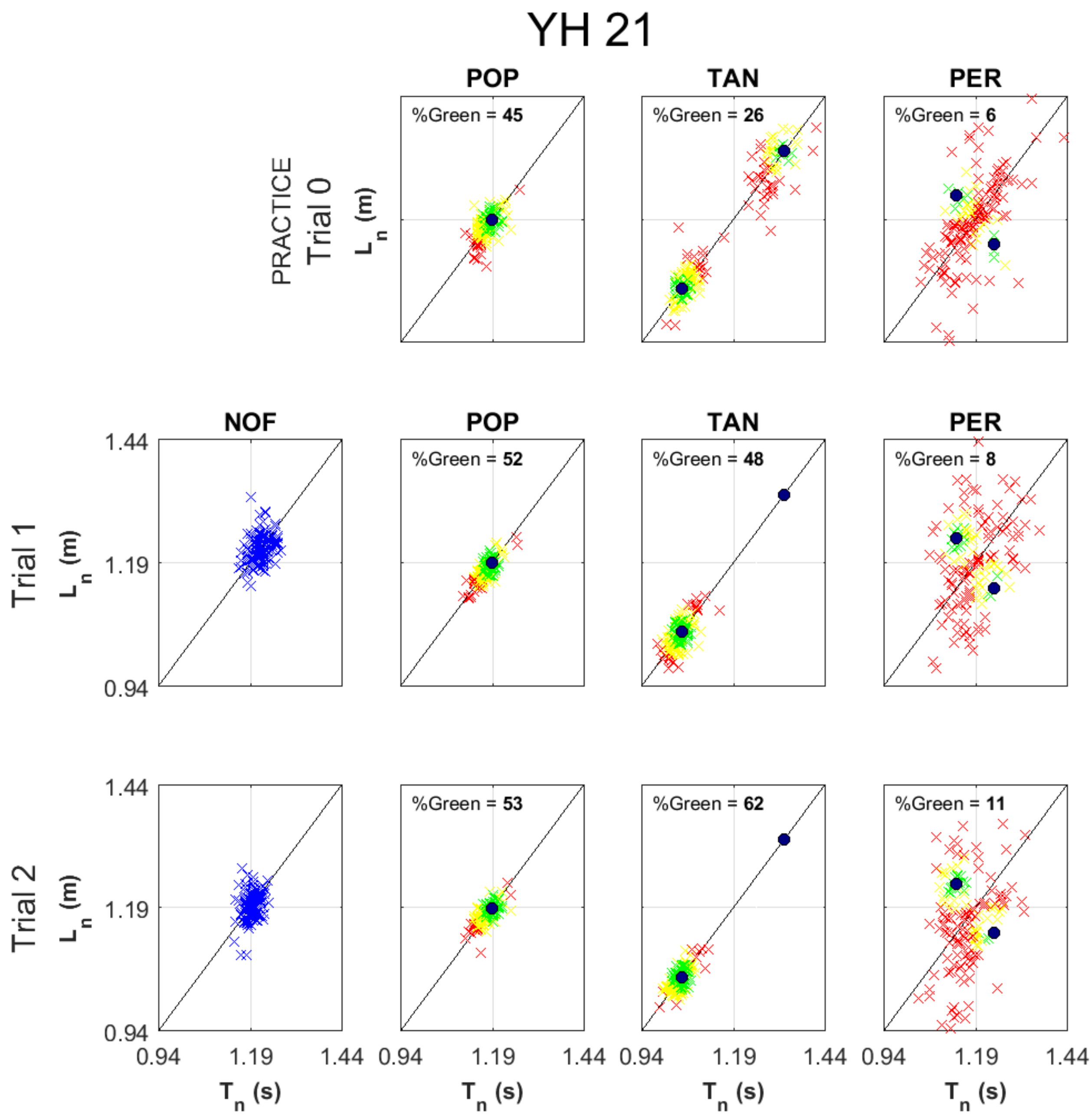

YH 17
POP
TAN
PER
%Green = 49
%Green = 26
%Green = 0
PRACTICE
Trial 0
L_n (m)
NOF
POP
TAN
PER
%Green = 43
%Green = 28
%Green = 16
Trial 1
L_n (m)
1.54
1.29
1.04
%Green = 43
%Green = 44
%Green = 14
Trial 2
L_n (m)
1.54
1.29
1.04
1.04
1.29
1.54
T_n (s)
T_n (s)
T_n (s)
T_n (s)

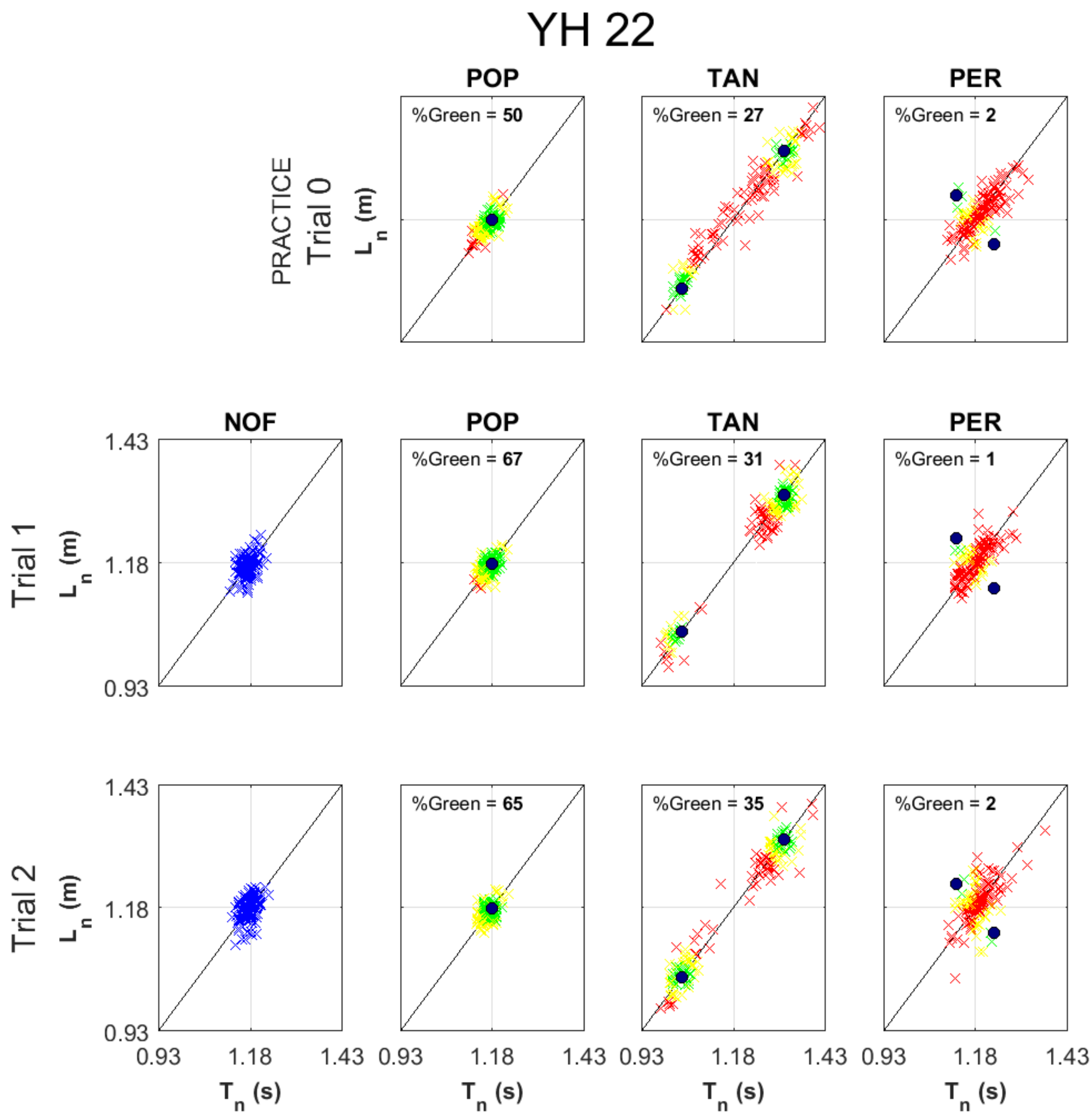

YH 18
POP
TAN
PER
%Green = 38
%Green = 38
%Green = 5
PRACTICE
Trial 0
Ln (m)
NOF
POP
TAN
PER
%Green = 46
%Green = 40
%Green = 6
Trial 1
Ln (m)
1.54
1.29
1.04
%Green = 57
%Green = 49
%Green = 3
Trial 2
Ln (m)
1.54
1.29
1.04
1.04
1.29
1.54
Tn (s)


YH 19
POP
TAN
PER
%Green = 70
%Green = 39
%Green = 9
PRACTICE
Trial 0
L_n (m)
NOF
POP
TAN
PER
%Green = 67
%Green = 56
%Green = 17
Trial 1
L_n (m)
%Green = 81
%Green = 56
%Green = 23
Trial 2
L_n (m)
1.38
1.13
0.88
0.88
1.13
1.38
T_n (s)

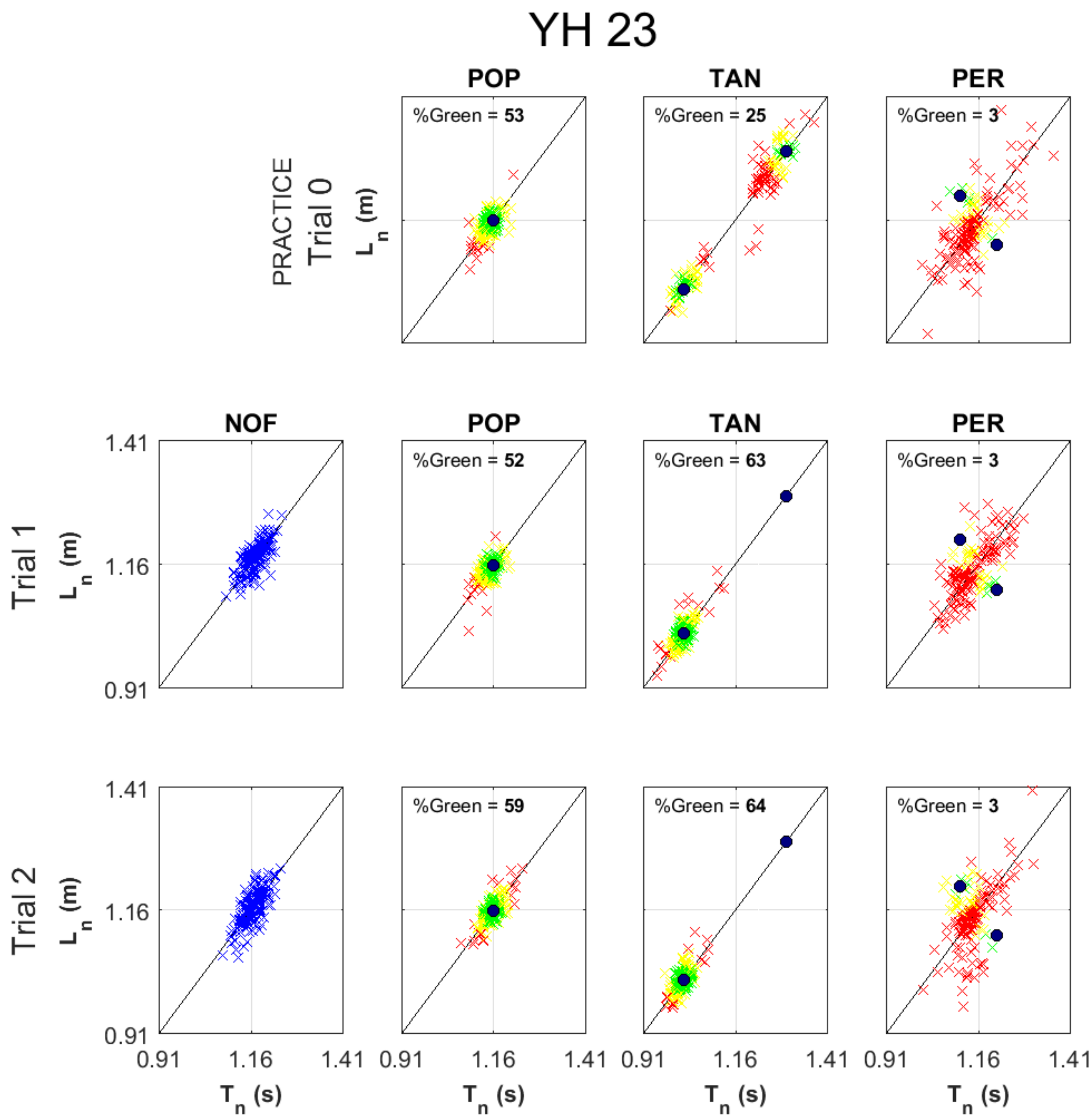


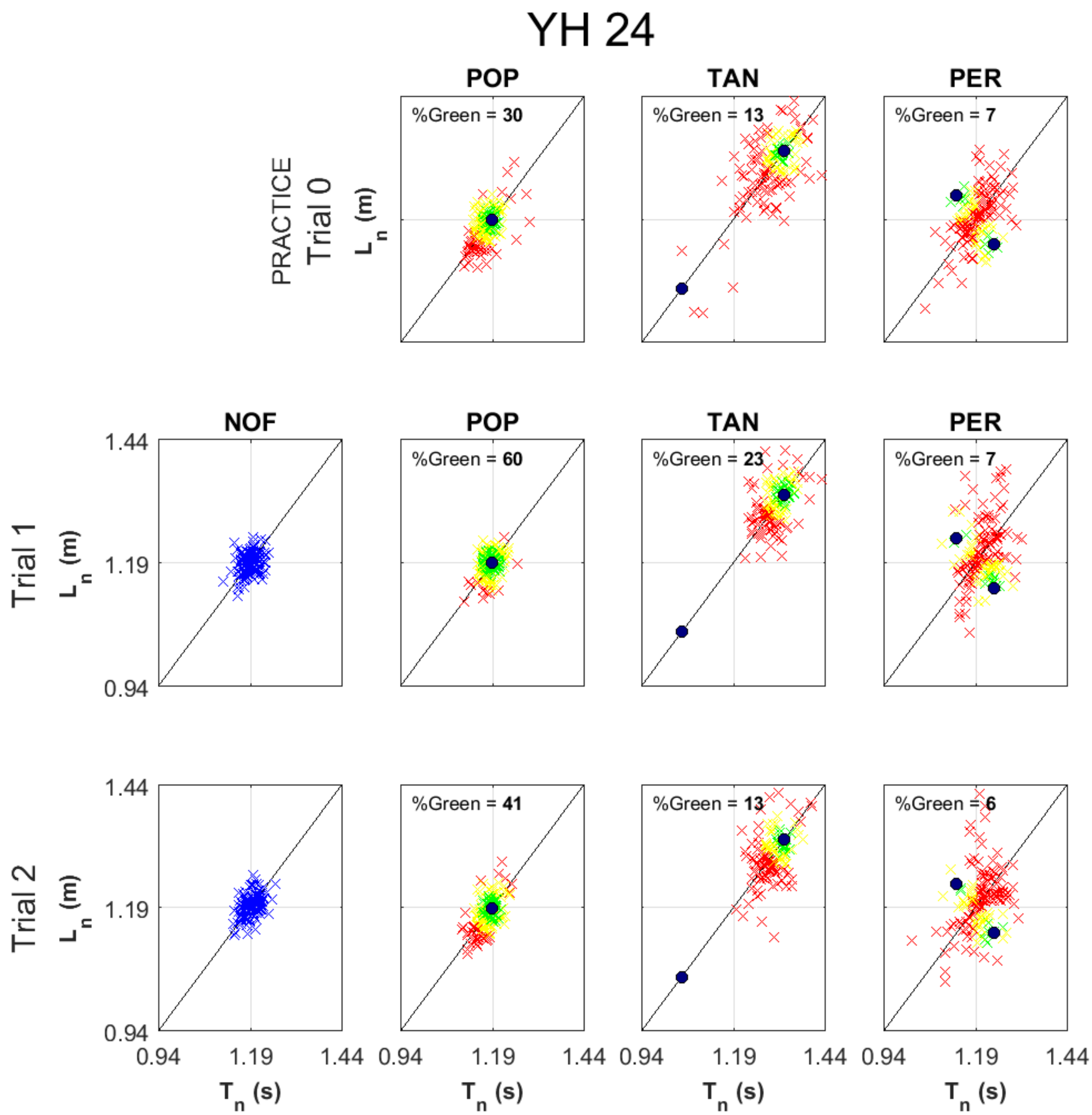
YH 20
POP
TAN
PER
%Green = 45
%Green = 55
%Green = 15
PRACTICE
Trial 0
L n (m)
NOF
POP
TAN
PER
%Green = 40
%Green = 60
%Green = 14
Trial 1
L n (m)
1.36
1.11
0.86
%Green = 52
%Green = 73
%Green = 13
Trial 2
L n (m)
1.36
1.11
0.86
0.86 1.11 1.36
T n (s)

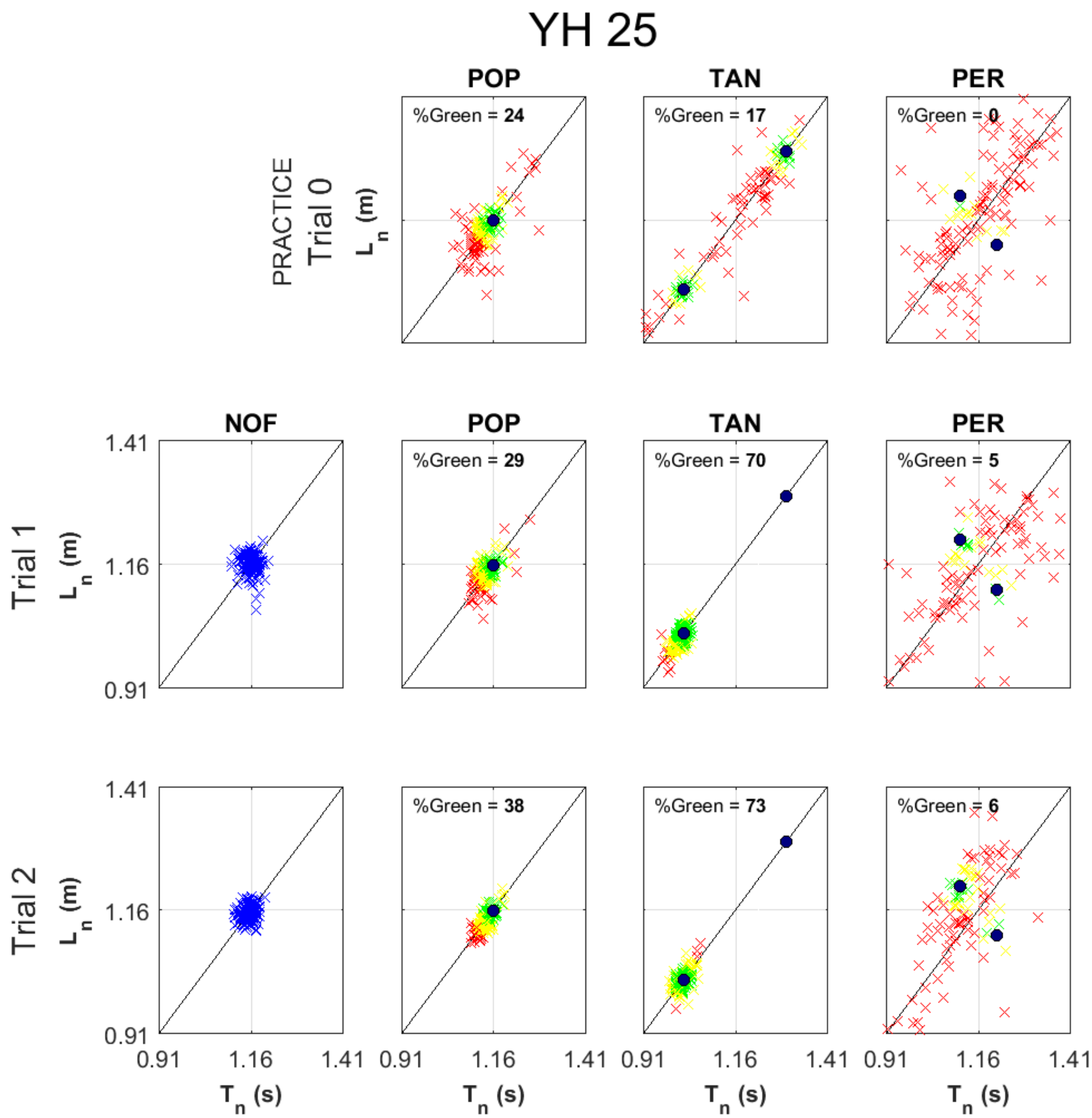

YH 21
POP
TAN
PER
%Green = 45
%Green = 26
%Green = 6
PRACTICE
Trial 0
L_n (m)
NOF
POP
TAN
PER
%Green = 52
%Green = 48
%Green = 8
Trial 1
L_n (m)
1.44
1.19
0.94
%Green = 53
%Green = 62
%Green = 11
Trial 2
L_n (m)
1.44
1.19
0.94
0.94 1.19 1.44
T_n (s)

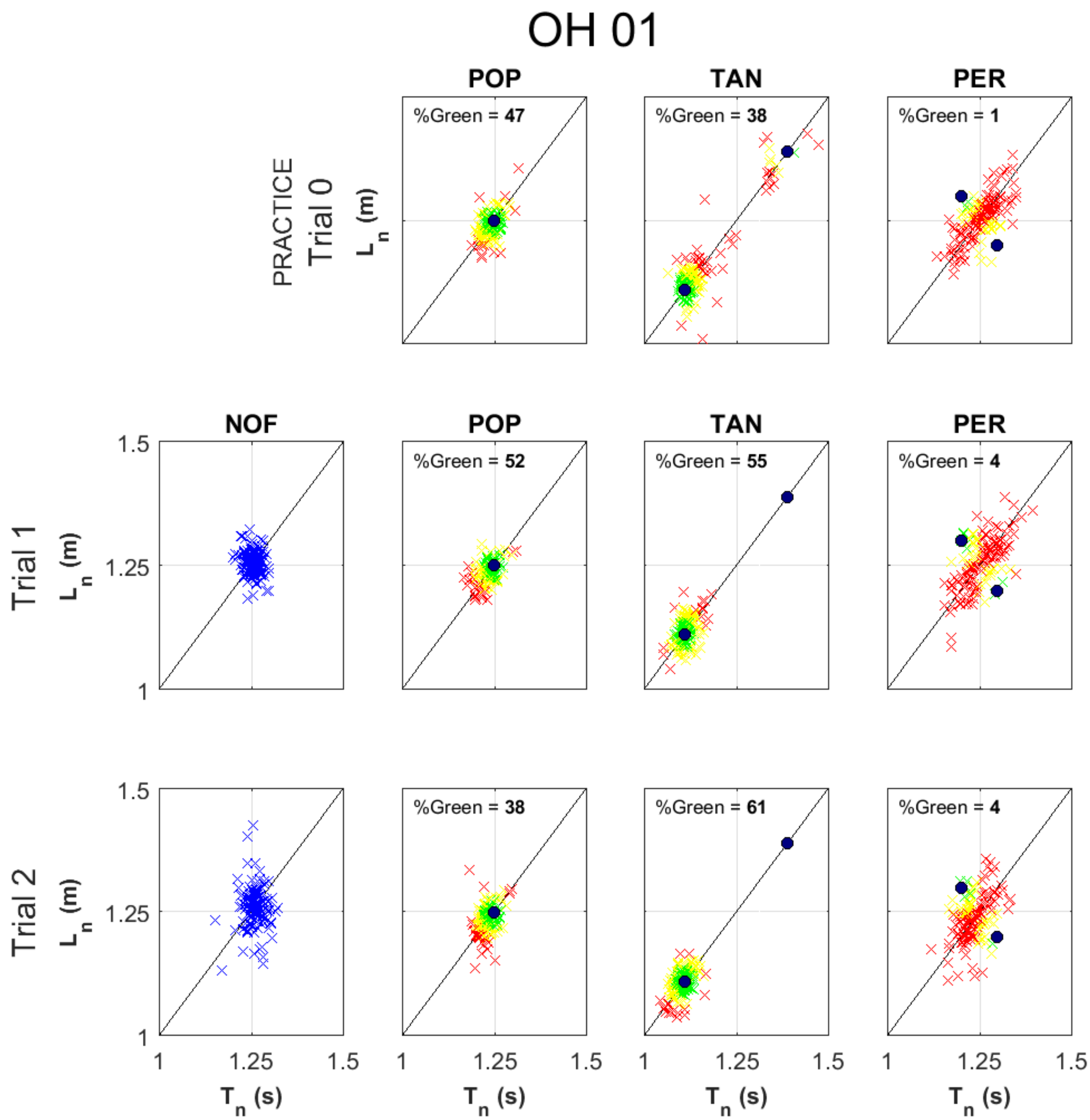


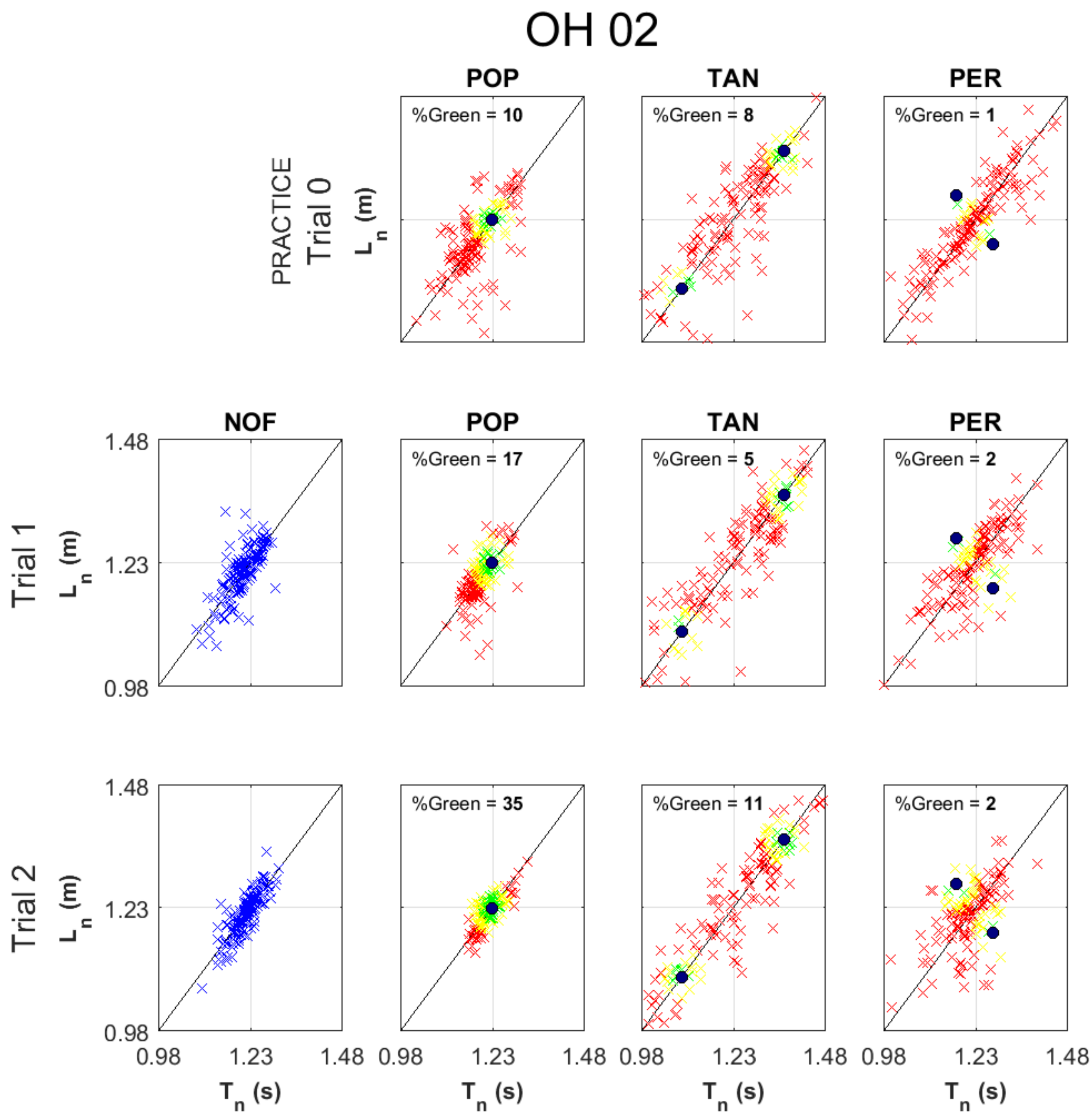
YH 22
POP
TAN
PER
PRACTICE
Trial 0
L_n (m)
%Green = 50
%Green = 27
%Green = 2
NOF
POP
TAN
PER
Trial 1
L_n (m)
%Green = 67
%Green = 31
%Green = 1
Trial 2
L_n (m)
%Green = 65
%Green = 35
%Green = 2
1.43
1.18
0.93
0.93
1.18
1.43
T_n (s)

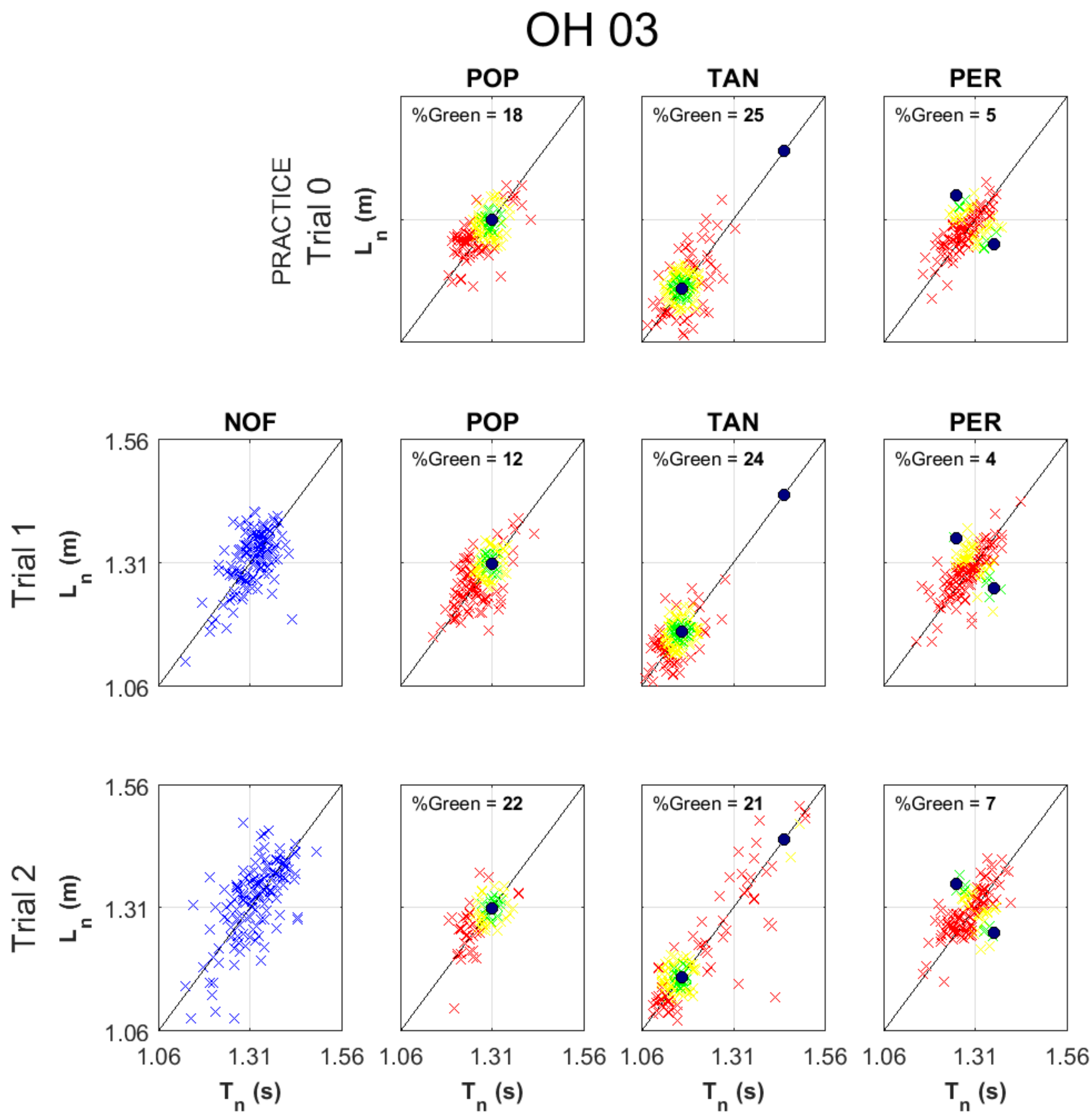

YH 23
POP
TAN
PER
PRACTICE
Trial 0
L n (m)
%Green = 53
%Green = 25
%Green = 3
NOF
Trial 1
%Green = 52
%Green = 63
%Green = 3
Trial 2
%Green = 59
%Green = 64
%Green = 3
1.41
1.16
0.91
0.91 1.16 1.41
T n (s)

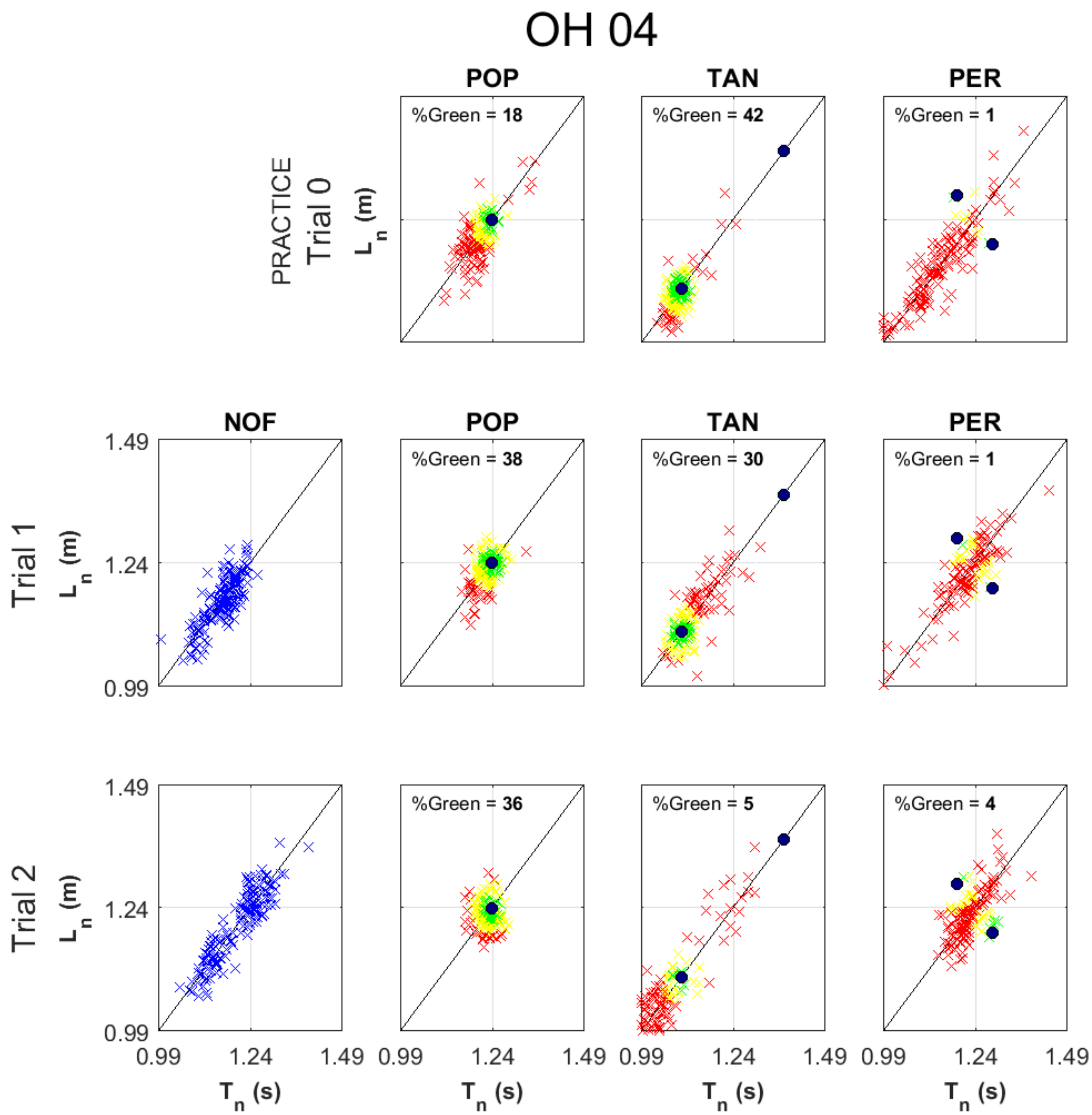

YH 24
POP
TAN
PER
%Green = 30
%Green = 13
%Green = 7
PRACTICE
Trial 0
L n (m)
NOF
POP
TAN
PER
%Green = 60
%Green = 23
%Green = 7
Trial 1
L n (m)
1.44
1.19
0.94
%Green = 41
%Green = 13
%Green = 6
Trial 2
L n (m)
1.44
1.19
0.94
0.94 1.19 1.44
T n (s)
0.94 1.19 1.44
T n (s)
0.94 1.19 1.44
T n (s)
0.94 1.19 1.44
T n (s)

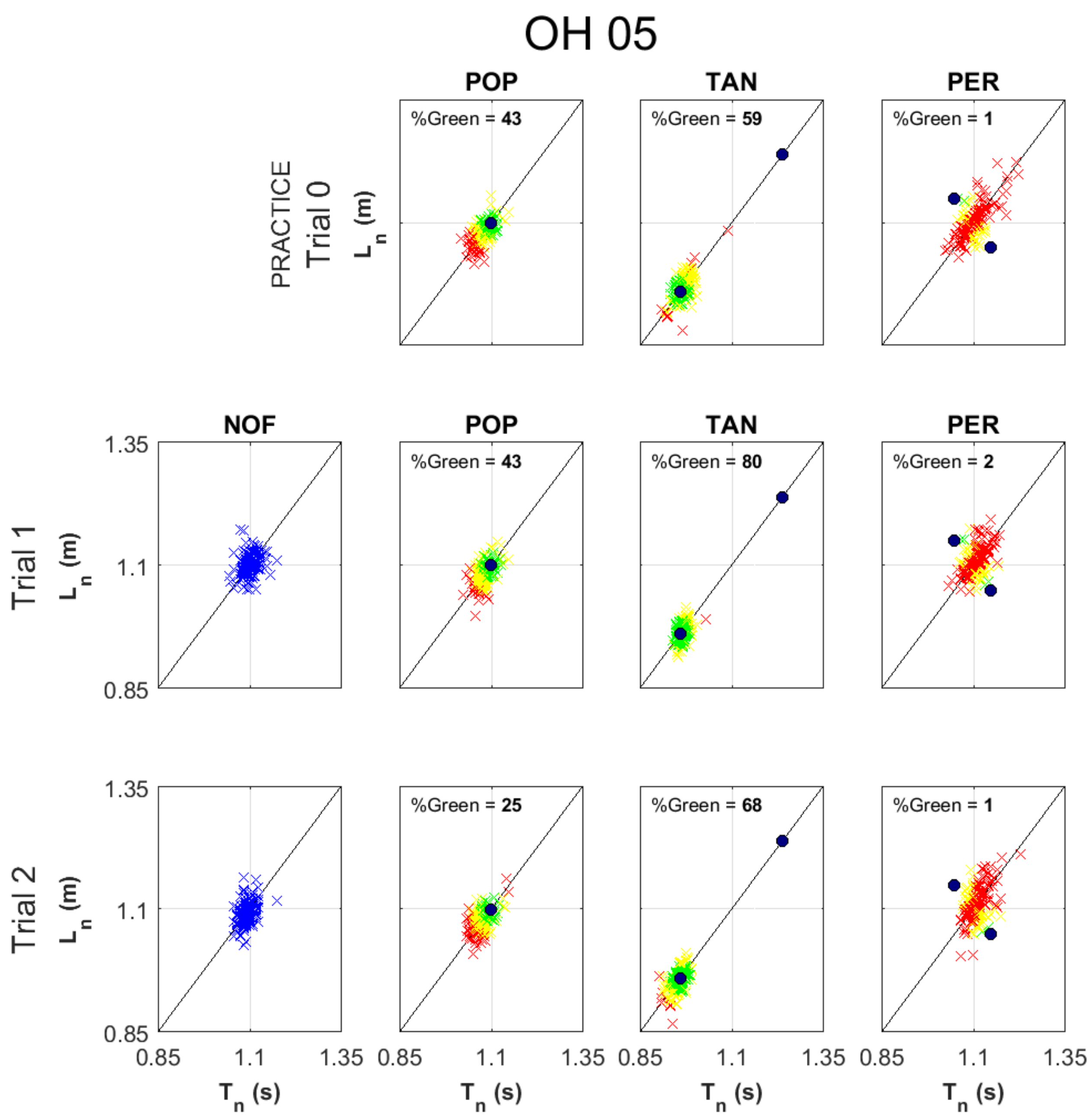

YH 25
POP
TAN
PER
PRACTICE
Trial 0
L_n (m)
%Green = 24
%Green = 17
%Green = 0
NOF
POP
TAN
PER
Trial 1
L_n (m)
1.41
1.16
0.91
%Green = 29
%Green = 70
%Green = 5
Trial 2
L_n (m)
1.41
1.16
0.91
%Green = 38
%Green = 73
%Green = 6
0.91 1.16 1.41
T_n (s)
0.91 1.16 1.41
T_n (s)
0.91 1.16 1.41
T_n (s)
0.91 1.16 1.41
T_n (s)

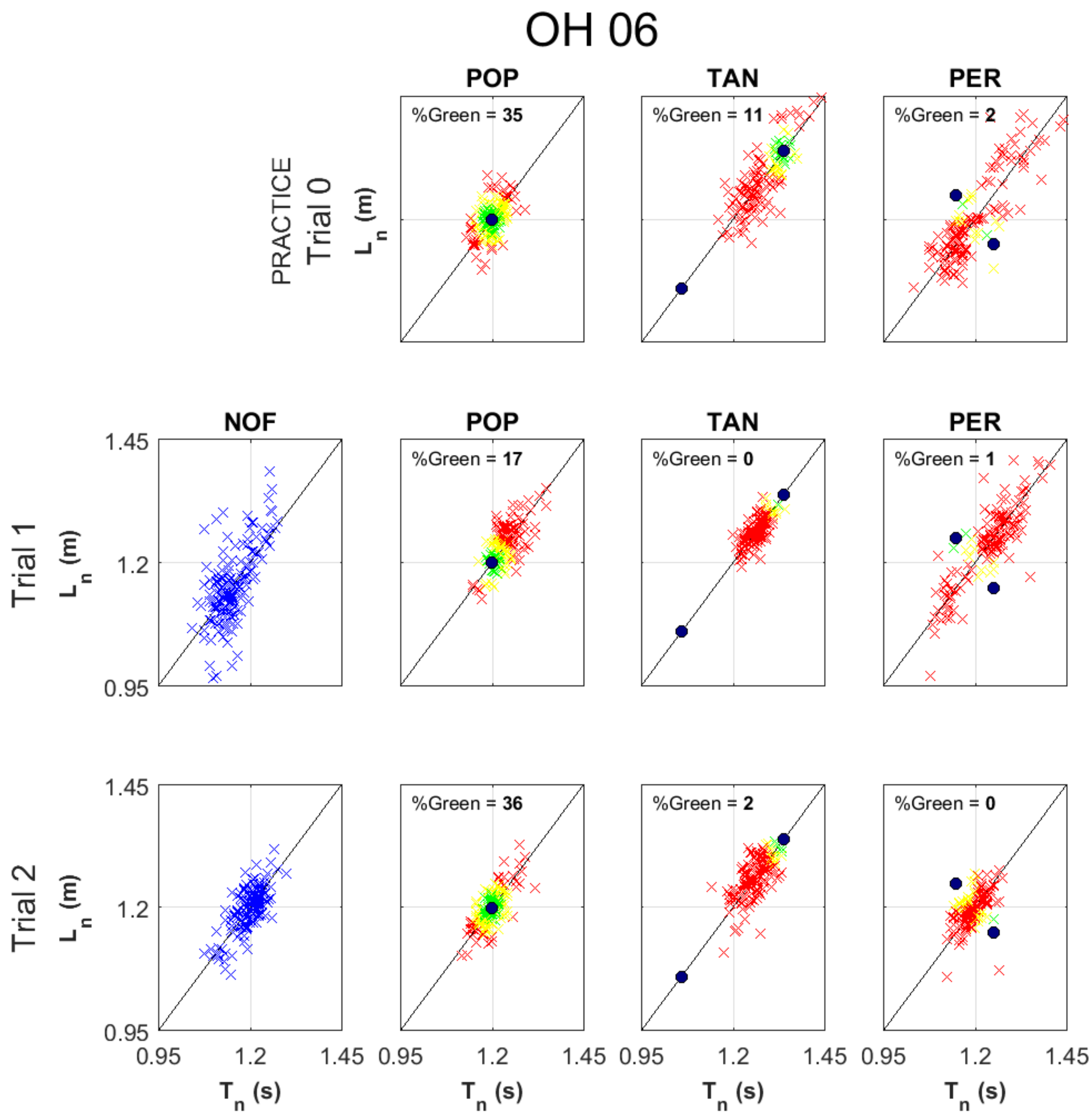

OH 01
POP
TAN
PER
%Green = 47
%Green = 38
%Green = 1
PRACTICE
Trial 0
L_n (m)
NOF
POP
TAN
PER
%Green = 52
%Green = 55
%Green = 4
Trial 1
L_n (m)
%Green = 38
%Green = 61
%Green = 4
Trial 2
L_n (m)
1.5
1.25
1
T_n (s)

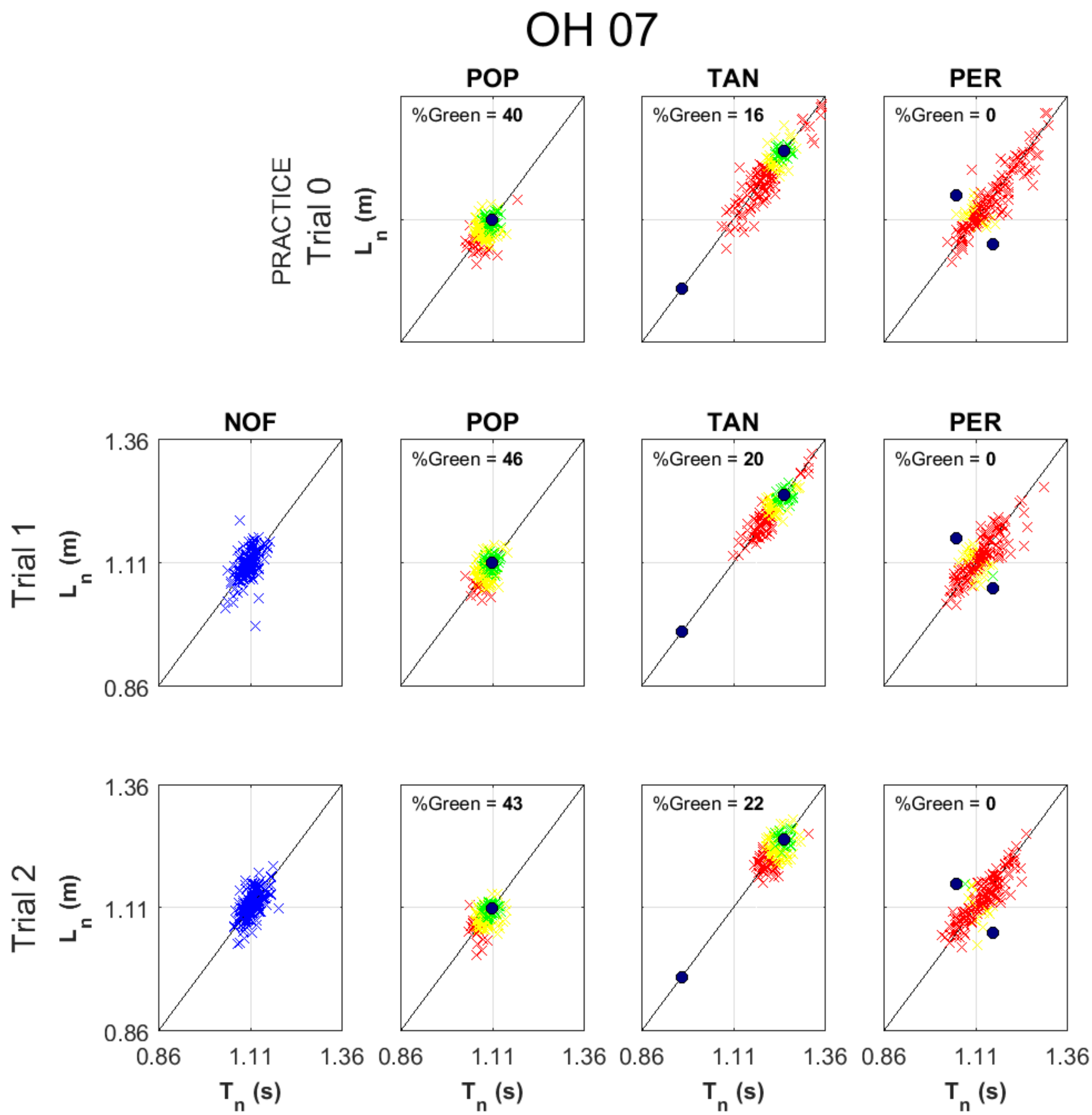

OH 02
POP
TAN
PER
PRACTICE
Trial 0
L n (m)
%Green = 10
%Green = 8
%Green = 1
NOF
POP
TAN
PER
Trial 1
L n (m)
1.48
1.23
0.98
%Green = 17
%Green = 5
%Green = 2
Trial 2
L n (m)
1.48
1.23
0.98
%Green = 35
%Green = 11
%Green = 2
0.98 1.23 1.48
T n (s)

