Using Noise to Enhance Transfer and Retention of Complex Motor Skills from Virtual to Real Environment

NECO Lab.

Abstract

It is imperative to determine what kinds of practice methods are effective in improving motor skills, not only to apply them to sports but also to understand the relationship between the brain and motor learning. Increased sensorimotor variability can strengthen motor skills, while virtual environments can provide immersive and flexible learning environment. This resaerch will examine whether inducing variability in virtual environment can enhance transfer and retention of complex motor skills to real-world.

Keywords: Virtual Environment, Head-Mounted Display, Motor Learning, Variability

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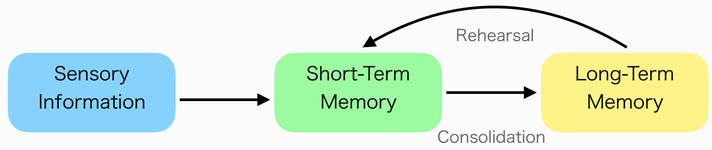
Motivation

Virtual Environment as a Training Platform

Virtual Environments (VEs) provide a safe, realistic, and interactive learning environment with the opportunity for repeated practice. However, a relatively small number of studies have explored motor skill acquisition and transfer from virtual to real environments [1]. Moreover, even fewer studies have used Head-Mounted Displays (HMDs) as VE.

Motor Skill Consolidation

Newly acquired motor skills become stabilized through consolidation, which represents the process by which motor skills are transformed from an initial fragile state to a more solid state. **Motor skills can be modified and enhanced through exposure to increased sensorimotor variability** [2], **and contextual variability can strengthen retention** [3]. However, whether inducing variability in VEs enhances transfer and retention to real-world tasks is unknown.



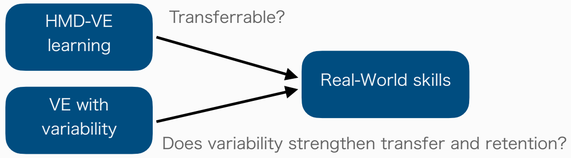
Problem

- Does motor learning in VEs transfer to real environment, and what is effective learning strategy to improve and strengthen retention of motor skills?

Hypothesis

I. Motor learning in VE using HMD transfers to real environment.

II. Inducing variability in motor learning under VE enhances transfer and retention in the real world.



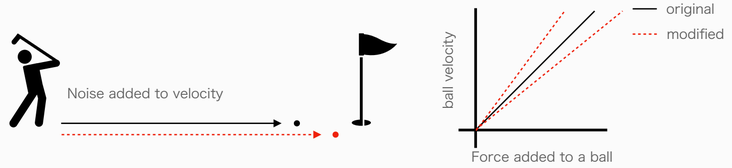
Approach

Using Noise in VE learning

Golf putting will be used as a motor learning task in this research. In order to test if inducing variability in VE can strengthen motor skill transfer and retention in the real-world, sensorimotor noise will be added to golf putting. For the virtual golf settings, Meta Quest 2 will be used as a HMD, and the golf putting environment will be implemented by Unity. A participant will use Meta Quest 2 controller as a putter.

Noise Implementation

The trajectory of a golf ball is determined by vector of the ball, and friction of surface. Noise will be added by changing the velocity of a golf ball in VE.



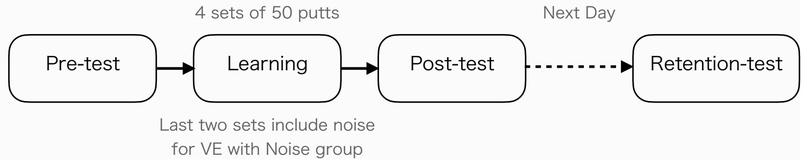
Experiment

Participants

Participants will be divided into three groups (VE learing group, VE learning with Noise group, and real-world learning group). Because motor skill experience affects consolidation and retention, **all participants should be novices at golf puttings**.

Learning and Test Phases

Experiment has four phases, pre-test, learning phase, post-test, and retention-test. During the learning phase, all participants will complete four sessions consisting of 50 putts. For a group practicing with noise in VE, noise will be added in the last two sessions, so that the participants can consolidate skill without noise in the first two sessions.



Evaluation

Pre-, Post-, and Retention test

During the test phase, all participants will complete 30 putts in the real-world settings. A participant's skill level is measured by the distance to the center of a target. In order to evaluate the motor skill preservation, retention test will be held in the next day of learning.

Schedule

	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.
Implementation								
Virtual golf putting								
Training system in VE								
Prepare real-world settings								
Experiment (at least 24 participants)								
Paper work								
Intro, background, and method								
Result, discussion, and concl.								
Presentation work								

References

1. Levac D, Huber M, Sternad D. Learning and transfer of complex motor skills in virtual reality: A perspective review. Journal of NeuroEngineering and Rehabilitation, (2019), 16(1).

2. Wymbs N, Bastian A, Celnik P. Motor skills are strengthend through reconsolidation. Current Biology, (2016), 338-343, 26(3).

3. Shea, J.B., and Morgan, R.L. Contextual interference effects on the acquisition, retention, and transfer of a motor skill. Journal of Experimental Psychology: Human Learning and Memory, (1979) 5, 179-187