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

NECO Lab.

Abstract

It is important 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 an immersive and flexible learning environment. This research will examine whether inducing variability in a virtual environment can enhance the transfer and retention of complex motor skills to the 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. **Consolidated 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.
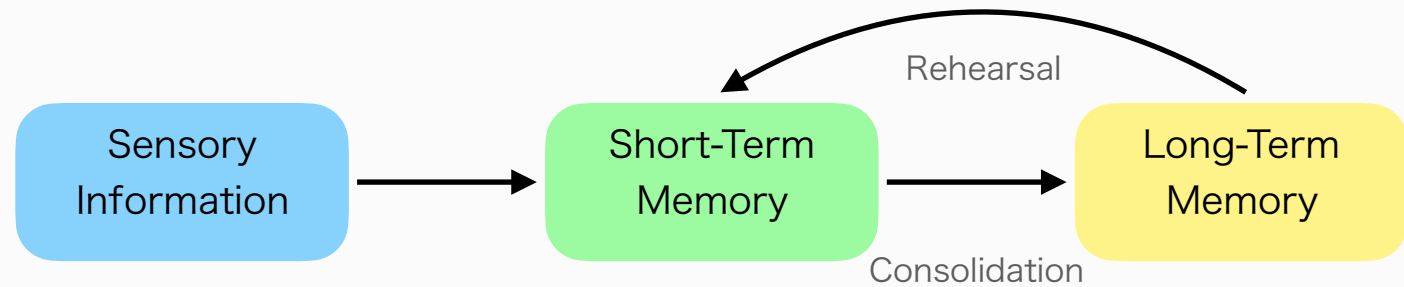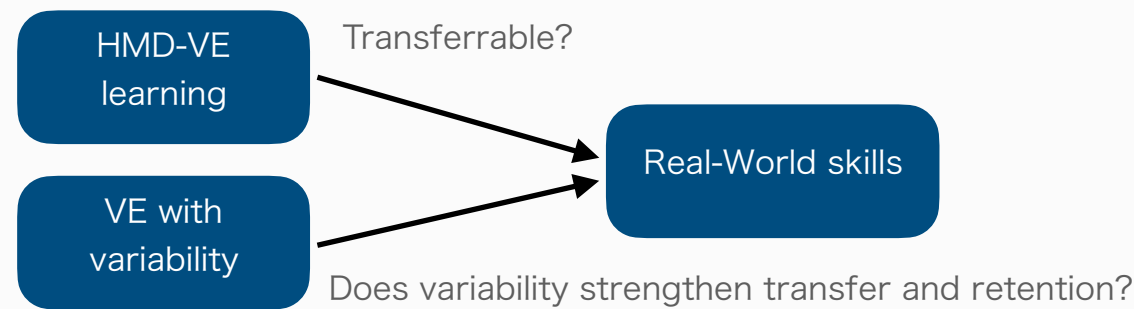

Problem

■ 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

This research will use golf putting as a motor learning task, and sensorimotor noise will be added to golf putting. For the virtual golf settings, Meta Quest 2 will be used as an HMD, and the golf putting environment will be implemented by using Unity. Participants will use a controller attached to a golf handle accessory as a putter.

Meta Quest 2   Putter for VE

■ Noise Implementation

The trajectory of a golf ball is determined by the vector of a ball, and the friction of the surface. Noise will be added by changing the velocity of a golf ball in VE, and the magnitude of the noise will be small so that participants will **not** notice the change.
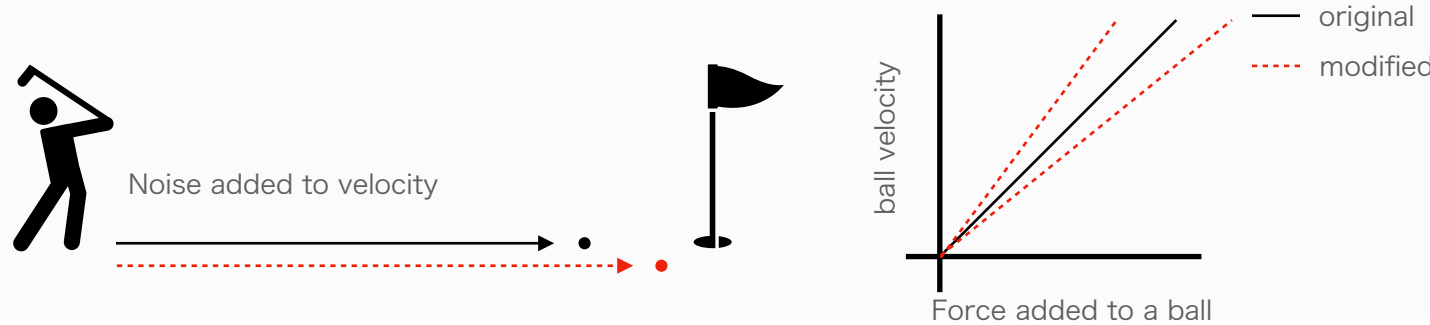

Experiment

■ Participants

Participants will be divided into three groups (VE learning 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

The 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, the noise will be added in the last two sessions, so that the participants can consolidate skills without noise in the first two sessions.
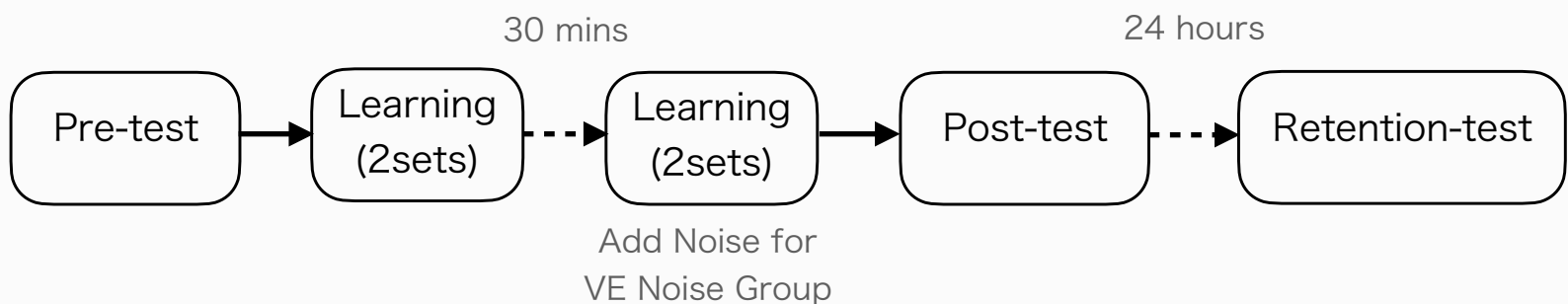
Evaluation

■ Pre-, Post-, and Retention test

During the test phase, all participants will complete 30 putts in real-world settings. A participant's skill level is measured by the distance to the center of a target. To evaluate motor skill preservation, a retention test will be held on 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)								
Writing Thesis								
Intro, background, and method								
Result, discussion, and concl.								
Presentation work								

References

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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