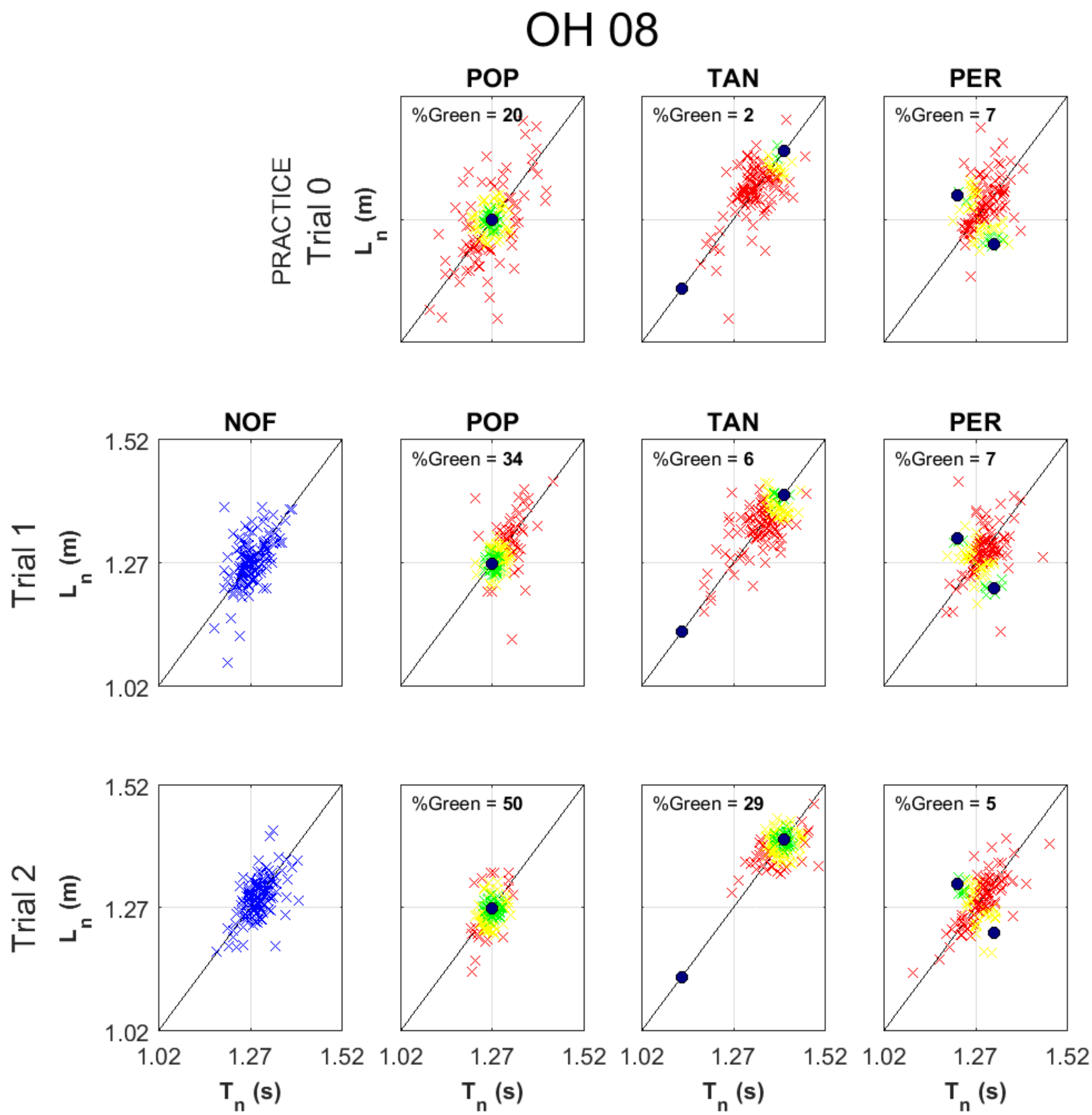

OH 03
POP
TAN
PER
%Green = 18
%Green = 25
%Green = 5
PRACTICE
Trial 0
L_n (m)
NOF
POP
TAN
PER
%Green = 12
%Green = 24
%Green = 4
Trial 1
L_n (m)
1.56
1.31
1.06
%Green = 22
%Green = 21
%Green = 7
Trial 2
L_n (m)
1.56
1.31
1.06
1.06 1.31 1.56
T_n (s)

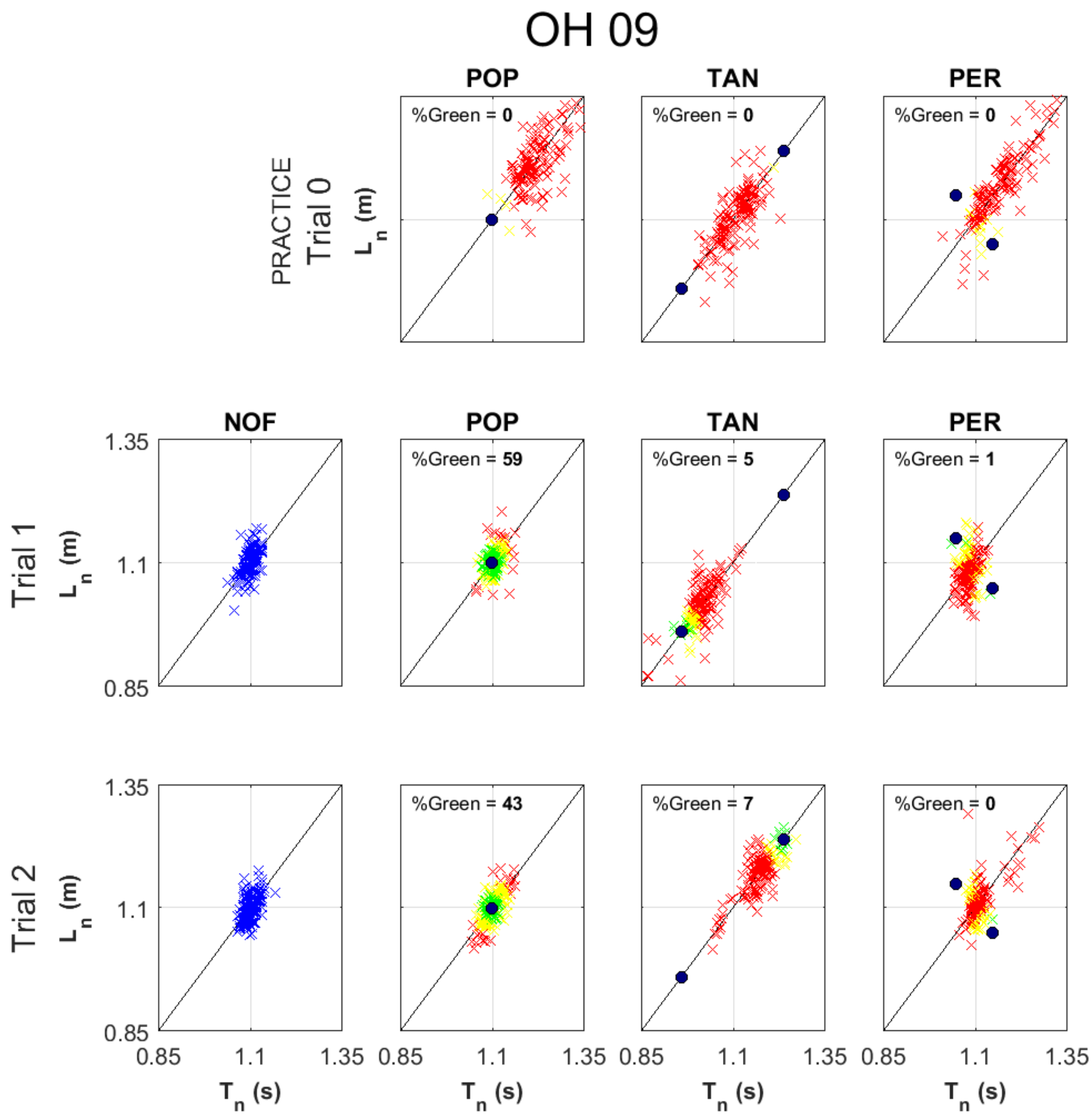

OH 04
POP
TAN
PER
PRACTICE
Trial 0
L_n (m)
%Green = 18
%Green = 42
%Green = 1
NOF
POP
TAN
PER
Trial 1
L_n (m)
1.49
1.24
0.99
%Green = 38
%Green = 30
%Green = 1
Trial 2
L_n (m)
1.49
1.24
0.99
%Green = 36
%Green = 5
%Green = 4
0.99 1.24 1.49
T_n (s)

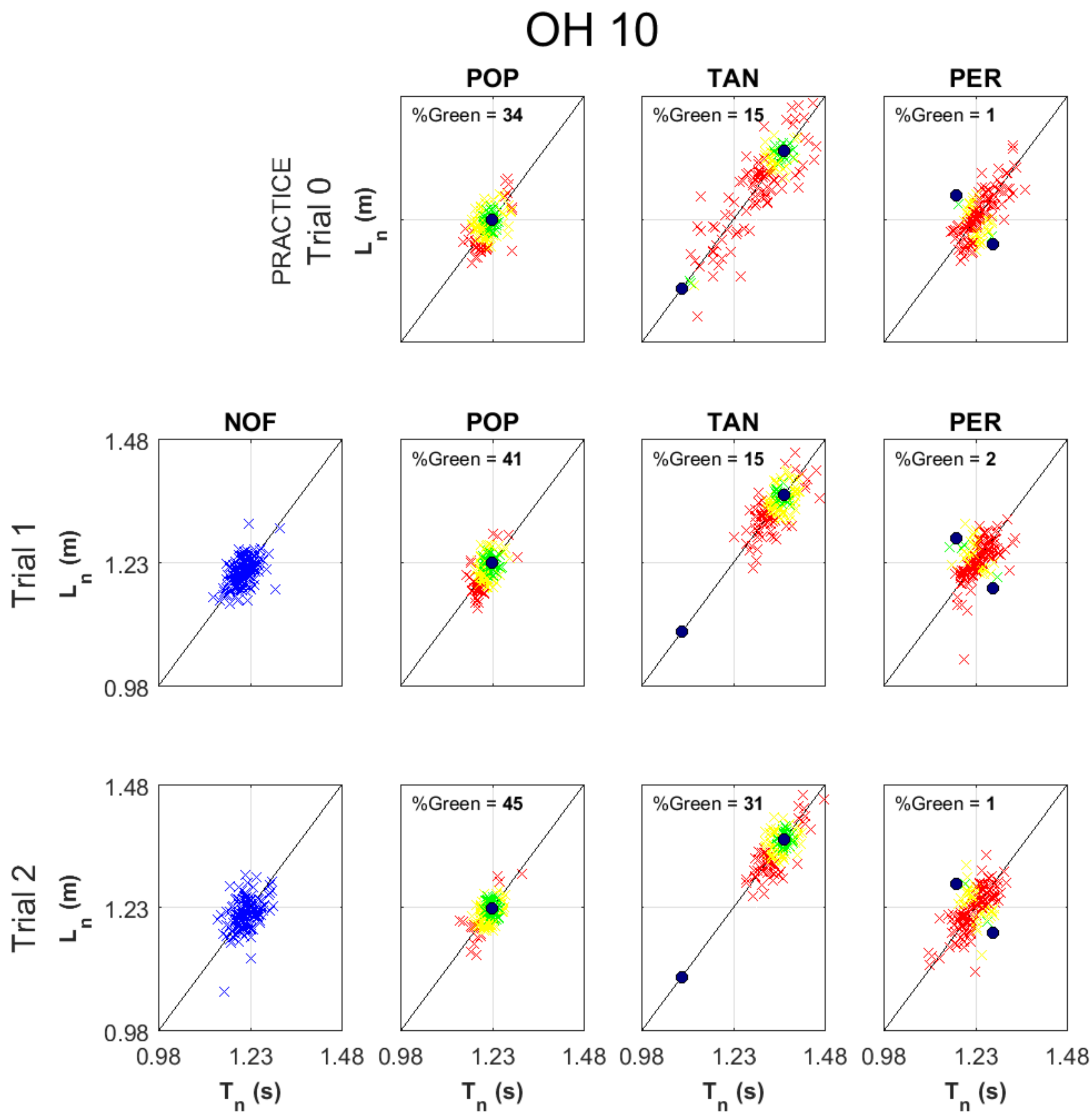

OH 05
POP
TAN
PER
NOF
%Green = 43
%Green = 59
%Green = 1
%Green = 43
%Green = 80
%Green = 2
%Green = 25
%Green = 68
%Green = 1
PRACTICE
Trial 0
Trial 1
Trial 2
L n (m)
T n (s)
0.85
1.1
1.35

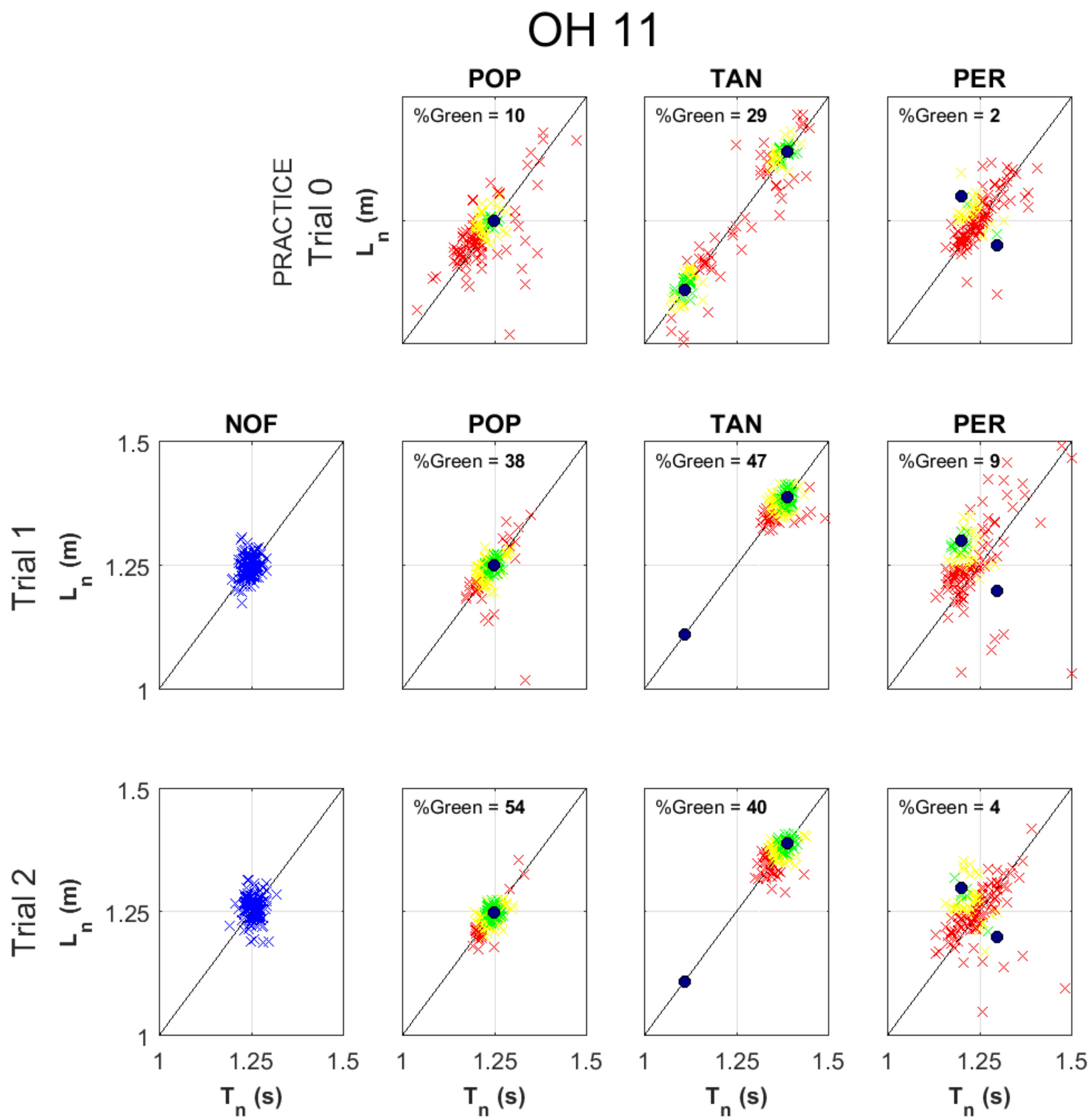

OH 06
POP
TAN
PER
%Green = 35
%Green = 11
%Green = 2
PRACTICE
Trial 0
L n (m)
NOF
%Green = 17
%Green = 0
%Green = 1
Trial 1
%Green = 36
%Green = 2
%Green = 0
Trial 2
1.45
1.2
0.95
T n (s)

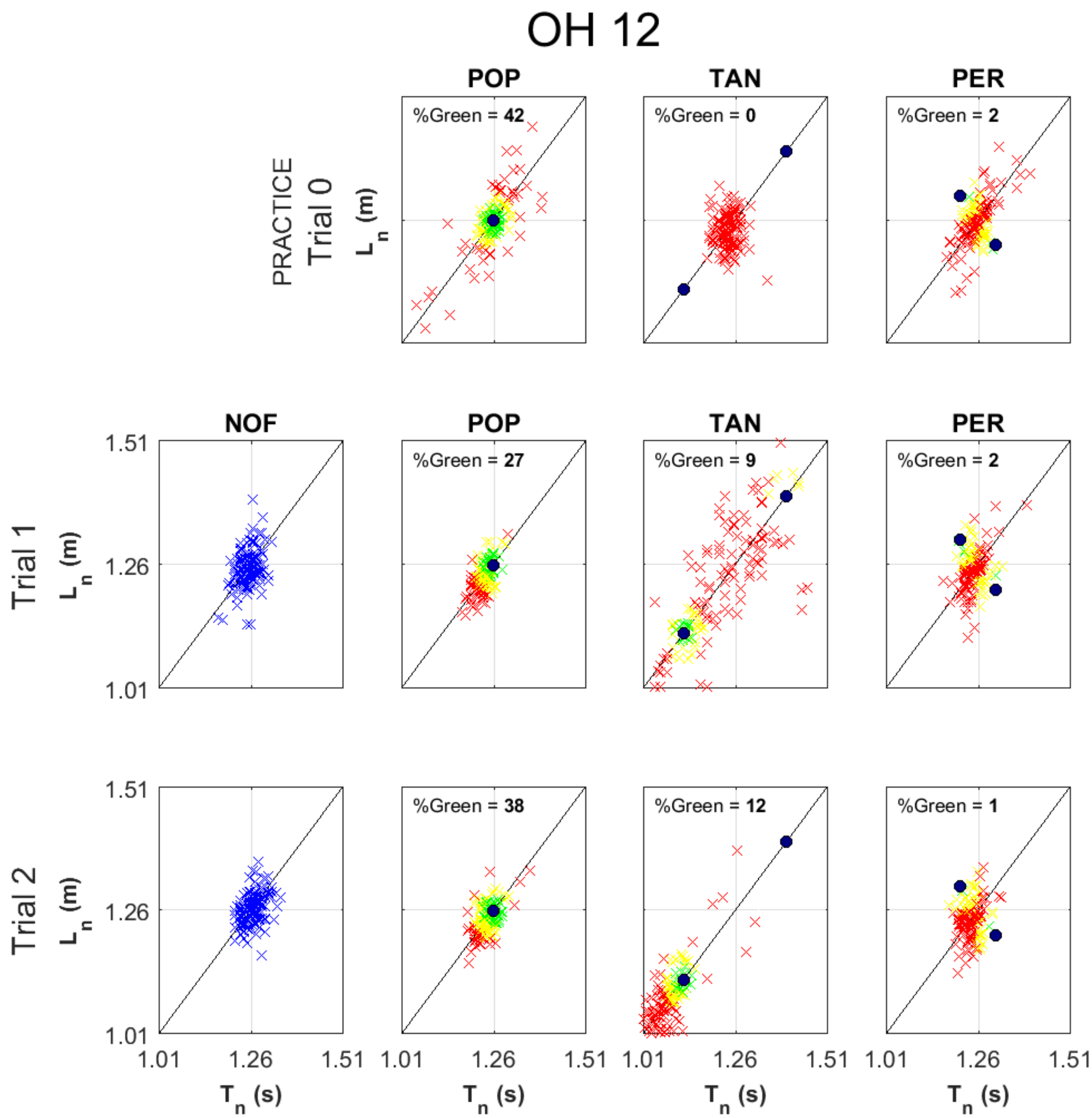

OH 07
POP
TAN
PER
PRACTICE
Trial 0
L_n (m)
%Green = 40
%Green = 16
%Green = 0
NOF
POP
TAN
PER
Trial 1
L_n (m)
1.36
1.11
0.86
%Green = 46
%Green = 20
%Green = 0
Trial 2
L_n (m)
1.36
1.11
0.86
%Green = 43
%Green = 22
%Green = 0
0.86 1.11 1.36
T_n (s)
0.86 1.11 1.36
T_n (s)
0.86 1.11 1.36
T_n (s)
0.86 1.11 1.36
T_n (s)

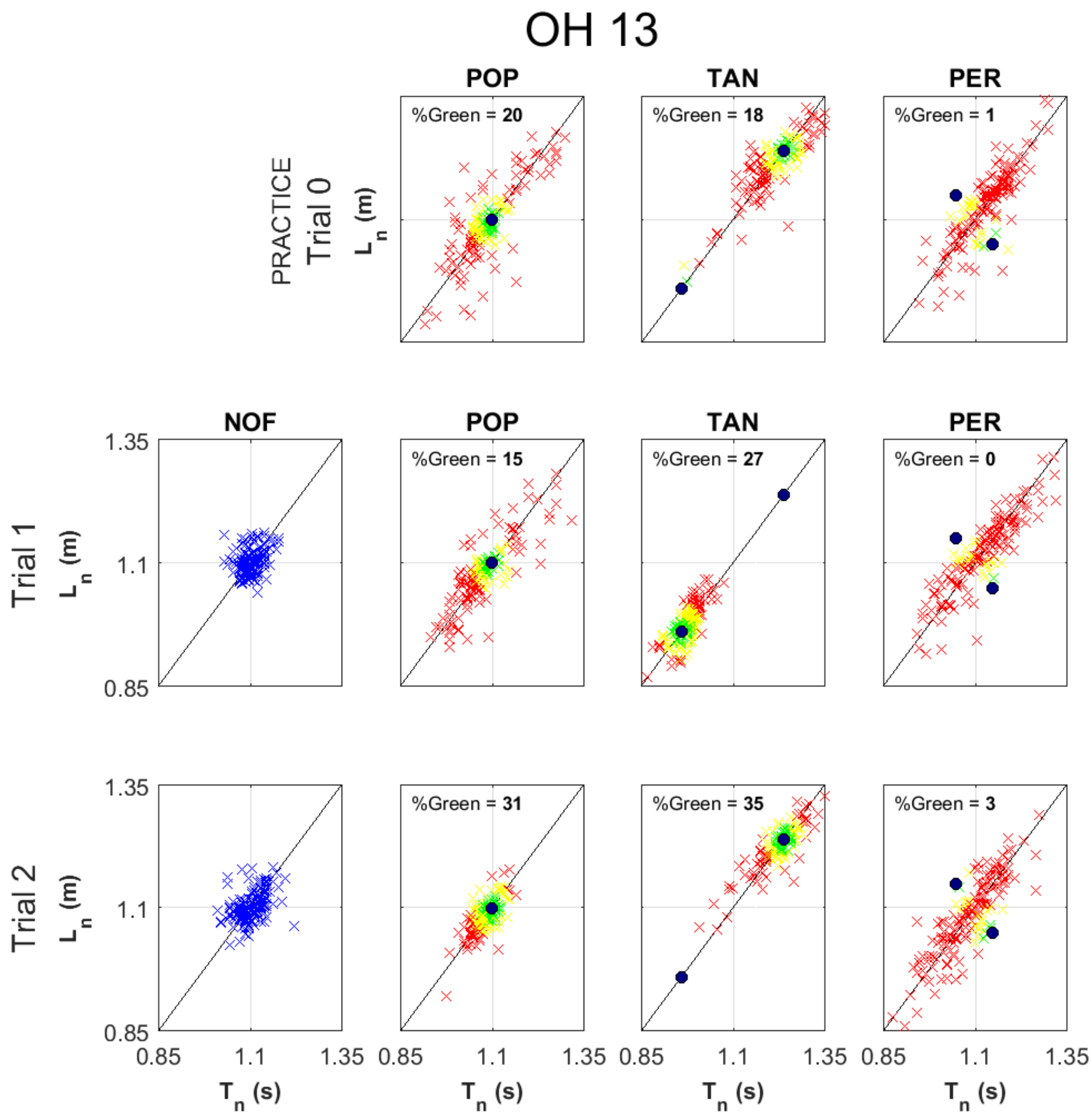

OH 08
POP
TAN
PER
PRACTICE
Trial 0
%Green = 20
%Green = 2
%Green = 7
NOF
Trial 1
%Green = 34
%Green = 6
%Green = 7
Trial 2
%Green = 50
%Green = 29
%Green = 5
L n (m)
T n (s)
1.02
1.27
1.52

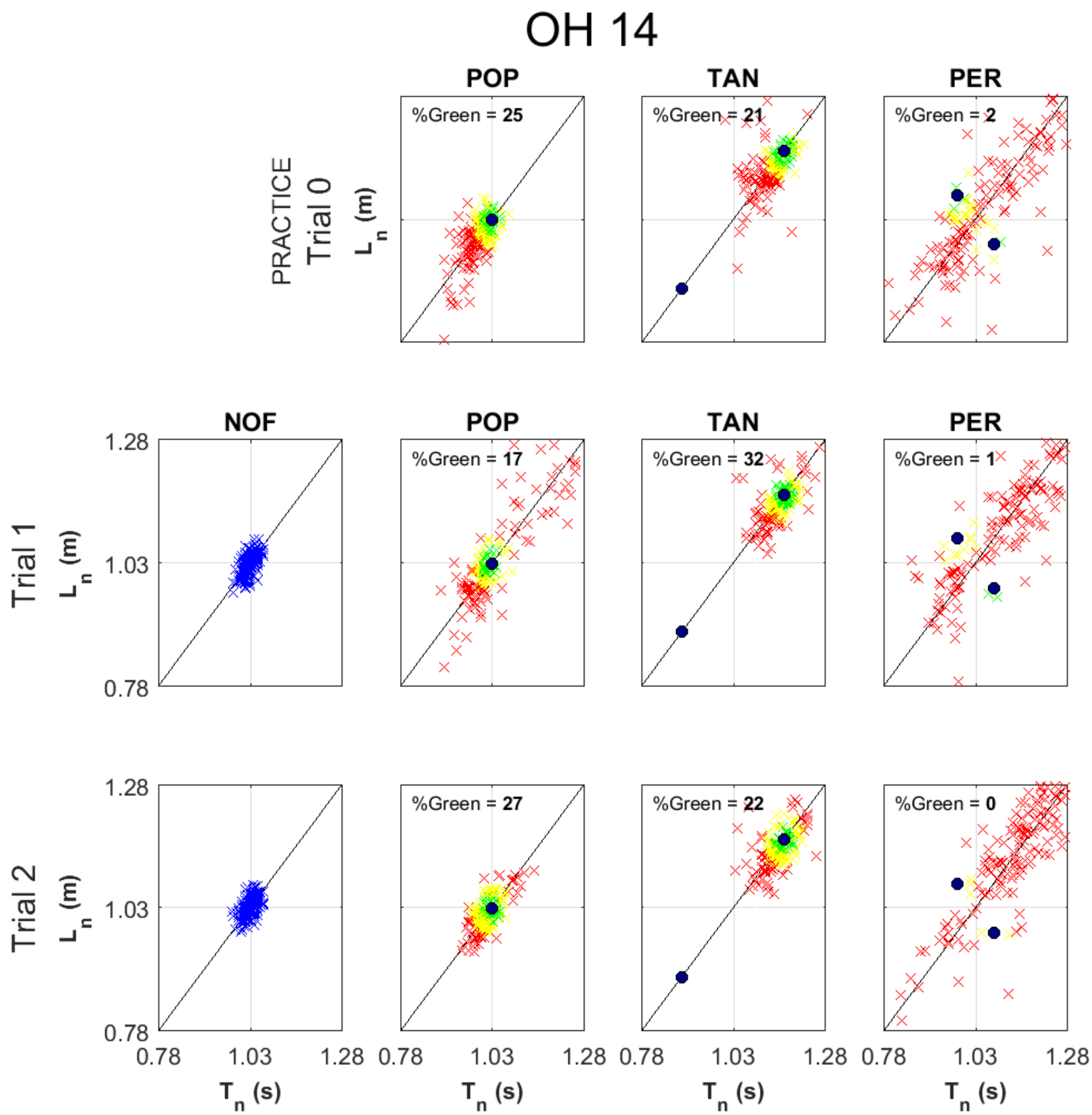

OH 09
POP
TAN
PER
PRACTICE
Trial 0
L n (m)
%Green = 0
%Green = 0
%Green = 0
NOF
POP
TAN
PER
1.35
1.1
0.85
Trial 1
L n (m)
%Green = 59
%Green = 5
%Green = 1
Trial 2
L n (m)
%Green = 43
%Green = 7
%Green = 0
0.85 1.1 1.35
T n (s)

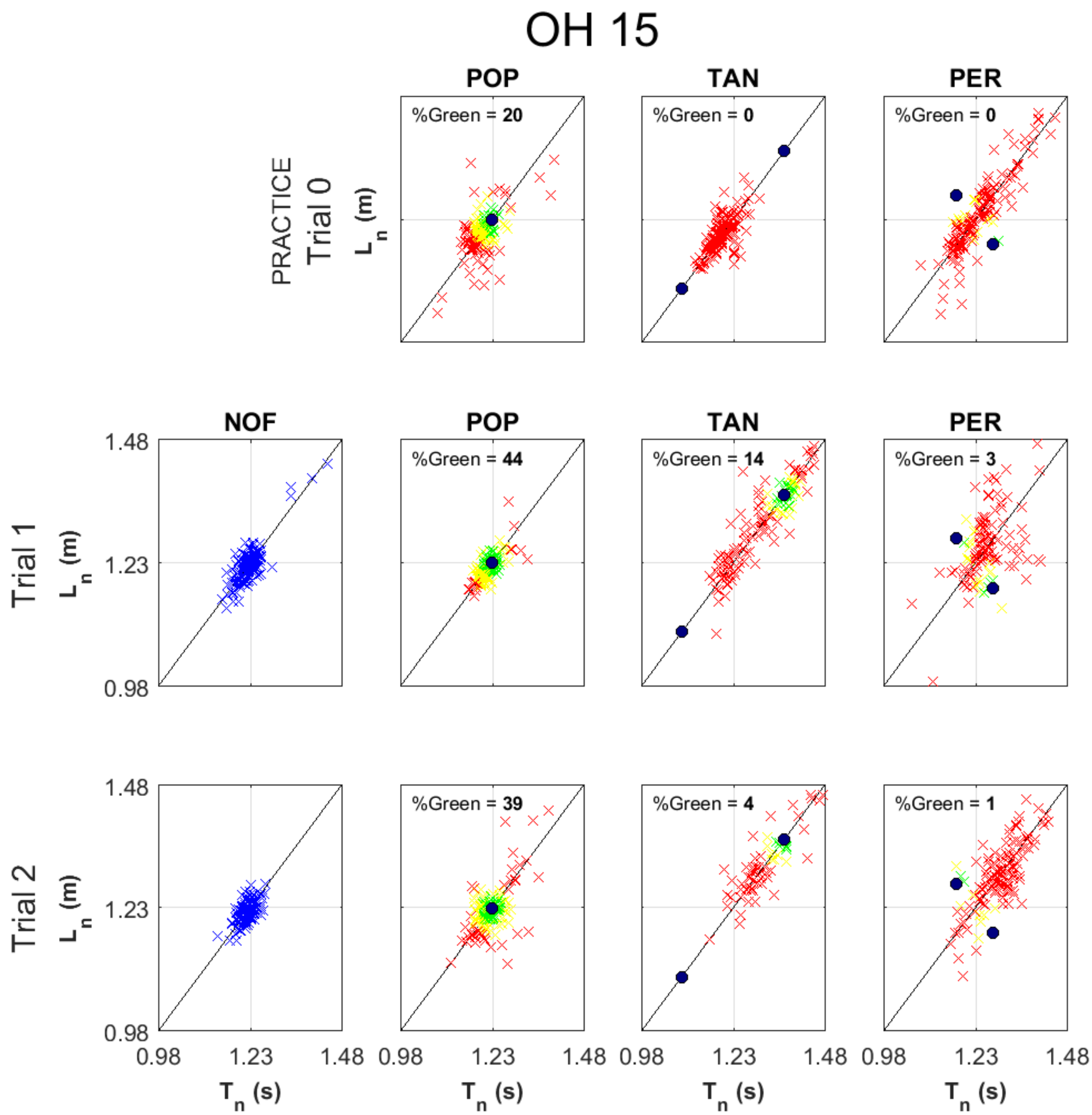

OH 10
POP
TAN
PER
%Green = 34
%Green = 15
%Green = 1
PRACTICE
Trial 0
L_n (m)
NOF
POP
TAN
PER
%Green = 41
%Green = 15
%Green = 2
Trial 1
L_n (m)
1.48
1.23
0.98
%Green = 45
%Green = 31
%Green = 1
Trial 2
L_n (m)
1.48
1.23
0.98
0.98
1.23
1.48
T_n (s)

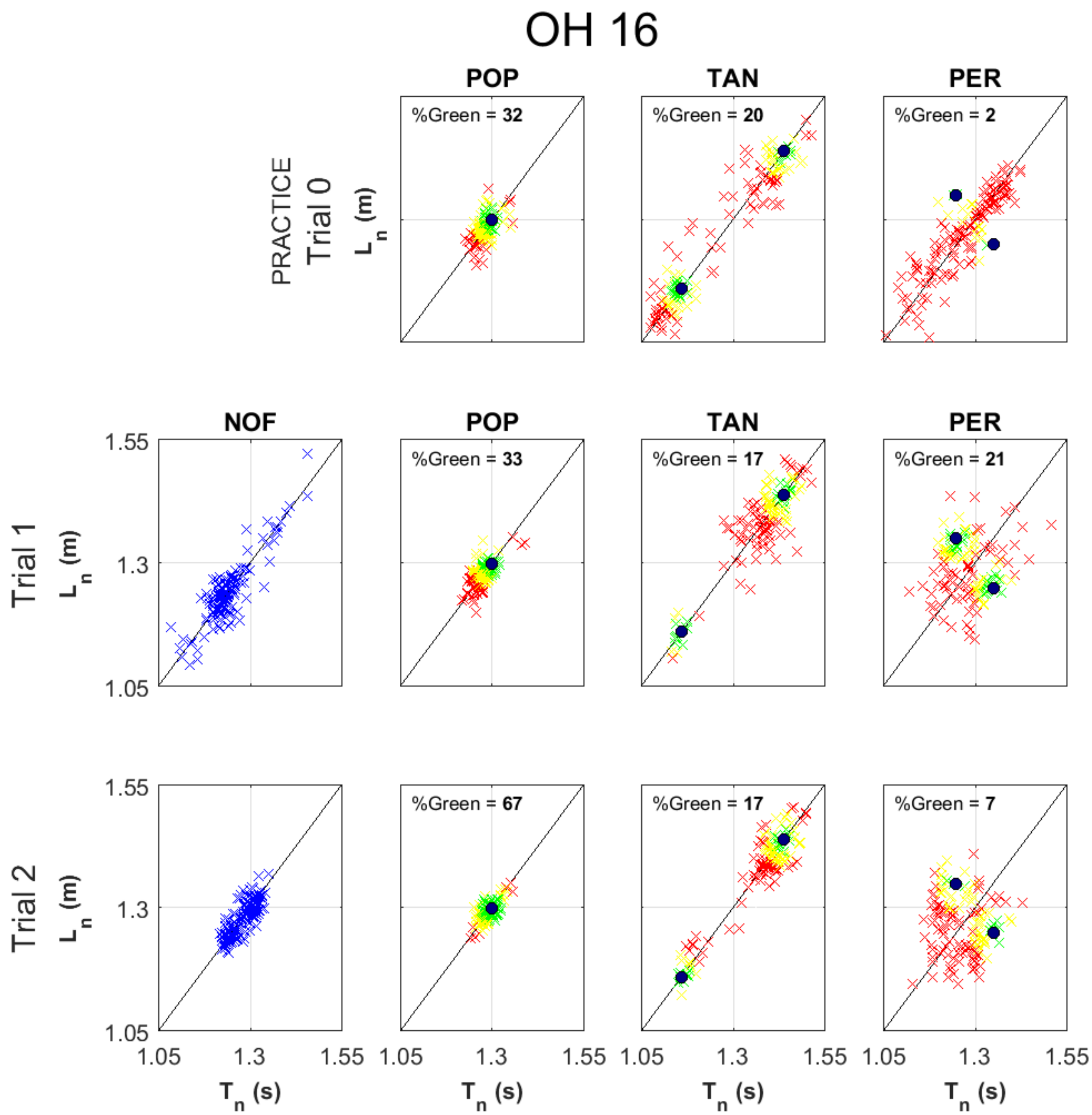

OH 11
POP
TAN
PER
PRACTICE
Trial 0
L_n (m)
%Green = 10
%Green = 29
%Green = 2
NOF
POP
TAN
PER
Trial 1
L_n (m)
1.5
1.25
1
%Green = 38
%Green = 47
%Green = 9
Trial 2
L_n (m)
1.5
1.25
1
%Green = 54
%Green = 40
%Green = 4
1
1.25
1.5
T_n (s)


OH 12
POP
TAN
PER
PRACTICE
Trial 0
L_n (m)
%Green = 42
%Green = 0
%Green = 2
NOF
POP
TAN
PER
Trial 1
L_n (m)
1.51
1.26
1.01
%Green = 27
%Green = 9
%Green = 2
Trial 2
L_n (m)
1.51
1.26
1.01
%Green = 38
%Green = 12
%Green = 1
1.01 1.26 1.51
T_n (s)
1.01 1.26 1.51
T_n (s)
1.01 1.26 1.51
T_n (s)
1.01 1.26 1.51
T_n (s)

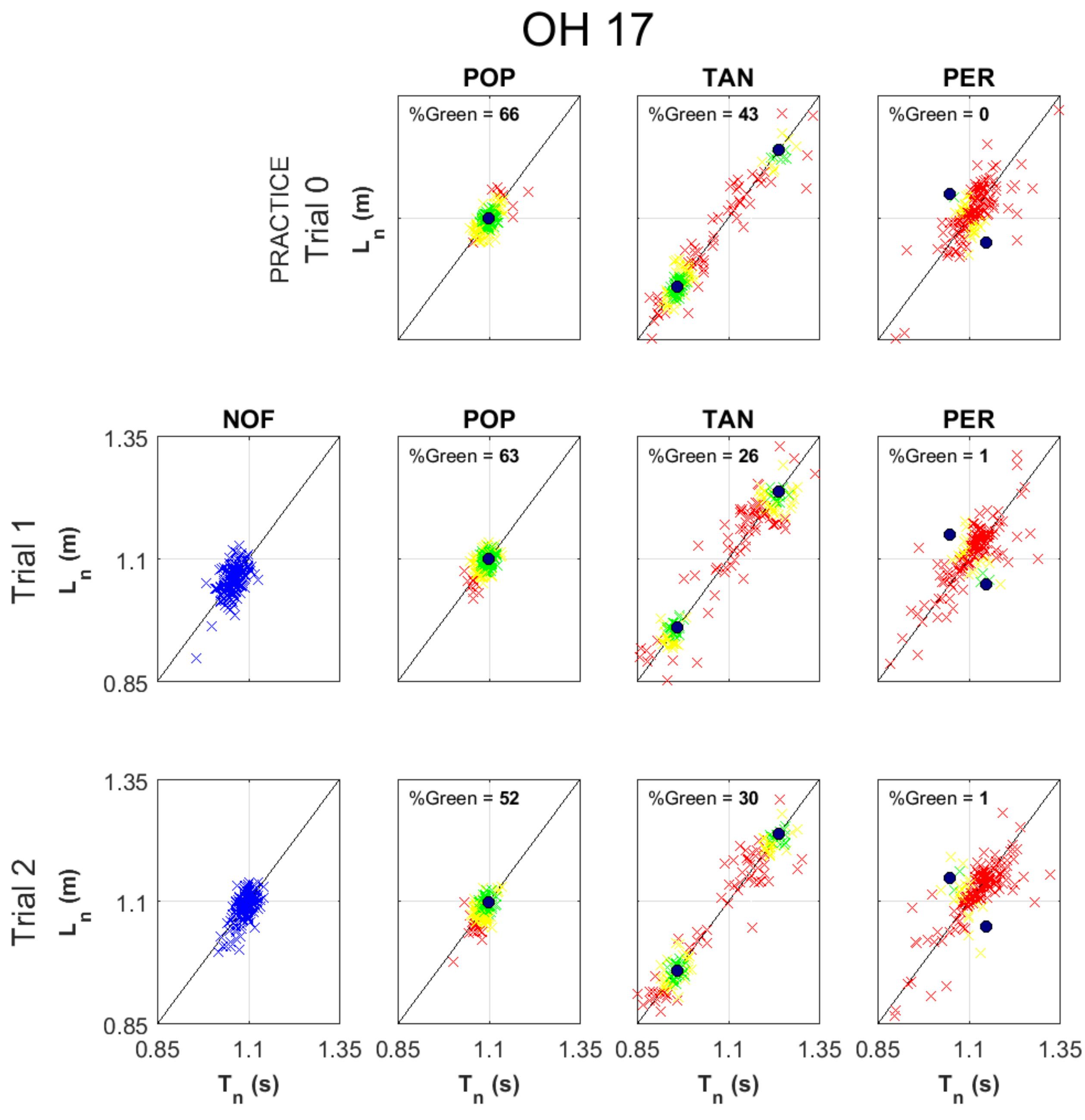

OH 13
POP
TAN
PER
NOF
PRACTICE
Trial 0
Trial 1
Trial 2
L_n (m)
T_n (s)
%Green = 20
%Green = 18
%Green = 1
%Green = 15
%Green = 27
%Green = 0
%Green = 31
%Green = 35
%Green = 3
0.85
1.1
1.35


OH 14
POP
TAN
PER
PRACTICE
Trial 0
Ln (m)
%Green = 25
%Green = 21
%Green = 2
NOF
Trial 1
%Green = 17
%Green = 32
%Green = 1
Trial 2
%Green = 27
%Green = 22
%Green = 0
1.28
1.03
0.78
Tn (s)

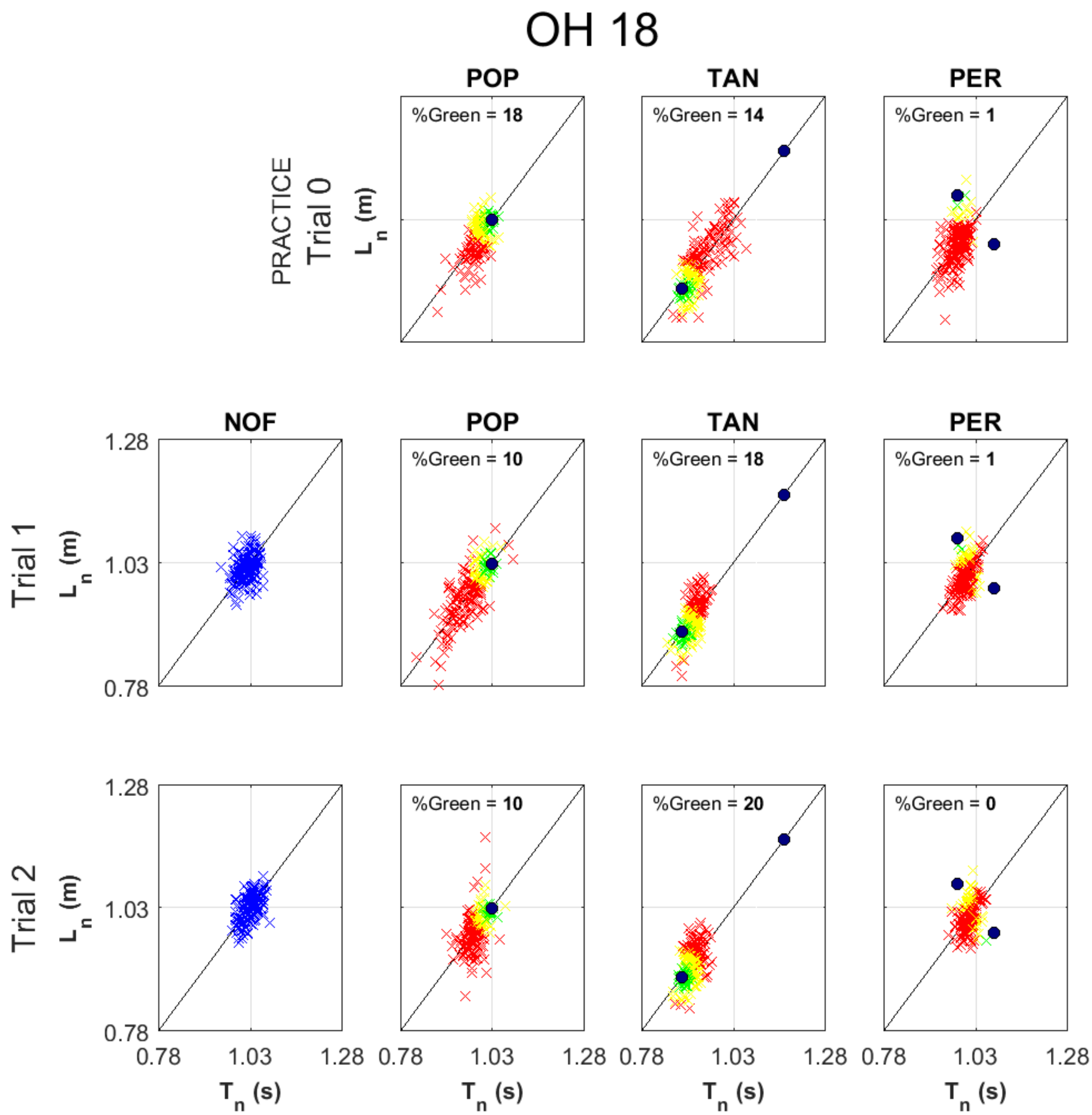

OH 15
POP
TAN
PER
NOF
PRACTICE
Trial 0
Trial 1
Trial 2
%Green = 20
%Green = 0
%Green = 0
%Green = 44
%Green = 14
%Green = 3
%Green = 39
%Green = 4
%Green = 1
L_n (m)
T_n (s)
1.48
1.23
0.98

