Therapeutic Use of Sailing for People with Physical Disabilities: Virtual Reality to Reality

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Certified Instructor

Outline:

1. Sailing as an Intervention
2. Virtual Reality Sailing Simulation
3. Virtual Reality to Reality
   - Phase I Research: Virtual Reality Sailing Simulation and Quality of Life of Persons with Physical Disabilities
   - Phase II Research: Adapted Sailing and Quality of Life of Persons with Physical Disabilities

Background

- Sailing as leisure and sport

- Sailing as a recreational therapy (RT) intervention for people with disabilities

Autry, C., & Anderson, S. (2016). Therapeutic use of sailing. In J. Dattilo & A. McKenney (Eds.), *Facilitation techniques in therapeutic recreation* (3rd ed.). College State, PA: Venture Publishing, Inc.

- Virtual reality sailing simulation for people with disabilities

The Therapeutic Use of Sailing

Sailing is pursued for both recreation and competitive sport purposes. Participation in sailing by people with disabilities is regarded as having positive outcomes on their quality of life. However, evidence-based research is lacking (Autry and Anderson, 2016).

Common constraints to sailing are: knowledge and skill of sailing, access to sailboats, swimming skills, financial resources, and the perception that sailing is elitist and dangerous (Recio, et al.). As such, persons with disabilities typically do not choose sailing as recreation or sport.

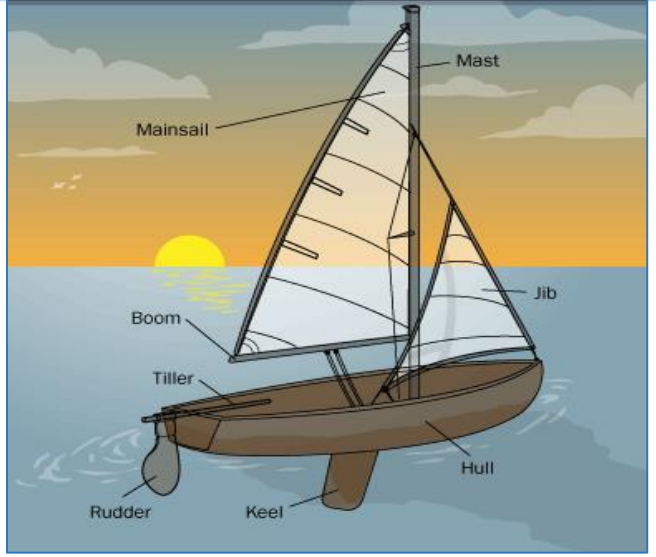
The Therapeutic Use of Sailing

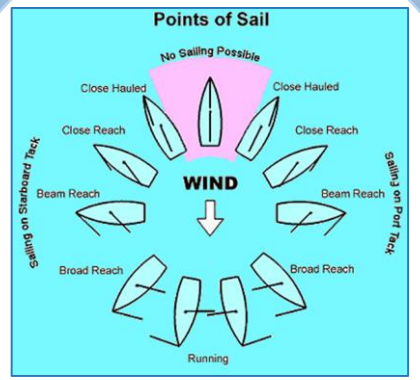
Sailing Principles

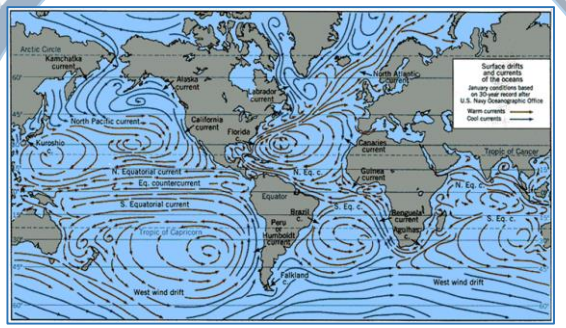
- Boat Design (hull shape and sails)
- Wind Direction
- Water Current
- Navigation

The Sailboat

- Learning a new “language”
- Examples of parts:
  - Mast
  - Keel
  - Rudder
  - Tiller
  - Mainsail
  - Jib







The Therapeutic Use of Sailing

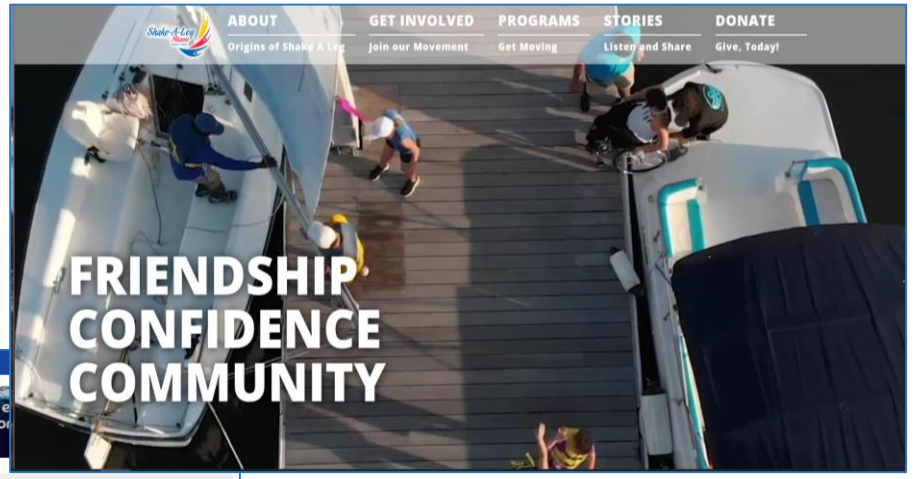
Adaptations:

