Gait & Posture 63 (2018) 1–4

Contents lists available at ScienceDirect

Gait & Posture

journal homepage: www.elsevier.com/locate/gaitpost

Short communication

Increased practice of a standing motor sequence task in healthy young and healthy elders: Short communication

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ARTICLE INFO

Keywords:
Postural control
Motor learning
Implicit sequence-specific learning
Healthy elder
Healthy young
Continuous tracking task

ABSTRACT

Background: Sequence-specific learning (SSL); the ability to implicitly integrate repeated sequences compared to random sequences during a motor sequence paradigm, is impaired in healthy elders (HE) compared to healthy young (HY). Prior studies have provided limited practice (small repetitions and only 1 to 3 days).
Research question: Using a standing, postural control task we sought to assess if more practice (7 days) would remediate the differences observed in SSL for HE.
Methods: We used a continuous tracking task following a sinusoidal path of randomly presented random and repeated patterns. Root mean square error (RMSE) was the primary dependent variable, and the difference in RMSE between the random and repeated sequences was calculated to determine if SSL occurred.
Results: Improvement in SSL was documented as a decreasing value of the mean repeated sequence and less or no change in the random sequence. Eight HY and 8 HE practiced the repeated sequences 420 times over 7 days. No differences were observed between the groups on cognition, balance, and mobility. HE did not demonstrate the ability to integrate the repeated sequence on day 1, but with increased practice, they integrated the repeated sequence similar to HY by the end of practice. The results of this study suggest that sustained practice over 7 days remediated differences in performance of a standing, implicit, sequence-specific task between HY and HE.
Significance: Clinically, it is important to provide individuals with sufficient practice amount to achieve integration of a standing task. Results suggest that older adults need more practice to demonstrate SSL.

1. Introduction

Sequence-specific learning (SSL), defined as the ability to implicitly integrate repeated sequences compared to random sequences during a motor sequence paradigm, has been found to be impaired in healthy elder (HE) compared to healthy young (HY) [1–3]. Prior studies have assessed sequence-specific performance for only one to three days using serial reaction time and continuous tracking tasks [1,2,4]. In this study HE and HY practiced a standing, postural control task for 7 days to determine if prolonged practice would diminish the delay in implicit SSL observed in HE compared to HY [5,6]. Individuals were asked to track a target across a screen, tracking either a repeating pattern or random patterns (without knowledge of the repeating pattern; Fig. 1). Assessment of implicit SSL was stated to occur if there was a greater improvement in performance (accuracy of tracking) in the repeating pattern compared to the random patterns over time.

We sought to assess if increased practice would remediate the differences in SSL for HE. We hypothesized that after increased practice, both HE and HY would demonstrate SSL. We further hypothesized no difference between the groups would be observed at the end of increased practice.

2. Methods

2.1. Participants

Sixteen participants were recruited from within the Departments of Physical Therapy and Athletic Training at the University of Utah (UU) and the community of the greater Salt Lake City area, and provided informed consent in compliance with the UU Institutional Review Board. A priori power analyses was based on the significant within group effect size observed from our previous study. 1 With an (effect size, f statistic 0.50), power of 0.80, and alpha of 0.05, a total sample size of 10 was suggested as a minimum.

Inclusion criteria were 1) ability to stand 10 min at a time, 2) no uncorrected vision loss (able to see screen), 3) no conditions affecting their mobility or balance, e.g. arthritis, vestibular concerns, and 4) English speaking. Age for healthy young (HY) was ≤ 40 years of age

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https://doi.org/10.1016/j.gaitpost.2018.04.028
Received 11 August 2017; Received in revised form 18 April 2018; Accepted 19 April 2018