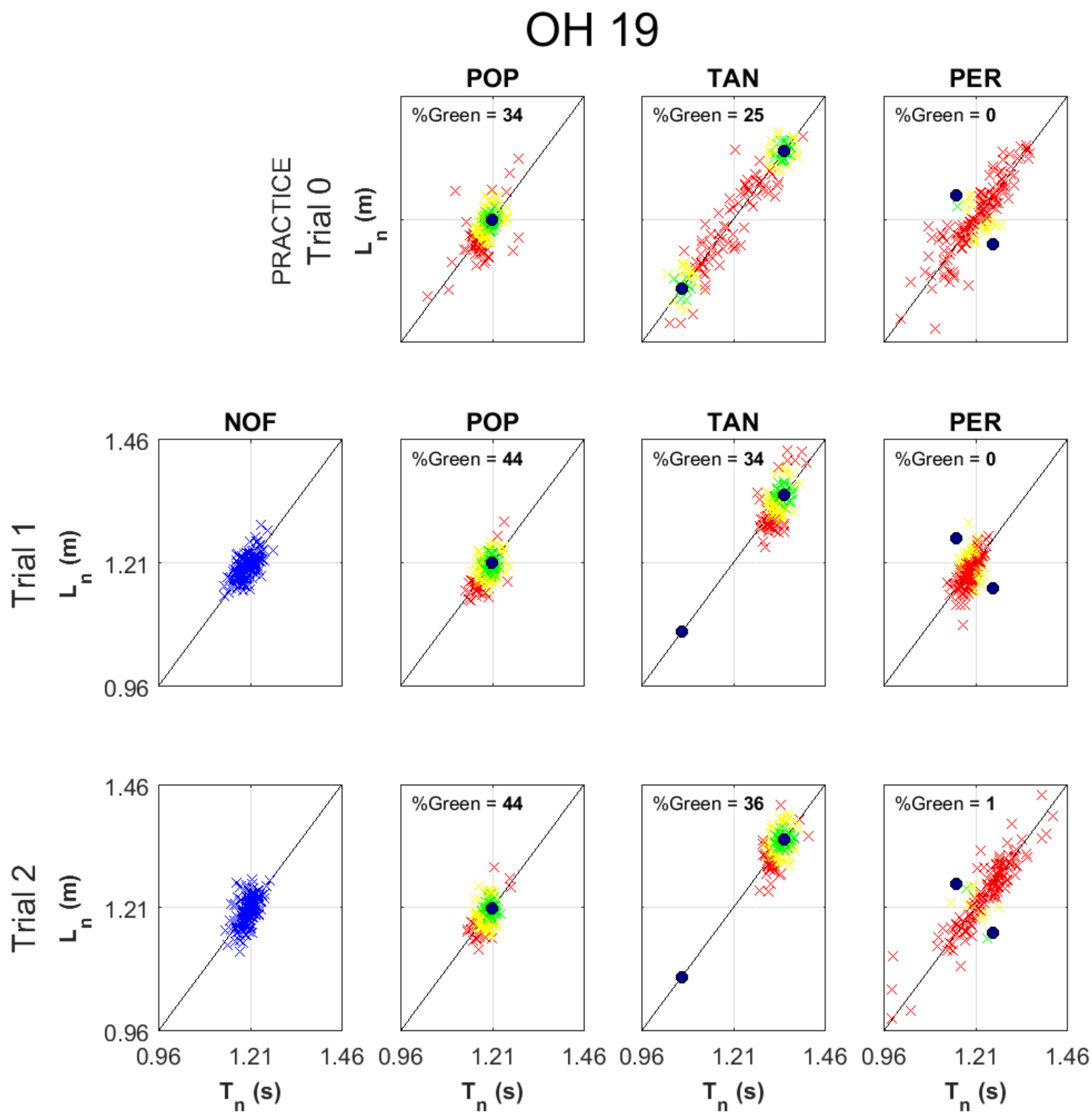


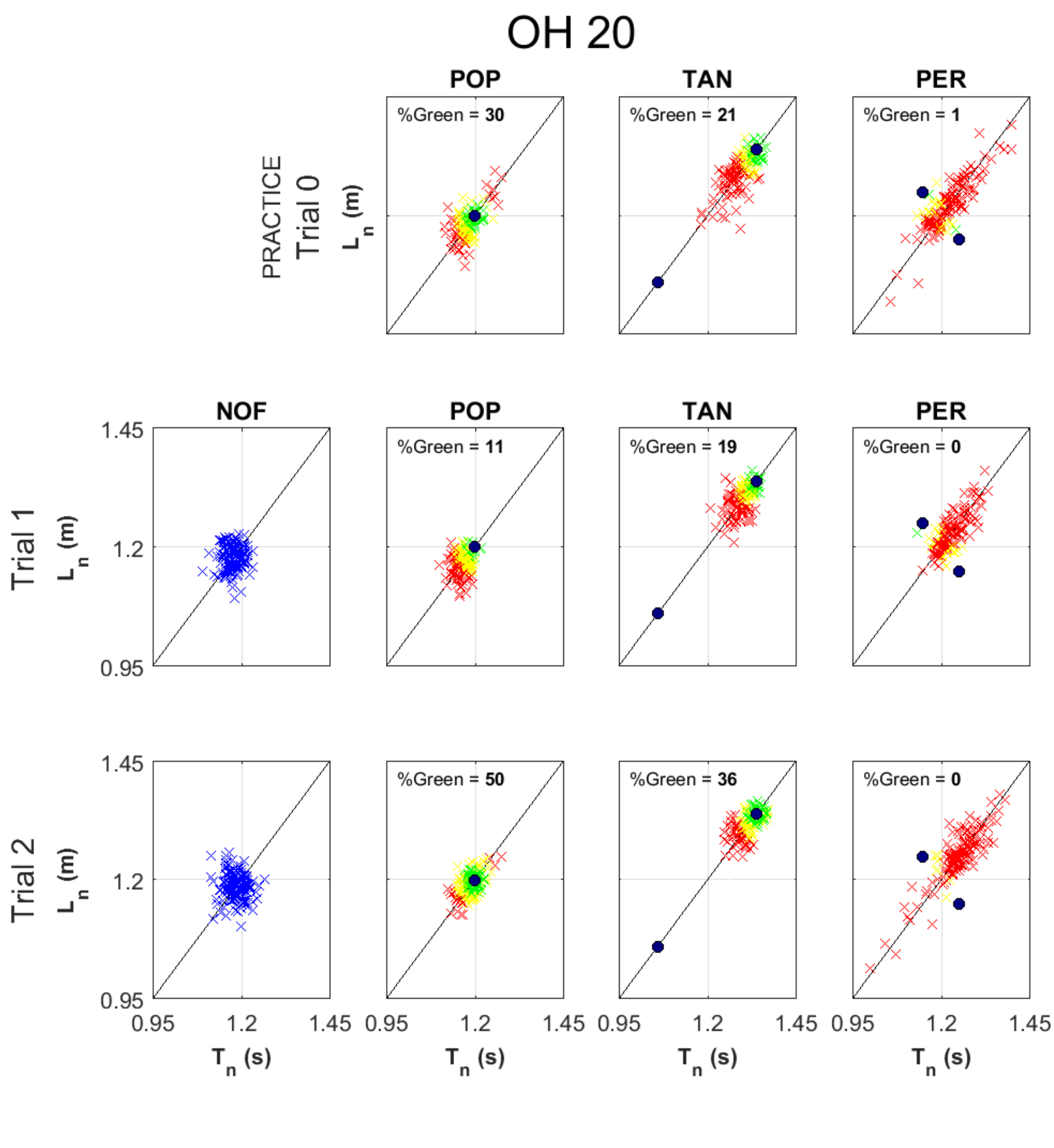
OH 16
POP
TAN
PER
PRACTICE
Trial 0
L n (m)
%Green = 32
%Green = 20
%Green = 2
NOF
Trial 1
%Green = 33
%Green = 17
%Green = 21
Trial 2
%Green = 67
%Green = 17
%Green = 7
1.55
1.3
1.05
T n (s)

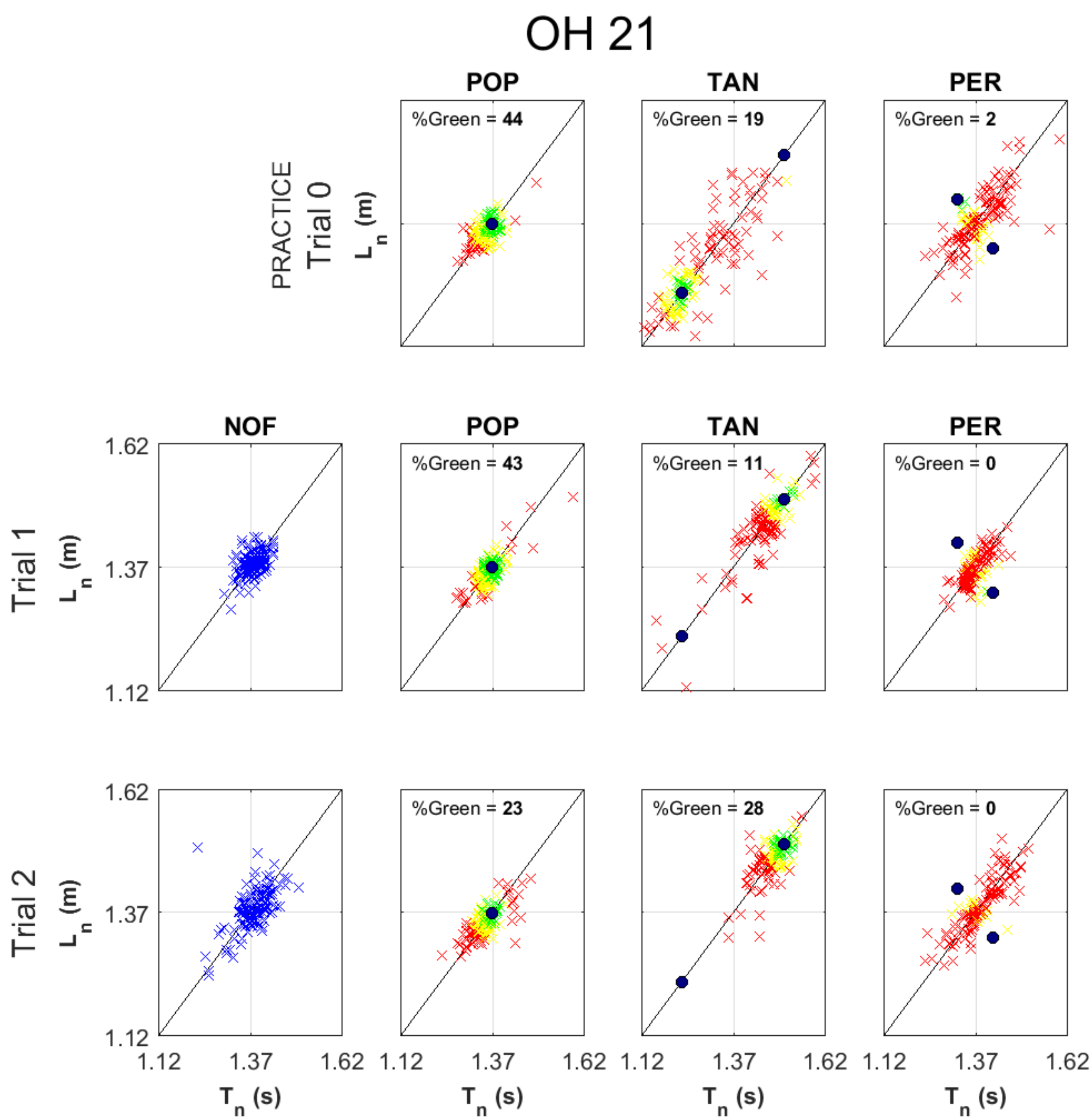


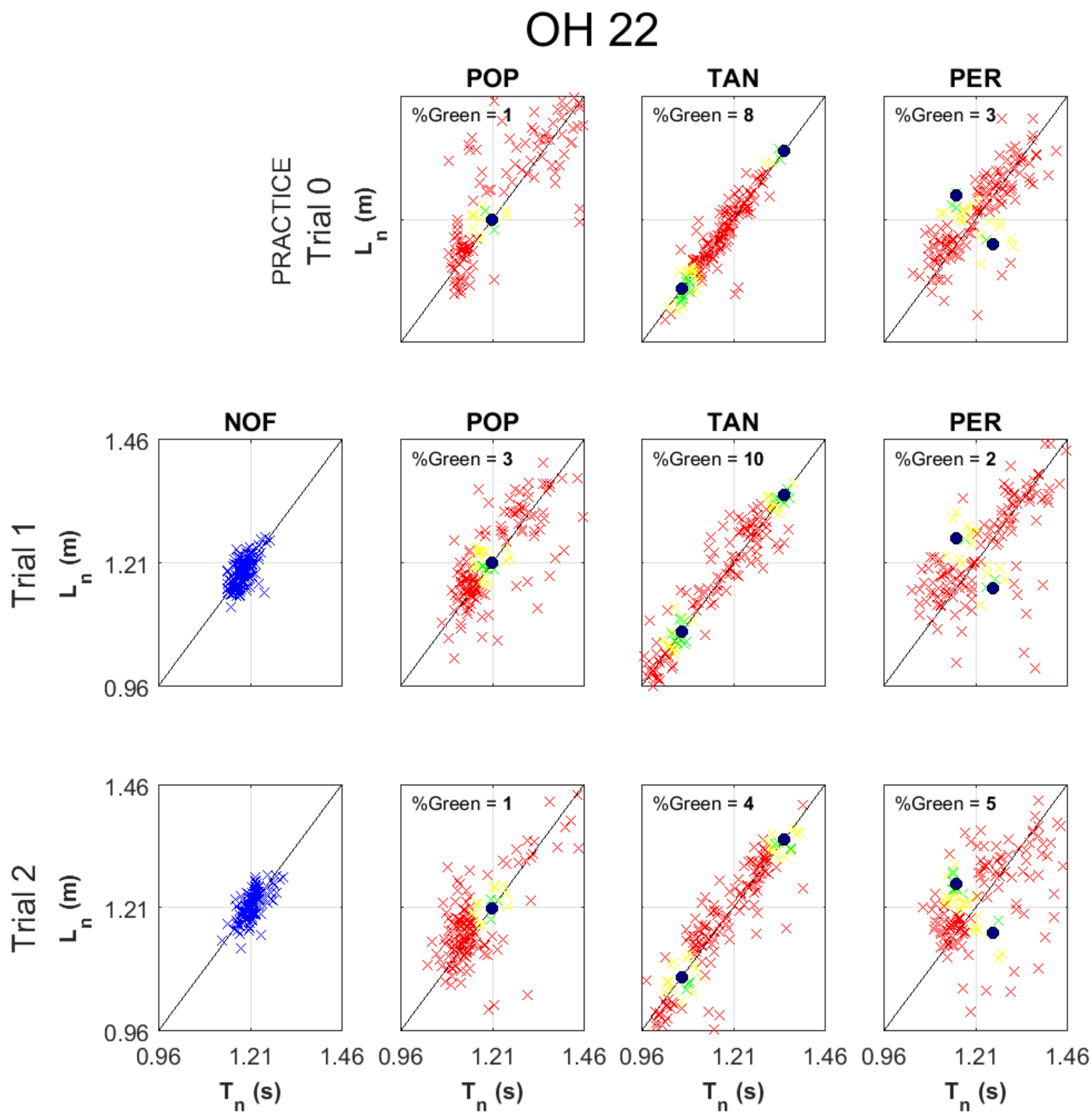
OH 17
POP
TAN
PER
PRACTICE
Trial 0
L_n (m)
%Green = 66
%Green = 43
%Green = 0
NOF
POP
TAN
PER
Trial 1
L_n (m)
%Green = 63
%Green = 26
%Green = 1
Trial 2
L_n (m)
%Green = 52
%Green = 30
%Green = 1
1.35
1.1
0.85
0.85
1.1
1.35
T_n (s)

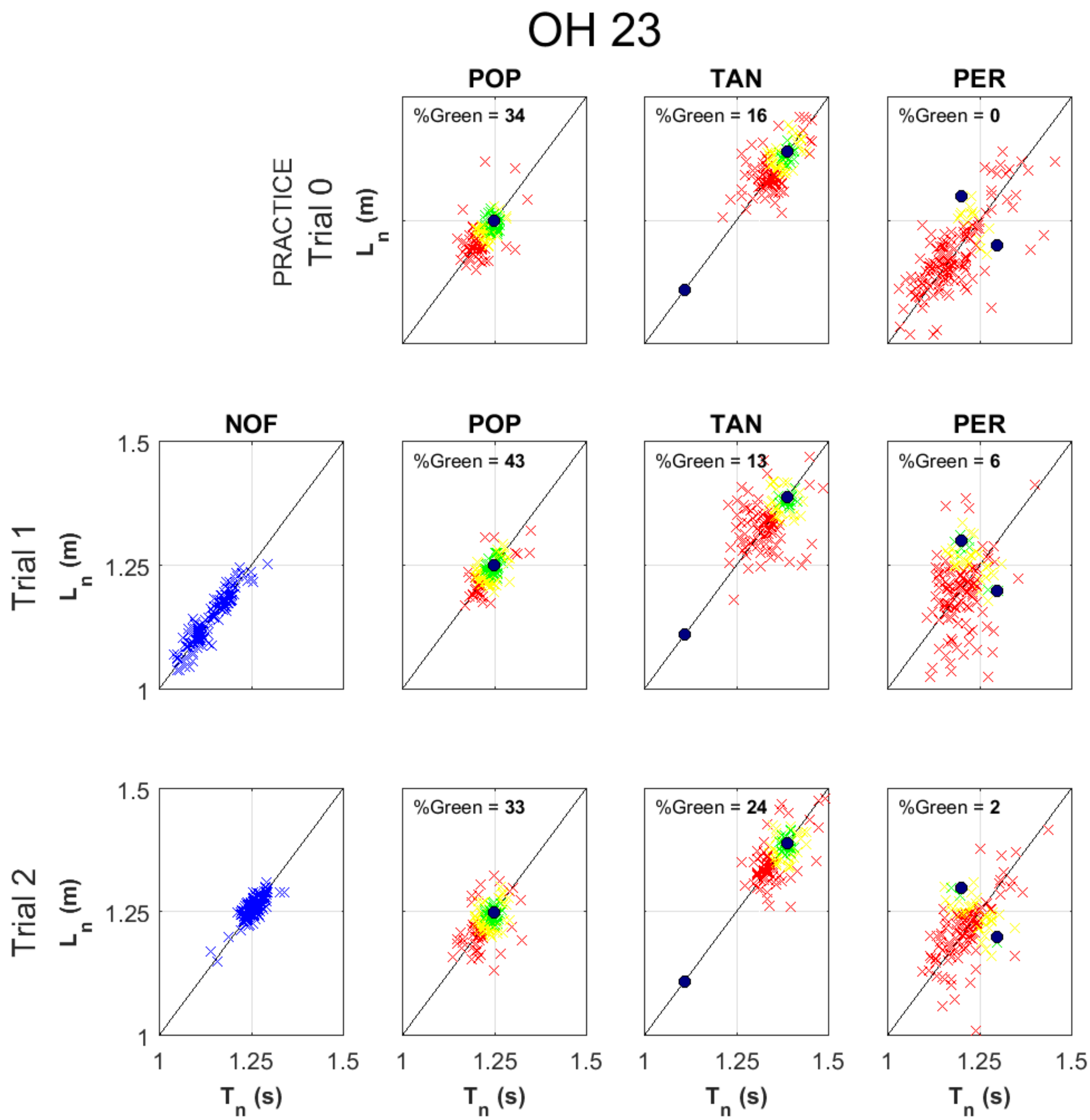

OH 18
POP
TAN
PER
%Green = 18
%Green = 14
%Green = 1
PRACTICE
Trial 0
L_n (m)
NOF
POP
TAN
PER
%Green = 10
%Green = 18
%Green = 1
Trial 1
L_n (m)
1.28
1.03
0.78
%Green = 10
%Green = 20
%Green = 0
Trial 2
L_n (m)
1.28
1.03
0.78
0.78
1.03
1.28
T_n (s)

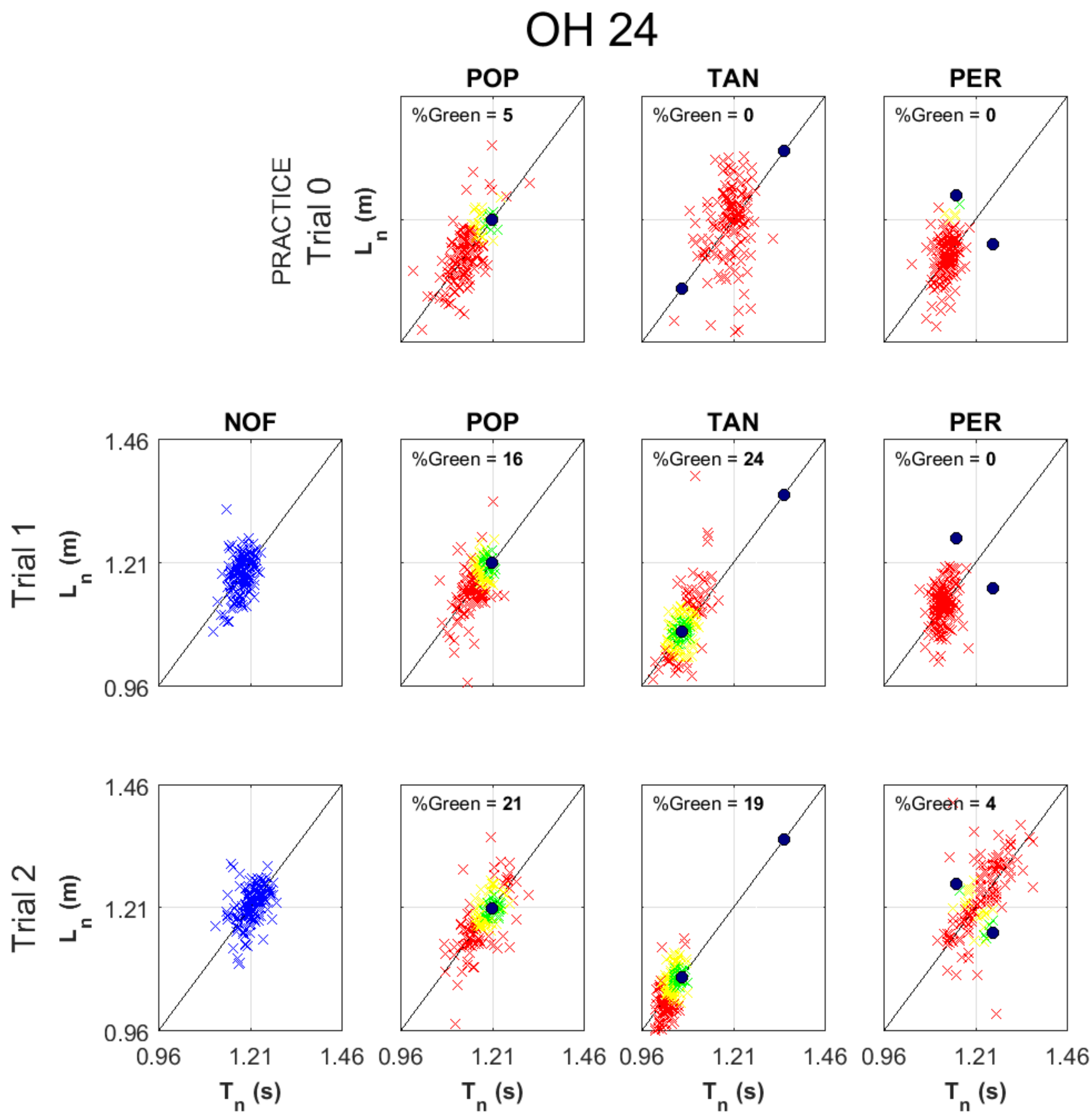

OH 19
POP
TAN
PER
%Green = 34
%Green = 25
%Green = 0
PRACTICE
Trial 0
Ln (m)
NOF
POP
TAN
PER
%Green = 44
%Green = 34
%Green = 0
Trial 1
Ln (m)
1.46
1.21
0.96
%Green = 44
%Green = 36
%Green = 1
Trial 2
Ln (m)
1.46
1.21
0.96
0.96
1.21
1.46
Tn (s)


OH 20
POP
TAN
PER
%Green = 30
%Green = 21
%Green = 1
PRACTICE
Trial 0
L_n (m)
NOF
POP
TAN
PER
1.45
%Green = 11
%Green = 19
%Green = 0
Trial 1
L_n (m)
1.2
0.95
1.45
%Green = 50
%Green = 36
%Green = 0
Trial 2
L_n (m)
1.2
0.95
0.95
1.2
1.45
T_n (s)


OH 21
POP
TAN
PER
%Green = 44
%Green = 19
%Green = 2
PRACTICE
Trial 0
L_n (m)
NOF
POP
TAN
PER
%Green = 43
%Green = 11
%Green = 0
Trial 1
L_n (m)
1.62
1.37
1.12
%Green = 23
%Green = 28
%Green = 0
Trial 2
L_n (m)
1.62
1.37
1.12
1.12 1.37 1.62
T_n (s)


OH 22
POP
TAN
PER
PRACTICE
Trial 0
L_n (m)
%Green = 1
%Green = 8
%Green = 3
NOF
%Green = 3
%Green = 10
%Green = 2
Trial 1
Trial 2
%Green = 1
%Green = 4
%Green = 5
1.46
1.21
0.96
T_n (s)


OH 23
POP
TAN
PER
%Green = 34
%Green = 16
%Green = 0
PRACTICE
Trial 0
L n (m)
NOF
POP
TAN
PER
%Green = 43
%Green = 13
%Green = 6
Trial 1
L n (m)
1.5
1.25
1
Trial 2
L n (m)
%Green = 33
%Green = 24
%Green = 2
1
1.25
1.5
T n (s)


OH 24
POP
TAN
PER
%Green = 5
%Green = 0
%Green = 0
PRACTICE
Trial 0
L_n (m)
NOF
POP
TAN
PER
%Green = 16
%Green = 24
%Green = 0
Trial 1
L_n (m)
1.46
1.21
0.96
%Green = 21
%Green = 19
%Green = 4
Trial 2
L_n (m)
1.46
1.21
0.96
0.96 1.21 1.46
T_n (s)
0.96 1.21 1.46
T_n (s)
0.96 1.21 1.46
T_n (s)
0.96 1.21 1.46
T_n (s)

				Age	Gender	Mass	Height	MMSE	TUG	Data Collection
					F = 0 / M =1					Avg L_n during NOF02 (last 20 strides)
	Subject	Date	Time	(yrs)	(F/M)	(kg)	(m)	XX/30	(sec)	(m)
1	A01	28-Sep-2015	8:00 AM	28	1	85.0	1.8350	29	6.16	1.28
2	A02	1-Oct-2015	8:00 AM	23	0	62.5	1.6450	30	5.88	1.17
3	A03	4-Oct-2015	8:00 AM	19	0	62.6	1.6600	30	7.78	1.18
4	A04	4-Oct-2015	12:00 PM	19	0	43.4	1.5650	30	7.81	1.10
5	A05	4-Oct-2015	4:00 PM	18	0	77.2	1.7000	30	7.06	1.21
6	A06	6-Oct-2015	8:30 AM	20	1	61.4	1.7250	30	9.47	1.22
7	A07	7-Oct-2015	8:30 AM	22	1	79.4	1.8250	28	7.69	1.21
8	A09	10-Oct-2015	1:00 PM	21	0	63.6	1.7250	30	5.47	1.16
9	A10	11-Oct-2015	8:30 AM	18	1	65.4	1.7850	27	6.07	1.33
10	A11	13-Oct-2015	5:00 PM	20	0	56.0	1.5600	28	8.75	1.10
11	A12	20-Oct-2015	8:30 AM	27	1	91.0	1.8150	30	6.37	1.25
12	A13	20-Oct-2015	5:00 PM	18	0	53.4	1.5400	29	6.84	1.15
13	A14	23-Oct-2015	8:30 AM	19	0	60.6	1.6700	29	6.22	1.18
14	A15	23-Oct-2015	12:00 PM	19	0	74.6	1.6800	30	7.44	1.22
15	A16	2-Nov-2015	9:00 AM	29	1	70.0	1.7950	30	8.03	1.27
16	A17	3-Nov-2015	9:00 AM	28	1	93.0	1.8100	30	6.50	1.29
17	A18	3-Nov-2015	1:00 PM	21	1	70.2	1.8250	29	6.50	1.29
18	A19	15-Dec-2015	9:00 AM	21	0	48.8	1.5950	29	6.75	1.13
19	A20	18-Dec-2015	9:00 AM	25	0	95.8	1.6600	29	7.09	1.11
20	A21	18-Dec-2015	1:00 PM	21	0	79.0	1.7150	30	7.50	1.19
21	A22	3-May-2016	3:30 PM	22	0	62.8	1.6300	30	7.06	1.18
22	A23	4-May-2016	10:00 AM	20	0	65.0	1.6000	30	7.78	1.16
23	A24	5-May-2016	3:30 PM	22	0	62.2	1.6300	28	7.80	1.19
24	A25	9-Jul-2016	9:00 AM	26	1	76.6	1.7700	30	5.69	1.16
25	B01	2-Nov-2015	1:00 PM	65	1	74.6	1.7450	30	6.53	1.25
26	B02	3-Apr-2016	9:00 AM	62	0	85.5	1.6650	29	8.50	1.23
27	B03	15-Dec-2015	3:00 PM	76	1	86.8	1.8350	30	5.56	1.31
28	B04	4-Apr-2016	10:00 AM	75	0	60.1	1.6350	30	6.69	1.24
29	B05	5-Apr-2016	10:00 AM	60	0	70.6	1.6350	29	6.85	1.10
30	B06	7-Apr-2016	10:00 AM	69	0	68.4	1.6200	30	9.50	1.20
31	B07	10-Apr-2016	10:00 AM	75	0	72.8	1.7500	30	7.81	1.11
32	B08	11-Apr-2016	10:00 AM	65	1	95.6	1.7700	30	8.63	1.27
33	B09	13-Apr-2016	10:00 AM	74	0	66.0	1.5350	27	7.59	1.10
34	B10	14-Apr-2016	8:00 AM	61	1	72.2	1.7650	29	5.25	1.23
35	B11	15-Apr-2016	10:00 AM	68	1	75.0	1.6600	30	9.63	1.25
36	B12	16-Apr-2016	9:00 AM	64	1	92.6	1.6900	30	9.37	1.26
37	B13	17-Apr-2016	9:00 AM	62	0	72.6	1.6400	30	7.69	1.10
38	B14	19-Apr-2016	5:00 PM	63	0	55.6	1.6150	30	6.00	1.03
39	B15	23-Apr-2016	10:00 AM	77	0	56.4	1.6800	27	7.47	1.23
40	B16	24-Apr-2016	9:00 AM	60	1	63.8	1.7150	30	7.06	1.30
41	B17	24-Apr-2016	1:00 PM	73	0	69.6	1.6550	30	7.72	1.10

42	B18	30-Apr-2016	8:00 AM	77	0	55.8	1.5600	30	7.84	1.03
43	B19	1-May-2016	8:00 AM	61	1	77.8	1.8500	30	8.66	1.21
44	B20	5-May-2016	10:00 AM	71	0	66.8	1.6750	30	7.41	1.20
45	B21	23-Jun-2016	5:00 PM	65	0	60.2	1.6750	30	7.72	1.37
46	B22	28-Jun-2016	9:00 AM	74	0	53.4	1.6800	30	9.12	1.21
47	B23	29-Jul-2016	9:00 AM	63	0	56.8	1.6250	30	8.38	1.25
48	B24	21-Sep-2016	11:00 AM	62	1	72.4	1.7600	29	7.53	1.21

Gait Events D–FLOW Script

```
-------------------------------------
-- IDENTIFY HeelStrike
--     & Calculate Gait Parameters
----------------------------------------------------------
----------------

-- +X is to the RIGHT SIDE of the Treadmill
-- +Y is UP
-- -Z is the direction of walking progression

-------------------------------------
---- Init Variables -----------------
-------------------------------------
 -- TREADMILL SPEED
TM_Speed = TM_Spd or 0

-- (HEEL-Pelvis) Z-VELOCITY
LHeePelZVel       = LHeePelZVel or 0
RHeePelZVel       = RHeePelZVel or 0
Prev_LHeePelZVel  = Prev_LHeePelZVel or 0
Prev_RHeePelZVel  = Prev_RHeePelZVel or 0

-- HEEL Z-POSITION
LHeeZPos = LHeeZPos or 0
RHeeZPos = RHeeZPos or 0
Prev_LHeeZPos = Prev_LHeeZPos or 0
Prev_RHeeZPos = Prev_RHeeZPos or 0

-- HEEL X-POSITION
LHeeXPos = LHeeXPos or 0
RHeeXPos = RHeeXPos or 0
Prev_LHeeXPos = Prev_LHeeXPos or 0
Prev_RHeeXPos = Prev_RHeeXPos or 0

-- HEELStrike Time ---
LHee_Time      = LHee_Time or 0
RHee_Time      = RHee_Time or 0
Prev_LHee_Time = Prev_LHee_Time or 0
Prev_RHee_Time = Prev_RHee_Time or 0
-------------------------------------
-------------------------------------

-------------------------------------
-- INPUTs to Scripting Module -------
-------------------------------------
TM_Speed = inputs.get("TM_Speed")  -- Fixed / Constant
LHeePelZVel = inputs.get("LHeePelZVel")
RHeePelZVel = inputs.get("RHeePelZVel")
-------------------------------------
-------------------------------------

-------------------------------------
-- IDENTIFYING LHS ------------------
-------------------------------------
if (LHeePelZVel > 0) and (Prev_LHeePelZVel < 0) then
        Prev_LHee_Time = LHee_Time
        LHee_Time = frametime() -- time at which LHS occurs
        Prev_LHeeZPos = LHeeZPos
        LHeeZPos = inputs.get("LHeeZPos")
        Prev_LHeeXPos = LHeeXPos
        LHeeXPos = inputs.get("LHeeXPos")

        broadcast("Left Heel Strike")
```

Gait Events Script

```
        local Left_Stride_Time = LHee_Time-Prev_LHee_Time
   --local Left_Stride_Length = math.abs(LHeeZPos-RHeeZPos) +
math.abs(RHeeZPos-Prev_LHeeZPos) + ((TM_Speed)*(Left_Stride_Time))
   local Left_Stride_Length = (-1*(LHeeZPos-RHeeZPos)) +
(-1*(RHeeZPos-Prev_LHeeZPos)) + ((TM_Speed)*(Left_Stride_Time))
   local RL_StepWidth = RHeeXPos - LHeeXPos -- +x direction is the RIGHT side of
Treadmill

        --print("TM_Spd",TM_Speed)

        print("Left Stride Time", Left_Stride_Time)
   print("Left Stride Length", Left_Stride_Length)
        print("RL Step Width", RL_StepWidth)
        print("LHeeTime",LHee_Time) -- End of the step (RL Step Width)

        outputs.set("Left Stride Time",  Left_Stride_Time)
        outputs.set("Left Stride Length",  Left_Stride_Length)
        outputs.set("RL Step Width",  RL_StepWidth)
        outputs.set("LHeeTime",LHee_Time) -- End of the step (RL Step Width)
        outputs.set("LHeeXPos", LHeeXPos)
        outputs.set("LHeeZPos", LHeeZPos)

end

-------------------------------------
-- IDENTIFYING RHS ------------------
-------------------------------------
if (RHeePelZVel > 0) and (Prev_RHeePelZVel < 0) then
   Prev_RHee_Time=RHee_Time
        RHee_Time=frametime() -- time at which RHS occurs
        Prev_RHeeZPos = RHeeZPos
        RHeeZPos = inputs.get("RHeeZPos")
        Prev_RHeeXPos = RHeeXPos
        RHeeXPos = inputs.get("RHeeXPos")

        broadcast("Right Heel Strike")

        local Right_Stride_Time = RHee_Time-Prev_RHee_Time
        --local Right_Stride_Length = math.abs(RHeeZPos-LHeeZPos) +
math.abs(LHeeZPos-Prev_RHeeZPos) + ((TM_Speed)*(Right_Stride_Time))
        local Right_Stride_Length =
(-1*(RHeeZPos-LHeeZPos))+(-1*(LHeeZPos-Prev_RHeeZPos)) +
((TM_Speed)*(Right_Stride_Time))
        local LR_StepWidth = RHeeXPos - LHeeXPos -- +x direction is the RIGHT side
of Treadmill

        --print("TM_Spd",TM_Speed)

        print("Right Stride Time", Right_Stride_Time)
        print("Right Stride Length", Right_Stride_Length)
        print("LR Step Width",LR_StepWidth)
        print("RHeeTime",RHee_Time) -- End of the step (LR Step Width)

        outputs.set("Right Stride Time", Right_Stride_Time)
        outputs.set("Right Stride Length",  Right_Stride_Length)
        outputs.set("LR Step Width",  LR_StepWidth)
        outputs.set("RHeeTime",RHee_Time) -- End of the step (LR Step Width)
        outputs.set("RHeeXPos", RHeeXPos)
        outputs.set("RHeeZPos", RHeeZPos)

end
```

Gait Events Script

```
-------------------------------------
-------------------------------------
-- These Variables (below) are
  -- updated at EACH FRAME, others
  -- are updated at their respective
  -- (Right or Left) Heel Strike.
-------------------------------------
-------------------------------------
Prev_LHeePelZVel = LHeePelZVel
Prev_RHeePelZVel = RHeePelZVel
```

```
clear all
close all
clc

addpath('..\Functions\')
%% Run Analyses

all_subj = [1 2 3 4 5 6 7 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 ...
    1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24];
grp_val = [1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 ...
    2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2]; % Group A = 1 / Group B = 2

conditions = {'NOF' 'POP' 'TAN' 'PER'};

%% Stride Data + Target Performance
vtr = 1.0; % m/s
OutData_ALL = [];

for ss = 1:length(all_subj)
    subject = all_subj(ss);
    group = grp_val(ss);

    if grp_val(ss) == 1
        grp = 'A';
    else
        grp = 'B';
    end

    if subject < 10
        subj = [grp,'0',num2str(all_subj(ss))];
    else
        subj = [grp,num2str(all_subj(ss))];
    end

    clear Age Sex Weight Height IPAQ TUG Strength NStrength  Pref_SL
    clear MMSE FOF Stroop DMS PVT
    clear NOF* POP* TAN* PER* SubjData
    load(['DATA\',subj,'\physical.mat']);
    load(['DATA\',subj,'\cognition.mat']);

    SubjData(1,  1:7)  = [subject, group, Age, Sex, Weight, Height, Pref_SL];
    SubjData(1,  8:11)  = [IPAQ, TUG, Strength, NStrength];
    SubjData(1,  12:13)  = [MMSE, FOF];
    SubjData(1,  14:17)  = [Stroop.Word, Stroop.Color, Stroop.ColorWord, Stroop.↙
InterfRatio];
    SubjData(1,  18:23)  = [PVT.MeanRT_all, PVT.StdRT_all, PVT.Correct, PVT.TooFast, PVT.↙
Lapse, PVT.SleepAttack];
    SubjData(1,  24:32)  = [PVT.MRT(1), PVT.MRT(2), PVT.MRT(3), PVT.MRT(4), PVT.MRT(5),↙
PVT.MRT(6), PVT.MRT(7), PVT.MRT(8), PVT.MRT(9)];
    SubjData(1,  33:41)  = [PVT.StdRT(1), PVT.StdRT(2), PVT.StdRT(3), PVT.StdRT(4), PVT.↙
StdRT(5), PVT.StdRT(6), PVT.StdRT(7), PVT.StdRT(8), PVT.StdRT(9)];
```

```
    SubjData(1,  42:44)  = [DMS.Correct, DMS.MeanStudyTime_Correct, DMS.MeanRT_Correct];

    for ccc = 1:length(conditions)
        cond = char(conditions(ccc));

        for tt = 1:2 % Only the Actual Trials
            clear SL ST SS
            if ccc ~= 1
                load(['DATA\',subj,'\MAT\',cond,'0',num2str(tt),'_Perf.mat'])
            else % NOF
                load(['DATA\',subj,'\MAT\',cond,'0',num2str(tt),'_Perf.mat'])
            end
            %------------------------------
            ndata = [SL ST SS];
            OutData = dmeas_strides_new(ndata,ss,ccc,tt,perf,Pref_SL,grp_val(ss));

            eval(['MeanLn.',cond,num2str(tt),' = OutData.MeanLn;']);
            eval(['MeanTn.',cond,num2str(tt),' = OutData.MeanTn;']);
            eval(['MeanSn.',cond,num2str(tt),' = OutData.MeanSn;']);
            eval(['SDLn.',cond,num2str(tt),' = OutData.SDLn;']);
            eval(['SDTn.',cond,num2str(tt),' = OutData.SDTn;']);
            eval(['SDSn.',cond,num2str(tt),' = OutData.SDSn;']);
            eval(['AlphaLn.',cond,num2str(tt),' = OutData.AlphaLn;']);
            eval(['AlphaTn.',cond,num2str(tt),' = OutData.AlphaTn;']);
            eval(['AlphaSn.',cond,num2str(tt),' = OutData.AlphaSn;']);
            eval(['MeanDP.',cond,num2str(tt),' = OutData.MeanDP;']);
            eval(['MeanDT.',cond,num2str(tt),' = OutData.MeanDT;']);
            eval(['SDDP.',cond,num2str(tt),' = OutData.SDDP;']);
            eval(['SDDT.',cond,num2str(tt),' = OutData.SDDT;']);
            eval(['AlphaDP.',cond,num2str(tt),' = OutData.AlphaDP;']);
            eval(['AlphaDT.',cond,num2str(tt),' = OutData.AlphaDT;']);
            eval(['grn_perct.',cond,num2str(tt),' = OutData.grn_perct;']);
            eval(['yel_perct.',cond,num2str(tt),' = OutData.yel_perct;']);
            eval(['red_perct.',cond,num2str(tt),' = OutData.red_perct;']);
            eval(['improve_perct.',cond,num2str(tt),' = OutData.improve_perct;']);
            eval(['error_reduct_perct.',cond,num2str(tt),' = OutData.↙
error_reduct_perct;']);
            eval(['RMSE_LnPerct.',cond,num2str(tt),' = OutData.RMSE_LnPerct;']);
            eval(['RMSE_TnPerct.',cond,num2str(tt),' = OutData.RMSE_TnPerct;']);
            eval(['RMSE_SnPerct.',cond,num2str(tt),' = OutData.RMSE_SnPerct;']);

            clear OutData
        end
    end
    delete(['DATA\',subj,'\treadmill.mat'])
    save(['DATA\',subj,'\treadmill.mat'], ...
        'MeanLn','MeanTn','MeanSn', ...
        'SDLn','SDTn','SDSn', ...
        'AlphaLn','AlphaTn','AlphaSn', ...
        'MeanDP','MeanDT','SDDP','SDDT','AlphaDP','AlphaDT', ...
        'grn_perct','yel_perct','red_perct','improve_perct', 'error_reduct_perct', ...
```

```
        'RMSE_LnPerct','RMSE_TnPerct', 'RMSE_SnPerct', ...
        'SubjData')
end
```

```
function OutData = dmeas_strides_new(ndata,subj,ccc, trial,perf,Lstar,grp) %
================================================================================

SL = ndata(:,1);
ST = ndata(:,2);
SS = ndata(:,3);
LnError = perf.LnError; % from Target(s)
TnError = perf.TnError; % from Target(s)
SnError = perf.SnError; % from Target(s)
derror = perf.derror;

RMSE_LnPerct = perf.rmse_perct_Ln;
RMSE_TnPerct = perf.rmse_perct_Tn;
RMSE_SnPerct = perf.rmse_perct_Sn;
grn_perct = perf.grn_perct;
yel_perct = perf.yel_perct;
red_perct = perf.red_perct;
improve_perct = perf.improve_perct;
ErrorReduct_perct = perf.error_decr_perct;

%================================================================================
%-- First, Normalize everything (SL & ST & SW) to unit variance:
SLn = SL ./ std(SL);
STn = ST ./ std(ST);
SSn = SLn ./ STn;
%----------------------------------------------------------------------
% Normalizing POP (determined in the NOF condition) - Mandy 02/25/2016
vtr = 1; % for this experiment!!!
Lstar_n = Lstar/std(SL);
Tstar = Lstar/vtr;
Tstar_n = Tstar/std(ST);
%-----------------------------
%-----------------------------
%================================================================================
%-- Define GEM from slope defined by average speed:
%--  (+/- 3 s.d.'s will plot lines on graphs a bit longer than the data
V = mean(SS);  %-- V = treadmill speed -- defines the slope of the GEM!

%-------------------------------------------------------------------------------
%-- Calculate Deviations Perpendicular & Tangent to the GEM:
%-- Use "geometrical" method -- See my notes...
% STShift = STn - mean(STn);              %- Shifts ST data to mean(ST) location...
% SLShift = SLn - (Vn.*mean(STn));        %- Shiftf SL data to same set point...
% STShift = ST - mean(ST);                  %- Shifts ST data to mean(ST) location... NOT ↙
NORMALIZED
% SLShift = SL - (V.*mean(ST));             %- Shiftf SL data to same set point...    NOT ↙
NORMALIZED
%----------------------------------------------------------------------
% Shifting now with the normalized POP (determined in the NOF condition)
% Mandy 02/25/2016
% STShift = STn - Tstar_n;                   %- Shifts ST data to Tstar location...
```

```
% SLShift = SLn - Lstar_n;                   %- Shiftf SL data to Lstar Location...

STShift = ST - Tstar;                        %- Shifts ST data to Tstar location... NOT↙
NORMALIZED
SLShift = SL - Lstar;                        %- Shiftf SL data to Lstar Location... NOT↙
NORMALIZED
%-----------------------------
DeltaT = (1./sqrt(1+(V.^2))) .* (STShift + (V.*SLShift));                  % NOT↙
NORMALIZED
DeltaP = (1./sqrt(1+(V.^2))) .* ((-V.*STShift) + SLShift);                 % NOT↙
NORMALIZED
%--------------------------------------------------------------------------------
%-- Calculate Means & SD's for 3 starting variables:
MeanLn = mean(SL);                SDLn = std(SL);
MeanTn = mean(ST);                SDTn = std(ST);
MeanSn = mean(SS);                SDSn = std(SS);

MeanDP = mean(DeltaP);
MeanDT = mean(DeltaT);

SDDP = std(DeltaP);
SDDT = std(DeltaT);
%--------------------------------------------------------------------------------
%-- Compute scaling exponents (alpha) of each measure:
[nSL  fSL  pSL]  = DFA(SL);          AlphaLn = pSL(1);
[nST  fST  pST]  = DFA(ST);          AlphaTn = pST(1);
[nSS  fSS  pSS]  = DFA(SS);          AlphaSn = pSS(1);
[nDPn fDPn pDPn] = DFA(DeltaP);     AlphaDP = pDPn(1); % Added by Mandy Jan 25 2013 [B/c↙
pDP does not exist - prev line]
[nDTn fDTn pDTn] = DFA(DeltaT);     AlphaDT = pDTn(1); % Added by Mandy Jan 25 2013

%--------------------------------------------------------------------------------
%-- Compute Target Error:
MeanDError = mean(derror);
SDDError = std(derror);
% Deviations in Ln
MeanLnError = mean(LnError); SDLnError = std(LnError);
[ndevLn fdevLn pdevLn] = DFA(LnError);  AlphaLnError = pdevLn(1);
% Deviations in Tn
MeanTnError = mean(TnError); SDTnError = std(TnError);
[ndevTn fdevTn pdevTn] = DFA(TnError);  AlphaTnError = pdevTn(1);
% Deviations in Sn
MeanSnError = mean(SnError); SDSnError = std(SnError);
[ndevSn fdevSn pdevSn] = DFA(SnError);  AlphaSnError = pdevSn(1);

%--------------------------------------------------------------------------------
%-- Put Final Dependent Measures into Big Fat Matrix:
% RowNum = (Num_Trials*Num_Cond).*(Subj-1) + (Num_Trials).*(Cond-1) + Trial;
% OutData(1,  1:3)  = [  MeanLn,    MeanTn,    MeanSn];
% OutData(1,  4:6)  = [ SDLn,  SDTn,  SDSn];
% OutData(1, 7:9) = [ AlphaLn,  AlphaTn,  AlphaSn];
```

```
% OutData(1, 10:11) = [ SDDP,     SDDT];
% OutData(1, 12:13) = [ AlphaDP,  AlphaDT];
% OutData(1, 14:15) = [ grn_perct,  improve_perct];
% OutData(1, 16:18) = [ RMSE_LnPerct, RMSE_TnPerct, RMSE_SnPerct];

OutData.MeanLn = MeanLn;
OutData.MeanTn = MeanTn;
OutData.MeanSn = MeanSn;
OutData.SDLn = SDLn;
OutData.SDTn = SDTn;
OutData.SDSn = SDSn;
OutData.AlphaLn = AlphaLn;
OutData.AlphaTn = AlphaTn;
OutData.AlphaSn = AlphaSn;
OutData.MeanDP = MeanDP;
OutData.MeanDT = MeanDT;
OutData.SDDP = SDDP;
OutData.SDDT = SDDT;
OutData.AlphaDP = AlphaDP;
OutData.AlphaDT = AlphaDT;
OutData.grn_perct = grn_perct;
OutData.yel_perct = yel_perct;
OutData.red_perct = red_perct;
OutData.improve_perct = improve_perct;
OutData.error_reduct_perct = ErrorReduct_perct;
OutData.RMSE_LnPerct = RMSE_LnPerct;
OutData.RMSE_TnPerct = RMSE_TnPerct;
OutData.RMSE_SnPerct = RMSE_SnPerct;
```

```
 GET
  FILE='G:\Dissertation\C - Statistics\Aim 1\2017_0516_Aim1_SPSS_WideData.sav'
.
DATASET NAME DataSet1 WINDOW=FRONT.
GLM SDLn_NOF2 SDLn_POP2 SDLn_TAN2 SDLn_PER2 BY Group
  /WSFACTOR=Cond 4 Polynomial
  /METHOD=SSTYPE(3)
  /POSTHOC=Group(BONFERRONI)
  /PLOT=PROFILE(Cond*Group)
  /EMMEANS=TABLES(Group) COMPARE ADJ(LSD)
  /EMMEANS=TABLES(Cond) COMPARE ADJ(LSD)
  /PRINT=DESCRIPTIVE ETASQ OPOWER
  /CRITERIA=ALPHA(.05)
  /WSDESIGN=Cond
  /DESIGN=Group.
```

General Linear Model

Notes

Output Created		05-AUG-2017 11:21:46
Comments		
Input	Data	G:\Dissertation\C - Statistics\Aim 1\2017_0516_Aim1_SPSS_WideData.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	48
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.

Notes

Syntax		GLM SDLn_NOF2 SDLn_POP2 SDLn_TAN2 SDLn_PER2 BY Group /WSFACTOR=Cond 4 Polynomial /METHOD=SSTYPE(3) /POSTHOC=Group (BONFERRONI) /PLOT=PROFILE(Cond*Group) /EMMEANS=TABLES(Group) COMPARE ADJ(LSD) /EMMEANS=TABLES(Cond) COMPARE ADJ(LSD) /PRINT=DESCRIPTIVE ETASQ OPOWER /CRITERIA=ALPHA(.05) /WSDESIGN=Cond...
Resources	Processor Time	00:00:05.41
	Elapsed Time	00:00:04.16

[DataSet1] G:\Dissertation\C - Statistics\Aim 1\2017_0516_Aim1_SPSS_WideData.sav

Warnings

Post hoc tests are not performed for Group because there are fewer than three groups.