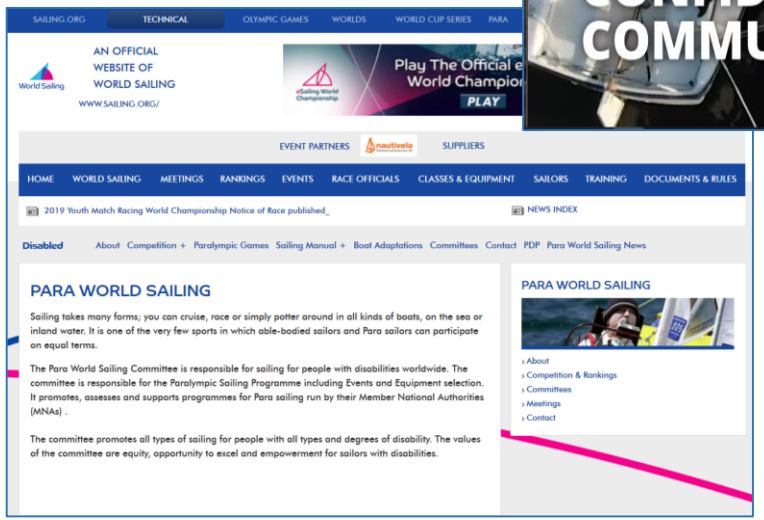
- The Dock
- The Boat
- The Course

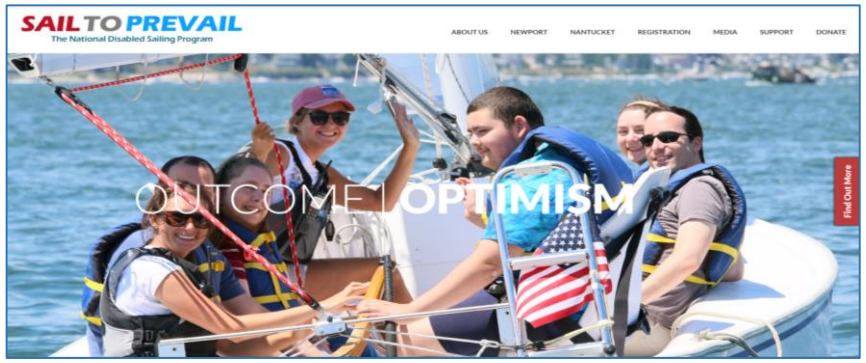
The Therapeutic Use of Sailing

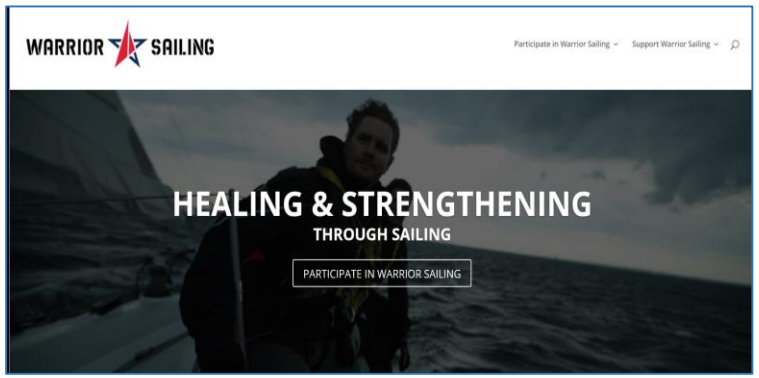
Community based sailing programs for people with disabilities:

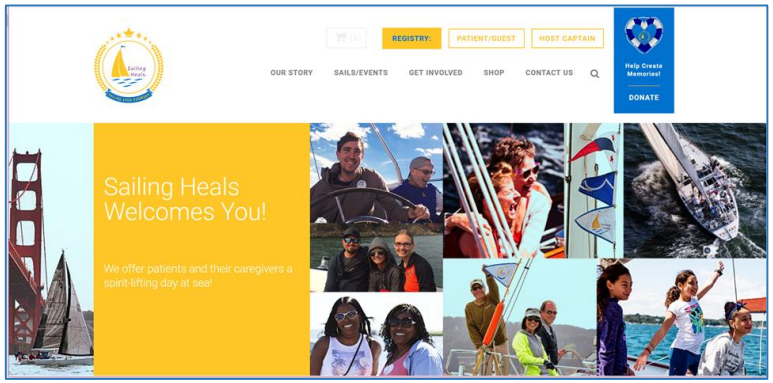
- Shake-A-Leg of Miami
- Warrior Sailing
- Sail to Prevail
- Sailing Heals
- Para World Sailing











The Therapeutic Use of Sailing

Sailing takes many forms; you can cruise, race or simply potter around in all kinds of boats, on the sea or inland water. It is one of the very few sports in which able-bodied sailors and Para sailors can participate on equal terms.

– Para World Sailing

The Therapeutic Use of Sailing

Benefits/Outcomes for People with Disabilities

Physical: balance, posture, gross motor, fine motor, strength, endurance, hand-eye coordination, tracking

Mental: knowledge of nautical terms, instruments, boat-wind-sails interaction, environmental conditions, weather

Emotional: connection to nature, mindfulness, confidence, self-esteem, flow

Social: team building, cooperation, decision-making, family-oriented, community engagement, environmental awareness

Virtual Reality Simulation

Definition and Types of Virtual Reality:

Virtual reality (VR): a computer-based technology that allows users to gain immersion and presence within a virtual environment (Chi, Chau, Yeo, & Tu, 2019).

Immersive: physical presence in a non-physical world (e.g. Oculus).

Non-Immersive: a computer-generated environment without a feeling of being immersed in the virtual world (most common today with technology).

