

YOU ARE INVITED TO ATTEND THE  
DEFENSE OF THE DOCTORAL  
DISSERTATION

**“Enhancing Exercise Intensity, Motivation and Enjoyment for  
Healthy Adults and Persons with Parkinson Disease during Virtual  
Reality Bicycling (VCYCLE-Competition)”**

by

John L. Palmieri

M.D./Ph.D. Program

B.S. 2017, New Jersey Institute of Technology, Newark, NJ

Thesis Advisor:

Judith E. Deutsch, PT Ph.D.

Professor, Department of Rehabilitation & Movement Sciences, Rutgers  
University

<https://rutgers.zoom.us/j/95156481128?pwd=NE5jT3dERXlmcDArMnRJdDEVtnRudz09>

Monday, March 20<sup>th</sup>, 2023

10:00 A.M.

Stanley S. Bergen Building, Dean’s Conference Room (133), Zoom

## Abstract

Fully-immersive virtual reality (VR) may be a valuable tool for enhancing exercise intensity and motivation to improve adherence to exercise. Particularly for persons with Parkinson Disease (PD), VR may be useful for promoting intense exercise as visual feedback and competition administered in VR may help increase movement speed. However, exercise intensity and motivation have not been studied extensively during competitive exercise in VR for persons with PD or healthy older adults. The purpose of this thesis is to investigate exercise intensity, motivation and enjoyment, and visual attention during a single session of VR bicycling incorporating visual feedback and competition to study differences across the lifespan (healthy young adults compared to older adults) and health condition (persons with PD compared to older adults).

Results indicate that young and older healthy adults (n=25 each) responded similarly to the VR bicycling conditions, both exercising at a moderate-vigorous intensity in the feedback and competition conditions and focusing on the task for over 70% of each trial. For the combined sample of healthy adults, competitive stimuli fostered higher exercise intensity and motivation than feedback. Persons with PD (n=22) achieved moderate-vigorous intensity in both competition and feedback bicycling, motivation and enjoyment were both rated favorably, and visual attention indicated high task focus. On average, participants with PD bicycled over 80-90 revolutions per minute, a target cadence reported in the exercise literature to possibly reduce motor disease severity. Though there were no differences in motivation, enjoyment, or task focus comparing feedback to competition, participants with PD exercised at a higher intensity (higher cadence and heart rate) in competition.

These findings provide preliminary evidence in support of the use of VR to drive high-intensity and enjoyable exercise for persons with PD. This study was also the first to investigate competitiveness in persons with PD and their response to competitive exercise in VR, with findings suggesting that the use of competitive stimuli may enhance bicycling intensity. However, larger samples may be necessary to detect differences in motivation, enjoyment, and attention. Future studies should also implement similar VR simulations over longer durations to investigate long-term adherence to intense exercise.