Within-Subjects Factors

Measure: MEASURE_1

Cond	Dependent Variable
1	SDLn_NOF2
2	SDLn_POP2
3	SDLn_TAN2
4	SDLn_PER2

Between-Subjects Factors

		N
Group	1	24
	2	24

Descriptive Statistics

	Group	Mean	Std. Deviation	N
SDLn_NOF2	1	.0263308670	.0063907497	24
	2	.0347899304	.0150729730	24
	Total	.0305603987	.0122244102	48
SDLn_POP2	1	.0232066216	.0073929826	24
	2	.0340988967	.0164657407	24
	Total	.0286527592	.0137736771	48
SDLn_TAN2	1	.0487210152	.0404521538	24
	2	.0585005262	.0378704816	24
	Total	.0536107707	.0390772064	48
SDLn_PER2	1	.0621495292	.0314595991	24
	2	.0594635010	.0230729121	24
	Total	.0608065151	.0273254954	48

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[c]
Cond	Pillai's Trace	.665	29.169[b]	3.000	44.000	.000	.665	87.508	1.000
	Wilks' Lambda	.335	29.169[b]	3.000	44.000	.000	.665	87.508	1.000
	Hotelling's Trace	1.989	29.169[b]	3.000	44.000	.000	.665	87.508	1.000
	Roy's Largest Root	1.989	29.169[b]	3.000	44.000	.000	.665	87.508	1.000
Cond * Group	Pillai's Trace	.063	.981[b]	3.000	44.000	.410	.063	2.943	.249
	Wilks' Lambda	.937	.981[b]	3.000	44.000	.410	.063	2.943	.249
	Hotelling's Trace	.067	.981[b]	3.000	44.000	.410	.063	2.943	.249
	Roy's Largest Root	.067	.981[b]	3.000	44.000	.410	.063	2.943	.249

a. Design: Intercept + Group
Within Subjects Design: Cond

b. Exact statistic

c. Computed using alpha = .05

Mauchly's Test of Sphericity[a]

Measure: MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b] Greenhouse-Geisser	Epsilon[b] Huynh-Feldt	Epsilon[b] Lower-bound
Cond	.318	51.270	5	.000	.635	.677	.333

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. Design: Intercept + Group
Within Subjects Design: Cond

b. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Cond	Sphericity Assumed	.038	3	.013	20.447	.000	.308	61.341	1.000
	Greenhouse-Geisser	.038	1.906	.020	20.447	.000	.308	38.977	1.000
	Huynh-Feldt	.038	2.030	.019	20.447	.000	.308	41.503	1.000
	Lower-bound	.038	1.000	.038	20.447	.000	.308	20.447	.993
Cond * Group	Sphericity Assumed	.001	3	.000	.765	.515	.016	2.296	.211
	Greenhouse-Geisser	.001	1.906	.001	.765	.463	.016	1.459	.173
	Huynh-Feldt	.001	2.030	.001	.765	.470	.016	1.553	.178
	Lower-bound	.001	1.000	.001	.765	.386	.016	.765	.137
Error(Cond)	Sphericity Assumed	.085	138	.001					
	Greenhouse-Geisser	.085	87.688	.001					
	Huynh-Feldt	.085	93.369	.001					
	Lower-bound	.085	46.000	.002					

a. Computed using alpha = .05

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	Cond	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Cond	Linear	.032	1	.032	66.368	.000	.591	66.368	1.000
	Quadratic	.001	1	.001	1.613	.210	.034	1.613	.238
	Cubic	.005	1	.005	6.349	.015	.121	6.349	.694
Cond * Group	Linear	.001	1	.001	1.479	.230	.031	1.479	.222
	Quadratic	.001	1	.001	1.080	.304	.023	1.080	.174
	Cubic	3.657E-5	1	3.657E-5	.049	.827	.001	.049	.055
Error(Cond)	Linear	.022	46	.000					
	Quadratic	.028	46	.001					
	Cubic	.035	46	.001					

a. Computed using alpha = .05

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Intercept	.362	1	.362	489.113	.000	.914	489.113	1.000
Group	.002	1	.002	2.836	.099	.058	2.836	.378
Error	.034	46	.001					

a. Computed using alpha = .05

Estimated Marginal Means

1. Group

Estimates

Measure: MEASURE_1

Group	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	.040	.003	.035	.046
2	.047	.003	.041	.052

Pairwise Comparisons

Measure: MEASURE_1

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
1	2	-.007	.004	.099	-.015	.001
2	1	.007	.004	.099	-.001	.015

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Univariate Tests

Measure: MEASURE_1

	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Contrast	.001	1	.001	2.836	.099	.058	2.836	.378
Error	.009	46	.000					

The F tests the effect of Group. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Computed using alpha = .05

2. Cond

Estimates

Measure: MEASURE_1

Cond	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	.031	.002	.027	.034
2	.029	.002	.025	.032
3	.054	.006	.042	.065
4	.061	.004	.053	.069

Pairwise Comparisons

Measure: MEASURE_1

(I) Cond	(J) Cond	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b] Lower Bound	Upper Bound
1	2	.002	.002	.433	-.003	.007
	3	-.023*	.006	.000	-.034	-.012
	4	-.030*	.005	.000	-.040	-.021
2	1	-.002	.002	.433	-.007	.003
	3	-.025*	.005	.000	-.036	-.014
	4	-.032*	.004	.000	-.040	-.024
3	1	.023*	.006	.000	.012	.034
	2	.025*	.005	.000	.014	.036
	4	-.007	.007	.314	-.021	.007
4	1	.030*	.005	.000	.021	.040
	2	.032*	.004	.000	.024	.040
	3	.007	.007	.314	-.007	.021

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Multivariate Tests

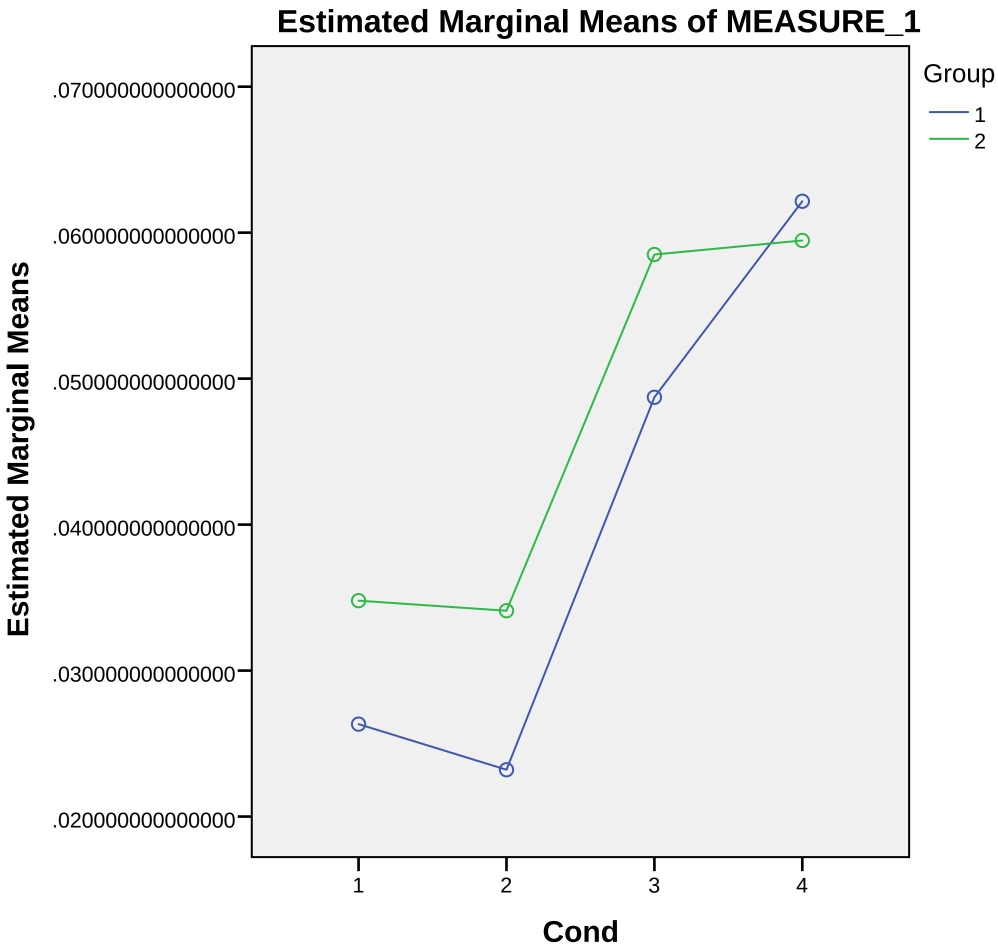
	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Pillai's trace	.665	29.169[a]	3.000	44.000	.000	.665	87.508	1.000
Wilks' lambda	.335	29.169[a]	3.000	44.000	.000	.665	87.508	1.000
Hotelling's trace	1.989	29.169[a]	3.000	44.000	.000	.665	87.508	1.000
Roy's largest root	1.989	29.169[a]	3.000	44.000	.000	.665	87.508	1.000

Each F tests the multivariate effect of Cond. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Exact statistic

b. Computed using alpha = .05

Profile Plots




```
 MANOVA SDLn_NOF2 SDLn_POP2 SDLn_TAN2 SDLn_PER2 BY Group(1,2)
/WSFACTORS=Cond(4)
/WSDESIGN=MWITHIN Cond(1) MWITHIN Cond(2) MWITHIN Cond(3) MWITHIN Cond(4).
```

Manova

Notes

Output Created		05-AUG-2017 11:25:46
Comments		
Input	Data	G:\Dissertation\C - Statistics\Aim 1\2017_0516_Aim1_SPSS_WideData.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	48
Syntax		MANOVA SDLn_NOF2 SDLn_POP2 SDLn_TAN2 SDLn_PER2 BY Group (1,2) /WSFACTORS=Cond(4) /WSDESIGN=MWITHIN Cond(1) MWITHIN Cond(2) MWITHIN Cond (3) MWITHIN Cond(4).
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.11

```
 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 - - - - - - - - - - - - - - - - - - - - -
The default error term in MANOVA has been changed from WITHIN CELLS to
WITHIN+RESIDUAL.  Note that these are the same for all full factorial designs.
```

```
* * * * * * * * * * * * * * * * * *A n a l y s i s   o f   V a r i a n c e* *
* * * * * * * * * * * * * * *

        48 cases accepted.
         0 cases rejected because of out-of-range factor values.
         0 cases rejected because of missing data.
         2 non-empty cells.

         1 design will be processed.

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 - - - - - - - - - - - - - - - - - - - - -
```

```
* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(1)' Within-Subject Effect.

 Tests of Significance for T1 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL             .01      46       .00
 MWITHIN COND(1)             .04       1       .04    334.50      .000
 Group BY MWITHIN CON        .00       1       .00      6.41      .015
 D(1)

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 - - - - - - - - - - - - - - - - - - - - -
```

```
* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(2)' Within-Subject Effect.

 Tests of Significance for T2 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL             .01      46       .00
 MWITHIN COND(2)             .04       1       .04    241.93      .000
 Group BY MWITHIN CON        .00       1       .00      8.74      .005
 D(2)

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 - - - - - - - - - - - - - - - - - - - - -
```

```
* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(3)' Within-Subject Effect.

 Tests of Significance for T3 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL             .07      46       .00
 MWITHIN COND(3)             .14       1       .14     89.86      .000
 Group BY MWITHIN CON        .00       1       .00       .75      .392
 D(3)

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 - - - - - - - - - - - - - - - - - - - - -
```

* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- Design   1 * * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(4)' Within-Subject Effect.

Tests of Significance for T4 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN+RESIDUAL	.04	46	.00		
MWITHIN COND(4)	.18	1	.18	233.21	.000
Group BY MWITHIN COND(4)	.00	1	.00	.11	.737

- -

```
GLM SDTn_NOF2 SDTn_POP2 SDTn_TAN2 SDTn_PER2 BY Group
  /WSFACTOR=Cond 4 Polynomial
  /METHOD=SSTYPE(3)
  /POSTHOC=Group(BONFERRONI)
  /PLOT=PROFILE(Cond*Group)
  /EMMEANS=TABLES(Group) COMPARE ADJ(LSD)
  /EMMEANS=TABLES(Cond) COMPARE ADJ(LSD)
  /PRINT=DESCRIPTIVE ETASQ OPOWER
  /CRITERIA=ALPHA(.05)
  /WSDESIGN=Cond
  /DESIGN=Group.
```

General Linear Model

Notes

Output Created		05-AUG-2017 11:32:39
Comments		
Input	Data	G:\Dissertation\C - Statistics\Aim 1\2017_0516_Aim1_SPSS_WideData.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	48
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.
Syntax		GLM SDTn_NOF2 SDTn_POP2 SDTn_TAN2 SDTn_PER2 BY Group /WSFACTOR=Cond 4 Polynomial /METHOD=SSTYPE(3) /POSTHOC=Group (BONFERRONI) /PLOT=PROFILE(Cond*Group) /EMMEANS=TABLES(Group) COMPARE ADJ(LSD) /EMMEANS=TABLES(Cond) COMPARE ADJ(LSD) /PRINT=DESCRIPTIVE ETASQ OPOWER /CRITERIA=ALPHA(.05) /WSDESIGN=Cond...

Notes

Resources	Processor Time	00:00:01.59
	Elapsed Time	00:00:00.86

Warnings

Post hoc tests are not performed for Group because there are fewer than three groups.

Within-Subjects Factors

Measure: MEASURE_1

Cond	Dependent Variable
1	SDTn_NOF2
2	SDTn_POP2
3	SDTn_TAN2
4	SDTn_PER2

Between-Subjects Factors

		N
Group	1	24
	2	24

Descriptive Statistics

	Group	Mean	Std. Deviation	N
SDTn_NOF2	1	.0233560081	.0061460911	24
	2	.0303134513	.0137105430	24
	Total	.0268347297	.0110830530	48
SDTn_POP2	1	.0216722014	.0068250020	24
	2	.0301378371	.0135305121	24
	Total	.0259050192	.0114316454	48
SDTn_TAN2	1	.0471320556	.0431281835	24
	2	.0564780487	.0393345704	24
	Total	.0518050522	.0411056992	48
SDTn_PER2	1	.0471940514	.0230347757	24
	2	.0552469977	.0236224512	24
	Total	.0512205246	.0234368706	48

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[c]
Cond	Pillai's Trace	.638	25.876[b]	3.000	44.000	.000	.638	77.627	1.000
	Wilks' Lambda	.362	25.876[b]	3.000	44.000	.000	.638	77.627	1.000
	Hotelling's Trace	1.764	25.876[b]	3.000	44.000	.000	.638	77.627	1.000
	Roy's Largest Root	1.764	25.876[b]	3.000	44.000	.000	.638	77.627	1.000
Cond * Group	Pillai's Trace	.004	.055[b]	3.000	44.000	.983	.004	.165	.059
	Wilks' Lambda	.996	.055[b]	3.000	44.000	.983	.004	.165	.059
	Hotelling's Trace	.004	.055[b]	3.000	44.000	.983	.004	.165	.059
	Roy's Largest Root	.004	.055[b]	3.000	44.000	.983	.004	.165	.059

a. Design: Intercept + Group
Within Subjects Design: Cond

b. Exact statistic

c. Computed using alpha = .05

Mauchly's Test of Sphericity[a]

Measure: MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b]		
					Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Cond	.203	71.292	5	.000	.571	.604	.333

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. Design: Intercept + Group
Within Subjects Design: Cond

b. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Cond	Sphericity Assumed	.030	3	.010	18.177	.000	.283	54.530	1.000
	Greenhouse-Geisser	.030	1.712	.018	18.177	.000	.283	31.126	.999
	Huynh-Feldt	.030	1.811	.017	18.177	.000	.283	32.914	1.000
	Lower-bound	.030	1.000	.030	18.177	.000	.283	18.177	.987
Cond * Group	Sphericity Assumed	3.539E-5	3	1.180E-5	.021	.996	.000	.064	.054
	Greenhouse-Geisser	3.539E-5	1.712	2.067E-5	.021	.966	.000	.036	.053
	Huynh-Feldt	3.539E-5	1.811	1.954E-5	.021	.971	.000	.038	.053
	Lower-bound	3.539E-5	1.000	3.539E-5	.021	.885	.000	.021	.052
Error(Cond)	Sphericity Assumed	.077	138	.001					
	Greenhouse-Geisser	.077	78.771	.001					
	Huynh-Feldt	.077	83.297	.001					
	Lower-bound	.077	46.000	.002					

a. Computed using alpha = .05

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	Cond	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Cond	Linear	.024	1	.024	60.471	.000	.568	60.471	1.000
	Quadratic	1.430E-6	1	1.430E-6	.003	.959	.000	.003	.050
	Cubic	.007	1	.007	9.027	.004	.164	9.027	.837
Cond * Group	Linear	1.042E-5	1	1.042E-5	.027	.871	.001	.027	.053
	Quadratic	2.354E-5	1	2.354E-5	.045	.833	.001	.045	.055
	Cubic	1.433E-6	1	1.433E-6	.002	.965	.000	.002	.050
Error(Cond)	Linear	.018	46	.000					
	Quadratic	.024	46	.001					
	Cubic	.035	46	.001					

a. Computed using alpha = .05

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Intercept	.291	1	.291	361.836	.000	.887	361.836	1.000
Group	.003	1	.003	4.016	.051	.080	4.016	.501
Error	.037	46	.001					

a. Computed using alpha = .05

Estimated Marginal Means

1. Group

Estimates

Measure: MEASURE_1

Group	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	.035	.003	.029	.041
2	.043	.003	.037	.049

Pairwise Comparisons

Measure: MEASURE_1

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
1	2	-.008	.004	.051	-.016	3.600E-5
2	1	.008	.004	.051	-3.600E-5	.016

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Univariate Tests

Measure: MEASURE_1

	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Contrast	.001	1	.001	4.016	.051	.080	4.016	.501
Error	.009	46	.000					

The F tests the effect of Group. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Computed using alpha = .05

2. Cond

Estimates

Measure: MEASURE_1

Cond	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	.027	.002	.024	.030
2	.026	.002	.023	.029
3	.052	.006	.040	.064
4	.051	.003	.044	.058

Pairwise Comparisons

Measure: MEASURE_1

(I) Cond	(J) Cond	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b] Lower Bound	Upper Bound
1	2	.001	.002	.633	-.003	.005
	3	-.025*	.006	.000	-.037	-.013
	4	-.024*	.004	.000	-.032	-.017
2	1	-.001	.002	.633	-.005	.003
	3	-.026*	.006	.000	-.037	-.014
	4	-.025*	.003	.000	-.032	-.019
3	1	.025*	.006	.000	.013	.037
	2	.026*	.006	.000	.014	.037
	4	.001	.007	.929	-.013	.014
4	1	.024*	.004	.000	.017	.032
	2	.025*	.003	.000	.019	.032
	3	-.001	.007	.929	-.014	.013

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Multivariate Tests

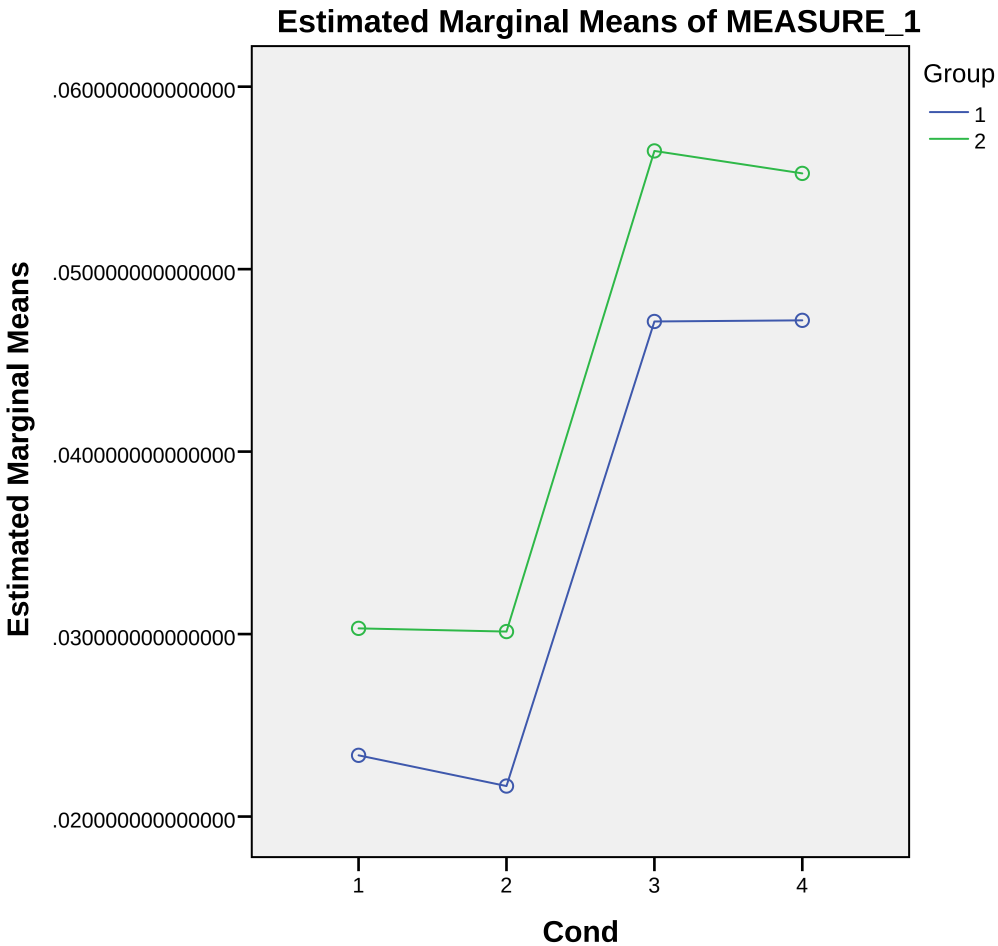
	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Pillai's trace	.638	25.876[a]	3.000	44.000	.000	.638	77.627	1.000
Wilks' lambda	.362	25.876[a]	3.000	44.000	.000	.638	77.627	1.000
Hotelling's trace	1.764	25.876[a]	3.000	44.000	.000	.638	77.627	1.000
Roy's largest root	1.764	25.876[a]	3.000	44.000	.000	.638	77.627	1.000

Each F tests the multivariate effect of Cond. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Exact statistic

b. Computed using alpha = .05

Profile Plots




```
 MANOVA SDTn_NOF2 SDTn_POP2 SDTn_TAN2 SDTn_PER2 BY Group(1,2)
/WSFACTORS=Cond(4)
/WSDESIGN=MWITHIN Cond(1) MWITHIN Cond(2) MWITHIN Cond(3) MWITHIN Cond(4).
```

Manova

Notes

Output Created		05-AUG-2017 11:33:35
Comments		
Input	Data	G:\Dissertation\C - Statistics\Aim 1\2017_0516_Aim1_SPSS_WideData.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	48
Syntax		MANOVA SDTn_NOF2 SDTn_POP2 SDTn_TAN2 SDTn_PER2 BY Group(1,2) /WSFACTORS=Cond(4) /WSDESIGN=MWITHIN Cond(1) MWITHIN Cond(2) MWITHIN Cond (3) MWITHIN Cond(4).
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.02

```
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
- - - - - - - - - - - - - - - - - - - - - -
The default error term in MANOVA has been changed from WITHIN CELLS to
WITHIN+RESIDUAL.  Note that these are the same for all full factorial designs.
```

```
* * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e * *
* * * * * * * * * * * * * * *

        48 cases accepted.
         0 cases rejected because of out-of-range factor values.
         0 cases rejected because of missing data.
         2 non-empty cells.

         1 design will be processed.

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 - - - - - - - - - - - - - - - - - - - - -
```

```
* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(1)' Within-Subject Effect.

 Tests of Significance for T1 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL             .01      46       .00
 MWITHIN COND(1)             .03       1       .03    306.22      .000
 Group BY MWITHIN CON        .00       1       .00      5.15      .028
 D(1)

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 - - - - - - - - - - - - - - - - - - - - -
```

```
* * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(2)' Within-Subject Effect.

 Tests of Significance for T2 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL             .01      46       .00
 MWITHIN COND(2)             .03       1       .03    280.52      .000
 Group BY MWITHIN CON        .00       1       .00      7.49      .009
 D(2)

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 - - - - - - - - - - - - - - - - - - - - -
```

```
* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(3)' Within-Subject Effect.

 Tests of Significance for T3 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL             .08      46       .00
 MWITHIN COND(3)             .13       1       .13     75.62      .000
 Group BY MWITHIN CON        .00       1       .00       .62      .437
 D(3)

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 - - - - - - - - - - - - - - - - - - - - - -
```

```
* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(4)' Within-Subject Effect.

 Tests of Significance for T4 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL             .03      46       .00
 MWITHIN COND(4)             .13       1       .13    231.36      .000
 Group BY MWITHIN CON        .00       1       .00      1.43      .238
 D(4)

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 - - - - - - - - - - - - - - - - - - - - -
```

```
GLM SDSn_NOF2 SDSn_POP2 SDSn_TAN2 SDSn_PER2 BY Group
 /WSFACTOR=Cond 4 Polynomial
 /METHOD=SSTYPE(3)
 /POSTHOC=Group(BONFERRONI)
 /PLOT=PROFILE(Cond*Group)
 /EMMEANS=TABLES(Group) COMPARE ADJ(LSD)
 /EMMEANS=TABLES(Cond) COMPARE ADJ(LSD)
 /PRINT=DESCRIPTIVE ETASQ OPOWER
 /CRITERIA=ALPHA(.05)
 /WSDESIGN=Cond
 /DESIGN=Group.
```

General Linear Model

Notes

Output Created		05-AUG-2017 11:45:07
Comments		
Input	Data	G:\Dissertation\C - Statistics\Aim 1\2017_0516_Aim1_SPSS_WideData.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	48
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.

Notes

Syntax		GLM SDSn_NOF2 SDSn_POP2 SDSn_TAN2 SDSn_PER2 BY Group /WSFACTOR=Cond 4 Polynomial /METHOD=SSTYPE(3) /POSTHOC=Group (BONFERRONI) /PLOT=PROFILE(Cond*Group) /EMMEANS=TABLES(Group) COMPARE ADJ(LSD) /EMMEANS=TABLES(Cond) COMPARE ADJ(LSD) /PRINT=DESCRIPTIVE ETASQ OPOWER /CRITERIA=ALPHA(.05) /WSDESIGN=Cond...
Resources	Processor Time	00:00:00.78
	Elapsed Time	00:00:00.60

Warnings

Post hoc tests are not performed for Group because there are fewer than three groups.

Within-Subjects Factors

Measure: MEASURE_1

Cond	Dependent Variable
1	SDSn_NOF2
2	SDSn_POP2
3	SDSn_TAN2
4	SDSn_PER2

Between-Subjects Factors

		N
Group	1	24
	2	24

Descriptive Statistics

	Group	Mean	Std. Deviation	N
SDSn_NOF2	1	.0228736893	.0048937415	24
	2	.0250654931	.0082386547	24
	Total	.0239695912	.0067942454	48
SDSn_POP2	1	.0174100985	.0052279439	24
	2	.0256930010	.0121795454	24
	Total	.0215515498	.0101727110	48
SDSn_TAN2	1	.0207201681	.0072982354	24
	2	.0284611588	.0079702190	24
	Total	.0245906634	.0085118363	48
SDSn_PER2	1	.0532404888	.0246901708	24
	2	.0393212392	.0166999365	24
	Total	.0462808640	.0220059332	48

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[c]
Cond	Pillai's Trace	.576	19.954[b]	3.000	44.000	.000	.576	59.863	1.000
	Wilks' Lambda	.424	19.954[b]	3.000	44.000	.000	.576	59.863	1.000
	Hotelling's Trace	1.361	19.954[b]	3.000	44.000	.000	.576	59.863	1.000
	Roy's Largest Root	1.361	19.954[b]	3.000	44.000	.000	.576	59.863	1.000
Cond * Group	Pillai's Trace	.264	5.268[b]	3.000	44.000	.003	.264	15.804	.906
	Wilks' Lambda	.736	5.268[b]	3.000	44.000	.003	.264	15.804	.906
	Hotelling's Trace	.359	5.268[b]	3.000	44.000	.003	.264	15.804	.906
	Roy's Largest Root	.359	5.268[b]	3.000	44.000	.003	.264	15.804	.906

a. Design: Intercept + Group
Within Subjects Design: Cond

b. Exact statistic

c. Computed using alpha = .05

Mauchly's Test of Sphericity[a]

Measure: MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b]		
					Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Cond	.207	70.395	5	.000	.510	.536	.333

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. Design: Intercept + Group
Within Subjects Design: Cond

b. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Cond	Sphericity Assumed	.019	3	.006	40.925	.000	.471	122.776	1.000
	Greenhouse-Geisser	.019	1.530	.013	40.925	.000	.471	62.631	1.000
	Huynh-Feldt	.019	1.607	.012	40.925	.000	.471	65.763	1.000
	Lower-bound	.019	1.000	.019	40.925	.000	.471	40.925	1.000
Cond * Group	Sphericity Assumed	.004	3	.001	8.273	.000	.152	24.818	.991
	Greenhouse-Geisser	.004	1.530	.003	8.273	.002	.152	12.660	.911
	Huynh-Feldt	.004	1.607	.002	8.273	.001	.152	13.293	.920
	Lower-bound	.004	1.000	.004	8.273	.006	.152	8.273	.804
Error(Cond)	Sphericity Assumed	.022	138	.000					
	Greenhouse-Geisser	.022	70.398	.000					
	Huynh-Feldt	.022	73.918	.000					
	Lower-bound	.022	46.000	.000					

a. Computed using alpha = .05

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	Cond	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Cond	Linear	.012	1	.012	45.874	.000	.499	45.874	1.000
	Quadratic	.007	1	.007	49.000	.000	.516	49.000	1.000
	Cubic	.000	1	.000	6.031	.018	.116	6.031	.672
Cond * Group	Linear	.001	1	.001	5.595	.022	.108	5.595	.639
	Quadratic	.002	1	.002	16.232	.000	.261	16.232	.976
	Cubic	.000	1	.000	1.817	.184	.038	1.817	.262
Error(Cond)	Linear	.012	46	.000					
	Quadratic	.007	46	.000					
	Cubic	.003	46	6.927E-5					

a. Computed using alpha = .05

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Intercept	.163	1	.163	964.051	.000	.954	964.051	1.000
Group	5.538E-5	1	5.538E-5	.328	.569	.007	.328	.087
Error	.008	46	.000					

a. Computed using alpha = .05

Estimated Marginal Means

1. Group

Estimates

Measure: MEASURE_1

Group	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	.029	.001	.026	.031
2	.030	.001	.027	.032

Pairwise Comparisons

Measure: MEASURE_1

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
1	2	-.001	.002	.569	-.005	.003
2	1	.001	.002	.569	-.003	.005

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Univariate Tests

Measure: MEASURE_1

	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Contrast	1.384E-5	1	1.384E-5	.328	.569	.007	.328	.087
Error	.002	46	4.216E-5					

The F tests the effect of Group. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Computed using alpha = .05

2. Cond

Estimates

Measure: MEASURE_1

Cond	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	.024	.001	.022	.026
2	.022	.001	.019	.024
3	.025	.001	.022	.027
4	.046	.003	.040	.052

Pairwise Comparisons

Measure: MEASURE_1

(I) Cond	(J) Cond	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b] Lower Bound	Upper Bound
1	2	.002	.002	.142	-.001	.006
	3	-.001	.001	.665	-.003	.002
	4	-.022*	.003	.000	-.029	-.015
2	1	-.002	.002	.142	-.006	.001
	3	-.003*	.001	.017	-.006	-.001
	4	-.025*	.003	.000	-.031	-.018
3	1	.001	.001	.665	-.002	.003
	2	.003*	.001	.017	.001	.006
	4	-.022*	.003	.000	-.028	-.015
4	1	.022*	.003	.000	.015	.029
	2	.025*	.003	.000	.018	.031
	3	.022*	.003	.000	.015	.028

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Multivariate Tests

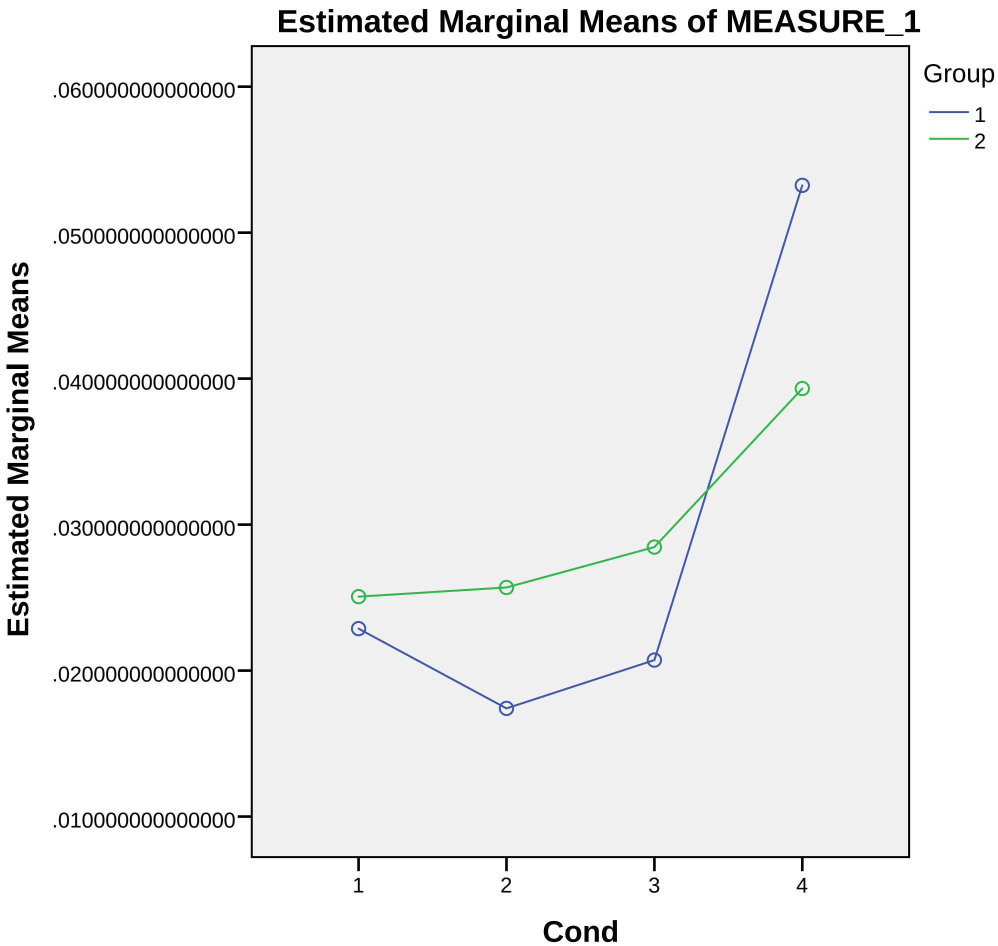
	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Pillai's trace	.576	19.954[a]	3.000	44.000	.000	.576	59.863	1.000
Wilks' lambda	.424	19.954[a]	3.000	44.000	.000	.576	59.863	1.000
Hotelling's trace	1.361	19.954[a]	3.000	44.000	.000	.576	59.863	1.000
Roy's largest root	1.361	19.954[a]	3.000	44.000	.000	.576	59.863	1.000

Each F tests the multivariate effect of Cond. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Exact statistic

b. Computed using alpha = .05

Profile Plots




```
 MANOVA SDSn_NOF2 SDSn_POP2 SDSn_TAN2 SDSn_PER2 BY Group(1,2)
/WSFACTORS=Cond(4)
/WSDESIGN=MWITHIN Cond(1) MWITHIN Cond(2) MWITHIN Cond(3) MWITHIN Cond(4).
```

Manova

Notes

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- -

```
The default error term in MANOVA has been changed from WITHIN CELLS to
WITHIN+RESIDUAL.  Note that these are the same for all full factorial designs.
```

```
* * * * * * * * * * * * * * * * * *A n a l y s i s   o f   V a r i a n c e * *
* * * * * * * * * * * * * * *

       48 cases accepted.
        0 cases rejected because of out-of-range factor values.
        0 cases rejected because of missing data.
        2 non-empty cells.

        1 design will be processed.

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 - - - - - - - - - - - - - - - - - - - - -
```

```
* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(1)' Within-Subject Effect.

 Tests of Significance for T1 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL             .00      46       .00
 MWITHIN COND(1)             .03       1       .03    600.67      .000
 Group BY MWITHIN CON        .00       1       .00      1.26      .268
 D(1)

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 - - - - - - - - - - - - - - - - - - - - -
```

* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(2)' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN+RESIDUAL	.00	46	.00		
MWITHIN COND(2)	.02	1	.02	253.82	.000
Group BY MWITHIN COND(2)	.00	1	.00	9.37	.004

- -

```
* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(3)' Within-Subject Effect.

 Tests of Significance for T3 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL             .00      46       .00
 MWITHIN COND(3)             .03       1       .03    497.06      .000
 Group BY MWITHIN CON        .00       1       .00     12.31      .001
 D(3)

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 - - - - - - - - - - - - - - - - - - - - -
```

```
* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(4)' Within-Subject Effect.

 Tests of Significance for T4 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL             .02      46       .00
 MWITHIN COND(4)             .10       1       .10    231.43      .000
 Group BY MWITHIN CON        .00       1       .00      5.23      .027
 D(4)

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 - - - - - - - - - - - - - - - - - - - - -
```

```
GLM AlphaLn_NOF2 AlphaLn_POP2 AlphaLn_TAN2 AlphaLn_PER2 BY Group
 /WSFACTOR=Cond 4 Polynomial
 /METHOD=SSTYPE(3)
 /POSTHOC=Group(BONFERRONI)
 /PLOT=PROFILE(Cond*Group)
 /EMMEANS=TABLES(Group) COMPARE ADJ(LSD)
 /EMMEANS=TABLES(Cond) COMPARE ADJ(LSD)
 /PRINT=DESCRIPTIVE ETASQ OPOWER
 /CRITERIA=ALPHA(.05)
 /WSDESIGN=Cond
 /DESIGN=Group.
```

General Linear Model

Notes

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Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.

Notes

Syntax		GLM AlphaLn_NOF2 AlphaLn_POP2 AlphaLn_TAN2 AlphaLn_PER2 BY Group /WSFACTOR=Cond 4 Polynomial /METHOD=SSTYPE(3) /POSTHOC=Group (BONFERRONI) /PLOT=PROFILE(Cond*Group) /EMMEANS=TABLES(Group) COMPARE ADJ(LSD) /EMMEANS=TABLES(Cond) COMPARE ADJ(LSD) /PRINT=DESCRIPTIVE ETASQ OPOWER /CRITERIA=ALPHA(.05) /WSDESIGN=Cond...
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Warnings

Post hoc tests are not performed for Group because there are fewer than three groups.

Within-Subjects Factors

Measure: MEASURE_1

Cond	Dependent Variable
1	AlphaLn_NOF2
2	AlphaLn_POP2
3	AlphaLn_TAN2
4	AlphaLn_PER2

Between-Subjects Factors

		N
Group	1	24
	2	24

Descriptive Statistics

	Group	Mean	Std. Deviation	N
AlphaLn_NOF2	1	.6320032807	.0992074734	24
	2	.7933069240	.1707075328	24
	Total	.7126551023	.1603745369	48
AlphaLn_POP2	1	.6171862437	.1548182351	24
	2	.6247021160	.1409331250	24
	Total	.6209441798	.1465044468	48
AlphaLn_TAN2	1	.8023762416	.3089800409	24
	2	.7835161026	.2540310871	24
	Total	.7929461721	.2799802049	48
AlphaLn_PER2	1	.6123238914	.1627555386	24
	2	.6766255129	.2334431057	24
	Total	.6444747021	.2017093184	48

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[c]
Cond	Pillai's Trace	.286	5.874[b]	3.000	44.000	.002	.286	17.621	.936
	Wilks' Lambda	.714	5.874[b]	3.000	44.000	.002	.286	17.621	.936
	Hotelling's Trace	.400	5.874[b]	3.000	44.000	.002	.286	17.621	.936
	Roy's Largest Root	.400	5.874[b]	3.000	44.000	.002	.286	17.621	.936
Cond * Group	Pillai's Trace	.172	3.037[b]	3.000	44.000	.039	.172	9.111	.674
	Wilks' Lambda	.828	3.037[b]	3.000	44.000	.039	.172	9.111	.674
	Hotelling's Trace	.207	3.037[b]	3.000	44.000	.039	.172	9.111	.674
	Roy's Largest Root	.207	3.037[b]	3.000	44.000	.039	.172	9.111	.674

a. Design: Intercept + Group
Within Subjects Design: Cond

b. Exact statistic

c. Computed using alpha = .05

Mauchly's Test of Sphericity[a]

Measure: MEASURE_1

					Epsilon[b]		
Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Cond	.661	18.492	5	.002	.782	.845	.333

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. Design: Intercept + Group
Within Subjects Design: Cond

b. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Cond	Sphericity Assumed	.860	3	.287	7.793	.000	.145	23.379	.988
	Greenhouse-Geisser	.860	2.346	.367	7.793	.000	.145	18.284	.967
	Huynh-Feldt	.860	2.534	.339	7.793	.000	.145	19.747	.975
	Lower-bound	.860	1.000	.860	7.793	.008	.145	7.793	.780
Cond * Group	Sphericity Assumed	.229	3	.076	2.075	.106	.043	6.225	.522
	Greenhouse-Geisser	.229	2.346	.098	2.075	.122	.043	4.869	.455
	Huynh-Feldt	.229	2.534	.090	2.075	.117	.043	5.258	.475
	Lower-bound	.229	1.000	.229	2.075	.156	.043	2.075	.292
Error(Cond)	Sphericity Assumed	5.078	138	.037					
	Greenhouse-Geisser	5.078	107.923	.047					
	Huynh-Feldt	5.078	116.560	.044					
	Lower-bound	5.078	46.000	.110					

a. Computed using alpha = .05

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	Cond	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Cond	Linear	.003	1	.003	.088	.769	.002	.088	.060
	Quadratic	.039	1	.039	1.200	.279	.025	1.200	.189
	Cubic	.819	1	.819	16.659	.000	.266	16.659	.979
Cond * Group	Linear	.060	1	.060	2.084	.156	.043	2.084	.293
	Quadratic	.168	1	.168	5.228	.027	.102	5.228	.610
	Cubic	.000	1	.000	.004	.950	.000	.004	.050
Error(Cond)	Linear	1.334	46	.029					
	Quadratic	1.482	46	.032					
	Cubic	2.262	46	.049					

a. Computed using alpha = .05

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Intercept	92.143	1	92.143	1788.737	.000	.975	1788.737	1.000
Group	.138	1	.138	2.674	.109	.055	2.674	.360
Error	2.370	46	.052					

a. Computed using alpha = .05

Estimated Marginal Means

1. Group

Estimates

Measure: MEASURE_1

Group	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	.666	.023	.619	.713
2	.720	.023	.673	.766

Pairwise Comparisons

Measure: MEASURE_1

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
1	2	-.054	.033	.109	-.120	.012
2	1	.054	.033	.109	-.012	.120

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Univariate Tests

Measure: MEASURE_1

	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Contrast	.034	1	.034	2.674	.109	.055	2.674	.360
Error	.592	46	.013					

The F tests the effect of Group. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Computed using alpha = .05

2. Cond

Estimates

Measure: MEASURE_1

Cond	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	.713	.020	.672	.753
2	.621	.021	.578	.664
3	.793	.041	.711	.875
4	.644	.029	.586	.703

Pairwise Comparisons

Measure: MEASURE_1

(I) Cond	(J) Cond	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b] Lower Bound	Upper Bound
1	2	.092*	.029	.002	.034	.149
	3	-.080	.042	.064	-.166	.005
	4	.068	.036	.062	-.003	.140
2	1	-.092*	.029	.002	-.149	-.034
	3	-.172*	.045	.000	-.262	-.082
	4	-.024	.031	.451	-.086	.039
3	1	.080	.042	.064	-.005	.166
	2	.172*	.045	.000	.082	.262
	4	.148*	.049	.004	.050	.246
4	1	-.068	.036	.062	-.140	.003
	2	.024	.031	.451	-.039	.086
	3	-.148*	.049	.004	-.246	-.050

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Multivariate Tests

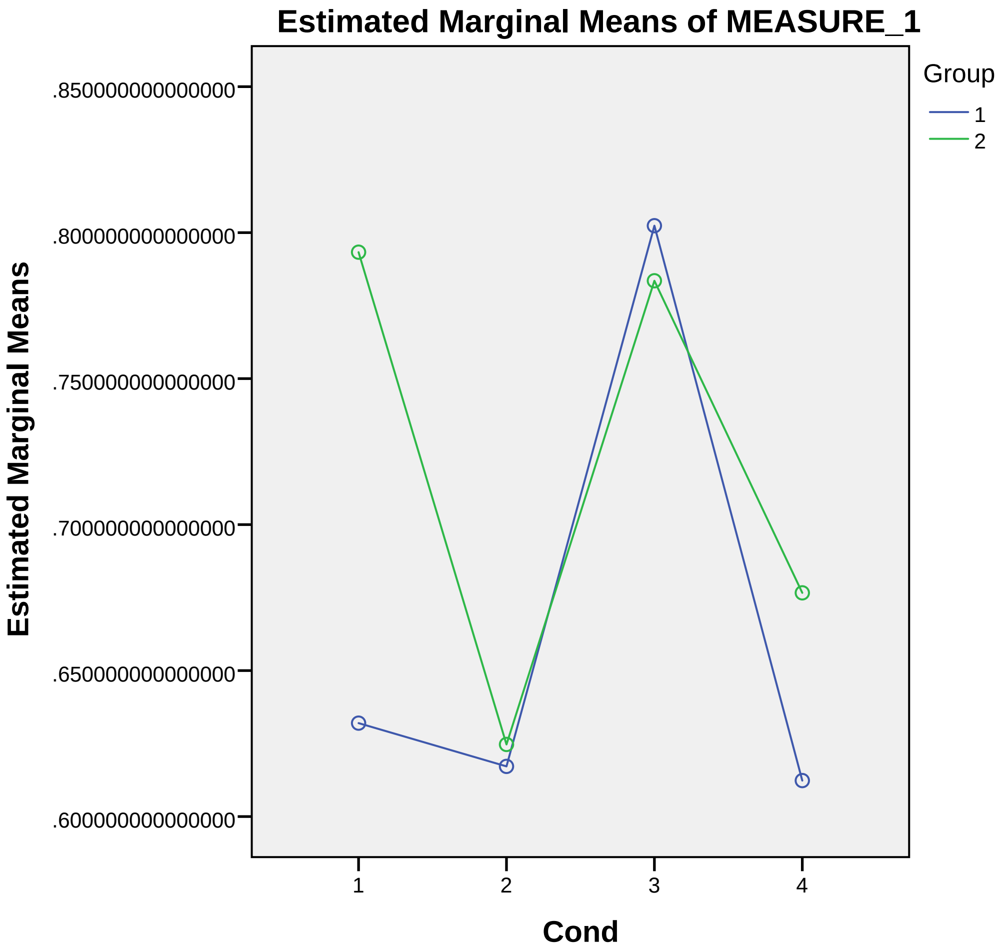
	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Pillai's trace	.286	5.874[a]	3.000	44.000	.002	.286	17.621	.936
Wilks' lambda	.714	5.874[a]	3.000	44.000	.002	.286	17.621	.936
Hotelling's trace	.400	5.874[a]	3.000	44.000	.002	.286	17.621	.936
Roy's largest root	.400	5.874[a]	3.000	44.000	.002	.286	17.621	.936

Each F tests the multivariate effect of Cond. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Exact statistic

b. Computed using alpha = .05

Profile Plots




```
MANOVA AlphaLn_NOF2 AlphaLn_POP2 AlphaLn_TAN2 AlphaLn_PER2 BY Group(1,2)
/WSFACTORS=Cond(4)
/WSDESIGN=MWITHIN Cond(1) MWITHIN Cond(2) MWITHIN Cond(3) MWITHIN Cond(4).
```

Manova

Notes

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Syntax		MANOVA AlphaLn_NOF2 AlphaLn_POP2 AlphaLn_TAN2 AlphaLn_PER2 BY Group(1,2) /WSFACTORS=Cond(4) /WSDESIGN=MWITHIN Cond(1) MWITHIN Cond(2) MWITHIN Cond (3) MWITHIN Cond(4).
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.02

```
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
- - - - - - - - - - - - - - - - - - - - - -
The default error term in MANOVA has been changed from WITHIN CELLS to
WITHIN+RESIDUAL.  Note that these are the same for all full factorial designs.
```

```
* * * * * * * * * * * * * * * * * *A n a l y s i s   o f   V a r i a n c e* *
* * * * * * * * * * * * * * * *


        48 cases accepted.
         0 cases rejected because of out-of-range factor values.
         0 cases rejected because of missing data.
         2 non-empty cells.

         1 design will be processed.

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 - - - - - - - - - - - - - - - - - - - - -
```

```
* * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(1)' Within-Subject Effect.

 Tests of Significance for T1 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL             .90      46       .02
 MWITHIN COND(1)           24.38       1     24.38   1250.70      .000
 Group BY MWITHIN CON        .31       1       .31     16.02      .000
 D(1)

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
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```

```
* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(2)' Within-Subject Effect.

 Tests of Significance for T2 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL            1.01      46       .02
 MWITHIN COND(2)           18.51       1     18.51    844.49      .000
 Group BY MWITHIN CON        .00       1       .00       .03      .861
 D(2)

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 - - - - - - - - - - - - - - - - - - - - -
```

```
* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(3)' Within-Subject Effect.