Simulation: use of 3D objects and environments to create immersive and engaging learning experiences.

Trends in TR/RT:

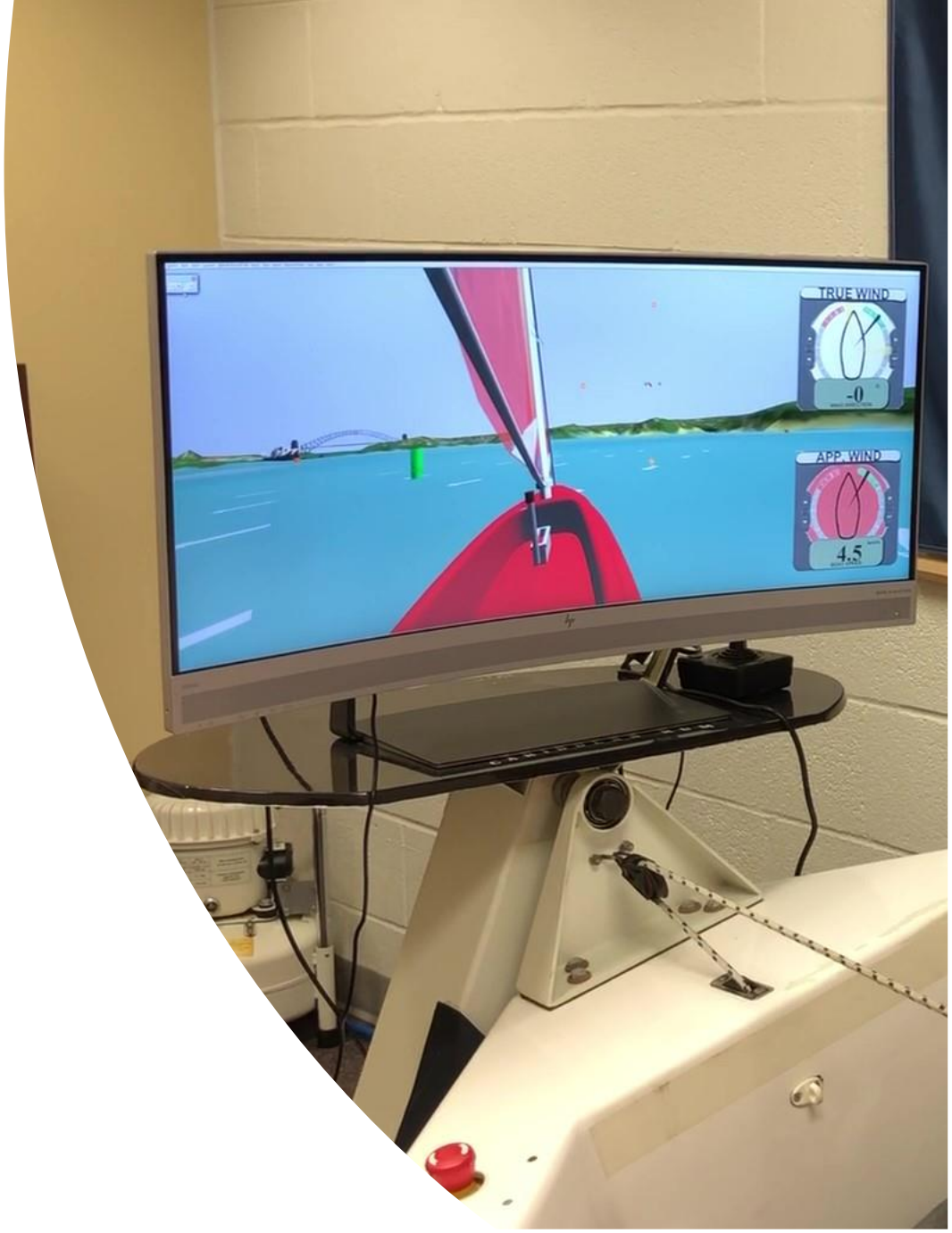
Gaming
Exergaming
Wiihabilitation

Virtual Reality Sailing Simulation

“Sim Sailing”

Virtual reality sailing simulators (www.virtualsailing.com.au) have the potential to bridge the gap between dry-land and on-the-water sailing for persons with disabilities.

- Recio, et al., 2013

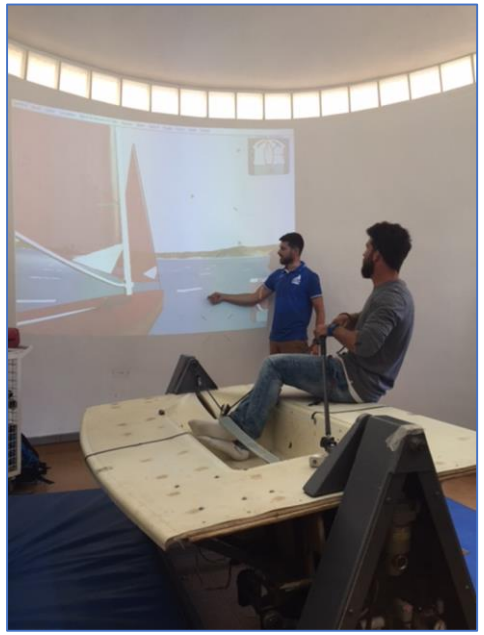


East Carolina University
Sailing Simulation Lab
Virtual Reality Sailing Simulator (VRSS)- “Bonny”

Purpose of the East Carolina University Sailing Simulation Lab:

- To use virtual reality sailing simulation as an intervention for people with disabilities and in youth development to increase quality of life physically, emotionally, cognitively, and socially and to produce evidence through research in the field of therapeutic recreation/recreational therapy.
- The lab is a member of the Sim Sailing International Research Consortium comprising of 8 countries and includes 25 members and 7 universities/research institutes.