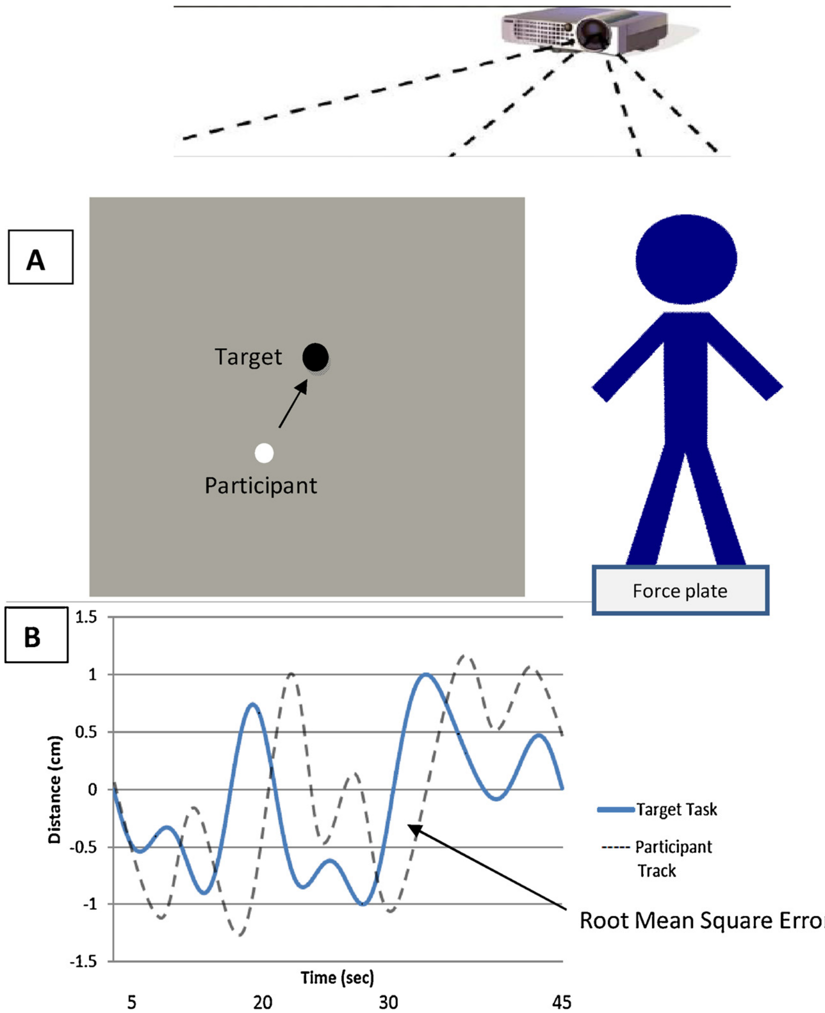

Fig. 1. The experimental set up. (A) Individual is standing on a force plate looking at a screen projected with 2 dots, the white dot is the participant's projection of their center of mass, and they are instructed to "track the target (black dot) as accurately as possible" as it moves across the screen. (B) Data is analyzed based on the root mean square error, which is the difference between the target and the participant track.

Table 1
Demographic, Cognitive, and Balance and Mobility Data for each group. Mean and Standard Deviation are presented with 95% confidence interval. Significance established a $p < 0.05$.

Variable	Healthy Young, N = 8 Mean (Std Dev) 95% CI	Healthy Elder, N = 8 Mean (Std Dev) 95% CI	*p*-value
DEMOGRAPHIC DATA			
Age (years)	22.63 (3.66) 19.56–25.69	63.63 (10.07) 55.21–72.04	–
Gender (F:M)	4:4	3:5	–
COGNITIVE			
Montreal Cognitive Assessment (max 30)	28.13 (1.55) 26.83–29.42	26.63 (2.13) 24.84–28.41	0.13
Trail Making Test Part B (seconds)	42.00 (10.71) 33.05–50.96	50.99 (15.93) 37.67–64.30c	0.21
MOBILITY AND BALANCE			
Berg Balance Scale (max 56)	56 (0)	55.88 (0.35) 55.58–56	0.33
Modified Dynamic Gait Index (max 64)	62.63 (2.00) 60.96–64.73	62.50 (2.67) 60.27–64.73	0.92

and healthy elders (HE) 41–90 years of age.

2.2. Pre-training assessment of participants

All participants completed a pre-training assessment to obtain demographic data (age and gender), cognitive, balance, and mobility status. Previous research has implicated overall cognitive status influences skill acquisition [7]. We assessed cognition using: 1) Montreal Cognitive Assessment, and 2) Trail Making Test Part B. The experimental task required upright postural control, therefore, we assessed postural control competence using: 1) Berg Balance Score, and 2) modified Dynamic Gait Index. All measures are reliable and valid [8–11].

2.3. Practice

The experimental setup and all details have been explained in our prior study [1]. Simply, individuals stood on a force place (moment data were collected at 200 Hz [12]) and were asked to shift their weight forward and backward to track the target cursor, as accurately as possible, as it crossed the screen in a sinusoidal motion (45 s for a repeated and random pattern to cross) Individuals practiced for 7 days, performing 6 blocks of training each day. One block consisted of 20 trials of an alternating and randomized order of the repeated pattern (10 trials) and random patterns (10 trials). One block took approximately