 Tests of Significance for T3 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL            3.68      46       .08
 MWITHIN COND(3)           30.18       1     30.18    377.26      .000
 Group BY MWITHIN CON        .00       1       .00       .05      .818
 D(3)

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 - - - - - - - - - - - - - - - - - - - - -
```

* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(4)' Within-Subject Effect.

Tests of Significance for T4 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN+RESIDUAL	1.86	46	.04		
MWITHIN COND(4)	19.94	1	19.94	492.35	.000
Group BY MWITHIN COND(4)	.05	1	.05	1.23	.274

- -

```
GLM AlphaTn_NOF2 AlphaTn_POP2 AlphaTn_TAN2 AlphaTn_PER2 BY Group
 /WSFACTOR=Cond 4 Polynomial
 /METHOD=SSTYPE(3)
 /POSTHOC=Group(BONFERRONI)
 /PLOT=PROFILE(Cond*Group)
 /EMMEANS=TABLES(Group) COMPARE ADJ(LSD)
 /EMMEANS=TABLES(Cond) COMPARE ADJ(LSD)
 /PRINT=DESCRIPTIVE ETASQ OPOWER
 /CRITERIA=ALPHA(.05)
 /WSDESIGN=Cond
 /DESIGN=Group.
```

General Linear Model

Notes

Output Created		05-AUG-2017 11:54:10
Comments		
Input	Data	G:\Dissertation\C - Statistics\Aim 1\2017_0516_Aim1_SPSS_WideData.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	48
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.

Notes

Syntax		GLM AlphaTn_NOF2 AlphaTn_POP2 AlphaTn_TAN2 AlphaTn_PER2 BY Group /WSFACTOR=Cond 4 Polynomial /METHOD=SSTYPE(3) /POSTHOC=Group (BONFERRONI) /PLOT=PROFILE(Cond*Group) /EMMEANS=TABLES(Group) COMPARE ADJ(LSD) /EMMEANS=TABLES(Cond) COMPARE ADJ(LSD) /PRINT=DESCRIPTIVE ETASQ OPOWER /CRITERIA=ALPHA(.05) /WSDESIGN=Cond...
Resources	Processor Time	00:00:00.55
	Elapsed Time	00:00:00.53

Warnings

Post hoc tests are not performed for Group because there are fewer than three groups.

Within-Subjects Factors

Measure: MEASURE_1

Cond	Dependent Variable
1	AlphaTn_NOF2
2	AlphaTn_POP2
3	AlphaTn_TAN2
4	AlphaTn_PER2

Between-Subjects Factors

		N
Group	1	24
	2	24

Descriptive Statistics

	Group	Mean	Std. Deviation	N
AlphaTn_NOF2	1	.6943553455	.1408370585	24
	2	.8788476334	.1558486649	24
	Total	.7866014894	.1740199407	48
AlphaTn_POP2	1	.6645760341	.1551506422	24
	2	.7121731376	.1827380384	24
	Total	.6883745858	.1694094120	48
AlphaTn_TAN2	1	.8497862025	.2833868799	24
	2	.8379694763	.2253194191	24
	Total	.8438778394	.2533371229	48
AlphaTn_PER2	1	.7139193585	.1495789638	24
	2	.7379319438	.2367408975	24
	Total	.7259256511	.1962728229	48

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[c]
Cond	Pillai's Trace	.281	5.742[b]	3.000	44.000	.002	.281	17.225	.930
	Wilks' Lambda	.719	5.742[b]	3.000	44.000	.002	.281	17.225	.930
	Hotelling's Trace	.391	5.742[b]	3.000	44.000	.002	.281	17.225	.930
	Roy's Largest Root	.391	5.742[b]	3.000	44.000	.002	.281	17.225	.930
Cond * Group	Pillai's Trace	.175	3.108[b]	3.000	44.000	.036	.175	9.325	.685
	Wilks' Lambda	.825	3.108[b]	3.000	44.000	.036	.175	9.325	.685
	Hotelling's Trace	.212	3.108[b]	3.000	44.000	.036	.175	9.325	.685
	Roy's Largest Root	.212	3.108[b]	3.000	44.000	.036	.175	9.325	.685

a. Design: Intercept + Group
Within Subjects Design: Cond

b. Exact statistic

c. Computed using alpha = .05

Mauchly's Test of Sphericity[a]

Measure: MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b] Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Cond	.742	13.321	5	.021	.827	.897	.333

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. Design: Intercept + Group
Within Subjects Design: Cond

b. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Cond	Sphericity Assumed	.673	3	.224	6.495	.000	.124	19.484	.967
	Greenhouse-Geisser	.673	2.480	.271	6.495	.001	.124	16.108	.941
	Huynh-Feldt	.673	2.690	.250	6.495	.001	.124	17.468	.953
	Lower-bound	.673	1.000	.673	6.495	.014	.124	6.495	.704
Cond * Group	Sphericity Assumed	.265	3	.088	2.558	.058	.053	7.673	.620
	Greenhouse-Geisser	.265	2.480	.107	2.558	.070	.053	6.344	.561
	Huynh-Feldt	.265	2.690	.099	2.558	.065	.053	6.879	.586
	Lower-bound	.265	1.000	.265	2.558	.117	.053	2.558	.347
Error(Cond)	Sphericity Assumed	4.769	138	.035					
	Greenhouse-Geisser	4.769	114.090	.042					
	Huynh-Feldt	4.769	123.721	.039					
	Lower-bound	4.769	46.000	.104					

a. Computed using alpha = .05

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	Cond	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Cond	Linear	.002	1	.002	.060	.807	.001	.060	.057
	Quadratic	.005	1	.005	.143	.707	.003	.143	.066
	Cubic	.667	1	.667	15.457	.000	.252	15.457	.971
Cond * Group	Linear	.176	1	.176	6.288	.016	.120	6.288	.690
	Quadratic	.090	1	.090	2.744	.104	.056	2.744	.368
	Cubic	.000	1	.000	.004	.947	.000	.004	.050
Error(Cond)	Linear	1.284	46	.028					
	Quadratic	1.500	46	.033					
	Cubic	1.985	46	.043					

a. Computed using alpha = .05

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Intercept	111.248	1	111.248	2145.168	.000	.979	2145.168	1.000
Group	.179	1	.179	3.452	.070	.070	3.452	.444
Error	2.386	46	.052					

a. Computed using alpha = .05

Estimated Marginal Means

1. Group

Estimates

Measure: MEASURE_1

Group	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1	.731	.023	.684	.777
2	.792	.023	.745	.839

Pairwise Comparisons

Measure: MEASURE_1

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a] Lower Bound	95% Confidence Interval for Difference[a] Upper Bound
1	2	-.061	.033	.070	-.127	.005
2	1	.061	.033	.070	-.005	.127

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Univariate Tests

Measure: MEASURE_1

	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Contrast	.045	1	.045	3.452	.070	.070	3.452	.444
Error	.596	46	.013					

The F tests the effect of Group. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Computed using alpha = .05

2. Cond

Estimates

Measure: MEASURE_1

Cond	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1	.787	.021	.743	.830
2	.688	.024	.639	.738
3	.844	.037	.769	.918
4	.726	.029	.668	.783

Pairwise Comparisons

Measure: MEASURE_1

(I) Cond	(J) Cond	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
1	2	.098*	.031	.002	.037	.160
	3	-.057	.039	.144	-.135	.020
	4	.061	.037	.106	-.013	.135
2	1	-.098*	.031	.002	-.160	-.037
	3	-.156*	.040	.000	-.236	-.075
	4	-.038	.032	.240	-.101	.026
3	1	.057	.039	.144	-.020	.135
	2	.156*	.040	.000	.075	.236
	4	.118*	.048	.017	.022	.214
4	1	-.061	.037	.106	-.135	.013
	2	.038	.032	.240	-.026	.101
	3	-.118*	.048	.017	-.214	-.022

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Multivariate Tests

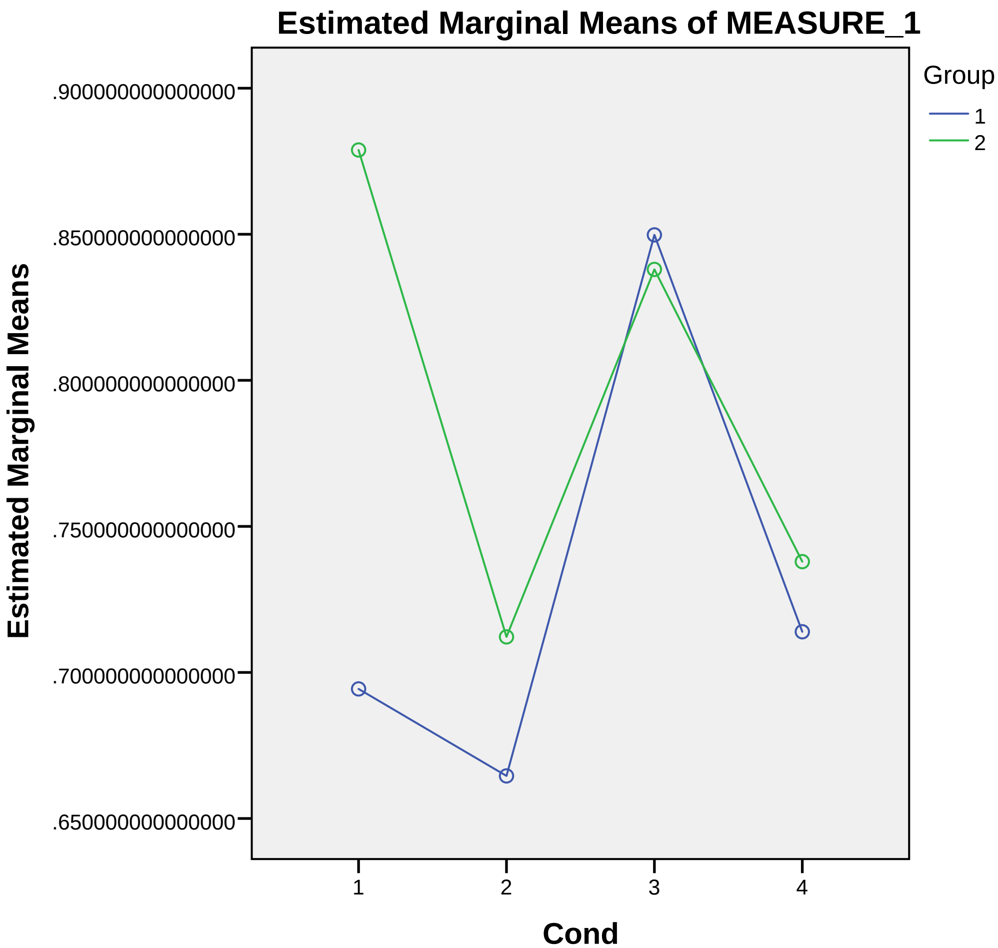
	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Pillai's trace	.281	5.742[a]	3.000	44.000	.002	.281	17.225	.930
Wilks' lambda	.719	5.742[a]	3.000	44.000	.002	.281	17.225	.930
Hotelling's trace	.391	5.742[a]	3.000	44.000	.002	.281	17.225	.930
Roy's largest root	.391	5.742[a]	3.000	44.000	.002	.281	17.225	.930

Each F tests the multivariate effect of Cond. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Exact statistic

b. Computed using alpha = .05

Profile Plots




```
MANOVA AlphaTn_NOF2 AlphaTn_POP2 AlphaTn_TAN2 AlphaTn_PER2 BY Group(1,2)
/WSFACTORS=Cond(4)
/WSDESIGN=MWITHIN Cond(1) MWITHIN Cond(2) MWITHIN Cond(3) MWITHIN Cond(4).
```

Manova

Notes

Output Created		05-AUG-2017 11:54:42
Comments		
Input	Data	G:\Dissertation\C - Statistics\Aim 1\2017_0516_Aim1_SPSS_WideData.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	48
Syntax		MANOVA AlphaTn_NOF2 AlphaTn_POP2 AlphaTn_TAN2 AlphaTn_PER2 BY Group(1,2) /WSFACTORS=Cond(4) /WSDESIGN=MWITHIN Cond(1) MWITHIN Cond(2) MWITHIN Cond (3) MWITHIN Cond(4).
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.04

```
 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 - - - - - - - - - - - - - - - - - - - - - -
The default error term in MANOVA has been changed from WITHIN CELLS to
WITHIN+RESIDUAL.  Note that these are the same for all full factorial designs.
```

```
* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e * *
* * * * * * * * * * * * * * *

        48 cases accepted.
         0 cases rejected because of out-of-range factor values.
         0 cases rejected because of missing data.
         2 non-empty cells.

         1 design will be processed.

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 - - - - - - - - - - - - - - - - - - - - -
```

```
* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(1)' Within-Subject Effect.

 Tests of Significance for T1 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL            1.01      46       .02
 MWITHIN COND(1)           29.70       1     29.70   1346.19      .000
 Group BY MWITHIN CON        .41       1       .41     18.51      .000
 D(1)

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 - - - - - - - - - - - - - - - - - - - - -
```

```
* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(2)' Within-Subject Effect.

 Tests of Significance for T2 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL            1.32      46       .03
 MWITHIN COND(2)           22.75       1     22.75    791.62      .000
 Group BY MWITHIN CON        .03       1       .03       .95      .336
 D(2)

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 - - - - - - - - - - - - - - - - - - - - -
```

```
* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(3)' Within-Subject Effect.

 Tests of Significance for T3 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL            3.01      46       .07
 MWITHIN COND(3)           34.18       1     34.18    521.56      .000
 Group BY MWITHIN CON        .00       1       .00       .03      .874
 D(3)

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 - - - - - - - - - - - - - - - - - - - - -
```

```
* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(4)' Within-Subject Effect.

 Tests of Significance for T4 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL            1.80      46       .04
 MWITHIN COND(4)           25.29       1     25.29    645.10      .000
 Group BY MWITHIN CON        .01       1       .01       .18      .676
 D(4)

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 - - - - - - - - - - - - - - - - - - - - -
```

```
GLM AlphaSn_NOF2 AlphaSn_POP2 AlphaSn_TAN2 AlphaSn_PER2 BY Group
 /WSFACTOR=Cond 4 Polynomial
 /METHOD=SSTYPE(3)
 /POSTHOC=Group(BONFERRONI)
 /PLOT=PROFILE(Cond*Group)
 /EMMEANS=TABLES(Group) COMPARE ADJ(LSD)
 /EMMEANS=TABLES(Cond) COMPARE ADJ(LSD)
 /PRINT=DESCRIPTIVE ETASQ OPOWER
 /CRITERIA=ALPHA(.05)
 /WSDESIGN=Cond
 /DESIGN=Group.
```

General Linear Model

Notes

Output Created		05-AUG-2017 11:58:43
Comments		
Input	Data	G:\Dissertation\C - Statistics\Aim 1\2017_0516_Aim1_SPSS_WideData.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	48
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.

Notes

Syntax		GLM AlphaSn_NOF2 AlphaSn_POP2 AlphaSn_TAN2 AlphaSn_PER2 BY Group /WSFACTOR=Cond 4 Polynomial /METHOD=SSTYPE(3) /POSTHOC=Group (BONFERRONI) /PLOT=PROFILE(Cond*Group) /EMMEANS=TABLES(Group) COMPARE ADJ(LSD) /EMMEANS=TABLES(Cond) COMPARE ADJ(LSD) /PRINT=DESCRIPTIVE ETASQ OPOWER /CRITERIA=ALPHA(.05) /WSDESIGN=Cond...
Resources	Processor Time	00:00:00.52
	Elapsed Time	00:00:00.48

Warnings

Post hoc tests are not performed for Group because there are fewer than three groups.

Within-Subjects Factors

Measure: MEASURE_1

Cond	Dependent Variable
1	AlphaSn_NOF2
2	AlphaSn_POP2
3	AlphaSn_TAN2
4	AlphaSn_PER2

Between-Subjects Factors

		N
Group	1	24
	2	24

Descriptive Statistics

	Group	Mean	Std. Deviation	N
AlphaSn_NOF2	1	.3883070931	.1386789077	24
	2	.4430025569	.1342745473	24
	Total	.4156548250	.1378338095	48
AlphaSn_POP2	1	.4170512866	.1039918425	24
	2	.3913426779	.1517630011	24
	Total	.4041969822	.1293516042	48
AlphaSn_TAN2	1	.4096179078	.1107842468	24
	2	.4248148987	.1260090765	24
	Total	.4172164032	.1176231294	48
AlphaSn_PER2	1	.3665119915	.1603430523	24
	2	.3254668069	.1137238071	24
	Total	.3459893992	.1390702758	48

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[c]
Cond	Pillai's Trace	.174	3.100[b]	3.000	44.000	.036	.174	9.299	.684
	Wilks' Lambda	.826	3.100[b]	3.000	44.000	.036	.174	9.299	.684
	Hotelling's Trace	.211	3.100[b]	3.000	44.000	.036	.174	9.299	.684
	Roy's Largest Root	.211	3.100[b]	3.000	44.000	.036	.174	9.299	.684
Cond * Group	Pillai's Trace	.076	1.202[b]	3.000	44.000	.320	.076	3.606	.300
	Wilks' Lambda	.924	1.202[b]	3.000	44.000	.320	.076	3.606	.300
	Hotelling's Trace	.082	1.202[b]	3.000	44.000	.320	.076	3.606	.300
	Roy's Largest Root	.082	1.202[b]	3.000	44.000	.320	.076	3.606	.300

a. Design: Intercept + Group
Within Subjects Design: Cond

b. Exact statistic

c. Computed using alpha = .05

Mauchly's Test of Sphericity[a]

Measure: MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b] Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Cond	.909	4.280	5	.510	.940	1.000	.333

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. Design: Intercept + Group
Within Subjects Design: Cond

b. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Cond	Sphericity Assumed	.163	3	.054	3.754	.012	.075	11.262	.802
	Greenhouse-Geisser	.163	2.821	.058	3.754	.014	.075	10.592	.783
	Huynh-Feldt	.163	3.000	.054	3.754	.012	.075	11.262	.802
	Lower-bound	.163	1.000	.163	3.754	.059	.075	3.754	.475
Cond * Group	Sphericity Assumed	.067	3	.022	1.534	.208	.032	4.603	.398
	Greenhouse-Geisser	.067	2.821	.024	1.534	.211	.032	4.329	.384
	Huynh-Feldt	.067	3.000	.022	1.534	.208	.032	4.603	.398
	Lower-bound	.067	1.000	.067	1.534	.222	.032	1.534	.228
Error(Cond)	Sphericity Assumed	2.002	138	.015					
	Greenhouse-Geisser	2.002	129.782	.015					
	Huynh-Feldt	2.002	138.000	.015					
	Lower-bound	2.002	46.000	.044					

a. Computed using alpha = .05

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	Cond	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Cond	Linear	.092	1	.092	5.045	.030	.099	5.045	.595
	Quadratic	.043	1	.043	3.544	.066	.072	3.544	.454
	Cubic	.028	1	.028	2.155	.149	.045	2.155	.301
Cond * Group	Linear	.036	1	.036	1.992	.165	.042	1.992	.282
	Quadratic	.002	1	.002	.145	.705	.003	.145	.066
	Cubic	.029	1	.029	2.175	.147	.045	2.175	.303
Error(Cond)	Linear	.840	46	.018					
	Quadratic	.556	46	.012					
	Cubic	.606	46	.013					

a. Computed using alpha = .05

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Intercept	30.073	1	30.073	1182.958	.000	.963	1182.958	1.000
Group	2.955E-5	1	2.955E-5	.001	.973	.000	.001	.050
Error	1.169	46	.025					

a. Computed using alpha = .05

Estimated Marginal Means

1. Group

Estimates

Measure: MEASURE_1

Group	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	.395	.016	.363	.428
2	.396	.016	.363	.429

Pairwise Comparisons

Measure: MEASURE_1

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
1	2	-.001	.023	.973	-.047	.046
2	1	.001	.023	.973	-.046	.047

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Univariate Tests

Measure: MEASURE_1

	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Contrast	7.388E-6	1	7.388E-6	.001	.973	.000	.001	.050
Error	.292	46	.006					

The F tests the effect of Group. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Computed using alpha = .05

2. Cond

Estimates

Measure: MEASURE_1

Cond	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	.416	.020	.376	.455
2	.404	.019	.366	.442
3	.417	.017	.383	.452
4	.346	.020	.306	.386

Pairwise Comparisons

Measure: MEASURE_1

(I) Cond	(J) Cond	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b] Lower Bound	Upper Bound
1	2	.011	.025	.645	-.038	.061
	3	-.002	.022	.944	-.046	.043
	4	.070*	.028	.017	.013	.126
2	1	-.011	.025	.645	-.061	.038
	3	-.013	.023	.568	-.059	.033
	4	.058*	.026	.027	.007	.110
3	1	.002	.022	.944	-.043	.046
	2	.013	.023	.568	-.033	.059
	4	.071*	.024	.004	.024	.119
4	1	-.070*	.028	.017	-.126	-.013
	2	-.058*	.026	.027	-.110	-.007
	3	-.071*	.024	.004	-.119	-.024

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Multivariate Tests

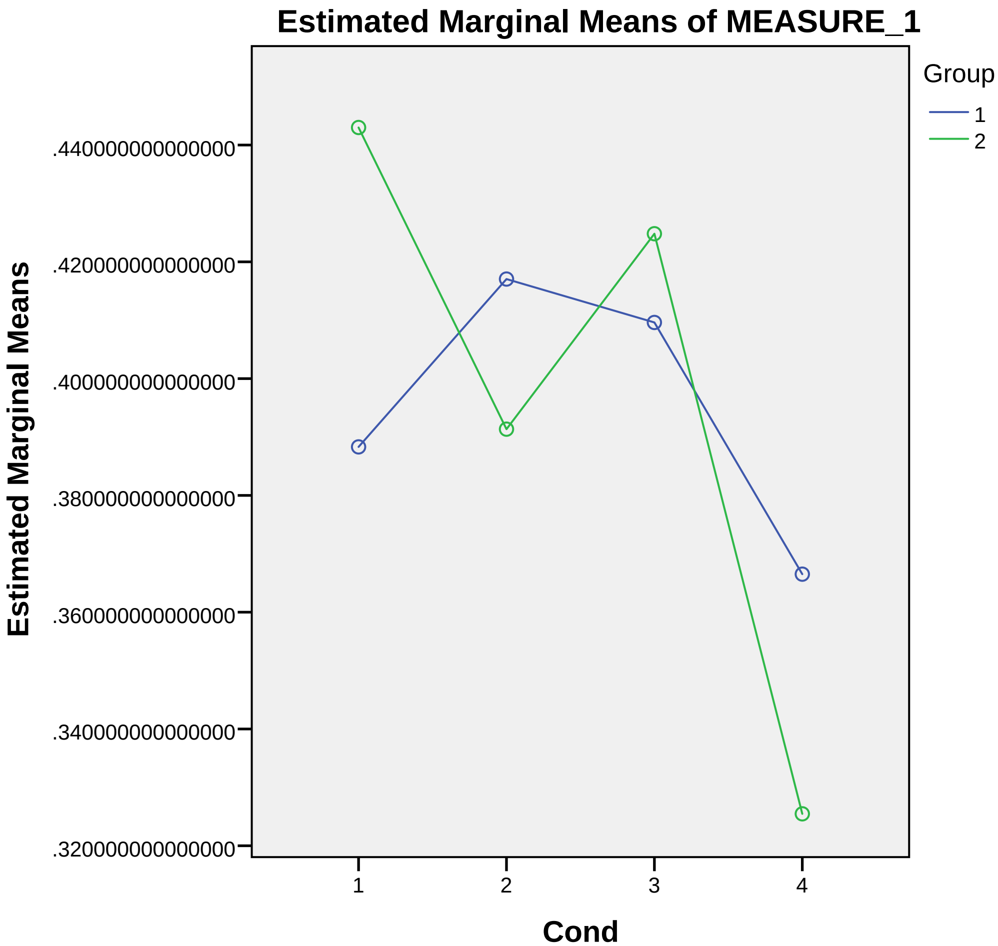
	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Pillai's trace	.174	3.100[a]	3.000	44.000	.036	.174	9.299	.684
Wilks' lambda	.826	3.100[a]	3.000	44.000	.036	.174	9.299	.684
Hotelling's trace	.211	3.100[a]	3.000	44.000	.036	.174	9.299	.684
Roy's largest root	.211	3.100[a]	3.000	44.000	.036	.174	9.299	.684

Each F tests the multivariate effect of Cond. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Exact statistic

b. Computed using alpha = .05

Profile Plots




```
 MANOVA AlphaSn_NOF2 AlphaSn_POP2 AlphaSn_TAN2 AlphaSn_PER2 BY Group(1,2)
/WSFACTORS=Cond(4)
/WSDESIGN=MWITHIN Cond(1) MWITHIN Cond(2) MWITHIN Cond(3) MWITHIN Cond(4).
```

Manova

Notes

Output Created		05-AUG-2017 11:59:27
Comments		
Input	Data	G:\Dissertation\C - Statistics\Aim 1\2017_0516_Aim1_SPSS_WideData.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
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Syntax		MANOVA AlphaSn_NOF2 AlphaSn_POP2 AlphaSn_TAN2 AlphaSn_PER2 BY Group(1,2) /WSFACTORS=Cond(4) /WSDESIGN=MWITHIN Cond(1) MWITHIN Cond(2) MWITHIN Cond (3) MWITHIN Cond(4).
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.03

```
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
- - - - - - - - - - - - - - - - - - - - - -
The default error term in MANOVA has been changed from WITHIN CELLS to
WITHIN+RESIDUAL.  Note that these are the same for all full factorial designs.
```

* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e * *
* * * * * * * * * * * * * * *

```
48 cases accepted.
 0 cases rejected because of out-of-range factor values.
 0 cases rejected because of missing data.
 2 non-empty cells.

 1 design will be processed.
```

- -
- -

* * * * * * * * * * * * * * * * * A n a l y s i s o f V a r i a n c e -- D esign 1 * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(1)' Within-Subject Effect.

Tests of Significance for T1 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN+RESIDUAL	.86	46	.02		
MWITHIN COND(1)	8.29	1	8.29	445.12	.000
Group BY MWITHIN COND(1)	.04	1	.04	1.93	.172

\- -

```
* * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(2)' Within-Subject Effect.

 Tests of Significance for T2 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL             .78      46       .02
 MWITHIN COND(2)            7.84       1      7.84    463.39      .000
 Group BY MWITHIN CON        .01       1       .01       .47      .497
 D(2)

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 - - - - - - - - - - - - - - - - - - - - - -
```

```
* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(3)' Within-Subject Effect.

 Tests of Significance for T3 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL             .65      46       .01
 MWITHIN COND(3)            8.36       1      8.36    593.60      .000
 Group BY MWITHIN CON        .00       1       .00       .20      .659
 D(3)

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 - - - - - - - - - - - - - - - - - - - - - -
```

```
* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(4)' Within-Subject Effect.

 Tests of Significance for T4 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL             .89      46       .02
 MWITHIN COND(4)            5.75       1      5.75    297.39      .000
 Group BY MWITHIN CON        .02       1       .02      1.05      .312
 D(4)

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 - - - - - - - - - - - - - - - - - - - - -
```

```
GLM SDDT_NOF2 SDDT_POP2 SDDT_TAN2 SDDT_PER2 BY Group
 /WSFACTOR=Cond 4 Polynomial
 /METHOD=SSTYPE(3)
 /POSTHOC=Group(BONFERRONI)
 /PLOT=PROFILE(Cond*Group)
 /EMMEANS=TABLES(Group) COMPARE ADJ(LSD)
 /EMMEANS=TABLES(Cond) COMPARE ADJ(LSD)
 /PRINT=DESCRIPTIVE ETASQ OPOWER
 /CRITERIA=ALPHA(.05)
 /WSDESIGN=Cond
 /DESIGN=Group.
```

General Linear Model

Notes

Output Created		05-AUG-2017 12:06:11
Comments		
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	Split File	<none>
	N of Rows in Working Data File	48
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.

Notes

Syntax		GLM SDDT_NOF2 SDDT_POP2 SDDT_TAN2 SDDT_PER2 BY Group /WSFACTOR=Cond 4 Polynomial /METHOD=SSTYPE(3) /POSTHOC=Group (BONFERRONI) /PLOT=PROFILE(Cond*Group) /EMMEANS=TABLES(Group) COMPARE ADJ(LSD) /EMMEANS=TABLES(Cond) COMPARE ADJ(LSD) /PRINT=DESCRIPTIVE ETASQ OPOWER /CRITERIA=ALPHA(.05) /WSDESIGN=Cond...
Resources	Processor Time	00:00:00.55
	Elapsed Time	00:00:00.46

Warnings

Post hoc tests are not performed for Group because there are fewer than three groups.

Within-Subjects Factors

Measure: MEASURE_1

Cond	Dependent Variable
1	SDDT_NOF2
2	SDDT_POP2
3	SDDT_TAN2
4	SDDT_PER2

Between-Subjects Factors

		N
Group	1	24
	2	24

Descriptive Statistics

	Group	Mean	Std. Deviation	N
SDDT_NOF2	1	.0293267455	.0079917194	24
	2	.0404509406	.0198587758	24
	Total	.0348888430	.0159949855	48
SDDT_POP2	1	.0281403243	.0095780814	24
	2	.0400414314	.0189788272	24
	Total	.0340908779	.0160412721	48
SDDT_TAN2	1	.0648959635	.0596572093	24
	2	.0769435065	.0552400745	24
	Total	.0709197350	.0572010329	48
SDDT_PER2	1	.0628280827	.0365792964	24
	2	.0725265321	.0320755895	24
	Total	.0676773074	.0343842961	48

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[c]
Cond	Pillai's Trace	.604	22.330[b]	3.000	44.000	.000	.604	66.991	1.000
	Wilks' Lambda	.396	22.330[b]	3.000	44.000	.000	.604	66.991	1.000
	Hotelling's Trace	1.523	22.330[b]	3.000	44.000	.000	.604	66.991	1.000
	Roy's Largest Root	1.523	22.330[b]	3.000	44.000	.000	.604	66.991	1.000
Cond * Group	Pillai's Trace	.002	.023[b]	3.000	44.000	.995	.002	.068	.054
	Wilks' Lambda	.998	.023[b]	3.000	44.000	.995	.002	.068	.054
	Hotelling's Trace	.002	.023[b]	3.000	44.000	.995	.002	.068	.054
	Roy's Largest Root	.002	.023[b]	3.000	44.000	.995	.002	.068	.054

a. Design: Intercept + Group
Within Subjects Design: Cond

b. Exact statistic

c. Computed using alpha = .05

Mauchly's Test of Sphericity[a]

Measure: MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b] Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Cond	.240	63.875	5	.000	.592	.628	.333

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. Design: Intercept + Group
Within Subjects Design: Cond

b. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Cond	Sphericity Assumed	.058	3	.019	17.166	.000	.272	51.499	1.000
	Greenhouse-Geisser	.058	1.777	.033	17.166	.000	.272	30.509	.999
	Huynh-Feldt	.058	1.884	.031	17.166	.000	.272	32.338	1.000
	Lower-bound	.058	1.000	.058	17.166	.000	.272	17.166	.982
Cond * Group	Sphericity Assumed	4.164E-5	3	1.388E-5	.012	.998	.000	.037	.052
	Greenhouse-Geisser	4.164E-5	1.777	2.343E-5	.012	.981	.000	.022	.052
	Huynh-Feldt	4.164E-5	1.884	2.210E-5	.012	.985	.000	.023	.052
	Lower-bound	4.164E-5	1.000	4.164E-5	.012	.912	.000	.012	.051
Error(Cond)	Sphericity Assumed	.157	138	.001					
	Greenhouse-Geisser	.157	81.752	.002					
	Huynh-Feldt	.157	86.655	.002					
	Lower-bound	.157	46.000	.003					

a. Computed using alpha = .05

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	Cond	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Cond	Linear	.044	1	.044	54.143	.000	.541	54.143	1.000
	Quadratic	7.170E-5	1	7.170E-5	.067	.797	.001	.067	.057
	Cubic	.014	1	.014	9.538	.003	.172	9.538	.856
Cond * Group	Linear	1.024E-5	1	1.024E-5	.013	.911	.000	.013	.051
	Quadratic	2.932E-5	1	2.932E-5	.027	.870	.001	.027	.053
	Cubic	2.087E-6	1	2.087E-6	.001	.971	.000	.001	.050
Error(Cond)	Linear	.037	46	.001					
	Quadratic	.049	46	.001					
	Cubic	.070	46	.002					

a. Computed using alpha = .05

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Intercept	.517	1	.517	335.703	.000	.879	335.703	1.000
Group	.006	1	.006	3.904	.054	.078	3.904	.490
Error	.071	46	.002					

a. Computed using alpha = .05

Estimated Marginal Means

1. Group

Estimates

Measure: MEASURE_1

Group	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	.046	.004	.038	.054
2	.057	.004	.049	.066

Pairwise Comparisons

Measure: MEASURE_1

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
1	2	-.011	.006	.054	-.023	.000
2	1	.011	.006	.054	.000	.023

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Univariate Tests

Measure: MEASURE_1

	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Contrast	.002	1	.002	3.904	.054	.078	3.904	.490
Error	.018	46	.000					

The F tests the effect of Group. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Computed using alpha = .05

2. Cond

Estimates

Measure: MEASURE_1

Cond	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	.035	.002	.030	.039
2	.034	.002	.030	.038
3	.071	.008	.054	.088
4	.068	.005	.058	.078

Pairwise Comparisons

Measure: MEASURE_1

(I) Cond	(J) Cond	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
1	2	.001	.003	.786	-.005	.007
	3	-.036*	.008	.000	-.052	-.020
	4	-.033*	.006	.000	-.044	-.021
2	1	-.001	.003	.786	-.007	.005
	3	-.037*	.008	.000	-.053	-.021
	4	-.034*	.005	.000	-.043	-.024
3	1	.036*	.008	.000	.020	.052
	2	.037*	.008	.000	.021	.053
	4	.003	.009	.732	-.016	.022
4	1	.033*	.006	.000	.021	.044
	2	.034*	.005	.000	.024	.043
	3	-.003	.009	.732	-.022	.016

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Multivariate Tests

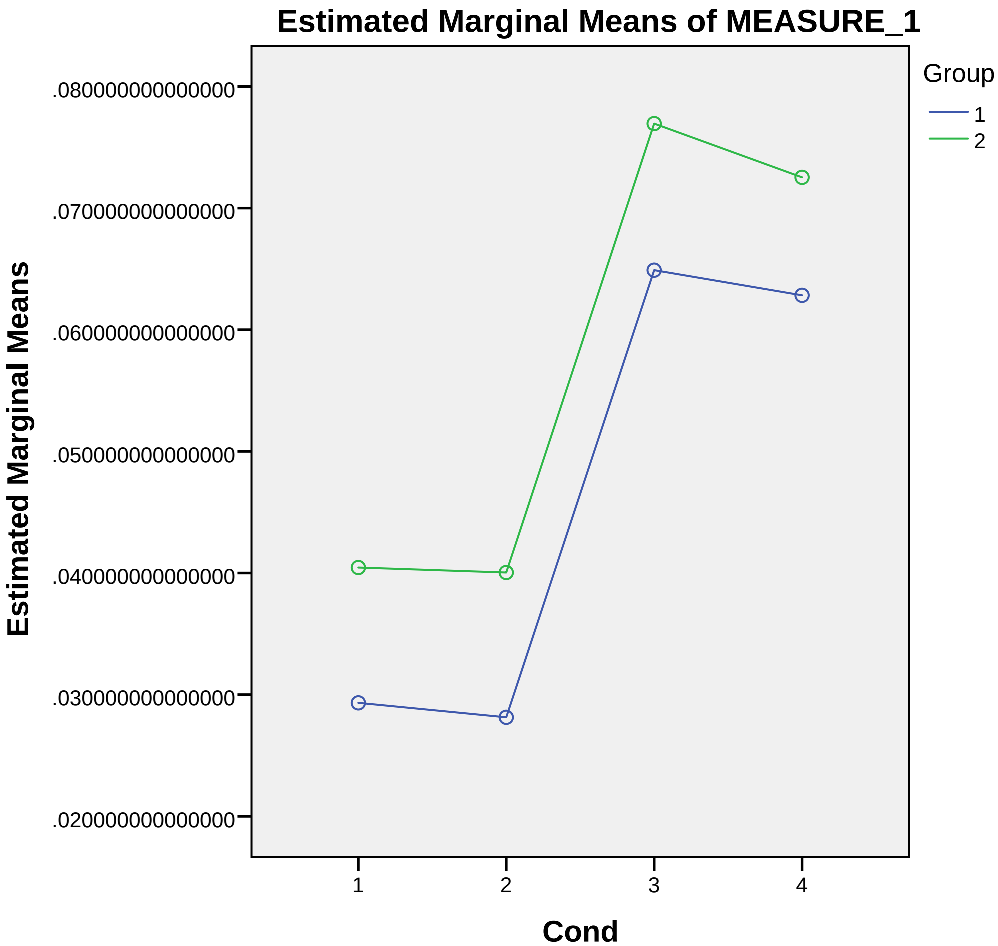
	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Pillai's trace	.604	22.330[a]	3.000	44.000	.000	.604	66.991	1.000
Wilks' lambda	.396	22.330[a]	3.000	44.000	.000	.604	66.991	1.000
Hotelling's trace	1.523	22.330[a]	3.000	44.000	.000	.604	66.991	1.000
Roy's largest root	1.523	22.330[a]	3.000	44.000	.000	.604	66.991	1.000

Each F tests the multivariate effect of Cond. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Exact statistic

b. Computed using alpha = .05

Profile Plots




```
 MANOVA SDDT_NOF2 SDDT_POP2 SDDT_TAN2 SDDT_PER2 BY Group(1,2)
/WSFACTORS=Cond(4)
/WSDESIGN=MWITHIN Cond(1) MWITHIN Cond(2) MWITHIN Cond(3) MWITHIN Cond(4).
```

Manova

Notes

Output Created		05-AUG-2017 12:06:52
Comments		
Input	Data	G:\Dissertation\C - Statistics\Aim 1\2017_0516_Aim1_SPSS_WideData.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	48
Syntax		MANOVA SDDT_NOF2 SDDT_POP2 SDDT_TAN2 SDDT_PER2 BY Group(1,2) /WSFACTORS=Cond(4) /WSDESIGN=MWITHIN Cond(1) MWITHIN Cond(2) MWITHIN Cond (3) MWITHIN Cond(4).
Resources	Processor Time	00:00:00.03
	Elapsed Time	00:00:00.06

- -

```
The default error term in MANOVA has been changed from WITHIN CELLS to
WITHIN+RESIDUAL.  Note that these are the same for all full factorial designs.
```

```
* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e * *
* * * * * * * * * * * * * * * *

        48 cases accepted.
         0 cases rejected because of out-of-range factor values.
         0 cases rejected because of missing data.
         2 non-empty cells.

         1 design will be processed.

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 - - - - - - - - - - - - - - - - - - - - - -
```

```
* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(1)' Within-Subject Effect.

 Tests of Significance for T1 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL             .01      46       .00
 MWITHIN COND(1)             .06       1       .06    255.01      .000
 Group BY MWITHIN CON        .00       1       .00      6.48      .014
 D(1)

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 - - - - - - - - - - - - - - - - - - - - -
```

```
* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(2)' Within-Subject Effect.

 Tests of Significance for T2 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL             .01      46       .00
 MWITHIN COND(2)             .06       1       .06    246.87      .000
 Group BY MWITHIN CON        .00       1       .00      7.52      .009
 D(2)

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 - - - - - - - - - - - - - - - - - - - - -
```

```
* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(3)' Within-Subject Effect.

 Tests of Significance for T3 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL             .15      46       .00
 MWITHIN COND(3)             .24       1       .24     73.04      .000
 Group BY MWITHIN CON        .00       1       .00       .53      .472
 D(3)

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 - - - - - - - - - - - - - - - - - - - - -
```

```
* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(4)' Within-Subject Effect.

 Tests of Significance for T4 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL             .05      46       .00
 MWITHIN COND(4)             .22       1       .22    185.77      .000
 Group BY MWITHIN CON        .00       1       .00       .95      .334
 D(4)

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 - - - - - - - - - - - - - - - - - - - - -
```

```
GLM SDDP_NOF2 SDDP_POP2 SDDP_TAN2 SDDP_PER2 BY Group
  /WSFACTOR=Cond 4 Polynomial
  /METHOD=SSTYPE(3)
  /POSTHOC=Group(BONFERRONI)
  /PLOT=PROFILE(Cond*Group)
  /EMMEANS=TABLES(Group) COMPARE ADJ(LSD)
  /EMMEANS=TABLES(Cond) COMPARE ADJ(LSD)
  /PRINT=DESCRIPTIVE ETASQ OPOWER
  /CRITERIA=ALPHA(.05)
  /WSDESIGN=Cond
  /DESIGN=Group.
```

General Linear Model

Notes

Output Created		05-AUG-2017 12:12:35
Comments		
Input	Data	G:\Dissertation\C - Statistics\Aim 1\2017_0516_Aim1_SPSS_WideData.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	48
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.

Notes

Syntax		GLM SDDP_NOF2 SDDP_POP2 SDDP_TAN2 SDDP_PER2 BY Group /WSFACTOR=Cond 4 Polynomial /METHOD=SSTYPE(3) /POSTHOC=Group (BONFERRONI) /PLOT=PROFILE(Cond*Group) /EMMEANS=TABLES(Group) COMPARE ADJ(LSD) /EMMEANS=TABLES(Cond) COMPARE ADJ(LSD) /PRINT=DESCRIPTIVE ETASQ OPOWER /CRITERIA=ALPHA(.05) /WSDESIGN=Cond...
Resources	Processor Time	00:00:00.61
	Elapsed Time	00:00:00.73

Warnings

Post hoc tests are not performed for Group because there are fewer than three groups.

Within-Subjects Factors

Measure: MEASURE_1

Cond	Dependent Variable
1	SDDP_NOF2
2	SDDP_POP2
3	SDDP_TAN2
4	SDDP_PER2

Between-Subjects Factors

		N
Group	1	24
	2	24

Descriptive Statistics

	Group	Mean	Std. Deviation	N
SDDP_NOF2	1	.0193257910	.0045001436	24
	2	.0213109828	.0078292935	24
	Total	.0203183869	.0063963450	48
SDDP_POP2	1	.0145014319	.0039778129	24
	2	.0214409376	.0101163728	24
	Total	.0179711848	.0083737848	48
SDDP_TAN2	1	.0169954287	.0060328277	24
	2	.0242689623	.0060976379	24
	Total	.0206321955	.0070365369	48
SDDP_PER2	1	.0440254959	.0198839662	24
	2	.0338984956	.0157559060	24
	Total	.0389619957	.0184701884	48

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[c]
Cond	Pillai's Trace	.583	20.478[b]	3.000	44.000	.000	.583	61.434	1.000
	Wilks' Lambda	.417	20.478[b]	3.000	44.000	.000	.583	61.434	1.000
	Hotelling's Trace	1.396	20.478[b]	3.000	44.000	.000	.583	61.434	1.000
	Roy's Largest Root	1.396	20.478[b]	3.000	44.000	.000	.583	61.434	1.000
Cond * Group	Pillai's Trace	.259	5.116[b]	3.000	44.000	.004	.259	15.348	.897
	Wilks' Lambda	.741	5.116[b]	3.000	44.000	.004	.259	15.348	.897
	Hotelling's Trace	.349	5.116[b]	3.000	44.000	.004	.259	15.348	.897
	Roy's Largest Root	.349	5.116[b]	3.000	44.000	.004	.259	15.348	.897

a. Design: Intercept + Group
Within Subjects Design: Cond

b. Exact statistic

c. Computed using alpha = .05

Mauchly's Test of Sphericity[a]

Measure: MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b] Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Cond	.210	69.758	5	.000	.511	.537	.333

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. Design: Intercept + Group
Within Subjects Design: Cond

b. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Cond	Sphericity Assumed	.014	3	.005	41.079	.000	.472	123.236	1.000
	Greenhouse-Geisser	.014	1.533	.009	41.079	.000	.472	62.992	1.000
	Huynh-Feldt	.014	1.610	.008	41.079	.000	.472	66.150	1.000
	Lower-bound	.014	1.000	.014	41.079	.000	.472	41.079	1.000
Cond * Group	Sphericity Assumed	.002	3	.001	7.167	.000	.135	21.500	.980
	Greenhouse-Geisser	.002	1.533	.002	7.167	.003	.135	10.990	.866
	Huynh-Feldt	.002	1.610	.001	7.167	.003	.135	11.541	.878
	Lower-bound	.002	1.000	.002	7.167	.010	.135	7.167	.746
Error(Cond)	Sphericity Assumed	.015	138	.000					
	Greenhouse-Geisser	.015	70.539	.000					
	Huynh-Feldt	.015	74.075	.000					
	Lower-bound	.015	46.000	.000					

a. Computed using alpha = .05

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	Cond	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Cond	Linear	.008	1	.008	44.398	.000	.491	44.398	1.000
	Quadratic	.005	1	.005	52.530	.000	.533	52.530	1.000
	Cubic	.000	1	.000	5.582	.022	.108	5.582	.638
Cond * Group	Linear	.001	1	.001	4.191	.046	.083	4.191	.518
	Quadratic	.001	1	.001	15.350	.000	.250	15.350	.970
	Cubic	.000	1	.000	2.112	.153	.044	2.112	.296
Error(Cond)	Linear	.009	46	.000					
	Quadratic	.004	46	9.767E-5					
	Cubic	.002	46	4.886E-5					

a. Computed using alpha = .05

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Intercept	.115	1	.115	909.976	.000	.952	909.976	1.000
Group	.000	1	.000	.875	.354	.019	.875	.150
Error	.006	46	.000					

a. Computed using alpha = .05

Estimated Marginal Means

1. Group

Estimates

Measure: MEASURE_1

Group	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1	.024	.001	.021	.026
2	.025	.001	.023	.028

Pairwise Comparisons

Measure: MEASURE_1

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a] Lower Bound	95% Confidence Interval for Difference[a] Upper Bound
1	2	-.002	.002	.354	-.005	.002
2	1	.002	.002	.354	-.002	.005

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Univariate Tests

Measure: MEASURE_1

	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Contrast	2.764E-5	1	2.764E-5	.875	.354	.019	.875	.150
Error	.001	46	3.159E-5					

The F tests the effect of Group. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Computed using alpha = .05

2. Cond

Estimates

Measure: MEASURE_1

Cond	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1	.020	.001	.018	.022
2	.018	.001	.016	.020
3	.021	.001	.019	.022
4	.039	.003	.034	.044

Pairwise Comparisons

Measure: MEASURE_1

(I) Cond	(J) Cond	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b] Lower Bound	Upper Bound
1	2	.002	.001	.093	.000	.005
	3	.000	.001	.798	-.003	.002
	4	-.019*	.003	.000	-.025	-.013
2	1	-.002	.001	.093	-.005	.000
	3	-.003*	.001	.014	-.005	-.001
	4	-.021*	.003	.000	-.026	-.016
3	1	.000	.001	.798	-.002	.003
	2	.003*	.001	.014	.001	.005
	4	-.018*	.003	.000	-.024	-.013
4	1	.019*	.003	.000	.013	.025
	2	.021*	.003	.000	.016	.026
	3	.018*	.003	.000	.013	.024

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Multivariate Tests

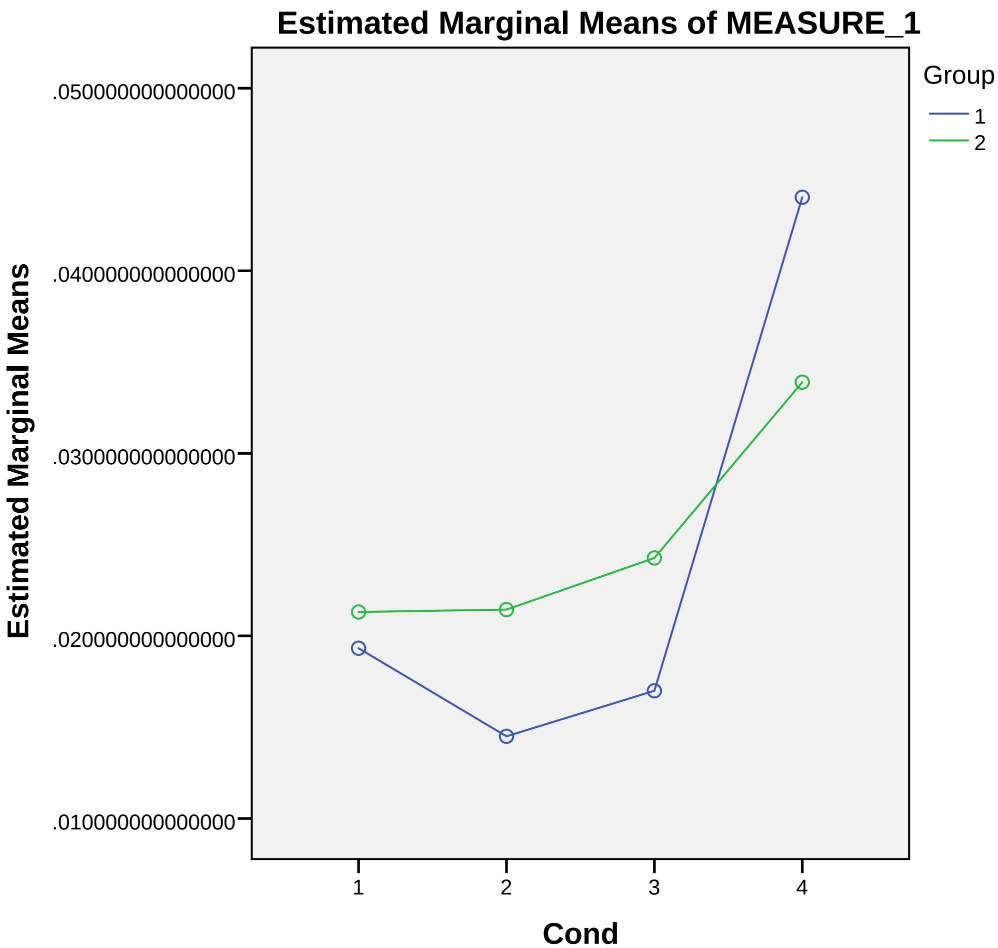
	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Pillai's trace	.583	20.478[a]	3.000	44.000	.000	.583	61.434	1.000
Wilks' lambda	.417	20.478[a]	3.000	44.000	.000	.583	61.434	1.000
Hotelling's trace	1.396	20.478[a]	3.000	44.000	.000	.583	61.434	1.000
Roy's largest root	1.396	20.478[a]	3.000	44.000	.000	.583	61.434	1.000

Each F tests the multivariate effect of Cond. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Exact statistic

b. Computed using alpha = .05

Profile Plots




```
 MANOVA SDDP_NOF2 SDDP_POP2 SDDP_TAN2 SDDP_PER2 BY Group(1,2)
/WSFACTORS=Cond(4)
/WSDESIGN=MWITHIN Cond(1) MWITHIN Cond(2) MWITHIN Cond(3) MWITHIN Cond(4).
```

Manova

Notes

Output Created		05-AUG-2017 12:12:57
Comments		
Input	Data	G:\Dissertation\C - Statistics\Aim 1\2017_0516_Aim1_SPSS_WideData.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	48
Syntax		MANOVA SDDP_NOF2 SDDP_POP2 SDDP_TAN2 SDDP_PER2 BY Group(1,2) /WSFACTORS=Cond(4) /WSDESIGN=MWITHIN Cond(1) MWITHIN Cond(2) MWITHIN Cond (3) MWITHIN Cond(4).
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.02

```
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
- - - - - - - - - - - - - - - - - - - - -
The default error term in MANOVA has been changed from WITHIN CELLS to
WITHIN+RESIDUAL.  Note that these are the same for all full factorial designs.
```

```
* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e * *
* * * * * * * * * * * * * * * *

        48 cases accepted.
         0 cases rejected because of out-of-range factor values.
         0 cases rejected because of missing data.
         2 non-empty cells.

         1 design will be processed.

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 - - - - - - - - - - - - - - - - - - - - -
```

```
* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(1)' Within-Subject Effect.

 Tests of Significance for T1 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL             .00      46       .00
 MWITHIN COND(1)             .02       1       .02    485.99      .000
 Group BY MWITHIN CON        .00       1       .00      1.16      .287
 D(1)

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 - - - - - - - - - - - - - - - - - - - - -
```

```
* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(2)' Within-Subject Effect.

 Tests of Significance for T2 using UNIQUE sums of squares
 Source of Variation           SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL              .00      46       .00
 MWITHIN COND(2)              .02       1       .02    262.39      .000
 Group BY MWITHIN CON         .00       1       .00      9.78      .003
 D(2)

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 - - - - - - - - - - - - - - - - - - - - -
```

* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(3)' Within-Subject Effect.

Tests of Significance for T3 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN+RESIDUAL	.00	46	.00		
MWITHIN COND(3)	.02	1	.02	555.42	.000
Group BY MWITHIN COND(3)	.00	1	.00	17.26	.000

\- -

```
* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(4)' Within-Subject Effect.