Sim Sailing International Consortium



Spain: Universidad Católica San Antonio de Murcia (UCAM)

Australia: University of Melbourne

USA: University of Michigan and Ann Arbor VA Hospitals

USA: The International Center for Spinal Cord Injury, Kennedy Krieger Institute

Japan
Netherlands
New Zealand
Poland
United Kingdom

Norman Saunders

Professorial Fellow in Neuroscience , University of Melbourne, Australia

Founder and CEO, Virtual Sailing: Manufacturer of the VRSS

www.virtualsailing.com.au/

Video: *Wind in the Sails*
https://www.youtube.com/watch?time_continue=224&v=7YhVlLhaC2E

VRSS: Video for Evidence Based Programming

Albert Recio, MD, RPT, PTRP

Kennedy Krieger Institute, Baltimore, MD; Aquatics Medicine Program

The Johns Hopkins University School of Medicine; Physical Medicine and Rehabilitation

Paralysis Restoration Program: International Center for Spinal Cord Injury (ICSCI).

CNN Video: https://www.cnn.com/videos/health/2012/10/16/health-minute-virtual-sailing.cnn

ECU Sailing Simulation Lab: Target Populations & Future

Student Opportunities:

Recreational Therapy Courses
Recreational Therapy Student Society
Research (undergraduate and graduate)

Participants with Disabilities:

Current Focus- Physical Disabilities:
Spinal Cord Injury
Cerebral Palsy
Spina bifida

Future:
Youth development/youth at-risk
Veterans with disabilities (physical, PTSD, etc.)
Adapt VRSS with chin/mouth controller for higher SCI