 Tests of Significance for T4 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL             .01      46       .00
 MWITHIN COND(4)             .07       1       .07    226.42      .000
 Group BY MWITHIN CON        .00       1       .00      3.82      .057
 D(4)

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 - - - - - - - - - - - - - - - - - - - - -
```

```
GLM AlphaDT_NOF2 AlphaDT_POP2 AlphaDT_TAN2 AlphaDT_PER2 BY Group
 /WSFACTOR=Cond 4 Polynomial
 /METHOD=SSTYPE(3)
 /POSTHOC=Group(BONFERRONI)
 /PLOT=PROFILE(Cond*Group)
 /EMMEANS=TABLES(Group) COMPARE ADJ(LSD)
 /EMMEANS=TABLES(Cond) COMPARE ADJ(LSD)
 /PRINT=DESCRIPTIVE ETASQ OPOWER
 /CRITERIA=ALPHA(.05)
 /WSDESIGN=Cond
 /DESIGN=Group.
```

General Linear Model

Notes

Output Created		05-AUG-2017 12:15:02
Comments		
Input	Data	G:\Dissertation\C - Statistics\Aim 1\2017_0516_Aim1_SPSS_WideData.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	48
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.

Notes

Syntax		GLM AlphaDT_NOF2 AlphaDT_POP2 AlphaDT_TAN2 AlphaDT_PER2 BY Group /WSFACTOR=Cond 4 Polynomial /METHOD=SSTYPE(3) /POSTHOC=Group (BONFERRONI) /PLOT=PROFILE(Cond*Group) /EMMEANS=TABLES(Group) COMPARE ADJ(LSD) /EMMEANS=TABLES(Cond) COMPARE ADJ(LSD) /PRINT=DESCRIPTIVE ETASQ OPOWER /CRITERIA=ALPHA(.05) /WSDESIGN=Cond...
Resources	Processor Time	00:00:00.50
	Elapsed Time	00:00:00.53

Warnings

Post hoc tests are not performed for Group because there are fewer than three groups.

Within-Subjects Factors

Measure: MEASURE_1

Cond	Dependent Variable
1	AlphaDT_NOF2
2	AlphaDT_POP2
3	AlphaDT_TAN2
4	AlphaDT_PER2

Between-Subjects Factors

		N
Group	1	24
	2	24

Descriptive Statistics

	Group	Mean	Std. Deviation	N
AlphaDT_NOF2	1	.7361748420	.1285303993	24
	2	.9104639917	.1659599910	24
	Total	.8233194169	.1712261465	48
AlphaDT_POP2	1	.6765377593	.1741712424	24
	2	.7101524153	.1647921326	24
	Total	.6933450873	.1685909642	48
AlphaDT_TAN2	1	.8563324625	.2945884908	24
	2	.8400261521	.2398209104	24
	Total	.8481793073	.2658590673	48
AlphaDT_PER2	1	.7327391677	.1503450583	24
	2	.7519901900	.2301190134	24
	Total	.7423646788	.1925357303	48

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[c]
Cond	Pillai's Trace	.338	7.486[b]	3.000	44.000	.000	.338	22.457	.978
	Wilks' Lambda	.662	7.486[b]	3.000	44.000	.000	.338	22.457	.978
	Hotelling's Trace	.510	7.486[b]	3.000	44.000	.000	.338	22.457	.978
	Roy's Largest Root	.510	7.486[b]	3.000	44.000	.000	.338	22.457	.978
Cond * Group	Pillai's Trace	.172	3.049[b]	3.000	44.000	.038	.172	9.146	.676
	Wilks' Lambda	.828	3.049[b]	3.000	44.000	.038	.172	9.146	.676
	Hotelling's Trace	.208	3.049[b]	3.000	44.000	.038	.172	9.146	.676
	Roy's Largest Root	.208	3.049[b]	3.000	44.000	.038	.172	9.146	.676

a. Design: Intercept + Group
Within Subjects Design: Cond

b. Exact statistic

c. Computed using alpha = .05

Mauchly's Test of Sphericity[a]

Measure: MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b] Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Cond	.704	15.699	5	.008	.804	.870	.333

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. Design: Intercept + Group
Within Subjects Design: Cond

b. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Cond	Sphericity Assumed	.740	3	.247	6.762	.000	.128	20.285	.973
	Greenhouse-Geisser	.740	2.411	.307	6.762	.001	.128	16.302	.945
	Huynh-Feldt	.740	2.609	.283	6.762	.001	.128	17.642	.957
	Lower-bound	.740	1.000	.740	6.762	.012	.128	6.762	.721
Cond * Group	Sphericity Assumed	.252	3	.084	2.307	.079	.048	6.920	.571
	Greenhouse-Geisser	.252	2.411	.105	2.307	.094	.048	5.562	.507
	Huynh-Feldt	.252	2.609	.097	2.307	.089	.048	6.019	.529
	Lower-bound	.252	1.000	.252	2.307	.136	.048	2.307	.318
Error(Cond)	Sphericity Assumed	5.032	138	.036					
	Greenhouse-Geisser	5.032	110.908	.045					
	Huynh-Feldt	5.032	120.021	.042					
	Lower-bound	5.032	46.000	.109					

a. Computed using alpha = .05

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	Cond	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Cond	Linear	.019	1	.019	.656	.422	.014	.656	.125
	Quadratic	.007	1	.007	.207	.652	.004	.207	.073
	Cubic	.714	1	.714	15.140	.000	.248	15.140	.968
Cond * Group	Linear	.159	1	.159	5.617	.022	.109	5.617	.641
	Quadratic	.093	1	.093	2.749	.104	.056	2.749	.368
	Cubic	1.670E-5	1	1.670E-5	.000	.985	.000	.000	.050
Error(Cond)	Linear	1.303	46	.028					
	Quadratic	1.559	46	.034					
	Cubic	2.170	46	.047					

a. Computed using alpha = .05

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Intercept	115.857	1	115.857	2257.863	.000	.980	2257.863	1.000
Group	.133	1	.133	2.599	.114	.053	2.599	.352
Error	2.360	46	.051					

a. Computed using alpha = .05

Estimated Marginal Means

1. Group

Estimates

Measure: MEASURE_1

Group	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	.750	.023	.704	.797
2	.803	.023	.757	.850

Pairwise Comparisons

Measure: MEASURE_1

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
1	2	-.053	.033	.114	-.119	.013
2	1	.053	.033	.114	-.013	.119

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Univariate Tests

Measure: MEASURE_1

	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Contrast	.033	1	.033	2.599	.114	.053	2.599	.352
Error	.590	46	.013					

The F tests the effect of Group. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Computed using alpha = .05

2. Cond

Estimates

Measure: MEASURE_1

Cond	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	.823	.021	.780	.866
2	.693	.024	.644	.743
3	.848	.039	.770	.926
4	.742	.028	.686	.799

Pairwise Comparisons

Measure: MEASURE_1

(I) Cond	(J) Cond	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b] Lower Bound	Upper Bound
1	2	.130*	.029	.000	.071	.189
	3	-.025	.041	.552	-.108	.059
	4	.081*	.035	.027	.010	.152
2	1	-.130*	.029	.000	-.189	-.071
	3	-.155*	.043	.001	-.242	-.067
	4	-.049	.032	.134	-.114	.016
3	1	.025	.041	.552	-.059	.108
	2	.155*	.043	.001	.067	.242
	4	.106*	.049	.035	.008	.204
4	1	-.081*	.035	.027	-.152	-.010
	2	.049	.032	.134	-.016	.114
	3	-.106*	.049	.035	-.204	-.008

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Multivariate Tests

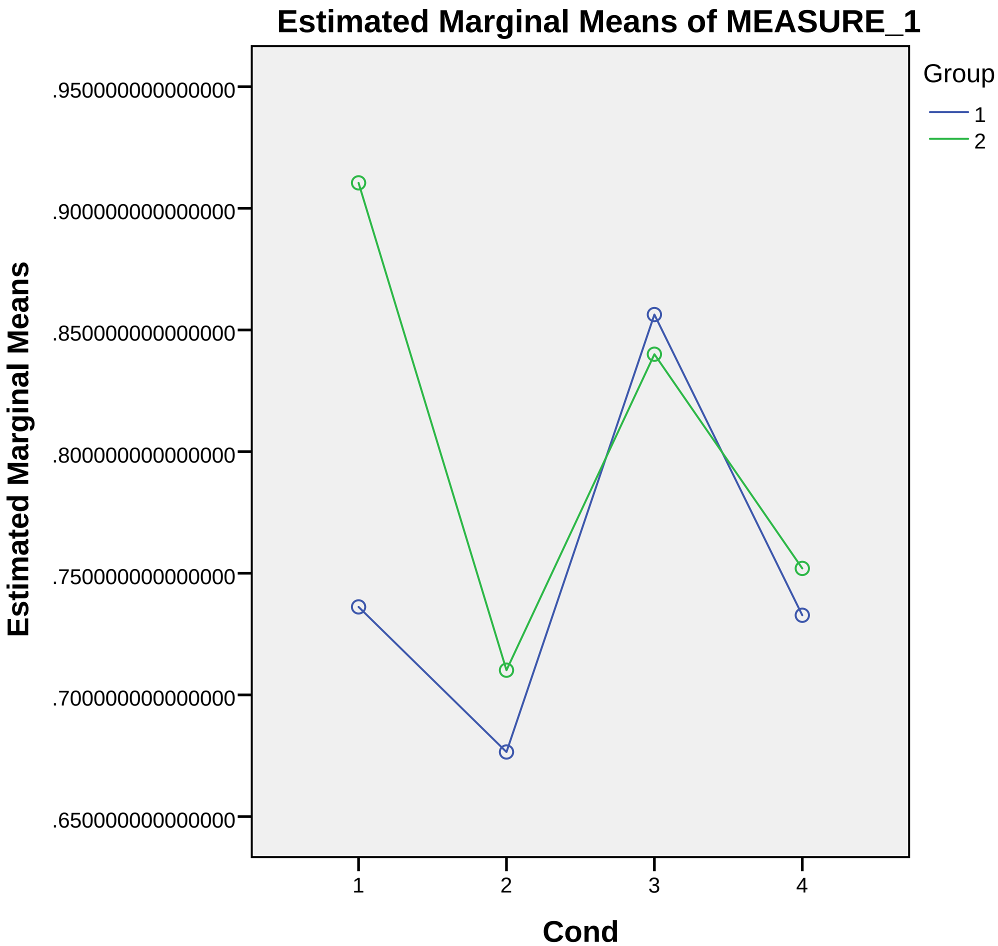
	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Pillai's trace	.338	7.486[a]	3.000	44.000	.000	.338	22.457	.978
Wilks' lambda	.662	7.486[a]	3.000	44.000	.000	.338	22.457	.978
Hotelling's trace	.510	7.486[a]	3.000	44.000	.000	.338	22.457	.978
Roy's largest root	.510	7.486[a]	3.000	44.000	.000	.338	22.457	.978

Each F tests the multivariate effect of Cond. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Exact statistic

b. Computed using alpha = .05

Profile Plots




```
 MANOVA AlphaDT_NOF2 AlphaDT_POP2 AlphaDT_TAN2 AlphaDT_PER2 BY Group(1,2)
/WSFACTORS=Cond(4)
/WSDESIGN=MWITHIN Cond(1) MWITHIN Cond(2) MWITHIN Cond(3) MWITHIN Cond(4).
```

Manova

Notes

Output Created		05-AUG-2017 12:15:35
Comments		
Input	Data	G:\Dissertation\C - Statistics\Aim 1\2017_0516_Aim1_SPSS_WideData.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	48
Syntax		MANOVA AlphaDT_NOF2 AlphaDT_POP2 AlphaDT_TAN2 AlphaDT_PER2 BY Group(1,2) /WSFACTORS=Cond(4) /WSDESIGN=MWITHIN Cond(1) MWITHIN Cond(2) MWITHIN Cond (3) MWITHIN Cond(4).
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.02

```
 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 - - - - - - - - - - - - - - - - - - - - - -
The default error term in MANOVA has been changed from WITHIN CELLS to
WITHIN+RESIDUAL.  Note that these are the same for all full factorial designs.
```

```
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e * *
* * * * * * * * * * * * * * *

       48 cases accepted.
        0 cases rejected because of out-of-range factor values.
        0 cases rejected because of missing data.
        2 non-empty cells.

        1 design will be processed.

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 - - - - - - - - - - - - - - - - - - - - -
```

```
* * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(1)' Within-Subject Effect.

 Tests of Significance for T1 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL            1.01      46       .02
 MWITHIN COND(1)           32.54       1     32.54   1476.85      .000
 Group BY MWITHIN CON        .36       1       .36     16.55      .000
 D(1)

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 - - - - - - - - - - - - - - - - - - - - -
```

```
* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(2)' Within-Subject Effect.

 Tests of Significance for T2 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS        F  Sig of F

 WITHIN+RESIDUAL            1.32      46       .03
 MWITHIN COND(2)           23.07       1     23.07   802.72      .000
 Group BY MWITHIN CON        .01       1       .01      .47      .496
 D(2)

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 - - - - - - - - - - - - - - - - - - - - -
```

* * * * * * * * * * * * * * * * * * A n a l y s i s o f V a r i a n c e -- D
esign 1 * * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(3)' Within-Subject Effect.

Tests of Significance for T3 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN+RESIDUAL	3.32	46	.07		
MWITHIN COND(3)	34.53	1	34.53	478.62	.000
Group BY MWITHIN CON D(3)	.00	1	.00	.04	.834

- -

```
* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(4)' Within-Subject Effect.

 Tests of Significance for T4 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL            1.74      46       .04
 MWITHIN COND(4)           26.45       1     26.45    700.20      .000
 Group BY MWITHIN CON        .00       1       .00       .12      .733
 D(4)

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 - - - - - - - - - - - - - - - - - - - - -
```

```
GLM AlphaDP_NOF2 AlphaDP_POP2 AlphaDP_TAN2 AlphaDP_PER2 BY Group
 /WSFACTOR=Cond 4 Polynomial
 /METHOD=SSTYPE(3)
 /POSTHOC=Group(BONFERRONI)
 /PLOT=PROFILE(Cond*Group)
 /EMMEANS=TABLES(Group) COMPARE ADJ(LSD)
 /EMMEANS=TABLES(Cond) COMPARE ADJ(LSD)
 /PRINT=DESCRIPTIVE ETASQ OPOWER
 /CRITERIA=ALPHA(.05)
 /WSDESIGN=Cond
 /DESIGN=Group.
```

General Linear Model

Notes

Output Created		05-AUG-2017 12:19:34
Comments		
Input	Data	G:\Dissertation\C - Statistics\Aim 1\2017_0516_Aim1_SPSS_WideData.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	48
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.

Notes

Syntax		GLM AlphaDP_NOF2 AlphaDP_POP2 AlphaDP_TAN2 AlphaDP_PER2 BY Group /WSFACTOR=Cond 4 Polynomial /METHOD=SSTYPE(3) /POSTHOC=Group (BONFERRONI) /PLOT=PROFILE(Cond*Group) /EMMEANS=TABLES(Group) COMPARE ADJ(LSD) /EMMEANS=TABLES(Cond) COMPARE ADJ(LSD) /PRINT=DESCRIPTIVE ETASQ OPOWER /CRITERIA=ALPHA(.05) /WSDESIGN=Cond...
Resources	Processor Time	00:00:00.52
	Elapsed Time	00:00:00.50

Warnings

Post hoc tests are not performed for Group because there are fewer than three groups.

Within-Subjects Factors

Measure: MEASURE_1

Cond	Dependent Variable
1	AlphaDP_NOF2
2	AlphaDP_POP2
3	AlphaDP_TAN2
4	AlphaDP_PER2

Between-Subjects Factors

		N
Group	1	24
	2	24

Descriptive Statistics

	Group	Mean	Std. Deviation	N
AlphaDP_NOF2	1	.3885090557	.1398138010	24
	2	.4421853499	.1332522603	24
	Total	.4153472028	.1378070809	48
AlphaDP_POP2	1	.4167950832	.1032721512	24
	2	.3918927077	.1531124952	24
	Total	.4043438954	.1298066260	48
AlphaDP_TAN2	1	.4091009383	.1115690418	24
	2	.4238126646	.1266294698	24
	Total	.4164568014	.1182945039	48
AlphaDP_PER2	1	.3613385371	.1662548886	24
	2	.3235678417	.1123668863	24
	Total	.3424531894	.1416664214	48

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[c]
Cond	Pillai's Trace	.179	3.207[b]	3.000	44.000	.032	.179	9.620	.701
	Wilks' Lambda	.821	3.207[b]	3.000	44.000	.032	.179	9.620	.701
	Hotelling's Trace	.219	3.207[b]	3.000	44.000	.032	.179	9.620	.701
	Roy's Largest Root	.219	3.207[b]	3.000	44.000	.032	.179	9.620	.701
Cond * Group	Pillai's Trace	.071	1.115[b]	3.000	44.000	.353	.071	3.345	.280
	Wilks' Lambda	.929	1.115[b]	3.000	44.000	.353	.071	3.345	.280
	Hotelling's Trace	.076	1.115[b]	3.000	44.000	.353	.071	3.345	.280
	Roy's Largest Root	.076	1.115[b]	3.000	44.000	.353	.071	3.345	.280

a. Design: Intercept + Group
Within Subjects Design: Cond

b. Exact statistic

c. Computed using alpha = .05

Mauchly's Test of Sphericity[a]

Measure: MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b] Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Cond	.910	4.199	5	.521	.940	1.000	.333

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. Design: Intercept + Group
Within Subjects Design: Cond

b. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Cond	Sphericity Assumed	.179	3	.060	4.036	.009	.081	12.108	.832
	Greenhouse-Geisser	.179	2.820	.063	4.036	.010	.081	11.381	.814
	Huynh-Feldt	.179	3.000	.060	4.036	.009	.081	12.108	.832
	Lower-bound	.179	1.000	.179	4.036	.050	.081	4.036	.503
Cond * Group	Sphericity Assumed	.062	3	.021	1.392	.248	.029	4.177	.364
	Greenhouse-Geisser	.062	2.820	.022	1.392	.249	.029	3.926	.351
	Huynh-Feldt	.062	3.000	.021	1.392	.248	.029	4.177	.364
	Lower-bound	.062	1.000	.062	1.392	.244	.029	1.392	.211
Error(Cond)	Sphericity Assumed	2.036	138	.015					
	Greenhouse-Geisser	2.036	129.719	.016					
	Huynh-Feldt	2.036	138.000	.015					
	Lower-bound	2.036	46.000	.044					

a. Computed using alpha = .05

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	Cond	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Cond	Linear	.102	1	.102	5.502	.023	.107	5.502	.632
	Quadratic	.048	1	.048	3.793	.058	.076	3.793	.479
	Cubic	.029	1	.029	2.186	.146	.045	2.186	.305
Cond * Group	Linear	.033	1	.033	1.776	.189	.037	1.776	.257
	Quadratic	.002	1	.002	.163	.689	.004	.163	.068
	Cubic	.027	1	.027	2.025	.161	.042	2.025	.286
Error(Cond)	Linear	.856	46	.019					
	Quadratic	.578	46	.013					
	Cubic	.603	46	.013					

a. Computed using alpha = .05

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Intercept	29.904	1	29.904	1158.598	.000	.962	1158.598	1.000
Group	9.798E-5	1	9.798E-5	.004	.951	.000	.004	.050
Error	1.187	46	.026					

a. Computed using alpha = .05

Estimated Marginal Means

1. Group

Estimates

Measure: MEASURE_1

Group	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	.394	.016	.361	.427
2	.395	.016	.362	.428

Pairwise Comparisons

Measure: MEASURE_1

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
1	2	-.001	.023	.951	-.048	.045
2	1	.001	.023	.951	-.045	.048

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Univariate Tests

Measure: MEASURE_1

	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Contrast	2.450E-5	1	2.450E-5	.004	.951	.000	.004	.050
Error	.297	46	.006					

The F tests the effect of Group. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Computed using alpha = .05

2. Cond

Estimates

Measure: MEASURE_1

Cond	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	.415	.020	.376	.455
2	.404	.019	.366	.442
3	.416	.017	.382	.451
4	.342	.020	.301	.384

Pairwise Comparisons

Measure: MEASURE_1

(I) Cond	(J) Cond	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b] Lower Bound	Upper Bound
1	2	.011	.025	.656	-.038	.060
	3	-.001	.022	.961	-.046	.044
	4	.073*	.028	.014	.016	.130
2	1	-.011	.025	.656	-.060	.038
	3	-.012	.023	.594	-.058	.033
	4	.062*	.026	.021	.010	.114
3	1	.001	.022	.961	-.044	.046
	2	.012	.023	.594	-.033	.058
	4	.074*	.024	.004	.025	.123
4	1	-.073*	.028	.014	-.130	-.016
	2	-.062*	.026	.021	-.114	-.010
	3	-.074*	.024	.004	-.123	-.025

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Multivariate Tests

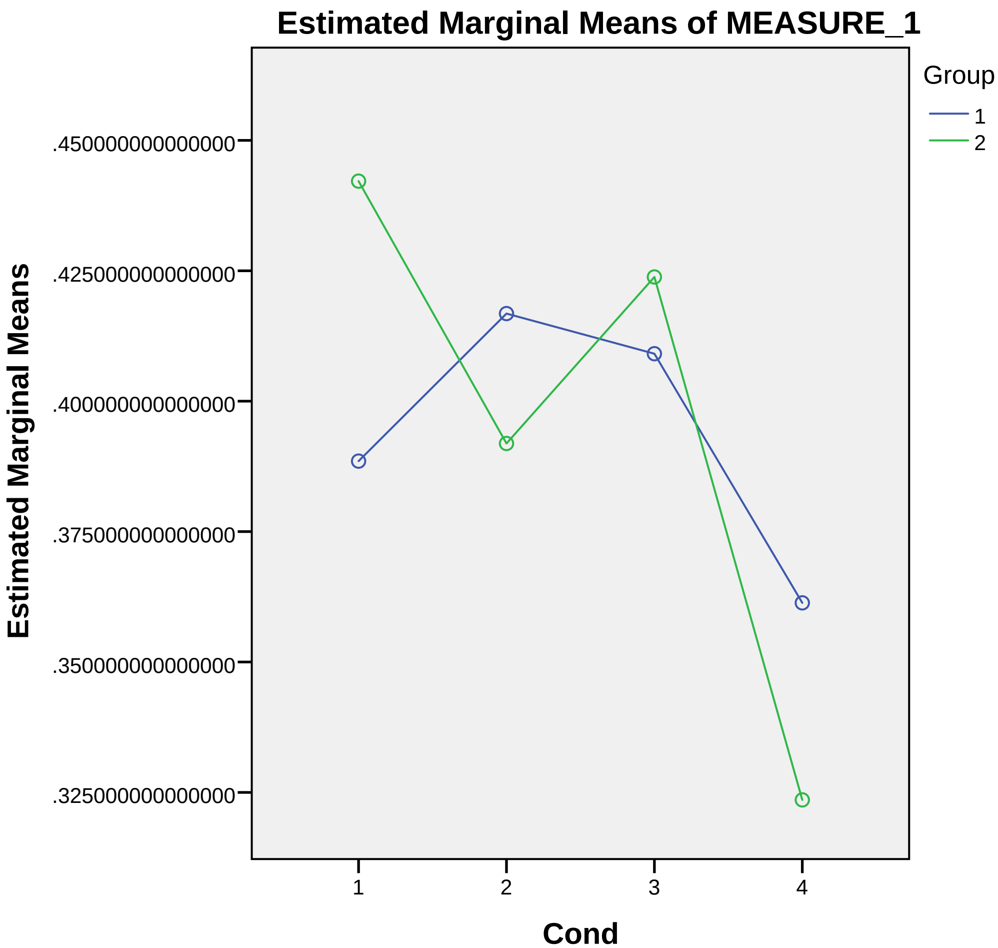
	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Pillai's trace	.179	3.207[a]	3.000	44.000	.032	.179	9.620	.701
Wilks' lambda	.821	3.207[a]	3.000	44.000	.032	.179	9.620	.701
Hotelling's trace	.219	3.207[a]	3.000	44.000	.032	.179	9.620	.701
Roy's largest root	.219	3.207[a]	3.000	44.000	.032	.179	9.620	.701

Each F tests the multivariate effect of Cond. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Exact statistic

b. Computed using alpha = .05

Profile Plots




```
MANOVA AlphaDP_NOF2 AlphaDP_POP2 AlphaDP_TAN2 AlphaDP_PER2 BY Group(1,2)
/WSFACTORS=Cond(4)
/WSDESIGN=MWITHIN Cond(1) MWITHIN Cond(2) MWITHIN Cond(3) MWITHIN Cond(4).
```

Manova

Notes

Output Created		05-AUG-2017 12:19:55
Comments		
Input	Data	G:\Dissertation\C - Statistics\Aim 1\2017_0516_Aim1_SPSS_WideData.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	48
Syntax		MANOVA AlphaDP_NOF2 AlphaDP_POP2 AlphaDP_TAN2 AlphaDP_PER2 BY Group(1,2) /WSFACTORS=Cond(4) /WSDESIGN=MWITHIN Cond(1) MWITHIN Cond(2) MWITHIN Cond (3) MWITHIN Cond(4).
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.03

```
 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 - - - - - - - - - - - - - - - - - - - - - - -
The default error term in MANOVA has been changed from WITHIN CELLS to
WITHIN+RESIDUAL.  Note that these are the same for all full factorial designs.
```

* * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e * *
* * * * * * * * * * * * * * *

```
48 cases accepted.
 0 cases rejected because of out-of-range factor values.
 0 cases rejected because of missing data.
 2 non-empty cells.

 1 design will be processed.
```

- -
- -

* * * * * * * * * * * * * * * * * * A n a l y s i s o f V a r i a n c e -- D
esign 1 * * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(1)' Within-Subject Effect.

Tests of Significance for T1 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN+RESIDUAL	.86	46	.02		
MWITHIN COND(1)	8.28	1	8.28	443.95	.000
Group BY MWITHIN COND(1)	.03	1	.03	1.85	.180

- -

```
* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(2)' Within-Subject Effect.

 Tests of Significance for T2 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL             .78      46       .02
 MWITHIN COND(2)            7.85       1      7.85    460.16      .000
 Group BY MWITHIN CON        .01       1       .01       .44      .512
 D(2)

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 - - - - - - - - - - - - - - - - - - - - -
```

```
* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(3)' Within-Subject Effect.

 Tests of Significance for T3 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL             .66      46       .01
 MWITHIN COND(3)            8.32       1      8.32    584.56      .000
 Group BY MWITHIN CON        .00       1       .00       .18      .671
 D(3)

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 - - - - - - - - - - - - - - - - - - - - - -
```

```
* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(4)' Within-Subject Effect.

 Tests of Significance for T4 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL             .93      46       .02
 MWITHIN COND(4)            5.63       1      5.63    279.59      .000
 Group BY MWITHIN CON        .02       1       .02       .85      .361
 D(4)

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 - - - - - - - - - - - - - - - - - - - - -
```

				Age	Gender	Mass	Height	MMSE	TUG	Data Collection
					F = 0 / M =1					Avg L_n during NWalk02 (last 20 strides)
	Subject	Date	Time	(yrs)	(F/M)	(kg)	(m)	XX/30	(sec)	(m)
1	C16	30-Oct-2016	9:00 AM	19	1	72.0	1.8600	30	8.03	1.23
2	C17	31-Oct-2016	12:00 PM	22	0	73.6	1.5850	30	6.18	1.19
3	C18	1-Nov-2016	9:00 AM	18	0	36.2	1.5700	30	10.06	1.22
4	C19	2-Nov-2016	5:00 PM	18	0	50.8	1.6200	29	7.69	1.08
5	C20	3-Nov-2016	12:00 PM	22	0	65.2	1.6950	29	7.22	1.06
6	C21	3-Nov-2016	3:00 PM	29	1	66.0	1.7850	29	7.21	1.16
7	C22	4-Nov-2016	3:00 PM	21	0	63.4	1.5600	30	7.68	1.11
8	C23	5-Nov-2016	9:00 AM	18	0	75.8	1.6550	30	7.15	1.17
9	C24	5-Nov-2016	12:00 PM	18	0	60.6	1.5900	30	8.12	1.17
10	C25	6-Nov-2016	12:00 PM	19	1	67.2	1.8300	30	6.97	1.24
11	C26	7-Nov-2016	12:00 PM	21	1	69.0	1.7200	30	6.93	1.25
12	C27	7-Nov-2016	3:00 PM	20	0	75.6	1.6700	30	7.06	1.14
13	C29	8-Nov-2016	12:00 PM	21	1	73.0	1.6950	30	8.21	1.25
14	C30	9-Nov-2016	12:00 PM	19	1	69.4	1.7450	27	5.87	1.16
15	C31	9-Nov-2016	4:00 PM	18	1	75.2	1.7400	29	8.03	1.25
16	C32	10-Nov-2016	9:00 AM	23	1	83.0	1.9300	30	7.65	1.29
17	C33	11-Nov-2016	9:30 AM	18	0	51.4	1.6500	29	5.31	1.20
18	C34	11-Nov-2016	3:00 PM	19	0	61.2	1.6750	30	6.94	1.21
19	C35	13-Nov-2016	12:00 PM	19	0	83.0	1.6200	30	6.47	1.18
20	C36	15-Nov-2016	8:00 AM	18	0	73.0	1.7350	30	6.28	1.25
21	C37	16-Nov-2016	9:00 AM	18	1	92.2	1.8600	29	8.70	1.27
22	D01	18-Aug-2016	9:00 AM	69	1	75.4	1.6500	30	10.03	1.19
23	D03	20-Aug-2016	9:00 AM	62	0	73.2	1.6550	30	8.66	1.14
24	D06	23-Aug-2016	1:00 PM	67	0	67.8	1.5650	30	8.16	1.29
25	D08	8-Sep-2016	5:00 PM	63	0	55.2	1.6150	29	7.97	1.04
26	D09	17-Sep-2016	9:00 AM	62	0	84.0	1.6600	30	6.94	1.21
27	D11	22-Sep-2016	10:00 AM	65	0	90.2	1.6350	30	9.07	1.07
28	D13	23-Sep-2016	9:00 AM	66	1	95.4	1.7450	30	8.91	1.22
29	D15	28-Sep-2016	3:00 PM	71	1	90.6	1.7600	30	7.75	1.24
30	D16	29-Sep-2016	11:00 AM	62	1	72.5	1.7600	29	7.53	1.23
31	D17	1-Oct-2016	9:30 AM	60	1	66.2	1.7350	30	9.25	1.09
32	D18	2-Oct-2016	12:00 AM	62	0	65.6	1.6300	30	7.90	1.08
33	D19	2-Oct-2016	4:00 PM	66	1	72.0	1.7050	30	8.66	1.19
34	D20	5-Oct-2016	11:30 AM	66	0	52.4	1.6250	30	7.90	1.15
35	D21	6-Oct-2016	9:00 AM	79	0	54.6	1.6850	30	7.81	1.23
36	D22	9-Oct-2016	9:00 AM	75	0	63.4	1.5950	30	6.63	1.09
37	D23	13-Oct-2016	12:00 PM	73	0	71.4	1.6550	30	7.41	1.09
38	D25	17-Oct-2016	1:00 PM	66	0	55.8	1.7000	30	6.44	1.25
39	D27	19-Oct-2016	12:00 PM	71	0	71.8	1.6400	30	6.98	1.12
40	D28	21-Oct-2016	10:30 AM	74	0	60.8	1.5300	28	7.00	1.06

41	D29	22-Oct-2016	3:00 PM	70	0	69.0	1.6700	30	6.72	1.21
42	D30	26-Oct-2016	10:30 AM	70	0	72.0	1.6150	29	7.68	1.10

Gait Events D–FLOW Script

```
-------------------------------------
-- IDENTIFY HeelStrike
--     & Calculate Gait Parameters
----------------------------------------------------------
---------------

-- +X is to the RIGHT SIDE of the Treadmill
-- +Y is UP
-- -Z is the direction of walking progression

-------------------------------------
---- Init Variables -----------------
-------------------------------------
 -- TREADMILL SPEED
TM_Speed = TM_Spd or 0

-- (HEEL-Pelvis) Z-VELOCITY
LHeePelZVel       = LHeePelZVel or 0
RHeePelZVel       = RHeePelZVel or 0
Prev_LHeePelZVel  = Prev_LHeePelZVel or 0
Prev_RHeePelZVel  = Prev_RHeePelZVel or 0

-- HEEL Z-POSITION
LHeeZPos = LHeeZPos or 0
RHeeZPos = RHeeZPos or 0
Prev_LHeeZPos = Prev_LHeeZPos or 0
Prev_RHeeZPos = Prev_RHeeZPos or 0

-- HEEL X-POSITION
LHeeXPos = LHeeXPos or 0
RHeeXPos = RHeeXPos or 0
Prev_LHeeXPos = Prev_LHeeXPos or 0
Prev_RHeeXPos = Prev_RHeeXPos or 0

-- HEELStrike Time ---
LHee_Time      = LHee_Time or 0
RHee_Time      = RHee_Time or 0
Prev_LHee_Time = Prev_LHee_Time or 0
Prev_RHee_Time = Prev_RHee_Time or 0
-------------------------------------
-------------------------------------

-------------------------------------
-- INPUTs to Scripting Module -------
-------------------------------------
TM_Speed = inputs.get("TM_Speed")  -- Fixed / Constant
LHeePelZVel = inputs.get("LHeePelZVel")
RHeePelZVel = inputs.get("RHeePelZVel")
-------------------------------------
-------------------------------------

-------------------------------------
-- IDENTIFYING LHS ------------------
-------------------------------------
if (LHeePelZVel > 0) and (Prev_LHeePelZVel < 0) then
        Prev_LHee_Time = LHee_Time
        LHee_Time = frametime() -- time at which LHS occurs
        Prev_LHeeZPos = LHeeZPos
        LHeeZPos = inputs.get("LHeeZPos")
        Prev_LHeeXPos = LHeeXPos
        LHeeXPos = inputs.get("LHeeXPos")

        broadcast("Left Heel Strike")
```

```
        local Left_Stride_Time = LHee_Time-Prev_LHee_Time
   --local Left_Stride_Length = math.abs(LHeeZPos-RHeeZPos) +
math.abs(RHeeZPos-Prev_LHeeZPos) + ((TM_Speed)*(Left_Stride_Time))
   local Left_Stride_Length = (-1*(LHeeZPos-RHeeZPos)) +
(-1*(RHeeZPos-Prev_LHeeZPos)) + ((TM_Speed)*(Left_Stride_Time))
   local RL_StepWidth = RHeeXPos - LHeeXPos -- +x direction is the RIGHT side of
Treadmill

        --print("TM_Spd",TM_Speed)

        print("Left Stride Time", Left_Stride_Time)
   print("Left Stride Length", Left_Stride_Length)
        print("RL Step Width", RL_StepWidth)
        print("LHeeTime",LHee_Time) -- End of the step (RL Step Width)

        outputs.set("Left Stride Time",  Left_Stride_Time)
        outputs.set("Left Stride Length",  Left_Stride_Length)
        outputs.set("RL Step Width",  RL_StepWidth)
        outputs.set("LHeeTime",LHee_Time) -- End of the step (RL Step Width)
        outputs.set("LHeeXPos", LHeeXPos)
        outputs.set("LHeeZPos", LHeeZPos)

end

-------------------------------------
-- IDENTIFYING RHS ------------------
-------------------------------------
if (RHeePelZVel > 0) and (Prev_RHeePelZVel < 0) then
   Prev_RHee_Time=RHee_Time
        RHee_Time=frametime() -- time at which RHS occurs
        Prev_RHeeZPos = RHeeZPos
        RHeeZPos = inputs.get("RHeeZPos")
        Prev_RHeeXPos = RHeeXPos
        RHeeXPos = inputs.get("RHeeXPos")

        broadcast("Right Heel Strike")

        local Right_Stride_Time = RHee_Time-Prev_RHee_Time
        --local Right_Stride_Length = math.abs(RHeeZPos-LHeeZPos) +
math.abs(LHeeZPos-Prev_RHeeZPos) + ((TM_Speed)*(Right_Stride_Time))
        local Right_Stride_Length =
(-1*(RHeeZPos-LHeeZPos))+(-1*(LHeeZPos-Prev_RHeeZPos)) +
((TM_Speed)*(Right_Stride_Time))
        local LR_StepWidth = RHeeXPos - LHeeXPos -- +x direction is the RIGHT side
of Treadmill

        --print("TM_Spd",TM_Speed)

        print("Right Stride Time", Right_Stride_Time)
        print("Right Stride Length", Right_Stride_Length)
        print("LR Step Width",LR_StepWidth)
        print("RHeeTime",RHee_Time) -- End of the step (LR Step Width)

        outputs.set("Right Stride Time", Right_Stride_Time)
        outputs.set("Right Stride Length",  Right_Stride_Length)
        outputs.set("LR Step Width",  LR_StepWidth)
        outputs.set("RHeeTime",RHee_Time) -- End of the step (LR Step Width)
        outputs.set("RHeeXPos", RHeeXPos)
        outputs.set("RHeeZPos", RHeeZPos)

end
```

Gait Events Script

```
------------------------------------
------------------------------------
-- These Variables (below) are
  -- updated at EACH FRAME, others
  -- are updated at their respective
  -- (Right or Left) Heel Strike.
------------------------------------
------------------------------------
Prev_LHeePelZVel = LHeePelZVel
Prev_RHeePelZVel = RHeePelZVel
```

Study 2_Create Stepping Objects D-FLOW Script

```
----------------------------------------------------------------------------------
---------
----------------------------------------------------------------------------------
---------
-- Written By Mandy Salinas
-- Summer 2016
----------------------------------------------------------------------------------
---------
---- Init Variables
-----------------------------------------------------------------------
----------------------------------------------------------------------------------
---------
Lo = Lo or 0                                                          -- preferred
stride length (input by experimenter) at a particular walking speed
which_cond = which_cond or 100          -- which cond 1-3 (input by experimenter)
which_trial = which_trial or 0          -- which trial 1 or 2 (input by
experimenter)

frame_counter = frame_counter or 0      -- frame counter (remember script runs every
DFLOW frame)

target_count = target_count or 0                        -- Number of Targets Created
obstacle_count = obstacle_count or 0    -- Number of Obstacles Created

-- --------------------------------
-- Environmental Positions/distance
--    on/from treadmill
-- --------------------------------
zstart = zstart or 0    -- AP location on TM where objects will start to appear
(initialized below)
zback = zback or 0              -- AP location on TM where projection ends
(initialized below)
zdist = zdist or 0              -- distance variable from treadmill

trial_time = trial_time or 0

-- --------------------------------
-- Object Related Variables
-- --------------------------------
obj_counter = obj_counter or 1

-- this an array of 1s and 0s to
--  tell the script if the object
--  should be a "target" or "obstacle" or "other"
obj_color = obj_color or 2

-- temp variable used in a conditional
--  [is the new object created a target or
--  not (1 or 0)]
target = target or 2

-- Is objX a "target"??
-- yes = 1 or no = 0
obj1_target = obj1_target or 2
obj2_target = obj2_target or 2
obj3_target = obj3_target or 2
obj4_target = obj4_target or 2

-- --------------------------------
-- object starting position
Z1pos_start = Z1pos_start or 0
Z2pos_start = Z2pos_start or 0
Z3pos_start = Z3pos_start or 0
```

```
Z4pos_start = Z4pos_start or 0

-- object DISTANCE COVERED starting point
Z1pos_dist_start = Z1pos_dist_start or 0
Z2pos_dist_start = Z2pos_dist_start or 0
Z3pos_dist_start = Z3pos_dist_start or 0
Z4pos_dist_start = Z4pos_dist_start or 0

-- object ongoing position
Z1pos = Z1pos or 0
Z2pos = Z2pos or 0
Z3pos = Z3pos or 0
Z4pos = Z4pos or 0

-- object DISTANCE COVERED
Z1pos_dist_cov = Z1pos_dist_cov or 0
Z2pos_dist_cov = Z2pos_dist_cov or 0
Z3pos_dist_cov = Z3pos_dist_cov or 0
Z4pos_dist_cov = Z4pos_dist_cov or 0

-- object position & scaling
obj1_x = obj1_x or 0
obj2_x = obj2_x or 0
obj3_x = obj3_x or 0
obj4_x = obj4_x or 0

obj1_y = obj1_y or 0
obj2_y = obj2_y or 0
obj3_y = obj3_y or 0
obj4_y = obj4_y or 0

obj_xscal = obj_xscal or 0
obj_yscal = obj_yscal or 0
obj_zscal = obj_zscal or 0

----------------------------------------------------------------------------------
---------
-- INPUTs to Scripting Module
---------------------------------------------------------------
----------------------------------------------------------------------------------
---------
zdist = inputs.get("zdist")                                    -- distance variable
from treadmill
Lo = inputs.get("Lo")                                                  -- preferred
stride length (input by experimenter)
which_cond = inputs.get("which_cond")           -- which cond 1-3 (input by
experimenter)
which_trial = inputs.get("which_trial") -- which trial 1 or 2 (input by
experimenter)
trial_time = inputs.get("trial_time")           -- Ramp Trial Time...
-------------------------------------
zback = inputs.get("zback")     -- AP location on TM objects will be destroyed - to
be recreated at the front of the treadmill
zstart = zback-(3*Lo)                   -- AP location on TM where objects will
start to appear

--obj_x = 0.250
--obj_x = 0.125
obj_x = 0.18
obj1_x = -obj_x         -- objects' absolute value of x position on TM
(medial-lateral)
obj3_x = -obj_x         -- objects' absolute value of x position on TM
(medial-lateral)
```

Study 2_Create Stepping Objects D-FLOW Script

```
obj2_x = obj_x                    -- objects' absolute value of x position on TM
(medial-lateral)
obj4_x = obj_x                    -- objects' absolute value of x position on TM
(medial-lateral)

obj_y = 0
obj1_y = obj_y                    -- objects' y position on the TM (up-down)
obj2_y = obj_y                            -- objects' y position on the TM (up-down)
obj3_y = obj_y                            -- objects' y position on the TM (up-down)
obj4_y = obj_y                            -- objects' y position on the TM (up-down)

obj_xscal = inputs.get("obj_xscal")                    -- objects' x scaling (input
by experimenter)
obj_yscal = 0.008
-- objects' y scaling
obj_zscal = 0.49
-- objects' z scaling

-- ------------------------------------
-- OBJECT COLOR --------------------
-- ------------------------------------
-- object_color = 1 means "TARGET" color
-- object_color = 0 means "OBSTACLE" color

if which_cond == 1 then -- No Objects

        if frame_counter == 0 then
                broadcast("START_NO_OBJECTS")
        end

end

if which_cond == 2 then
        target_color = target_color or material.create("Yellow")
        obstacle_color = obstacle_color or material.create("Red")
        other_color = other_color or material.create("Blue")

        material.setspecularcolor(target_color,1,1,0)
        material.setspecularcolor(obstacle_color,1,0,0)
        material.setspecularcolor(other_color,0,0,1)

        if which_trial == 0 then
                obj_color =
{2,2,2,2,2,1,1,1,1,1,0,1,1,1,1,1,1,1,0,1,1,0,1,1,1,0,1,0,1,1,1,1,1,1,1,1,1,1,1,1,1
,0,1,1,0,1,1,1,1,1,1,1,1,0,1,0,1,1,1,1,1,1,1,1,1,0,1,1,1,1,1,0,1,0,1,1,1,1,1,1,1,1,1
,1,1,1,1,0,1,1,1,1,0,0,1,1,0,1,1,0,1,1,1,0,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,0,0,1
,1,1,0,1,0,1,1,1,1,1,0,1,1,1,1,1,1,0,1,1,0,1,0,1,0,0,1,1,0,1,1,0,1,1,1,1,1,1,1,0,1,1
,1,0,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,0,1,1,1,1,0,1,1,1,1,1,0,1,1,1,1,1,1,1,1,0,1,1,1
,1,1,1,1,0,1,0,1,1,1,1,0,1,1,1,1,0,1,0,1,1,1,0,1,1,1,1,1,0,1,1,1,1,1,0,0,1,1,1,0,0,1
,1,1,1,1,1,1,0,0,1,0,0,1,1,1,1,1,1,1,0,1,1,1,0,0,1,1,1,0,1,1,1,1,1,1,1,1,1,1,0,0,0,0
,1,1,1,1,1,0,1,1,1,1,1,2,2,2,2,2,2,2,2,2,2}
        end
        if which_trial == 1 then
                obj_color =
{2,2,2,2,2,1,1,1,1,1,0,1,1,1,1,1,1,1,0,1,1,0,1,1,1,0,1,0,1,0,1,1,1,1,1,1,1,1,1,0,1,1
,1,1,1,0,1,0,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,0,1,1,0,1,1,1,1,1,1,1,1,0,1,1
,1,1,1,1,0,1,1,1,1,0,1,0,1,0,1,0,0,1,1,0,1,1,0,1,1,1,1,1,1,1,0,1,1,1,0,1,1,1,1,1,1,1
,0,1,1,0,1,1,0,1,1,1,0,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,0,0,1,1,1,0,1,0,1,1,1,1,1
,0,1,1,1,1,1,1,0,1,1,1,1,1,1,1,1,1,0,1,1,1,1,0,1,1,1,1,1,0,1,1,1,1,1,1,1,1,0,1,1,1
,1,1,1,1,0,1,0,0,1,1,1,0,0,1,1,1,1,1,1,1,0,0,1,0,0,1,1,1,1,1,1,1,0,1,1,1,0,0,1,1,1,0
,1,1,1,1,1,1,1,1,0,1,1,1,1,0,1,0,1,1,1,0,1,1,1,1,1,0,1,1,1,1,1,0,1,1,1,1,1,1,0,0,0,0
,1,1,1,1,1,0,1,1,1,1,1,2,2,2,2,2,2,2,2,2,2}
        end
```

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Study 2_Create Stepping Objects D-FLOW Script

```
        if which_trial == 2 then
                obj_color =
{2,2,2,2,2,1,1,1,1,0,1,1,1,1,1,0,1,1,1,1,1,1,0,1,1,1,1,1,0,0,1,1,0,1,1,1,1,0,1,1,1,0
,0,1,1,1,1,0,1,1,1,0,1,1,1,1,0,1,1,1,1,1,1,0,1,1,1,1,1,0,1,0,1,1,0,1,1,1,1,1,1
,1,1,1,1,1,0,1,1,1,1,1,0,1,1,1,0,1,1,0,1,0,1,1,0,1,1,1,1,1,0,1,1,0,1,0,1,1,1,1,0,0,1
,0,1,1,0,1,0,1,1,0,1,0,1,1,1,1,1,1,1,0,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,0
,1,1,1,1,1,1,1,1,0,1,0,1,1,1,1,1,1,0,0,0,1,1,0,1,1,1,1,1,1,1,1,1,1,0,0,0,1,1,1,1,1
,1,1,0,1,1,1,1,1,1,1,1,0,1,1,1,1,1,1,0,1,1,0,1,1,1,1,1,1,1,1,1,1,0,1,1,1,1,1,1,1,1
,1,1,1,1,0,1,0,1,1,1,1,1,0,1,0,1,0,1,1,1,1,1,1,1,0,1,1,1,1,1,1,1,1,1,1,1,0,0,0,1,1
,1,1,1,0,0,1,1,1,0,1,1,2,2,2,2,2,2,2,2,2,2}
        end
end

if which_cond == 3 then
        target_color = target_color or material.create("Red")
        obstacle_color = obstacle_color or material.create("Yellow")
        other_color = other_color or material.create("Blue")

        material.setspecularcolor(target_color,1,0,0)
        material.setspecularcolor(obstacle_color,1,1,0)
        material.setspecularcolor(other_color,0,0,1)

        if which_trial == 1 then
                obj_color =
{2,2,2,2,2,0,0,0,0,0,1,0,0,0,0,0,1,1,1,1,0,0,0,0,0,1,0,0,0,0,0,1,0,0,0,0,0,1,0,0,0
,1,0,1,0,0,0,0,1,0,0,0,0,0,0,0,0,1,0,0,0,1,1,0,0,0,1,0,0,0,0,0,0,0,1,1,0,1,1,0,0,0,0
,0,0,0,1,1,0,0,0,1,1,0,1,0,0,0,0,0,0,0,1,0,0,0,0,0,0,0,0,1,0,0,0,0,0,1,0,0,0,0,1,0
,0,0,0,0,0,0,0,0,1,0,0,0,0,0,1,0,0,0,0,0,1,0,1,0,0,0,1,1,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,1,0,0,0,1,0,0,1,0,0,1,0,0,0,0,0,0,1,0,0,0,1,0,0,0,0,0,0,0,1,0,0,1,0,0,1
,1,0,1,0,1,0,1,0,0,0,0,1,0,0,0,0,0,0,1,0,0,0,0,0,0,0,0,1,0,0,1,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,1,0,1,0,0,0,0,0,1,0,0,0,0,0,0,0,0,0,1,0,1,0,1,0,0,0,1,0,0,1,0,0
,0,0,0,0,0,1,0,0,0,0,0,2,2,2,2,2,2,2,2,2,2}
        end
        if which_trial == 2 then
                obj_color =
{2,2,2,2,2,0,0,1,0,0,0,1,1,0,0,0,0,0,1,1,1,0,0,0,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0,0,1
,0,1,0,1,0,0,0,0,0,1,0,1,0,0,0,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0,0,0,0,0,0,1,0,0,1,0,0
,0,0,0,0,1,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0,0,1,1,1,0,0,0,0,0,0,0,0,0,0,0,1,0,0,1,1,1,0
,0,0,0,0,0,1,0,1,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,0,0
,0,0,0,0,0,1,0,1,0,0,1,0,1,0,0,1,0,1,1,0,0,0,0,1,0,1,0,0,1,0,0,0,0,0,1,0,0,1,0,1,0,0
,1,0,0,0,1,0,0,0,0,0,1,0,0,0,0,0,0,0,0,0,0,0,0,1,0,0,1,0,1,0,0,0,0,0,0,1,0,0,0,0,0,0
,0,1,0,0,0,0,1,0,0,0,1,0,0,0,0,1,1,0,0,0,1,0,0,0,0,1,0,0,1,1,0,0,0,0,0,1,0,0,0,0,0,0
,1,0,0,0,0,0,1,0,0,0,0,2,2,2,2,2,2,2,2,2,2}
        end
end
if which_cond == 4 then -- TRAINING TRIAL ADDED ON 08-09-2016
        target_color = target_color or material.create("White")
        other_color = other_color or material.create("Blue")
        material.setspecularcolor(target_color,1,1,1)
        material.setspecularcolor(other_color,0,0,1)

        if which_trial == 0 then
                obj_color =
{2,2,2,2,2,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1
,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1
,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1
,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1
,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1
,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1
,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1
,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1
,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1
,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1
```

```
                   Study 2_Create Stepping Objects D-FLOW Script
,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1
,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1
,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1
,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1
,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1
,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1
,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1
,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1
,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1
,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1
,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1
,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1
,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1
,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1
,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1
,1,1,1,1,1,1,1,1,1,1,1,1,2,2,2,2,2}
        end
end
------------------------------------------------------------------------------------
---------
------------------------------------------------------------------------------------
---------
-- ------ Frame == 0
------------------------------------------------------------------------
------------------------------------------------------------------------------------
---------
------------------------------------------------------------------------------------
---------
-- Set Object's Positions / Color / Scaling

if which_cond ~= 1 then

        -- ------------------------------------------------
        if frame_counter == 0 then

                Z1pos_start = zstart + (2*Lo)
                Z2pos_start = zstart + (1.5*Lo)
                Z3pos_start = zstart + (1*Lo)
                Z4pos_start = zstart + (0.5*Lo)

                other_color = other_color or material.create("Blue")
                material.setspecularcolor(other_color,0,0,1)

                object1 = object.create("Cube",other_color)
                object.setposition(object1,obj1_x,obj1_y,Z1pos_start)
                object.setrotation(object1,0,-90,0)
                object.setscaling(object1,obj_xscal,obj_yscal,obj_zscal)

                object2 = object.create("Cube",other_color)
                object.setposition(object2,obj2_x,obj2_y,Z2pos_start)
                object.setrotation(object2,0,-90,0)
                object.setscaling(object2,obj_xscal,obj_yscal,obj_zscal)

                object3 = object.create("Cube",other_color)
                object.setposition(object3,obj3_x,obj3_y,Z3pos_start)
                object.setrotation(object3,0,-90,0)
                object.setscaling(object3,obj_xscal,obj_yscal,obj_zscal)

                object4 = object.create("Cube",other_color)
                object.setposition(object4,obj4_x,obj4_y,Z4pos_start)
                object.setrotation(object4,0,-90,0)
                object.setscaling(object4,obj_xscal,obj_yscal,obj_zscal)
```

```
                Z1pos_dist_start = zdist
                Z2pos_dist_start = zdist
                Z3pos_dist_start = zdist
                Z4pos_dist_start = zdist

        end


------------------------------------------------------------------------------------
---------

------------------------------------------------------------------------------------
---------
        -- WHEN FRAME_COUNTER IS NOT EQUAL TO ZERO
--------------------------------------------------

------------------------------------------------------------------------------------
---------

------------------------------------------------------------------------------------
---------
        if frame_counter ~= 0 then
                -- ---------------------------------------------------------
                -- ---------------------------------------------------------
                -- Object 1
                -- ---------------------------------------------------------
                Z1pos_dist_cov = zdist - Z1pos_dist_start
                Z1pos = Z1pos_dist_cov + Z1pos_start
                object.setposition(object1,obj1_x,obj1_y,Z1pos)
                object.setrotation(object1,0,-90,0)
                object.setscaling(object1,obj_xscal,obj_yscal,obj_zscal)

                -- ---------------------------------------------------
                if (Z1pos > zback) then
                        print("Object 1 moved past zback")
                        object.destroy(object1)

                        Z1pos_start = Z4pos-(Lo/2)
                        Z1pos_dist_start = zdist
                        target = obj_color[obj_counter]

                                if target == 2 then
                                        object1 = object.create("Cube",other_color)
                                        object.setmaterial(object1,other_color)

object.setposition(object1,obj1_x,obj1_y,Z1pos_start)
                                        object.setrotation(object1,0,-90,0)

object.setscaling(object1,obj_xscal,obj_yscal,obj_zscal)

                                        obj_counter = obj_counter + 1
                                end

                                if target == 1 then
                                        object1 = object.create("Cube",target_color)
                                        object.setmaterial(object1,target_color)

object.setposition(object1,obj1_x,obj1_y,Z1pos_start)
                                        object.setrotation(object1,0,-90,0)

object.setscaling(object1,obj_xscal,obj_yscal,obj_zscal)

                                        target_count = target_count + 1
```

Study 2_Create Stepping Objects D-FLOW Script

```
                        obj_counter = obj_counter + 1
                end
                if target == 0 then
                        object1 =
object.create("Cube",obstacle_color)
                        object.setmaterial(object1,obstacle_color)

object.setposition(object1,obj1_x,obj1_y,Z1pos_start)
                        object.setrotation(object1,0,-90,0)

object.setscaling(object1,obj_xscal,obj_yscal,obj_zscal)

                        obstacle_count = obstacle_count + 1
                        obj_counter = obj_counter + 1
                end
                obj1_target = target
        end
        -- --------------------------------------------------

        -- --------------------------------------------------------
        -- --------------------------------------------------------

        -- --------------------------------------------------------
        -- --------------------------------------------------------
        -- Object 2
        -- --------------------------------------------------------
        Z2pos_dist_cov = zdist - Z2pos_dist_start
        Z2pos = Z2pos_dist_cov + Z2pos_start

        object.setposition(object2,obj2_x,obj2_y,Z2pos)
        object.setrotation(object2,0,-90,0)
        object.setscaling(object2,obj_xscal,obj_yscal,obj_zscal)

        -- --------------------------------------------------
        if (Z2pos > zback) then
                print("Object 2 moved past zback")
                object.destroy(object2)

                Z2pos_start = Z1pos-(Lo/2)
                Z2pos_dist_start = zdist
                target = obj_color[obj_counter]

                        if target == 2 then
                                object2 = object.create("Cube",other_color)
                                object.setmaterial(object2,other_color)

object.setposition(object2,obj2_x,obj2_y,Z2pos_start)
                                object.setrotation(object2,0,-90,0)

object.setscaling(object2,obj_xscal,obj_yscal,obj_zscal)

                                obj_counter = obj_counter + 1
                        end

                        if target == 1 then
                                object2 = object.create("Cube",target_color)
                                object.setmaterial(object2,target_color)

object.setposition(object2,obj2_x,obj2_y,Z2pos_start)
                                object.setrotation(object2,0,-90,0)

object.setscaling(object2,obj_xscal,obj_yscal,obj_zscal)
```

```
                                target_count = target_count + 1
                                obj_counter = obj_counter + 1
                        end
                        if target == 0 then
                                object2 =
object.create("Cube",obstacle_color)
                                object.setmaterial(object2,obstacle_color)

object.setposition(object2,obj2_x,obj2_y,Z2pos_start)
                                object.setrotation(object2,0,-90,0)

object.setscaling(object2,obj_xscal,obj_yscal,obj_zscal)

                                obstacle_count = obstacle_count + 1
                                obj_counter = obj_counter + 1
                        end
                        obj2_target = target
                end
                -- --------------------------------------------------

                -- --------------------------------------------------------
                -- --------------------------------------------------------


                -- --------------------------------------------------------
                -- --------------------------------------------------------
                -- Object 3
                -- --------------------------------------------------------
                Z3pos_dist_cov = zdist - Z3pos_dist_start
                Z3pos = Z3pos_dist_cov + Z3pos_start

                object.setposition(object3,obj3_x,obj3_y,Z3pos)
                object.setrotation(object3,0,-90,0)
                object.setscaling(object3,obj_xscal,obj_yscal,obj_zscal)

                -- --------------------------------------------------
                if (Z3pos > zback) then
                        print("Object 3 moved past zback")
                        object.destroy(object3)

                        Z3pos_start = Z2pos-(Lo/2)
                        Z3pos_dist_start = zdist
                        target = obj_color[obj_counter]

                                if target == 2 then
                                        object3 = object.create("Cube",other_color)
                                        object.setmaterial(object3,other_color)

object.setposition(object3,obj3_x,obj3_y,Z3pos_start)
                                        object.setrotation(object3,0,-90,0)

object.setscaling(object3,obj_xscal,obj_yscal,obj_zscal)

                                        obj_counter = obj_counter + 1
                                end

                                if target == 1 then
                                        object3 = object.create("Cube",target_color)
                                        object.setmaterial(object3,target_color)

object.setposition(object3,obj3_x,obj3_y,Z3pos_start)
                                        object.setrotation(object3,0,-90,0)
```

```
object.setscaling(object3,obj_xscal,obj_yscal,obj_zscal)

                                        target_count = target_count + 1
                                        obj_counter = obj_counter + 1
                                end
                                if target == 0 then
                                        object3 =
object.create("Cube",obstacle_color)
                                        object.setmaterial(object3,obstacle_color)

object.setposition(object3,obj3_x,obj3_y,Z3pos_start)
                                        object.setrotation(object3,0,-90,0)

object.setscaling(object3,obj_xscal,obj_yscal,obj_zscal)

                                        obstacle_count = obstacle_count + 1
                                        obj_counter = obj_counter + 1
                                end
                                obj3_target = target
                end
                -- --------------------------------------------------

                -- --------------------------------------------------------
                -- --------------------------------------------------------

                -- --------------------------------------------------------
                -- --------------------------------------------------------
                -- Object 4
                -- --------------------------------------------------------
                Z4pos_dist_cov = zdist - Z4pos_dist_start
                Z4pos = Z4pos_dist_cov + Z4pos_start

                object.setposition(object4,obj4_x,obj4_y,Z4pos)
                object.setrotation(object4,0,-90,0)
                object.setscaling(object4,obj_xscal,obj_yscal,obj_zscal)

                -- --------------------------------------------------
                if (Z4pos > zback) then
                        print("Object 4 moved past zback")
                        object.destroy(object4)

                        Z4pos_start = Z3pos-(Lo/2)
                        Z4pos_dist_start = zdist
                        target = obj_color[obj_counter]

                                if target == 2 then
                                        object4 = object.create("Cube",other_color)
                                        object.setmaterial(object4,other_color)

object.setposition(object4,obj4_x,obj4_y,Z4pos_start)
                                        object.setrotation(object4,0,-90,0)

object.setscaling(object4,obj_xscal,obj_yscal,obj_zscal)

                                        obj_counter = obj_counter + 1
                                end

                                if target == 1 then
                                        object4 = object.create("Cube",target_color)
                                        object.setmaterial(object4,target_color)

object.setposition(object4,obj4_x,obj4_y,Z4pos_start)
                                        object.setrotation(object4,0,-90,0)
```

```
object.setscaling(object4,obj_xscal,obj_yscal,obj_zscal)

                                        target_count = target_count + 1
                                        obj_counter = obj_counter + 1
                                end
                                if target == 0 then
                                        object4 =
object.create("Cube",obstacle_color)
                                        object.setmaterial(object4,obstacle_color)

object.setposition(object4,obj4_x,obj4_y,Z4pos_start)
                                        object.setrotation(object4,0,-90,0)

object.setscaling(object4,obj_xscal,obj_yscal,obj_zscal)

                                        obstacle_count = obstacle_count + 1
                                        obj_counter = obj_counter + 1
                                end
                                obj4_target = target
                end
                -- --------------------------------------------------

                -- --------------------------------------------------------
                -- --------------------------------------------------------
        end


------------------------------------------------------------------------------------
---------

------------------------------------------------------------------------------------
---------
        -- OUTPUTs to Scripting Module
--------------------------------------------------------------

------------------------------------------------------------------------------------
---------

------------------------------------------------------------------------------------
---------
        outputs.set("frame_counter",frame_counter)
        outputs.set("obj_counter",obj_counter)

        outputs.set("target_count",target_count)
        outputs.set("obstacle_count",obstacle_count)

        outputs.set("obj1_target",obj1_target)
        outputs.set("obj1_x",obj1_x)
        outputs.set("obj1_y",obj1_y)
        outputs.set("Z1pos",Z1pos)

        outputs.set("obj2_target",obj2_target)
        outputs.set("obj2_x",obj2_x)
        outputs.set("obj2_y",obj2_y)
        outputs.set("Z2pos",Z2pos)

        outputs.set("obj3_target",obj3_target)
        outputs.set("obj3_x",obj3_x)
        outputs.set("obj3_y",obj3_y)
        outputs.set("Z3pos",Z3pos)

        outputs.set("obj4_target",obj4_target)
```

Study 2_Create Stepping Objects D-FLOW Script

```
        outputs.set("obj4_x",obj4_x)
        outputs.set("obj4_y",obj4_y)
        outputs.set("Z4pos",Z4pos)
        outputs.set("obj_xscal",obj_xscal)
        outputs.set("zback",zback)
        -------------------------------------

        --------------------------------------
        -- WHEN TO STOP THE SCRIPT
        --------------------------------------
        if which_cond ~= 4 then
                if obj_counter == 315 then -- we're doing 300 objects, however, a
few in front and back are fillers
                        object.destroy(object1)
                        object.destroy(object2)
                        object.destroy(object3)
                        object.destroy(object4)
                        broadcast("Stop Countdown")
                        broadcast("STOP_OBJECTS")
                end
        end
        if which_cond == 4 then -- TRAINING TRIAL
                if obj_counter == 150 then
                        object.destroy(object1)
                        object.destroy(object2)
                        object.destroy(object3)
                        object.destroy(object4)
                        broadcast("Start Short Training Clock")
                        broadcast("STOP_OBJECTS")
                end
        end

        if which_trial == 0 and which_cond == 2 then -- RAMP Speed Trial - Go YEL
Condition ONLY
                if trial_time >= 180 then
                        object.destroy(object1)
                        object.destroy(object2)
                        object.destroy(object3)
                        object.destroy(object4)
                        broadcast("Stop Countdown")
                        broadcast("STOP_OBJECTS")
                end
        end
        --------------------------------------
        --------------------------------------

end -- which_cond ~= 1

frame_counter = frame_counter + 1
```

Study2_Detect Collision RFoot D-FLOW Script

```
-------------------------------------
---- Init Variables -----------------
-------------------------------------
Feedback = Feedback or 0
                                        -- Give auditory stepping feedback, yes (1)
or no (0)? (This is input by experimenter)
which_cond = which_cond or 100
                        -- which cond 1-3 (input by experimenter)
frame_counter = frame_counter or 1
                        -- D-Flow Frame Counter
Collision_current_frame = Collision_current_frame or 2                  -- current
frame
Collision_prev_frame = Collision_prev_frame or 2
-- previous frame
Collision_last_prev_frame = Collision_last_prev_frame or 2              -- 2 frames
ago from current frame
Collision_prev3_frame = Collision_prev3_frame or 2                              -- 3
frames ago from current frame

zback = zback or 0              -- AP location on TM where projection ends

-- collision frames stored in an array (first one is "current" frame)
--  I'm looking for a "collision" indicated for 3 consecutive frames to avoid giving
auditory feedback for a step that is not actually a collision
frame_coll = frame_coll or {2,2,2,2}

-- Right-Side Objects Locations
obj_xscal = obj_xscal or 0 -- AP width of obstacles
obj2_target = obj2_target or 0
obj2_x = obj2_x or 0
obj2_z = obj2_z or 0
obj4_target = obj4_target or 0
obj4_x = obj4_x or 0
obj4_z = obj4_z or 0

-- Foot Positions
Foot_xfront = Foot_xfront or 100
Foot_zfront = Foot_zfront or 100
Foot_xback = Foot_xback  or 100
Foot_zback = Foot_zback  or 100

-- Foot AP Velocity
Foot_zfront_vel = Foot_zfront_vel or 100

-- Left Belt Speed
TM_vel = TM_vel or 0

-- Intermediate Velocity Variable
Vel_Comp = Vel_Comp or 0

-- Targets and Obstacles Hit
Targets_Hit = Targets_Hit or 0
Obstacles_Hit = Obstacles_Hit or 0

-- was the object hit?
--  if not, we want to give an alternate sound (well, if the object is a target and
you miss it,
--   give bad sound; if the object is an obstacle and you miss it, give a good
sound).
obj2_hit = obj2_hit or 2
obj4_hit = obj4_hit or 2
obj2_altern_sound = obj2_altern_sound or 0
```

Study2_Detect Collision RFoot D-FLOW Script

```
obj4_altern_sound = obj4_altern_sound or 0

-- ------------------------------------------
-- ------------- INPUTS ---------------------
-- ------------------------------------------
-- Variable used in conditional to start
--   Auditory Stepping Feedback (set by experimenter, if == 1, then YES /
--   in Runtime Console)
Feedback = inputs.get("Feedback")
which_cond = inputs.get("which_cond")           -- which cond 1-3 (input by
experimenter)
zback = inputs.get("zback")                                         -- AP location on TM
objects will be destroyed - to be recreated at the front of the treadmill

-- Right-Side Objects
obj_xscal = inputs.get("obj_xscal") -- AP width of obstacles
obj2_target = inputs.get("obj2_target") -- is it a target?
obj2_x = inputs.get("obj2_x")
obj2_z = inputs.get("obj2_z")
obj4_target = inputs.get("obj4_target") -- is it a target?
obj4_x = inputs.get("obj4_x")
obj4_z = inputs.get("obj4_z")

-- Foot Positions (z-position is adjusted prior to coming into the script)
--  "front" refers to anterior foot marker (should have named it that but too
late...)
--  "back" refers to posterior foot marker
Foot_xfront = inputs.get("Foot_xfront")
Foot_xback = inputs.get("Foot_xback")
Foot_zfront = inputs.get("Foot_zfront")
Foot_zback = inputs.get("Foot_zback")

-- Foot AP Velocity (using the anterior foot marker, should be ~same vel as
posterior foot marker))
Foot_zfront_vel = inputs.get("Foot_zfront_vel")

-- Right Belt Speed
TM_vel = inputs.get("TM_vel")

-- ---------------------------------------------------------------------
-- ---------------------------------------------------------------------
-- ------- --Start Evaluations -----------------------------------------
-- ---------------------------------------------------------------------
-- ---------------------------------------------------------------------
--if which_cond ~= 1 then

        obj2_zback = obj2_z + ((obj_xscal/2) + 0.01)            -- object's
posterior edge (the 0.01 is just a fudge factor)
        obj2_zfront = obj2_z - ((obj_xscal/2) + 0.01)   -- object's anterior edge
        Foot_xavg = (Foot_xfront + Foot_xback)/2                        -- Foot's
avg ML Location
        obj4_zback = obj4_z + ((obj_xscal/2) + 0.01)
        obj4_zfront = obj4_z - ((obj_xscal/2) + 0.01)

        if Feedback == 1 then

                -- when the foot is on the treadmill belt, the foot is moving
backwards
                ----- at the same speed as the treadmill, here we're looking for
this
                ----- variable to very small....
                Vel_Comp = Foot_zfront_vel - TM_vel
```

Study2_Detect Collision RFoot D-FLOW Script

```
            if (Vel_Comp < 0.25) and (Vel_Comp > -0.25) then -- Foot is ON the
treadmill

                        --
--------------------------------------------------------------
                        -- did the Right Foot collide with any of the Right Objects
                        --
--------------------------------------------------------------
                        -- -------------------------------
                        -- -------------------------------
                        -- ------- OBJECT 2 --------------
                        -- -------------------------------
                        -- -------------------------------
                        --if (Foot_z < obj2_zback) and (Foot_z > obj2_zfront) and
(Foot_x < 0) then

                        -- -------------------------------
                        -- Is the foot on the object???
                        -- -------------------------------
                        --if (Foot_xavg > 0) and ((Foot_zfront < obj2_zback and
Foot_zfront > obj2_zfront) or (Foot_zfront < obj2_zfront and Foot_zback >
obj2_zback) or (Foot_zback < obj2_zback and Foot_zback > obj2_zfront)) then
                        -- x_avg conditional value was chosen as "good enough"/not
perfect, objects were shifted Left (Mandy)
                        if (Foot_xavg > -0.05) and ((Foot_zfront < obj2_zback and
Foot_zfront > obj2_zfront) or (Foot_zfront < obj2_zfront and Foot_zback >
obj2_zback) or (Foot_zback < obj2_zback and Foot_zback > obj2_zfront)) then

                                frame_coll[1] = 1
                                --
--------------------------------------------------------
                                if frame_counter > 4 then

                                        if (frame_coll[1] == 1) and (frame_coll[2]
== 1) and (frame_coll[3] == 1) and (obj2_hit == 0) then

                                                if obj2_target == 1 then

                                                        broadcast("SOUND_Good_Step")

broadcast("SOUND_Good_Step","Position",obj2_x,0,obj2_z)
                                                        Targets_Hit = Targets_Hit +
1
                                                        obj2_hit = 1 -- object was
hit

                                                        print("Stepped on Object 2 -
Target!")

                                                end
                                                if obj2_target == 0 then
                                                        broadcast("SOUND_Bad_Step")

broadcast("SOUND_Bad_Step","Position",obj2_x,0,obj2_z)
                                                        Obstacles_Hit =
Obstacles_Hit + 1
                                                        obj2_hit = 1 -- object was
hit

                                                        print("Stepped on Object 2 -
Obstacle!")
```

```
                                        end
                                end
                        end
                                --
-------------------------------------------------------
                else
                        frame_coll[1] = 0
                end -- AP (Z) and ML (X) Check

                -- ------------------------------
                -- ------------------------------
                -- ------- OBJECT 4 -------------
                -- ------------------------------
                -- ------------------------------
                --if (Foot_z < obj4_zback) and (Foot_z > obj4_zfront) and
(Foot_x < 0) then

                -- ------------------------------
                -- Is the foot on the object???
                -- ------------------------------
                --if (Foot_xavg > 0) and ((Foot_zfront < obj4_zback and
Foot_zfront > obj4_zfront) or (Foot_zfront < obj4_zfront and Foot_zback >
obj4_zback) or (Foot_zback < obj4_zback and Foot_zback > obj4_zfront)) then
                -- x_avg conditional value was chosen as "good enough"/not
perfect, objects were shifted Left (Mandy)
                if (Foot_xavg > -0.05) and ((Foot_zfront < obj4_zback and
Foot_zfront > obj4_zfront) or (Foot_zfront < obj4_zfront and Foot_zback >
obj4_zback) or (Foot_zback < obj4_zback and Foot_zback > obj4_zfront)) then

                        frame_coll[1] = 1
                        --
-------------------------------------------------------
                        if frame_counter > 4 then

                                if (frame_coll[1] == 1) and (frame_coll[2]
== 1) and (frame_coll[3] == 1) and (obj4_hit == 0) then

                                        if obj4_target == 1 then

                                                broadcast("SOUND_Good_Step")


broadcast("SOUND_Good_Step","Position",obj4_x,0,obj4_z)
                                                Targets_Hit = Targets_Hit +
1
                                                obj4_hit = 1 -- object was
hit

                                                print("Stepped on Object 4 -
Target!")

                                        end
                                        if obj4_target == 0 then
                                                broadcast("SOUND_Bad_Step")

broadcast("SOUND_Bad_Step","Position",obj4_x,0,obj4_z)
                                                Obstacles_Hit =
Obstacles_Hit + 1
                                                obj4_hit = 1 -- object was
hit

                                                print("Stepped on Object 4 -
Obstacle!")
```

Study2_Detect Collision RFoot D-FLOW Script

```
                                        end
                                end
                        end
                        --
--------------------------------------------------------
                else
                        if frame_coll[1] ~= 1 then -- if script found a
collision with the other object, then do NOT set this to zero
                                frame_coll[1] = 0
                        end
                end -- AP (Z) and ML (X) Check
        end -- Velocity Check End

        -- -------------------------------------------------------------
        -- -------------------------------------------------------------
        -- ALTERNATE SOUNDS for a "bad step" or a "good miss"
        -- -------------------------------------------------------------
        obj2_zfront_extra = obj2_zfront - 0.02 -- 0.02 is just past object
        obj4_zfront_extra = obj4_zfront - 0.02 -- 0.02 is just past object
        Diff2 = math.abs(Foot_zback - obj2_zfront_extra)
        Diff4 = math.abs(Foot_zback - obj4_zfront_extra)

        -- Has the foot moved past the object??? without a collision??? (we
still are only evaluating when foot is in stance).
        if ((Foot_zback < obj2_zfront_extra) and (Diff2 < 0.05)) and
(obj2_hit == 0) and (obj2_altern_sound == 0) then

                if obj2_target == 1 then
                        broadcast("SOUND_Bad_Step")

broadcast("SOUND_Bad_Step","Position",obj2_x,0,obj2_z)
                        print("Missed Object 2 - Target!")
                end
                if obj2_target == 0 then
                        broadcast("SOUND_Good_Miss")

broadcast("SOUND_Good_Miss","Position",obj2_x,0,obj2_z)
                        print("Missed Object 2 - Obstacle!")
                end
                obj2_altern_sound = 1
        end
        -- -------------------------------------------------------------
        -- Has the foot moved past the object??? without a collision??? (we
still are only evaluating when foot is in stance).
        if ((Foot_zback < obj4_zfront_extra) and (Diff4 < 0.05)) and
(obj4_hit == 0) and (obj4_altern_sound == 0) then

                if obj4_target == 1 then
                        broadcast("SOUND_Bad_Step")

broadcast("SOUND_Bad_Step","Position",obj4_x,0,obj4_z)
                        print("Missed Object 4 - Target!")
                end
                if obj4_target == 0 then
                        broadcast("SOUND_Good_Miss")

broadcast("SOUND_Good_Miss","Position",obj4_x,0,obj4_z)
                        print("Missed Object 4 - Obstacle!")
                end
                obj4_altern_sound = 1
        end
        -- -------------------------------------------------------------
```

Study2_Detect Collision RFoot D-FLOW Script

```
		-- ----------------------------------------------------------------
		-- ----------------------------------------------------------------

		-- -----------------------------------------------------
		-- -----------------------------------------------------
		frame_counter = frame_counter + 1

		Collision_current_frame = frame_coll[1]                 -- current
frame
		Collision_prev_frame = frame_coll[2]                           --
previous frame
		Collision_last_prev_frame = frame_coll[3]                      -- 2
frames ago from current frame
		Collision_prev3_frame = frame_coll[4]                          -- 3
frames ago frames ago

		outputs.set("frame_counter", frame_counter)
		outputs.set("Collision_current_frame", Collision_prev_frame)
		outputs.set("obj2_target", obj2_target)
		outputs.set("obj2_hit", obj2_hit)
		outputs.set("obj2_altern_sound", obj2_altern_sound)
		outputs.set("obj2_x", obj2_x)
		outputs.set("obj2_z", obj2_z)

		outputs.set("obj4_target", obj4_target)
		outputs.set("obj4_hit", obj4_hit)
		outputs.set("obj4_altern_sound", obj4_altern_sound)
		outputs.set("obj4_x", obj4_x)
		outputs.set("obj4_z", obj4_z)

		outputs.set("Foot_xfront", Foot_xfront)
		outputs.set("Foot_zfront", Foot_zfront)
		outputs.set("Foot_xback", Foot_xback)
		outputs.set("Foot_zback", Foot_zback)
		outputs.set("Foot_zfront_vel", Foot_zfront_vel)

		outputs.set("TM_vel", TM_vel)
		outputs.set("Targets_Hit", Targets_Hit)
		outputs.set("Obstacles_Hit", Obstacles_Hit)

		------------------------------------------------
		frame_coll[4] = frame_coll[3]
		frame_coll[3] = frame_coll[2]
		frame_coll[2] = frame_coll[1]
		frame_coll[1] = 0
		-------------------------------------------------
	end

	-- Reset
	if obj2_z > zback then
		obj2_hit = 0 -- reset
		obj2_altern_sound = 0
	end
	if obj4_z > zback then
		obj4_hit = 0 -- reset
		obj4_altern_sound = 0
	end

--end -- which_condition if conditional (only run when in condition 2-3)
```

```
GLM SDLn_NWalk2 SDLn_GoYel2 SDLn_GoRed2 BY Group
 /WSFACTOR=Cond 3 Polynomial
 /METHOD=SSTYPE(3)
 /POSTHOC=Group(BONFERRONI)
 /PLOT=PROFILE(Cond*Group)
 /EMMEANS=TABLES(Group) COMPARE ADJ(LSD)
 /EMMEANS=TABLES(Cond) COMPARE ADJ(LSD)
 /PRINT=DESCRIPTIVE ETASQ OPOWER
 /CRITERIA=ALPHA(.05)
 /WSDESIGN=Cond
 /DESIGN=Group.
```

General Linear Model

Notes

Output Created		05-AUG-2017 16:18:12
Comments		
Input	Data	C:\Users\flyin\Documents\Dissertation\C - Statistics\Aim 2\2017_0606_Aim2_SPSS_WideData_RT_Added.sav
	Active Dataset	DataSet2
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	42
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.

Notes

Syntax		GLM SDLn_NWalk2 SDLn_GoYel2 SDLn_GoRed2 BY Group /WSFACTOR=Cond 3 Polynomial /METHOD=SSTYPE(3) /POSTHOC=Group (BONFERRONI) /PLOT=PROFILE(Cond*Group) /EMMEANS=TABLES(Group) COMPARE ADJ(LSD) /EMMEANS=TABLES(Cond) COMPARE ADJ(LSD) /PRINT=DESCRIPTIVE ETASQ OPOWER /CRITERIA=ALPHA(.05) /WSDESIGN=Cond...
Resources	Processor Time	00:00:00.48
	Elapsed Time	00:00:00.45

Warnings

Post hoc tests are not performed for Group because there are fewer than three groups.

Within-Subjects Factors

Measure: MEASURE_1

Cond	Dependent Variable
1	SDLn_NWalk2
2	SDLn_GoYel2
3	SDLn_GoRed2

Between-Subjects Factors

		N
Group	1	21
	2	21

Descriptive Statistics

	Group	Mean	Std. Deviation	N
SDLn_NWalk2	1	.0266313712	.0085466247	21
	2	.0306389871	.0098160486	21
	Total	.0286351791	.0093138141	42
SDLn_GoYel2	1	.1381061868	.0328672075	21
	2	.1499029864	.0193854232	21
	Total	.1440045866	.0273112977	42
SDLn_GoRed2	1	.1337164644	.0358906392	21
	2	.1508342792	.0320987520	21
	Total	.1422753718	.0347275327	42

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[c]
Cond	Pillai's Trace	.957	431.572[b]	2.000	39.000	.000	.957	863.144	1.000
	Wilks' Lambda	.043	431.572[b]	2.000	39.000	.000	.957	863.144	1.000
	Hotelling's Trace	22.132	431.572[b]	2.000	39.000	.000	.957	863.144	1.000
	Roy's Largest Root	22.132	431.572[b]	2.000	39.000	.000	.957	863.144	1.000
Cond * Group	Pillai's Trace	.045	.909[b]	2.000	39.000	.411	.045	1.819	.196
	Wilks' Lambda	.955	.909[b]	2.000	39.000	.411	.045	1.819	.196
	Hotelling's Trace	.047	.909[b]	2.000	39.000	.411	.045	1.819	.196
	Roy's Largest Root	.047	.909[b]	2.000	39.000	.411	.045	1.819	.196

a. Design: Intercept + Group
Within Subjects Design: Cond

b. Exact statistic

c. Computed using alpha = .05

Mauchly's Test of Sphericity[a]

Measure: MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b] Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Cond	.841	6.732	2	.035	.863	.921	.500

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. Design: Intercept + Group
Within Subjects Design: Cond

b. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Cond	Sphericity Assumed	.367	2	.184	522.963	.000	.929	1045.925	1.000
	Greenhouse-Geisser	.367	1.726	.213	522.963	.000	.929	902.791	1.000
	Huynh-Feldt	.367	1.842	.199	522.963	.000	.929	963.359	1.000
	Lower-bound	.367	1.000	.367	522.963	.000	.929	522.963	1.000
Cond * Group	Sphericity Assumed	.001	2	.000	1.300	.278	.031	2.601	.274
	Greenhouse-Geisser	.001	1.726	.001	1.300	.276	.031	2.245	.255
	Huynh-Feldt	.001	1.842	.000	1.300	.277	.031	2.395	.263
	Lower-bound	.001	1.000	.001	1.300	.261	.031	1.300	.200
Error(Cond)	Sphericity Assumed	.028	80	.000					
	Greenhouse-Geisser	.028	69.052	.000					
	Huynh-Feldt	.028	73.685	.000					
	Lower-bound	.028	40.000	.001					

a. Computed using alpha = .05

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	Cond	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Cond	Linear	.271	1	.271	560.133	.000	.933	560.133	1.000
	Quadratic	.096	1	.096	440.393	.000	.917	440.393	1.000
Cond * Group	Linear	.001	1	.001	1.864	.180	.045	1.864	.266
	Quadratic	1.066E-5	1	1.066E-5	.049	.826	.001	.049	.055
Error(Cond)	Linear	.019	40	.000					
	Quadratic	.009	40	.000					

a. Computed using alpha = .05

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Intercept	1.388	1	1.388	1093.366	.000	.965	1093.366	1.000
Group	.004	1	.004	2.987	.092	.069	2.987	.393
Error	.051	40	.001					

a. Computed using alpha = .05

Estimated Marginal Means

1. Group

Estimates

Measure: MEASURE_1

Group	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	.099	.004	.090	.109
2	.110	.004	.101	.120

Pairwise Comparisons

Measure: MEASURE_1

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
1	2	-.011	.006	.092	-.024	.002
2	1	.011	.006	.092	-.002	.024

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Univariate Tests

Measure: MEASURE_1

	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Contrast	.001	1	.001	2.987	.092	.069	2.987	.393
Error	.017	40	.000					

The F tests the effect of Group. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Computed using alpha = .05

2. Cond

Estimates

Measure: MEASURE_1

Cond	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	.029	.001	.026	.032
2	.144	.004	.136	.152
3	.142	.005	.132	.153

Pairwise Comparisons

Measure: MEASURE_1

(I) Cond	(J) Cond	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b] Lower Bound	Upper Bound
1	2	-.115*	.004	.000	-.123	-.107
	3	-.114*	.005	.000	-.123	-.104
2	1	.115*	.004	.000	.107	.123
	3	.002	.003	.617	-.005	.009
3	1	.114*	.005	.000	.104	.123
	2	-.002	.003	.617	-.009	.005

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Multivariate Tests

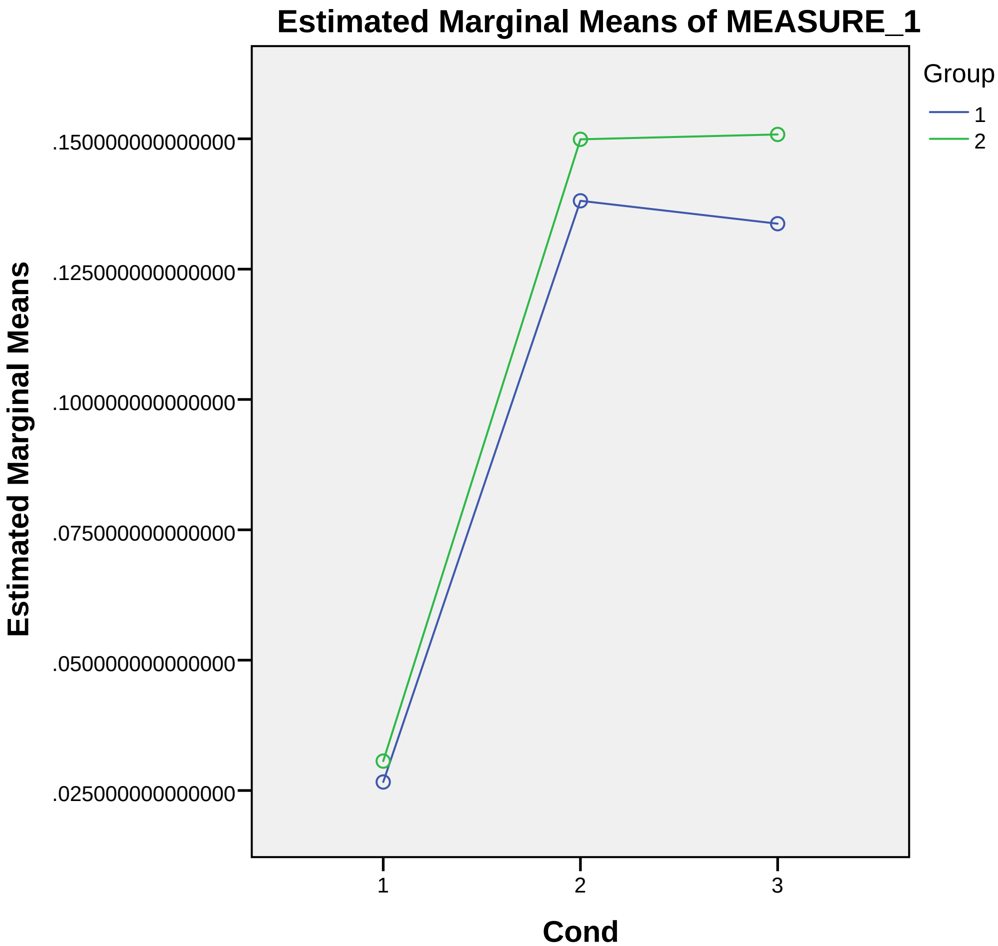
	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Pillai's trace	.957	431.572[a]	2.000	39.000	.000	.957	863.144	1.000
Wilks' lambda	.043	431.572[a]	2.000	39.000	.000	.957	863.144	1.000
Hotelling's trace	22.132	431.572[a]	2.000	39.000	.000	.957	863.144	1.000
Roy's largest root	22.132	431.572[a]	2.000	39.000	.000	.957	863.144	1.000

Each F tests the multivariate effect of Cond. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Exact statistic

b. Computed using alpha = .05

Profile Plots




```
 MANOVA SDLn_NWalk2 SDLn_GoYel2 SDLn_GoRed2 BY Group(1,2)
/WSFACTORS=Cond(3)
/WSDESIGN=MWITHIN Cond(1) MWITHIN Cond(2) MWITHIN Cond(3).
```

Manova

Notes

Output Created		05-AUG-2017 16:18:16
Comments		
Input	Data	C: \Users\flyin\Documents\Dissertation\ C - Statistics\Aim 2\2017_0606_Aim2_SPSS_WideData_RT_Added.sav
	Active Dataset	DataSet2
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	42
Syntax		MANOVA SDLn_NWalk2 SDLn_GoYel2 SDLn_GoRed2 BY Group(1,2) /WSFACTORS=Cond(3) /WSDESIGN=MWITHIN Cond(1) MWITHIN Cond(2) MWITHIN Cond (3).
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.02

```
 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 - - - - - - - - - - - - - - - - - - - - -
The default error term in MANOVA has been changed from WITHIN CELLS to
WITHIN+RESIDUAL.  Note that these are the same for all full factorial designs.
```

```
* * * * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e * *
* * * * * * * * * * * * * * * *

        42 cases accepted.
         0 cases rejected because of out-of-range factor values.
         0 cases rejected because of missing data.
         2 non-empty cells.

         1 design will be processed.

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 - - - - - - - - - - - - - - - - - - - - - -
```

```
* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(1)' Within-Subject Effect.

 Tests of Significance for T1 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL             .00      40       .00
 MWITHIN COND(1)             .03       1       .03    406.60      .000
 Group BY MWITHIN CON        .00       1       .00      1.99      .166
 D(1)

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 - - - - - - - - - - - - - - - - - - - - -
```

```
* * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(2)' Within-Subject Effect.

 Tests of Significance for T2 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS        F  Sig of F

 WITHIN+RESIDUAL             .03      40       .00
 MWITHIN COND(2)             .87       1       .87  1196.34      .000
 Group BY MWITHIN CON        .00       1       .00     2.01      .164
 D(2)

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 - - - - - - - - - - - - - - - - - - - - -
```

* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(3)' Within-Subject Effect.

Tests of Significance for T3 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN+RESIDUAL	.05	40	.00		
MWITHIN COND(3)	.85	1	.85	733.39	.000
Group BY MWITHIN COND(3)	.00	1	.00	2.65	.111

- -

```
GLM SDTn_NWalk2 SDTn_GoYel2 SDTn_GoRed2 BY Group
 /WSFACTOR=Cond 3 Polynomial
 /METHOD=SSTYPE(3)
 /POSTHOC=Group(BONFERRONI)
 /PLOT=PROFILE(Cond*Group)
 /EMMEANS=TABLES(Group) COMPARE ADJ(LSD)
 /EMMEANS=TABLES(Cond) COMPARE ADJ(LSD)
 /PRINT=DESCRIPTIVE ETASQ OPOWER
 /CRITERIA=ALPHA(.05)
 /WSDESIGN=Cond
 /DESIGN=Group.
```

General Linear Model

Notes

Output Created		05-AUG-2017 16:24:41
Comments		
Input	Data	C:\Users\flyin\Documents\Dissertation\C - Statistics\Aim 2\2017_0606_Aim2_SPSS_WideData_RT_Added.sav
	Active Dataset	DataSet2
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	42
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.

Notes

Syntax		GLM SDTn_NWalk2 SDTn_GoYel2 SDTn_GoRed2 BY Group /WSFACTOR=Cond 3 Polynomial /METHOD=SSTYPE(3) /POSTHOC=Group (BONFERRONI) /PLOT=PROFILE(Cond*Group) /EMMEANS=TABLES(Group) COMPARE ADJ(LSD) /EMMEANS=TABLES(Cond) COMPARE ADJ(LSD) /PRINT=DESCRIPTIVE ETASQ OPOWER /CRITERIA=ALPHA(.05) /WSDESIGN=Cond...
Resources	Processor Time	00:00:00.50
	Elapsed Time	00:00:00.46

Warnings

Post hoc tests are not performed for Group because there are fewer than three groups.

Within-Subjects Factors

Measure: MEASURE_1

Cond	Dependent Variable
1	SDTn_NWalk2
2	SDTn_GoYel2
3	SDTn_GoRed2

Between-Subjects Factors

		N
Group	1	21
	2	21

Descriptive Statistics

	Group	Mean	Std. Deviation	N
SDTn_NWalk2	1	.0230801569	.0100331614	21
	2	.0264926379	.0085998131	21
	Total	.0247863974	.0093895311	42
SDTn_GoYel2	1	.0915197522	.0375087759	21
	2	.1132077256	.0274973747	21
	Total	.1023637389	.0342868615	42
SDTn_GoRed2	1	.0864572424	.0389551877	21
	2	.1070377436	.0377181996	21
	Total	.0967474930	.0392772303	42

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[c]
Cond	Pillai's Trace	.861	121.270[b]	2.000	39.000	.000	.861	242.539	1.000
	Wilks' Lambda	.139	121.270[b]	2.000	39.000	.000	.861	242.539	1.000
	Hotelling's Trace	6.219	121.270[b]	2.000	39.000	.000	.861	242.539	1.000
	Roy's Largest Root	6.219	121.270[b]	2.000	39.000	.000	.861	242.539	1.000
Cond * Group	Pillai's Trace	.079	1.683[b]	2.000	39.000	.199	.079	3.366	.333
	Wilks' Lambda	.921	1.683[b]	2.000	39.000	.199	.079	3.366	.333
	Hotelling's Trace	.086	1.683[b]	2.000	39.000	.199	.079	3.366	.333
	Roy's Largest Root	.086	1.683[b]	2.000	39.000	.199	.079	3.366	.333

a. Design: Intercept + Group
Within Subjects Design: Cond

b. Exact statistic

c. Computed using alpha = .05

Mauchly's Test of Sphericity[a]

Measure: MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b] Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Cond	.699	13.982	2	.001	.768	.813	.500

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. Design: Intercept + Group
Within Subjects Design: Cond

b. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Cond	Sphericity Assumed	.157	2	.079	169.287	.000	.809	338.574	1.000
	Greenhouse-Geisser	.157	1.537	.102	169.287	.000	.809	260.184	1.000
	Huynh-Feldt	.157	1.626	.097	169.287	.000	.809	275.308	1.000
	Lower-bound	.157	1.000	.157	169.287	.000	.809	169.287	1.000
Cond * Group	Sphericity Assumed	.002	2	.001	2.374	.100	.056	4.749	.467
	Greenhouse-Geisser	.002	1.537	.001	2.374	.114	.056	3.649	.405
	Huynh-Feldt	.002	1.626	.001	2.374	.111	.056	3.862	.417
	Lower-bound	.002	1.000	.002	2.374	.131	.056	2.374	.324
Error(Cond)	Sphericity Assumed	.037	80	.000					
	Greenhouse-Geisser	.037	61.478	.001					
	Huynh-Feldt	.037	65.051	.001					
	Lower-bound	.037	40.000	.001					

a. Computed using alpha = .05

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	Cond	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Cond	Linear	.109	1	.109	164.813	.000	.805	164.813	1.000
	Quadratic	.048	1	.048	180.273	.000	.818	180.273	1.000
Cond * Group	Linear	.002	1	.002	2.345	.134	.055	2.345	.321
	Quadratic	.001	1	.001	2.446	.126	.058	2.446	.333
Error(Cond)	Linear	.026	40	.001					
	Quadratic	.011	40	.000					

a. Computed using alpha = .05

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Intercept	.702	1	.702	410.342	.000	.911	410.342	1.000
Group	.007	1	.007	4.270	.045	.096	4.270	.523
Error	.068	40	.002					

a. Computed using alpha = .05

Estimated Marginal Means

1. Group

Estimates

Measure: MEASURE_1

Group	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	.067	.005	.056	.078
2	.082	.005	.072	.093

Pairwise Comparisons

Measure: MEASURE_1

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
1	2	-.015*	.007	.045	-.030	.000
2	1	.015*	.007	.045	.000	.030

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Univariate Tests

Measure: MEASURE_1

	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Contrast	.002	1	.002	4.270	.045	.096	4.270	.523
Error	.023	40	.001					

The F tests the effect of Group. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Computed using alpha = .05

2. Cond

Estimates

Measure: MEASURE_1

Cond	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	.025	.001	.022	.028
2	.102	.005	.092	.113
3	.097	.006	.085	.109

Pairwise Comparisons

Measure: MEASURE_1

(I) Cond	(J) Cond	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
1	2	-.078*	.005	.000	-.088	-.068
	3	-.072*	.006	.000	-.083	-.061
2	1	.078*	.005	.000	.068	.088
	3	.006	.003	.094	-.001	.012
3	1	.072*	.006	.000	.061	.083
	2	-.006	.003	.094	-.012	.001

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Multivariate Tests

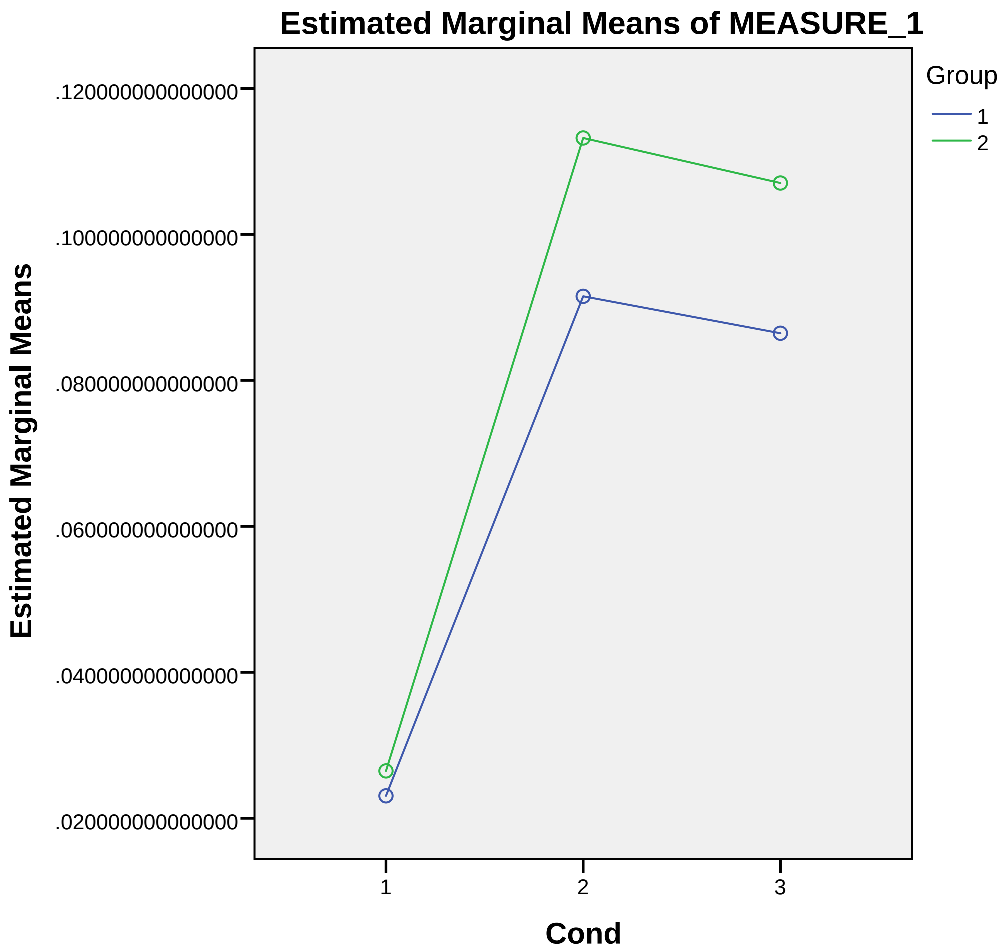
	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Pillai's trace	.861	121.270[a]	2.000	39.000	.000	.861	242.539	1.000
Wilks' lambda	.139	121.270[a]	2.000	39.000	.000	.861	242.539	1.000
Hotelling's trace	6.219	121.270[a]	2.000	39.000	.000	.861	242.539	1.000
Roy's largest root	6.219	121.270[a]	2.000	39.000	.000	.861	242.539	1.000

Each F tests the multivariate effect of Cond. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Exact statistic

b. Computed using alpha = .05

Profile Plots




```
 MANOVA SDTn_NWalk2 SDTn_GoYel2 SDTn_GoRed2 BY Group(1,2)
/WSFACTORS=Cond(3)
/WSDESIGN=MWITHIN Cond(1) MWITHIN Cond(2) MWITHIN Cond(3).
```

Manova

Notes

Output Created		05-AUG-2017 16:25:12
Comments		
Input	Data	C:\Users\flyin\Documents\Dissertation\C - Statistics\Aim 2\2017_0606_Aim2_SPSS_WideData_RT_Added.sav
	Active Dataset	DataSet2
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	42
Syntax		MANOVA SDTn_NWalk2 SDTn_GoYel2 SDTn_GoRed2 BY Group(1,2) /WSFACTORS=Cond(3) /WSDESIGN=MWITHIN Cond(1) MWITHIN Cond(2) MWITHIN Cond (3).
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00

\- -

The default error term in MANOVA has been changed from WITHIN CELLS to WITHIN+RESIDUAL. Note that these are the same for all full factorial designs.