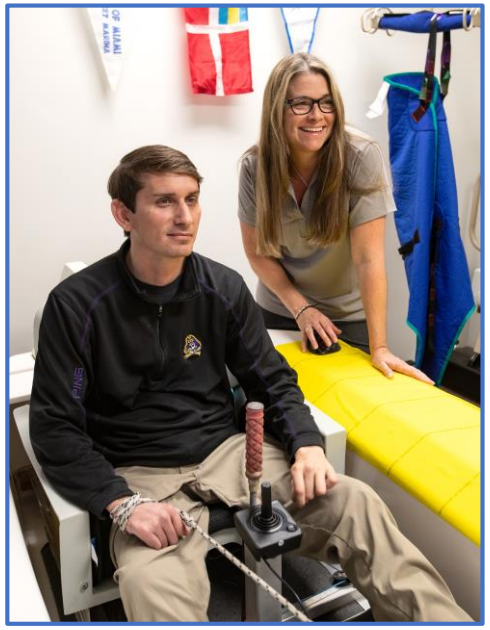
Set-up & Adaptions

Hansa Liberty

Program includes various one person designs:
Optimist, Laser, Byte, 29er

Transferring

Dycem

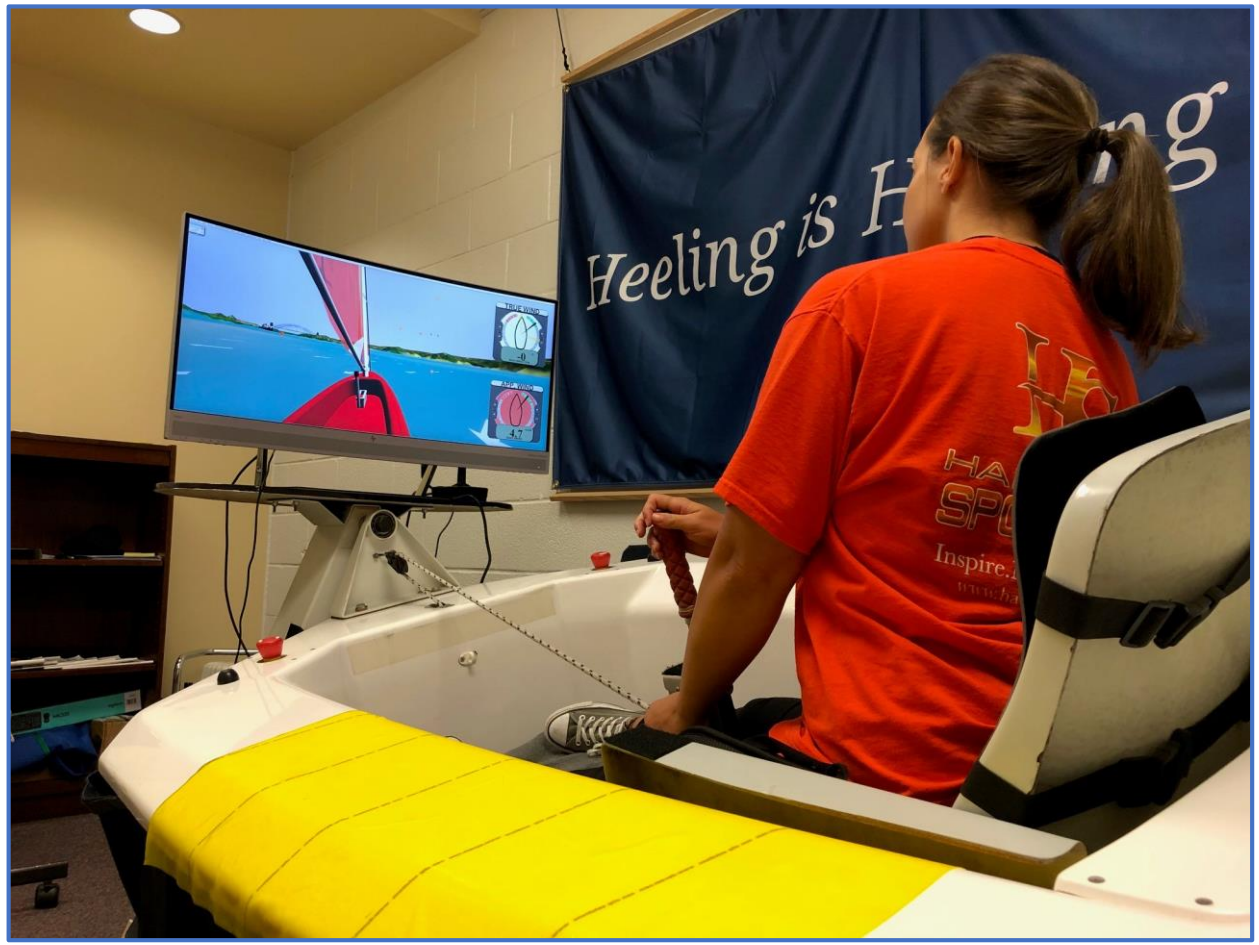


Cushions

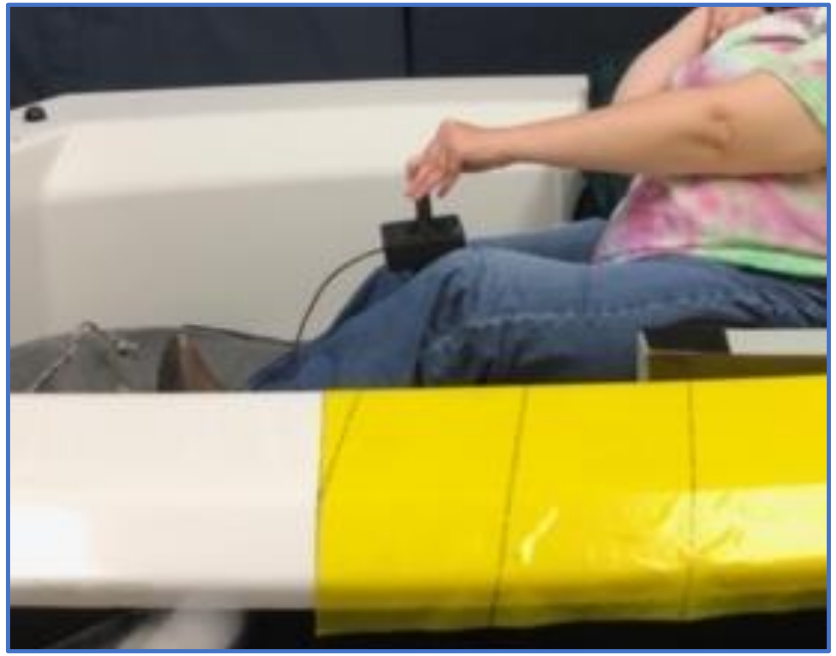

SOJOY
iGelComfort Expert
3 in 1
Folding
Separable Design
Can expand to any size you want

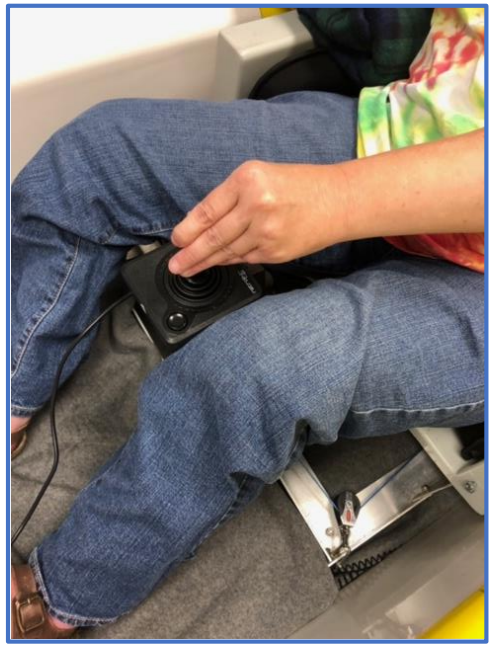

Feagar

Seat, Manual Joy-Stick, and Adapted Sailboat on Screen



Electronic Joy-Stick





VRSS Program Participant with Paraplegia

VRSS Program Participant with Quadriplegia

VRSS Program: Status of Current Research

Statement of the Problem

Sailing is pursued for both recreation and competitive sport purposes. Participation in sailing by people with disabilities is regarded as having positive outcomes on their quality of life. However, evidence-based research is lacking (Autry and Anderson, 2016).

Common constraints to sailing are: knowledge and skill of sailing, access to sailboats, swimming skills, financial resources, and the perception that sailing is elitist and dangerous (Recio, et al.). As such, persons with disabilities typically do not choose sailing as a sport.