```
* * * * * * * * * * * * * * * * * *A n a l y s i s   o f   V a r i a n c e * *
* * * * * * * * * * * * * * *

        42 cases accepted.
         0 cases rejected because of out-of-range factor values.
         0 cases rejected because of missing data.
         2 non-empty cells.

         1 design will be processed.

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```

```
* * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(1)' Within-Subject Effect.

 Tests of Significance for T1 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL             .00      40       .00
 MWITHIN COND(1)             .03       1       .03    295.54      .000
 Group BY MWITHIN CON        .00       1       .00      1.40      .244
 D(1)

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```

```
* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(2)' Within-Subject Effect.

 Tests of Significance for T2 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL             .04      40       .00
 MWITHIN COND(2)             .44       1       .44    406.92      .000
 Group BY MWITHIN CON        .00       1       .00      4.57      .039
 D(2)

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 - - - - - - - - - - - - - - - - - - - - -
```

```
* * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(3)' Within-Subject Effect.

 Tests of Significance for T3 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL             .06      40       .00
 MWITHIN COND(3)             .39       1       .39    267.42      .000
 Group BY MWITHIN CON        .00       1       .00      3.03      .090
 D(3)

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```

```
GLM SDSn_NWalk2 SDSn_GoYel2 SDSn_GoRed2 BY Group
  /WSFACTOR=Cond 3 Polynomial
  /METHOD=SSTYPE(3)
  /POSTHOC=Group(BONFERRONI)
  /PLOT=PROFILE(Cond*Group)
  /EMMEANS=TABLES(Group) COMPARE ADJ(LSD)
  /EMMEANS=TABLES(Cond) COMPARE ADJ(LSD)
  /PRINT=DESCRIPTIVE ETASQ OPOWER
  /CRITERIA=ALPHA(.05)
  /WSDESIGN=Cond
  /DESIGN=Group.
```

General Linear Model

Notes

Output Created		05-AUG-2017 16:27:10
Comments		
Input	Data	C:\Users\flyin\Documents\Dissertation\C - Statistics\Aim 2\2017_0606_Aim2_SPSS_WideData_RT_Added.sav
	Active Dataset	DataSet2
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	42
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.

Notes

Syntax		GLM SDSn_NWalk2 SDSn_GoYel2 SDSn_GoRed2 BY Group /WSFACTOR=Cond 3 Polynomial /METHOD=SSTYPE(3) /POSTHOC=Group (BONFERRONI) /PLOT=PROFILE(Cond*Group) /EMMEANS=TABLES(Group) COMPARE ADJ(LSD) /EMMEANS=TABLES(Cond) COMPARE ADJ(LSD) /PRINT=DESCRIPTIVE ETASQ OPOWER /CRITERIA=ALPHA(.05) /WSDESIGN=Cond...
Resources	Processor Time	00:00:00.47
	Elapsed Time	00:00:00.42

Warnings

Post hoc tests are not performed for Group because there are fewer than three groups.

Within-Subjects Factors

Measure: MEASURE_1

Cond	Dependent Variable
1	SDSn_NWalk2
2	SDSn_GoYel2
3	SDSn_GoRed2

Between-Subjects Factors

		N
Group	1	21
	2	21

Descriptive Statistics

	Group	Mean	Std. Deviation	N
SDSn_NWalk2	1	.0206457871	.0056370245	21
	2	.0224835996	.0043856009	21
	Total	.0215646933	.0050742178	42
SDSn_GoYel2	1	.0840981290	.0156257564	21
	2	.0976987092	.0152480185	21
	Total	.0908984191	.0167299733	42
SDSn_GoRed2	1	.0792628527	.0192594749	21
	2	.0913977501	.0160342914	21
	Total	.0853303014	.0185490140	42

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[c]
Cond	Pillai's Trace	.968	581.272[b]	2.000	39.000	.000	.968	1162.544	1.000
	Wilks' Lambda	.032	581.272[b]	2.000	39.000	.000	.968	1162.544	1.000
	Hotelling's Trace	29.809	581.272[b]	2.000	39.000	.000	.968	1162.544	1.000
	Roy's Largest Root	29.809	581.272[b]	2.000	39.000	.000	.968	1162.544	1.000
Cond * Group	Pillai's Trace	.172	4.063[b]	2.000	39.000	.025	.172	8.127	.689
	Wilks' Lambda	.828	4.063[b]	2.000	39.000	.025	.172	8.127	.689
	Hotelling's Trace	.208	4.063[b]	2.000	39.000	.025	.172	8.127	.689
	Roy's Largest Root	.208	4.063[b]	2.000	39.000	.025	.172	8.127	.689

a. Design: Intercept + Group
Within Subjects Design: Cond

b. Exact statistic

c. Computed using alpha = .05

Mauchly's Test of Sphericity[a]

Measure: MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b] Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Cond	.970	1.202	2	.548	.971	1.000	.500

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. Design: Intercept + Group
Within Subjects Design: Cond

b. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Cond	Sphericity Assumed	.125	2	.062	520.701	.000	.929	1041.402	1.000
	Greenhouse-Geisser	.125	1.941	.064	520.701	.000	.929	1010.723	1.000
	Huynh-Feldt	.125	2.000	.062	520.701	.000	.929	1041.402	1.000
	Lower-bound	.125	1.000	.125	520.701	.000	.929	520.701	1.000
Cond * Group	Sphericity Assumed	.001	2	.000	3.604	.032	.083	7.209	.652
	Greenhouse-Geisser	.001	1.941	.000	3.604	.033	.083	6.996	.642
	Huynh-Feldt	.001	2.000	.000	3.604	.032	.083	7.209	.652
	Lower-bound	.001	1.000	.001	3.604	.065	.083	3.604	.457
Error(Cond)	Sphericity Assumed	.010	80	.000					
	Greenhouse-Geisser	.010	77.643	.000					
	Huynh-Feldt	.010	80.000	.000					
	Lower-bound	.010	40.000	.000					

a. Computed using alpha = .05

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	Cond	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Cond	Linear	.085	1	.085	657.682	.000	.943	657.682	1.000
	Quadratic	.039	1	.039	358.399	.000	.900	358.399	1.000
Cond * Group	Linear	.001	1	.001	4.288	.045	.097	4.288	.524
	Quadratic	.000	1	.000	2.795	.102	.065	2.795	.371
Error(Cond)	Linear	.005	40	.000					
	Quadratic	.004	40	.000					

a. Computed using alpha = .05

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Intercept	.548	1	.548	1618.320	.000	.976	1618.320	1.000
Group	.003	1	.003	7.862	.008	.164	7.862	.781
Error	.014	40	.000					

a. Computed using alpha = .05

Estimated Marginal Means

1. Group

Estimates

Measure: MEASURE_1

Group	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	.061	.002	.057	.066
2	.071	.002	.066	.075

Pairwise Comparisons

Measure: MEASURE_1

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
1	2	-.009*	.003	.008	-.016	-.003
2	1	.009*	.003	.008	.003	.016

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Univariate Tests

Measure: MEASURE_1

	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Contrast	.001	1	.001	7.862	.008	.164	7.862	.781
Error	.005	40	.000					

The F tests the effect of Group. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Computed using alpha = .05

2. Cond

Estimates

Measure: MEASURE_1

Cond	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	.022	.001	.020	.023
2	.091	.002	.086	.096
3	.085	.003	.080	.091

Pairwise Comparisons

Measure: MEASURE_1

(I) Cond	(J) Cond	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b] Lower Bound	Upper Bound
1	2	-.069*	.002	.000	-.074	-.065
	3	-.064*	.002	.000	-.069	-.059
2	1	.069*	.002	.000	.065	.074
	3	.006*	.002	.031	.001	.011
3	1	.064*	.002	.000	.059	.069
	2	-.006*	.002	.031	-.011	-.001

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Multivariate Tests

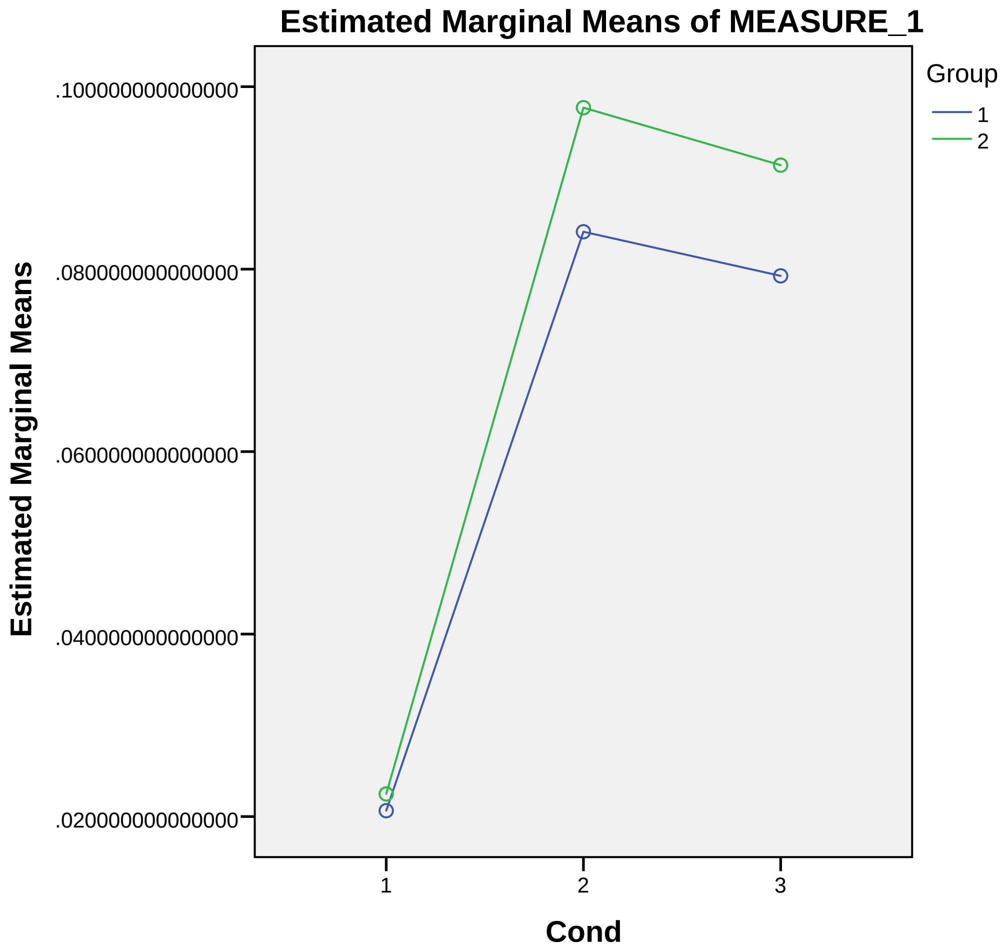
	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Pillai's trace	.968	581.272[a]	2.000	39.000	.000	.968	1162.544	1.000
Wilks' lambda	.032	581.272[a]	2.000	39.000	.000	.968	1162.544	1.000
Hotelling's trace	29.809	581.272[a]	2.000	39.000	.000	.968	1162.544	1.000
Roy's largest root	29.809	581.272[a]	2.000	39.000	.000	.968	1162.544	1.000

Each F tests the multivariate effect of Cond. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Exact statistic

b. Computed using alpha = .05

Profile Plots




```
MANOVA SDSn_NWalk2 SDSn_GoYel2 SDSn_GoRed2 BY Group(1,2)
/WSFACTORS=Cond(3)
/WSDESIGN=MWITHIN Cond(1) MWITHIN Cond(2) MWITHIN Cond(3).
```

Manova

Notes

Output Created		05-AUG-2017 16:27:32
Comments		
Input	Data	C: \Users\flyin\Documents\Dissertation\C - Statistics\Aim 2\2017_0606_Aim2_SPSS_WideData_RT_Added.sav
	Active Dataset	DataSet2
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	42
Syntax		MANOVA SDSn_NWalk2 SDSn_GoYel2 SDSn_GoRed2 BY Group(1,2) /WSFACTORS=Cond(3) /WSDESIGN=MWITHIN Cond(1) MWITHIN Cond(2) MWITHIN Cond (3).
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.04

```
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 - - - - - - - - - - - - - - - - - - - - -
The default error term in MANOVA has been changed from WITHIN CELLS to
WITHIN+RESIDUAL.  Note that these are the same for all full factorial designs.
```

```
* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e * *
* * * * * * * * * * * * * * * *


        42 cases accepted.
         0 cases rejected because of out-of-range factor values.
         0 cases rejected because of missing data.
         2 non-empty cells.

         1 design will be processed.

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```

```
* * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(1)' Within-Subject Effect.

 Tests of Significance for T1 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL             .00      40       .00
 MWITHIN COND(1)             .02       1       .02    765.80      .000
 Group BY MWITHIN CON        .00       1       .00      1.39      .245
 D(1)

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 - - - - - - - - - - - - - - - - - - - - -
```

```
* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(2)' Within-Subject Effect.

 Tests of Significance for T2 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL             .01      40       .00
 MWITHIN COND(2)             .35       1       .35   1456.05      .000
 Group BY MWITHIN CON        .00       1       .00      8.15      .007
 D(2)

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 - - - - - - - - - - - - - - - - - - - - -
```

```
* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(3)' Within-Subject Effect.

 Tests of Significance for T3 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL             .01      40       .00
 MWITHIN COND(3)             .31       1       .31    973.89      .000
 Group BY MWITHIN CON        .00       1       .00      4.92      .032
 D(3)

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 - - - - - - - - - - - - - - - - - - - - -
```

```
GLM AlphaLn_NWalk2 AlphaLn_GoYel2 AlphaLn_GoRed2 BY Group
 /WSFACTOR=Cond 3 Polynomial
 /METHOD=SSTYPE(3)
 /POSTHOC=Group(BONFERRONI)
 /PLOT=PROFILE(Cond*Group)
 /EMMEANS=TABLES(Group) COMPARE ADJ(LSD)
 /EMMEANS=TABLES(Cond) COMPARE ADJ(LSD)
 /PRINT=DESCRIPTIVE ETASQ OPOWER
 /CRITERIA=ALPHA(.05)
 /WSDESIGN=Cond
 /DESIGN=Group.
```

General Linear Model

Notes

Output Created		05-AUG-2017 16:29:21
Comments		
Input	Data	C: \Users\flyin\Documents\Dissertation\C - Statistics\Aim 2\2017_0606_Aim2_SPSS_WideData_RT_Added.sav
	Active Dataset	DataSet2
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	42
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.

Notes

Syntax		GLM AlphaLn_NWalk2 AlphaLn_GoYel2 AlphaLn_GoRed2 BY Group /WSFACTOR=Cond 3 Polynomial /METHOD=SSTYPE(3) /POSTHOC=Group (BONFERRONI) /PLOT=PROFILE(Cond*Group) /EMMEANS=TABLES(Group) COMPARE ADJ(LSD) /EMMEANS=TABLES(Cond) COMPARE ADJ(LSD) /PRINT=DESCRIPTIVE ETASQ OPOWER /CRITERIA=ALPHA(.05) /WSDESIGN=Cond...
Resources	Processor Time	00:00:00.67
	Elapsed Time	00:00:00.52

Warnings

Post hoc tests are not performed for Group because there are fewer than three groups.

Within-Subjects Factors

Measure: MEASURE_1

Cond	Dependent Variable
1	AlphaLn_NWalk2
2	AlphaLn_GoYel2
3	AlphaLn_GoRed2

Between-Subjects Factors

		N
Group	1	21
	2	21

Descriptive Statistics

	Group	Mean	Std. Deviation	N
AlphaLn_NWalk2	1	.6623287342	.1368468258	21
	2	.7095067196	.1250845310	21
	Total	.6859177269	.1316716516	42
AlphaLn_GoYel2	1	.2036833084	.1664893490	21
	2	.2910393217	.2287469353	21
	Total	.2473613151	.2024847806	42
AlphaLn_GoRed2	1	.2238442608	.1490450890	21
	2	.3293439680	.2240548361	21
	Total	.2765941144	.1953837462	42

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[c]
Cond	Pillai's Trace	.799	77.748[b]	2.000	39.000	.000	.799	155.496	1.000
	Wilks' Lambda	.201	77.748[b]	2.000	39.000	.000	.799	155.496	1.000
	Hotelling's Trace	3.987	77.748[b]	2.000	39.000	.000	.799	155.496	1.000
	Roy's Largest Root	3.987	77.748[b]	2.000	39.000	.000	.799	155.496	1.000
Cond * Group	Pillai's Trace	.017	.333[b]	2.000	39.000	.718	.017	.667	.099
	Wilks' Lambda	.983	.333[b]	2.000	39.000	.718	.017	.667	.099
	Hotelling's Trace	.017	.333[b]	2.000	39.000	.718	.017	.667	.099
	Roy's Largest Root	.017	.333[b]	2.000	39.000	.718	.017	.667	.099

a. Design: Intercept + Group
Within Subjects Design: Cond

b. Exact statistic

c. Computed using alpha = .05

Mauchly's Test of Sphericity[a]

Measure: MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b]		
					Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Cond	.835	7.017	2	.030	.859	.916	.500

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. Design: Intercept + Group
Within Subjects Design: Cond

b. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Cond	Sphericity Assumed	5.050	2	2.525	112.033	.000	.737	224.066	1.000
	Greenhouse-Geisser	5.050	1.717	2.941	112.033	.000	.737	192.386	1.000
	Huynh-Feldt	5.050	1.832	2.757	112.033	.000	.737	205.214	1.000
	Lower-bound	5.050	1.000	5.050	112.033	.000	.737	112.033	1.000
Cond * Group	Sphericity Assumed	.019	2	.009	.415	.662	.010	.830	.115
	Greenhouse-Geisser	.019	1.717	.011	.415	.631	.010	.713	.110
	Huynh-Feldt	.019	1.832	.010	.415	.644	.010	.760	.112
	Lower-bound	.019	1.000	.019	.415	.523	.010	.415	.096
Error(Cond)	Sphericity Assumed	1.803	80	.023					
	Greenhouse-Geisser	1.803	68.689	.026					
	Huynh-Feldt	1.803	73.269	.025					
	Lower-bound	1.803	40.000	.045					

a. Computed using alpha = .05

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	Cond	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Cond	Linear	3.518	1	3.518	132.840	.000	.769	132.840	1.000
	Quadratic	1.532	1	1.532	82.390	.000	.673	82.390	1.000
Cond * Group	Linear	.018	1	.018	.674	.416	.017	.674	.126
	Quadratic	.001	1	.001	.046	.832	.001	.046	.055
Error(Cond)	Linear	1.059	40	.026					
	Quadratic	.744	40	.019					

a. Computed using alpha = .05

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Intercept	20.493	1	20.493	423.956	.000	.914	423.956	1.000
Group	.202	1	.202	4.172	.048	.094	4.172	.513
Error	1.934	40	.048					

a. Computed using alpha = .05

Estimated Marginal Means

1. Group

Estimates

Measure: MEASURE_1

Group	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	.363	.028	.307	.419
2	.443	.028	.387	.499

Pairwise Comparisons

Measure: MEASURE_1

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
1	2	-.080*	.039	.048	-.159	-.001
2	1	.080*	.039	.048	.001	.159

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Univariate Tests

Measure: MEASURE_1

	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Contrast	.067	1	.067	4.172	.048	.094	4.172	.513
Error	.645	40	.016					

The F tests the effect of Group. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Computed using alpha = .05

2. Cond

Estimates

Measure: MEASURE_1

Cond	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	.686	.020	.645	.727
2	.247	.031	.185	.310
3	.277	.029	.217	.336

Pairwise Comparisons

Measure: MEASURE_1

(I) Cond	(J) Cond	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b] Lower Bound	Upper Bound
1	2	.439*	.036	.000	.365	.512
	3	.409*	.036	.000	.338	.481
2	1	-.439*	.036	.000	-.512	-.365
	3	-.029	.025	.254	-.080	.022
3	1	-.409*	.036	.000	-.481	-.338
	2	.029	.025	.254	-.022	.080

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Multivariate Tests

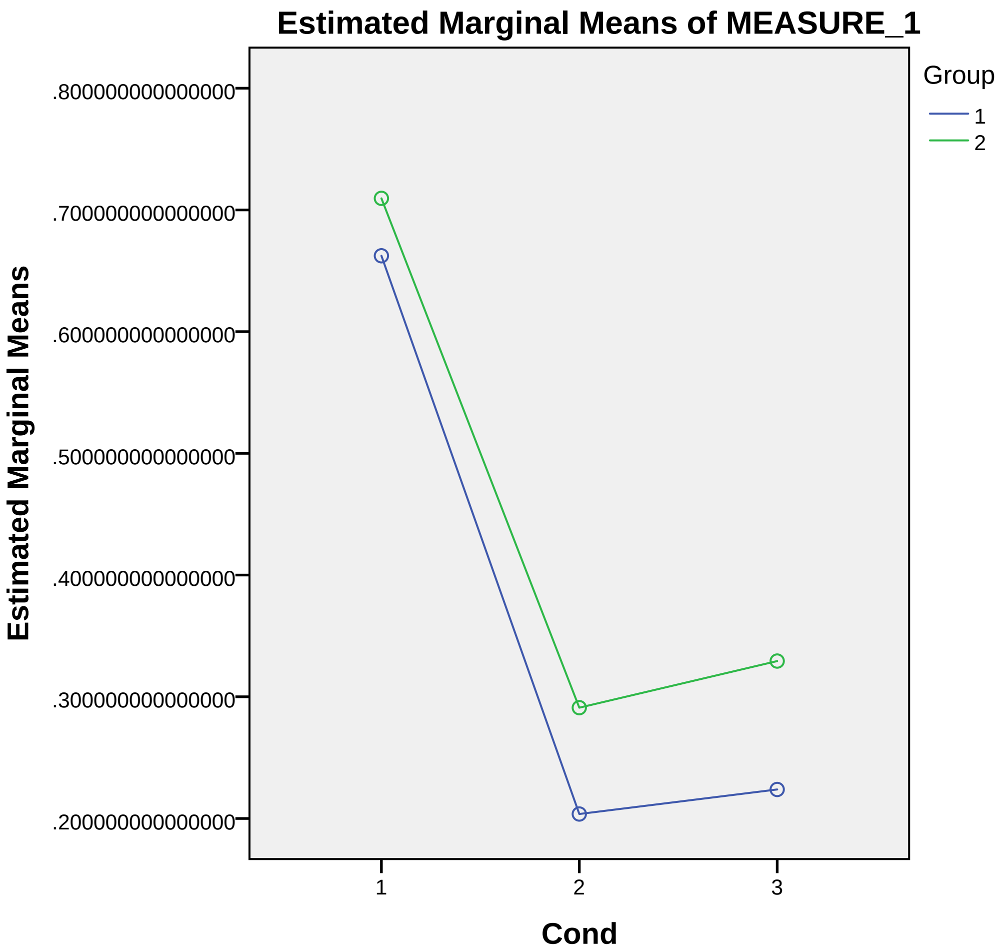
	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Pillai's trace	.799	77.748[a]	2.000	39.000	.000	.799	155.496	1.000
Wilks' lambda	.201	77.748[a]	2.000	39.000	.000	.799	155.496	1.000
Hotelling's trace	3.987	77.748[a]	2.000	39.000	.000	.799	155.496	1.000
Roy's largest root	3.987	77.748[a]	2.000	39.000	.000	.799	155.496	1.000

Each F tests the multivariate effect of Cond. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Exact statistic

b. Computed using alpha = .05

Profile Plots




```
MANOVA AlphaLn_NWalk2 AlphaLn_GoYel2 AlphaLn_GoRed2 BY Group(1,2)
/WSFACTORS=Cond(3)
/WSDESIGN=MWITHIN Cond(1) MWITHIN Cond(2) MWITHIN Cond(3).
```

Manova

Notes

Output Created		05-AUG-2017 16:30:00
Comments		
Input	Data	C: \Users\flyin\Documents\Dissertation\C - Statistics\Aim 2\2017_0606_Aim2_SPSS_WideData_RT_Added.sav
	Active Dataset	DataSet2
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	42
Syntax		MANOVA AlphaLn_NWalk2 AlphaLn_GoYel2 AlphaLn_GoRed2 BY Group(1,2) /WSFACTORS=Cond(3) /WSDESIGN=MWITHIN Cond(1) MWITHIN Cond(2) MWITHIN Cond (3).
Resources	Processor Time	00:00:00.03
	Elapsed Time	00:00:00.03

```
 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 - - - - - - - - - - - - - - - - - - - - -
The default error term in MANOVA has been changed from WITHIN CELLS to
WITHIN+RESIDUAL.  Note that these are the same for all full factorial designs.
```

* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e * * * * * * * * * * * * * * * * * * *

```
42 cases accepted.
 0 cases rejected because of out-of-range factor values.
 0 cases rejected because of missing data.
 2 non-empty cells.

 1 design will be processed.
```

- -

* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D esign   1 * * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(1)' Within-Subject Effect.

Tests of Significance for T1 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN+RESIDUAL	.69	40	.02		
MWITHIN COND(1)	19.76	1	19.76	1149.75	.000
Group BY MWITHIN COND(1)	.02	1	.02	1.36	.250

- -

```
* * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(2)' Within-Subject Effect.

 Tests of Significance for T2 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL            1.60      40       .04
 MWITHIN COND(2)            2.57       1      2.57     64.21      .000
 Group BY MWITHIN CON        .08       1       .08      2.00      .165
 D(2)

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 - - - - - - - - - - - - - - - - - - - - -
```

```
* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(3)' Within-Subject Effect.

 Tests of Significance for T3 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL            1.45      40       .04
 MWITHIN COND(3)            3.21       1      3.21     88.74      .000
 Group BY MWITHIN CON        .12       1       .12      3.23      .080
 D(3)

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 - - - - - - - - - - - - - - - - - - - - -
```

```
GLM AlphaTn_NWalk2 AlphaTn_GoYel2 AlphaTn_GoRed2 BY Group
 /WSFACTOR=Cond 3 Polynomial
 /METHOD=SSTYPE(3)
 /POSTHOC=Group(BONFERRONI)
 /PLOT=PROFILE(Cond*Group)
 /EMMEANS=TABLES(Group) COMPARE ADJ(LSD)
 /EMMEANS=TABLES(Cond) COMPARE ADJ(LSD)
 /PRINT=DESCRIPTIVE ETASQ OPOWER
 /CRITERIA=ALPHA(.05)
 /WSDESIGN=Cond
 /DESIGN=Group.
```

General Linear Model

Notes

Output Created		05-AUG-2017 16:32:08
Comments		
Input	Data	C: \Users\flyin\Documents\Dissertation\C - Statistics\Aim 2\2017_0606_Aim2_SPSS_WideData_RT_Added.sav
	Active Dataset	DataSet2
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	42
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.

Notes

Syntax		GLM AlphaTn_NWalk2 AlphaTn_GoYel2 AlphaTn_GoRed2 BY Group /WSFACTOR=Cond 3 Polynomial /METHOD=SSTYPE(3) /POSTHOC=Group (BONFERRONI) /PLOT=PROFILE(Cond*Group) /EMMEANS=TABLES(Group) COMPARE ADJ(LSD) /EMMEANS=TABLES(Cond) COMPARE ADJ(LSD) /PRINT=DESCRIPTIVE ETASQ OPOWER /CRITERIA=ALPHA(.05) /WSDESIGN=Cond...
Resources	Processor Time	00:00:00.39
	Elapsed Time	00:00:00.43

Warnings

Post hoc tests are not performed for Group because there are fewer than three groups.

Within-Subjects Factors

Measure: MEASURE_1

Cond	Dependent Variable
1	AlphaTn_NWalk2
2	AlphaTn_GoYel2
3	AlphaTn_GoRed2

Between-Subjects Factors

		N
Group	1	21
	2	21

Descriptive Statistics

	Group	Mean	Std. Deviation	N
AlphaTn_NWalk2	1	.6906704784	.1055750676	21
	2	.7684590282	.1318297804	21
	Total	.7295647533	.1243558850	42
AlphaTn_GoYel2	1	.3667966277	.1732804955	21
	2	.4187272089	.1672832032	21
	Total	.3927619183	.1702589311	42
AlphaTn_GoRed2	1	.3515666263	.1564079257	21
	2	.4704037235	.1987464359	21
	Total	.4109851749	.1865969561	42

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[c]
Cond	Pillai's Trace	.725	51.516[b]	2.000	39.000	.000	.725	103.032	1.000
	Wilks' Lambda	.275	51.516[b]	2.000	39.000	.000	.725	103.032	1.000
	Hotelling's Trace	2.642	51.516[b]	2.000	39.000	.000	.725	103.032	1.000
	Roy's Largest Root	2.642	51.516[b]	2.000	39.000	.000	.725	103.032	1.000
Cond * Group	Pillai's Trace	.052	1.070[b]	2.000	39.000	.353	.052	2.140	.224
	Wilks' Lambda	.948	1.070[b]	2.000	39.000	.353	.052	2.140	.224
	Hotelling's Trace	.055	1.070[b]	2.000	39.000	.353	.052	2.140	.224
	Roy's Largest Root	.055	1.070[b]	2.000	39.000	.353	.052	2.140	.224

a. Design: Intercept + Group
Within Subjects Design: Cond

b. Exact statistic

c. Computed using alpha = .05

Mauchly's Test of Sphericity[a]

Measure: MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b] Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Cond	.798	8.824	2	.012	.832	.885	.500

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. Design: Intercept + Group
Within Subjects Design: Cond

b. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Cond	Sphericity Assumed	3.014	2	1.507	76.567	.000	.657	153.134	1.000
	Greenhouse-Geisser	3.014	1.663	1.812	76.567	.000	.657	127.348	1.000
	Huynh-Feldt	3.014	1.770	1.703	76.567	.000	.657	135.522	1.000
	Lower-bound	3.014	1.000	3.014	76.567	.000	.657	76.567	1.000
Cond * Group	Sphericity Assumed	.024	2	.012	.607	.547	.015	1.215	.148
	Greenhouse-Geisser	.024	1.663	.014	.607	.519	.015	1.010	.139
	Huynh-Feldt	.024	1.770	.014	.607	.528	.015	1.075	.142
	Lower-bound	.024	1.000	.024	.607	.440	.015	.607	.118
Error(Cond)	Sphericity Assumed	1.574	80	.020					
	Greenhouse-Geisser	1.574	66.529	.024					
	Huynh-Feldt	1.574	70.799	.022					
	Lower-bound	1.574	40.000	.039					

a. Computed using alpha = .05

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	Cond	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Cond	Linear	2.131	1	2.131	90.102	.000	.693	90.102	1.000
	Quadratic	.882	1	.882	56.180	.000	.584	56.180	1.000
Cond * Group	Linear	.009	1	.009	.374	.544	.009	.374	.092
	Quadratic	.015	1	.015	.959	.333	.023	.959	.159
Error(Cond)	Linear	.946	40	.024					
	Quadratic	.628	40	.016					

a. Computed using alpha = .05

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Intercept	32.915	1	32.915	917.108	.000	.958	917.108	1.000
Group	.216	1	.216	6.025	.019	.131	6.025	.668
Error	1.436	40	.036					

a. Computed using alpha = .05

Estimated Marginal Means

1. Group

Estimates

Measure: MEASURE_1

Group	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	.470	.024	.421	.518
2	.553	.024	.504	.601

Pairwise Comparisons

Measure: MEASURE_1

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
1	2	-.083*	.034	.019	-.151	-.015
2	1	.083*	.034	.019	.015	.151

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Univariate Tests

Measure: MEASURE_1

	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Contrast	.072	1	.072	6.025	.019	.131	6.025	.668
Error	.479	40	.012					

The F tests the effect of Group. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Computed using alpha = .05

2. Cond

Estimates

Measure: MEASURE_1

Cond	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	.730	.018	.692	.767
2	.393	.026	.340	.446
3	.411	.028	.355	.467

Pairwise Comparisons

Measure: MEASURE_1

(I) Cond	(J) Cond	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b] Lower Bound	Upper Bound
1	2	.337*	.034	.000	.268	.406
	3	.319*	.034	.000	.251	.386
2	1	-.337*	.034	.000	-.406	-.268
	3	-.018	.023	.427	-.064	.028
3	1	-.319*	.034	.000	-.386	-.251
	2	.018	.023	.427	-.028	.064

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Multivariate Tests

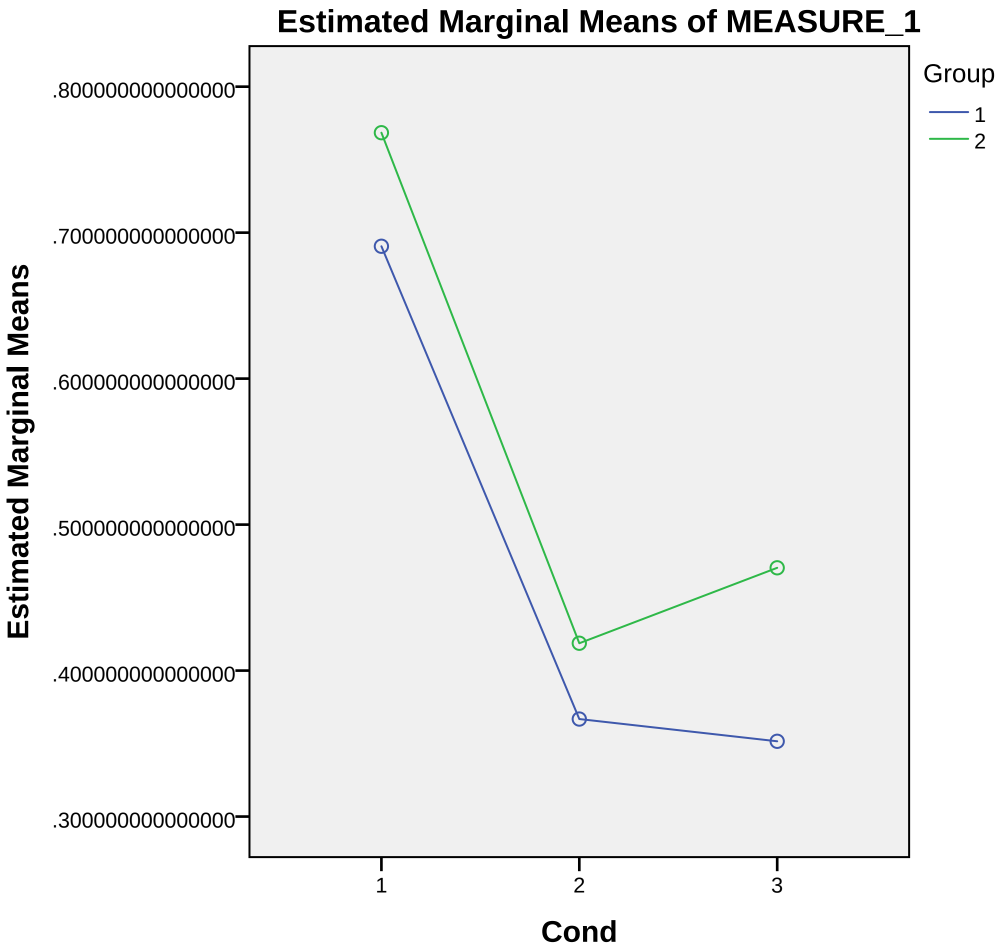
	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Pillai's trace	.725	51.516[a]	2.000	39.000	.000	.725	103.032	1.000
Wilks' lambda	.275	51.516[a]	2.000	39.000	.000	.725	103.032	1.000
Hotelling's trace	2.642	51.516[a]	2.000	39.000	.000	.725	103.032	1.000
Roy's largest root	2.642	51.516[a]	2.000	39.000	.000	.725	103.032	1.000

Each F tests the multivariate effect of Cond. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Exact statistic

b. Computed using alpha = .05

Profile Plots




```
MANOVA AlphaTn_NWalk2 AlphaTn_GoYel2 AlphaTn_GoRed2 BY Group(1,2)
/WSFACTORS=Cond(3)
/WSDESIGN=MWITHIN Cond(1) MWITHIN Cond(2) MWITHIN Cond(3).
```

Manova

Notes

Output Created		05-AUG-2017 16:32:31
Comments		
Input	Data	C: \Users\flyin\Documents\Dissertation\C - Statistics\Aim 2\2017_0606_Aim2_SPSS_WideData_RT_Added.sav
	Active Dataset	DataSet2
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	42
Syntax		MANOVA AlphaTn_NWalk2 AlphaTn_GoYel2 AlphaTn_GoRed2 BY Group(1,2) /WSFACTORS=Cond(3) /WSDESIGN=MWITHIN Cond(1) MWITHIN Cond(2) MWITHIN Cond (3).
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.02

```
 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 - - - - - - - - - - - - - - - - - - - - -
The default error term in MANOVA has been changed from WITHIN CELLS to
WITHIN+RESIDUAL.  Note that these are the same for all full factorial designs.
```

* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e * * * * * * * * * * * * * * * * * * *

```
42 cases accepted.
 0 cases rejected because of out-of-range factor values.
 0 cases rejected because of missing data.
 2 non-empty cells.

 1 design will be processed.
```

- -

* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(1)' Within-Subject Effect.

Tests of Significance for T1 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN+RESIDUAL	.57	40	.01		
MWITHIN COND(1)	22.36	1	22.36	1567.40	.000
Group BY MWITHIN CON D(1)	.06	1	.06	4.45	.041

- -

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* * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(2)' Within-Subject Effect.

 Tests of Significance for T2 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL            1.16      40       .03
 MWITHIN COND(2)            6.48       1      6.48    223.38      .000
 Group BY MWITHIN CON        .03       1       .03       .98      .329
 D(2)

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* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(3)' Within-Subject Effect.

 Tests of Significance for T3 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL            1.28      40       .03
 MWITHIN COND(3)            7.09       1      7.09    221.82      .000
 Group BY MWITHIN CON        .15       1       .15      4.64      .037
 D(3)

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 - - - - - - - - - - - - - - - - - - - - -
```

```
GLM AlphaSn_NWalk2 AlphaSn_GoYel2 AlphaSn_GoRed2 BY Group
 /WSFACTOR=Cond 3 Polynomial
 /METHOD=SSTYPE(3)
 /POSTHOC=Group(BONFERRONI)
 /PLOT=PROFILE(Cond*Group)
 /EMMEANS=TABLES(Group) COMPARE ADJ(LSD)
 /EMMEANS=TABLES(Cond) COMPARE ADJ(LSD)
 /PRINT=DESCRIPTIVE ETASQ OPOWER
 /CRITERIA=ALPHA(.05)
 /WSDESIGN=Cond
 /DESIGN=Group.
```

General Linear Model

Notes

Output Created		05-AUG-2017 16:34:09
Comments		
Input	Data	C:\Users\flyin\Documents\Dissertation\C - Statistics\Aim 2\2017_0606_Aim2_SPSS_WideData_RT_Added.sav
	Active Dataset	DataSet2
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	Split File	<none>
	N of Rows in Working Data File	42
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.

Notes

Syntax		GLM AlphaSn_NWalk2 AlphaSn_GoYel2 AlphaSn_GoRed2 BY Group /WSFACTOR=Cond 3 Polynomial /METHOD=SSTYPE(3) /POSTHOC=Group (BONFERRONI) /PLOT=PROFILE(Cond*Group) /EMMEANS=TABLES(Group) COMPARE ADJ(LSD) /EMMEANS=TABLES(Cond) COMPARE ADJ(LSD) /PRINT=DESCRIPTIVE ETASQ OPOWER /CRITERIA=ALPHA(.05) /WSDESIGN=Cond...
Resources	Processor Time	00:00:00.47
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Warnings

Post hoc tests are not performed for Group because there are fewer than three groups.

Within-Subjects Factors

Measure: MEASURE_1

Cond	Dependent Variable
1	AlphaSn_NWalk2
2	AlphaSn_GoYel2
3	AlphaSn_GoRed2

Between-Subjects Factors

		N
Group	1	21
	2	21

Descriptive Statistics

	Group	Mean	Std. Deviation	N
AlphaSn_NWalk2	1	.3261815423	.0986232652	21
	2	.3628792500	.0964857880	21
	Total	.3445303962	.0981365019	42
AlphaSn_GoYel2	1	.2017142612	.0850875037	21
	2	.2787683104	.0869105028	21
	Total	.2402412858	.0934707864	42
AlphaSn_GoRed2	1	.2052901963	.0638202604	21
	2	.3026836241	.0841652902	21
	Total	.2539869102	.0887218141	42

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[c]
Cond	Pillai's Trace	.432	14.852[b]	2.000	39.000	.000	.432	29.703	.998
	Wilks' Lambda	.568	14.852[b]	2.000	39.000	.000	.432	29.703	.998
	Hotelling's Trace	.762	14.852[b]	2.000	39.000	.000	.432	29.703	.998
	Roy's Largest Root	.762	14.852[b]	2.000	39.000	.000	.432	29.703	.998
Cond * Group	Pillai's Trace	.061	1.260[b]	2.000	39.000	.295	.061	2.520	.258
	Wilks' Lambda	.939	1.260[b]	2.000	39.000	.295	.061	2.520	.258
	Hotelling's Trace	.065	1.260[b]	2.000	39.000	.295	.061	2.520	.258
	Roy's Largest Root	.065	1.260[b]	2.000	39.000	.295	.061	2.520	.258

a. Design: Intercept + Group
Within Subjects Design: Cond

b. Exact statistic

c. Computed using alpha = .05

Mauchly's Test of Sphericity[a]

Measure: MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b] Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Cond	.918	3.336	2	.189	.924	.991	.500

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. Design: Intercept + Group
Within Subjects Design: Cond

b. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Cond	Sphericity Assumed	.270	2	.135	19.586	.000	.329	39.171	1.000
	Greenhouse-Geisser	.270	1.848	.146	19.586	.000	.329	36.203	1.000
	Huynh-Feldt	.270	1.983	.136	19.586	.000	.329	38.829	1.000
	Lower-bound	.270	1.000	.270	19.586	.000	.329	19.586	.991
Cond * Group	Sphericity Assumed	.020	2	.010	1.456	.239	.035	2.911	.303
	Greenhouse-Geisser	.020	1.848	.011	1.456	.240	.035	2.691	.291
	Huynh-Feldt	.020	1.983	.010	1.456	.239	.035	2.886	.301
	Lower-bound	.020	1.000	.020	1.456	.235	.035	1.456	.218
Error(Cond)	Sphericity Assumed	.551	80	.007					
	Greenhouse-Geisser	.551	73.939	.007					
	Huynh-Feldt	.551	79.300	.007					
	Lower-bound	.551	40.000	.014					

a. Computed using alpha = .05

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	Cond	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Cond	Linear	.172	1	.172	22.908	.000	.364	22.908	.997
	Quadratic	.098	1	.098	15.593	.000	.280	15.593	.971
Cond * Group	Linear	.019	1	.019	2.574	.117	.060	2.574	.347
	Quadratic	.001	1	.001	.112	.740	.003	.112	.062
Error(Cond)	Linear	.301	40	.008					
	Quadratic	.250	40	.006					

a. Computed using alpha = .05

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Intercept	9.849	1	9.849	1129.041	.000	.966	1129.041	1.000
Group	.156	1	.156	17.887	.000	.309	17.887	.985
Error	.349	40	.009					

a. Computed using alpha = .05

Estimated Marginal Means

1. Group

Estimates

Measure: MEASURE_1

Group	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	.244	.012	.221	.268
2	.315	.012	.291	.339

Pairwise Comparisons

Measure: MEASURE_1

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
1	2	-.070*	.017	.000	-.104	-.037
2	1	.070*	.017	.000	.037	.104

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Univariate Tests

Measure: MEASURE_1

	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Contrast	.052	1	.052	17.887	.000	.309	17.887	.985
Error	.116	40	.003					

The F tests the effect of Group. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Computed using alpha = .05

2. Cond

Estimates

Measure: MEASURE_1

Cond	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	.345	.015	.314	.375
2	.240	.013	.213	.267
3	.254	.012	.231	.277

Pairwise Comparisons

Measure: MEASURE_1

(I) Cond	(J) Cond	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b] Lower Bound	Upper Bound
1	2	.104*	.020	.000	.064	.144
	3	.091*	.019	.000	.052	.129
2	1	-.104*	.020	.000	-.144	-.064
	3	-.014	.015	.376	-.045	.017
3	1	-.091*	.019	.000	-.129	-.052
	2	.014	.015	.376	-.017	.045

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Multivariate Tests

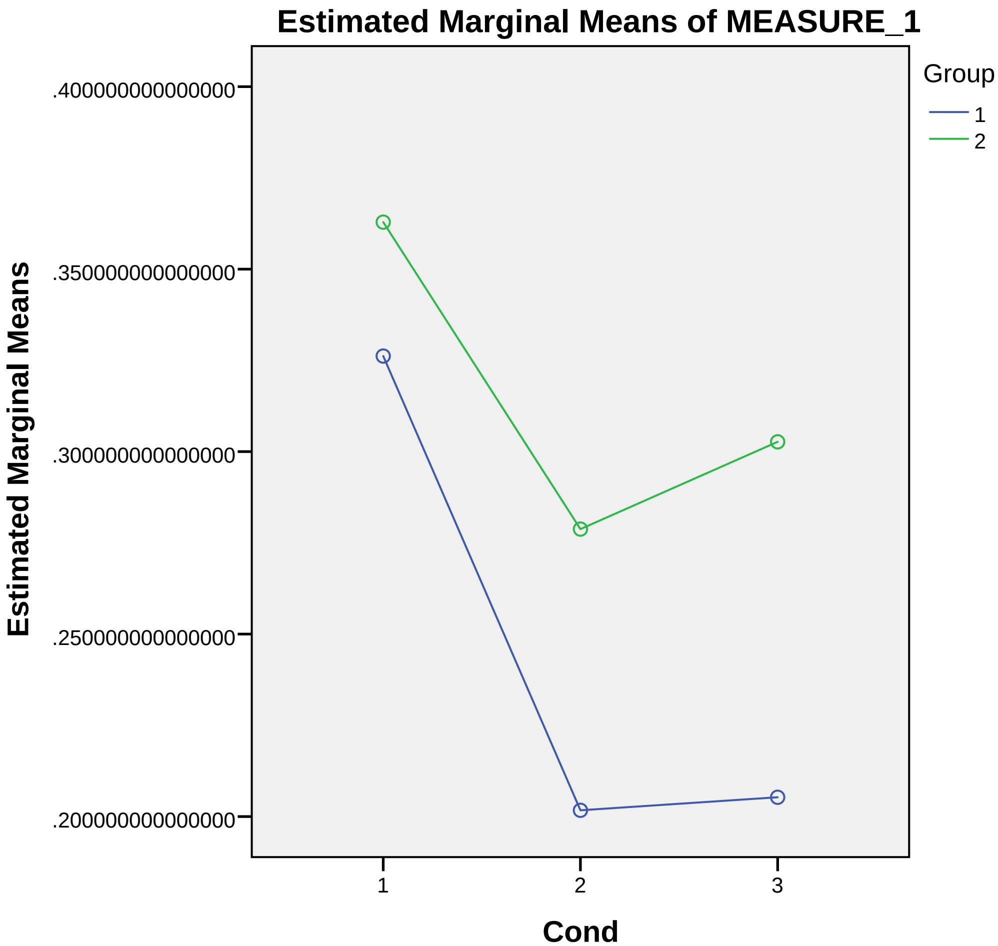
	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Pillai's trace	.432	14.852[a]	2.000	39.000	.000	.432	29.703	.998
Wilks' lambda	.568	14.852[a]	2.000	39.000	.000	.432	29.703	.998
Hotelling's trace	.762	14.852[a]	2.000	39.000	.000	.432	29.703	.998
Roy's largest root	.762	14.852[a]	2.000	39.000	.000	.432	29.703	.998

Each F tests the multivariate effect of Cond. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Exact statistic

b. Computed using alpha = .05

Profile Plots




```
 MANOVA AlphaSn_NWalk2 AlphaSn_GoYel2 AlphaSn_GoRed2 BY Group(1,2)
/WSFACTORS=Cond(3)
/WSDESIGN=MWITHIN Cond(1) MWITHIN Cond(2) MWITHIN Cond(3).
```

Manova

Notes

Output Created		05-AUG-2017 16:34:26
Comments		
Input	Data	C: \Users\flyin\Documents\Dissertation\C - Statistics\Aim 2\2017_0606_Aim2_SPSS_WideData_RT_Added.sav
	Active Dataset	DataSet2
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	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	42
Syntax		MANOVA AlphaSn_NWalk2 AlphaSn_GoYel2 AlphaSn_GoRed2 BY Group(1,2) /WSFACTORS=Cond(3) /WSDESIGN=MWITHIN Cond(1) MWITHIN Cond(2) MWITHIN Cond (3).
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.03

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```
The default error term in MANOVA has been changed from WITHIN CELLS to
WITHIN+RESIDUAL.  Note that these are the same for all full factorial designs.
```

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42 cases accepted.
0 cases rejected because of out-of-range factor values.
0 cases rejected because of missing data.
2 non-empty cells.

1 design will be processed.

- -

```
* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(1)' Within-Subject Effect.

 Tests of Significance for T1 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL             .38      40       .01
 MWITHIN COND(1)            4.99       1      4.99    523.79      .000
 Group BY MWITHIN CON        .01       1       .01      1.49      .230
 D(1)

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* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(2)' Within-Subject Effect.

 Tests of Significance for T2 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL             .30      40       .01
 MWITHIN COND(2)            2.42       1      2.42    327.72      .000
 Group BY MWITHIN CON        .06       1       .06      8.43      .006
 D(2)

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* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- D
esign   1 * * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN COND(3)' Within-Subject Effect.

 Tests of Significance for T3 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL             .22      40       .01
 MWITHIN COND(3)            2.71       1      2.71    485.69      .000
 Group BY MWITHIN CON        .10       1       .10     17.85      .000
 D(3)

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 - - - - - - - - - - - - - - - - - - - - - -
```

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