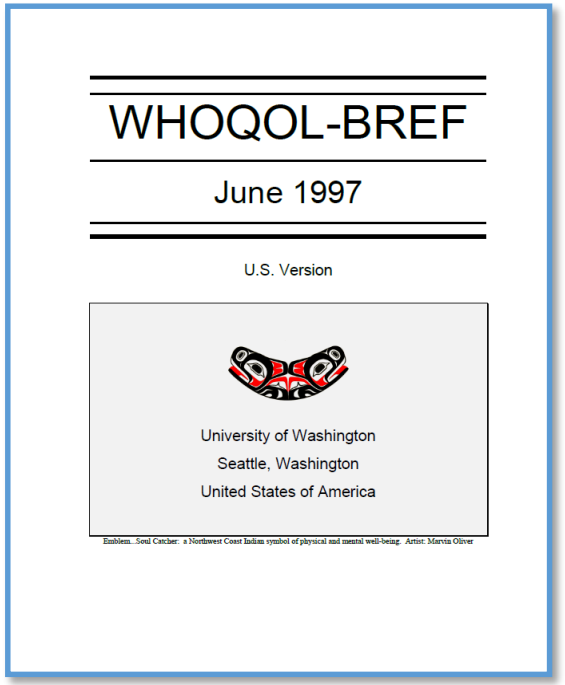
Hypothesis

Participation in the virtual reality sailing simulator (VRSS) program will result in an increase in participants' simulator sailing standard scores: knowledge (cognitive) and skills (physical), which is the competence level required for on-the-water sailing, and their quality of life (QOL) score.

Method

Quantitative

- World Health Organization Quality of Life- BREF (WHOQOL-BREF) (1997)
  - Pre and post
  - 26-item questionnaire
  - Includes four domains: physical health, psychological, social relationships and environment.
- Sailing Standards
  - Pre study requirement (never have sailed before)
  - Post Standard Scores
    - Knowledge
    - Practical Skills
- Reach and Strength
  - Pre and post
  - Functional Reach Test: Modified Functional Reach (Katz-Leurer, M., Fisher, I., Neeb, M., Schwartz, I., & Carmeli, E., 2009)
  - Degree in movement of manual joy stick
- Observation
  - Formative Evaluation
  - Check list per session



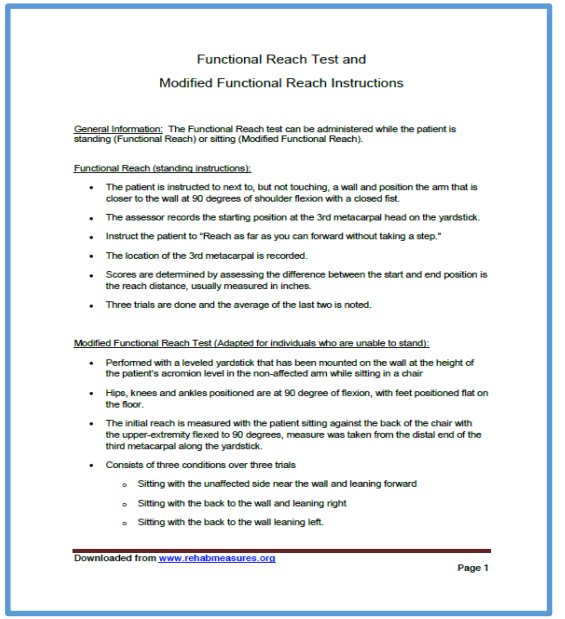
WHOQOL-BREF

June 1997

U.S. Version

University of Washington
Seattle, Washington
United States of America

Emblem...Soul Catcher: a Northwest Coast Indian symbol of physical and mental well-being. Artist: Marvin Oliver



Functional Reach Test and
Modified Functional Reach Instructions

General Information: The Functional Reach test can be administered while the patient is standing (Functional Reach) or sitting (Modified Functional Reach).

Functional Reach (standing instructions):

- The patient is instructed to next to, but not touching, a wall and position the arm that is closer to the wall at 90 degrees of shoulder flexion with a closed fist.
- The assessor records the starting position at the 3rd metacarpal head on the yardstick.
- Instruct the patient to "Reach as far as you can forward without taking a step."
- The location of the 3rd metacarpal is recorded.
- Scores are determined by assessing the difference between the start and end position is the reach distance, usually measured in inches.
- Three trials are done and the average of the last two is noted.

Modified Functional Reach Test (Adapted for individuals who are unable to stand):

- Performed with a leveled yardstick that has been mounted on the wall at the height of the patient's acromion level in the non-affected arm while sitting in a chair
- Hips, knees and ankles positioned are at 90 degree of flexion, with feet positioned flat on the floor.
- The initial reach is measured with the patient sitting against the back of the chair with the upper-extremity flexed to 90 degrees, measure was taken from the distal end of the third metacarpal along the yardstick.
- Consists of three conditions over three trials
  - Sitting with the unaffected side near the wall and leaning forward
  - Sitting with the back to the wall and leaning right
  - Sitting with the back to the wall leaning left.

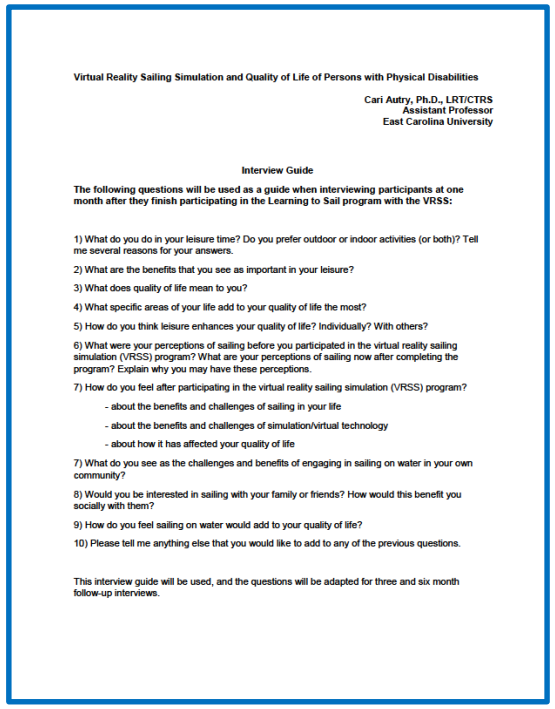
Downloaded from www.rehabmeasures.org

Page 1

Method

Qualitative

- Interviews
  - Post
  - Interview Guide Areas:
    - Leisure
    - Quality of Life
    - VRSS Program
    - Sailing on the Water
- Observation
  - Formative Evaluation
  - Notes per session



Virtual Reality Sailing Simulation and Quality of Life of Persons with Physical Disabilities

Cari Autry, Ph.D., LRT/CTRS
Assistant Professor
East Carolina University

Interview Guide

The following questions will be used as a guide when interviewing participants at one month after they finish participating in the Learning to Sail program with the VRSS:

1) What do you do in your leisure time? Do you prefer outdoor or indoor activities (or both)? Tell me several reasons for your answers.

2) What are the benefits that you see as important in your leisure?

3) What does quality of life mean to you?

4) What specific areas of your life add to your quality of life the most?

5) How do you think leisure enhances your quality of life? Individually? With others?

6) What were your perceptions of sailing before you participated in the virtual reality sailing simulation (VRSS) program? What are your perceptions of sailing now after completing the program? Explain why you may have these perceptions.

7) How do you feel after participating in the virtual reality sailing simulation (VRSS) program?

- about the benefits and challenges of sailing in your life
- about the benefits and challenges of simulation/virtual technology
- about how it has affected your quality of life

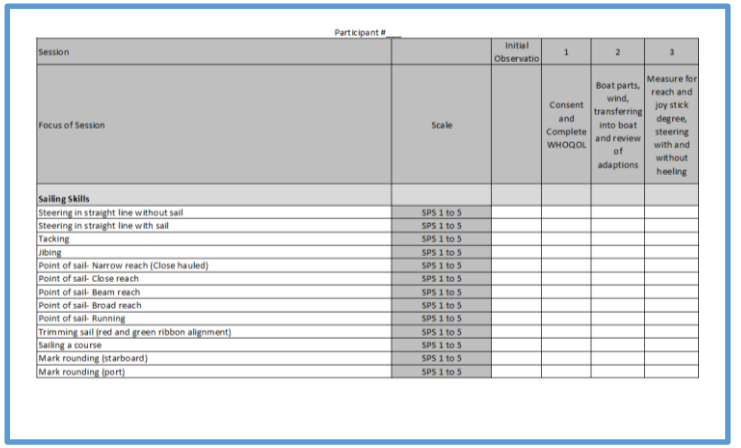
7) What do you see as the challenges and benefits of engaging in sailing on water in your own community?

8) Would you be interested in sailing with your family or friends? How would this benefit you socially with them?

9) How do you feel sailing on water would add to your quality of life?

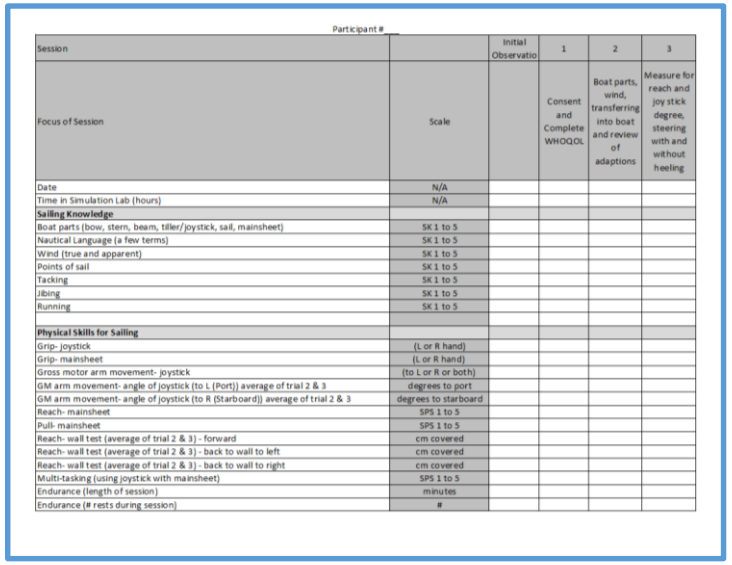
10) Please tell me anything else that you would like to add to any of the previous questions.

This interview guide will be used, and the questions will be adapted for three and six month follow-up interviews.



Participant #___

Session		Initial Observatio	1	2	3
Focus of Session	Scale		Consent and Complete WHOQOL	Boat parts, wind, transferring into boat and review of adaptions	Measure for reach and joy stick degree, steering with and without heeling
Sailing Skills					
Steering in straight line without sail	SPS 1 to 5				
Steering in straight line with sail	SPS 1 to 5				
Tacking	SPS 1 to 5				
Jibing	SPS 1 to 5				
Point of sail- Narrow reach (Close hauled)	SPS 1 to 5				
Point of sail- Close reach	SPS 1 to 5				
Point of sail- Beam reach	SPS 1 to 5				
Point of sail- Broad reach	SPS 1 to 5				
Point of sail- Running	SPS 1 to 5				
Trimming sail (red and green ribbon alignment)	SPS 1 to 5				
Sailing a course	SPS 1 to 5				
Mark rounding (starboard)	SPS 1 to 5				
Mark rounding (port)	SPS 1 to 5				



Participant #___

Session		Initial Observatio	1	2	3
Focus of Session	Scale		Consent and Complete WHOQOL	Boat parts, wind, transferring into boat and review of adaptions	Measure for reach and joy stick degree, steering with and without heeling
Date	N/A				
Time in Simulation Lab (hours)	N/A				
Sailing Knowledge					
Boat parts (bow, stern, beam, tiller/joystick, sail, mainsheet)	SK 1 to 5				
Nautical Language (a few terms)	SK 1 to 5				
Wind (true and apparent)	SK 1 to 5				
Points of sail	SK 1 to 5				
Tacking	SK 1 to 5				
Jibing	SK 1 to 5				
Running	SK 1 to 5				
Physical Skills for Sailing					
Grip- joystick	(L or R hand)				
Grip- mainsheet	(L or R hand)				
Gross motor arm movement- joystick	(to L or R or both)				
GM arm movement- angle of joystick (to L (Port)) average of trial 2 & 3	degrees to port				
GM arm movement- angle of joystick (to R (Starboard)) average of trial 2 & 3	degrees to starboard				
Reach- mainsheet	SPS 1 to 5				
Pull- mainsheet	SPS 1 to 5				
Reach- wall test (average of trial 2 & 3) - forward	cm covered				
Reach- wall test (average of trial 2 & 3) - back to wall to left	cm covered				
Reach- wall test (average of trial 2 & 3) - back to wall to right	cm covered				
Multi-tasking (using joystick with mainsheet)	SPS 1 to 5				
Endurance (length of session)	minutes				
Endurance (# rests during session)	#				

Knowledge (cognitive) Low 1=does not understand concepts; 2 = slightly understands concepts; 3= understands concept but does not use language; 4= understands concepts but uses language sometimes; 5 = understands concepts and uses language all the time High	**Sailing and Physical Skills** Low 1= does not master; 2 = slightly masters; 3= masters sometimes; 4= masters most of the time; 5 = masters all the time High

Participants

Eight participants with physical disabilities (to date).

Disability

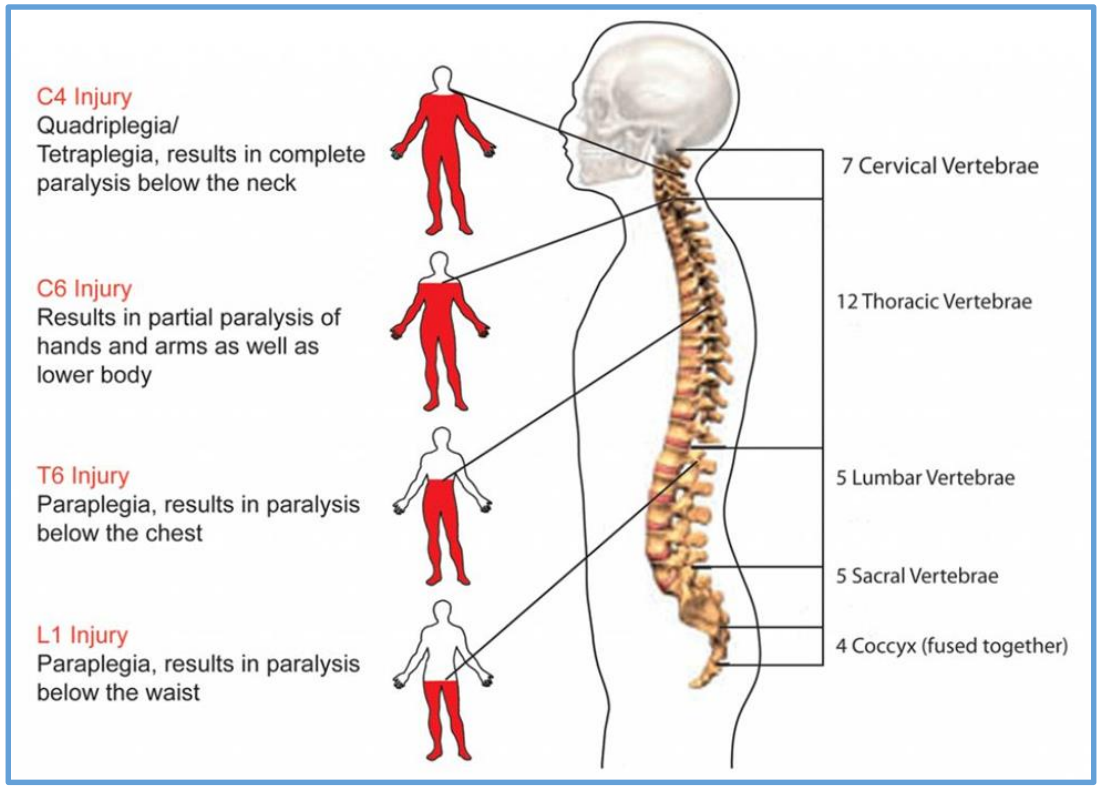
- 4 spinal cord injuries (SCI)
  - 1 with quadriplegia
  - 3 with paraplegia
  - Range: 3-13 year post injury
- 2 Cerebral palsy
- 2 spina bifida

Mobility

- 6 use wheelchair full time
- 1 uses crutches and wheelchair

Demographics

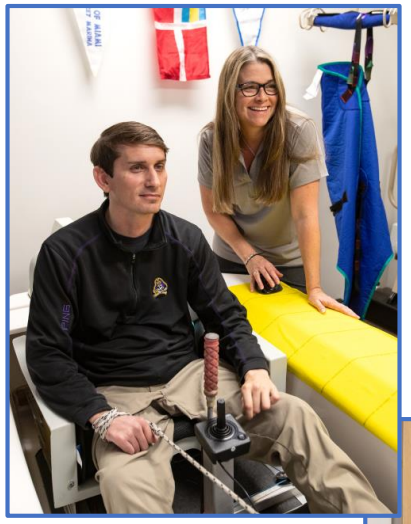
- 4 females
- 4 males
- Age range: 27-50

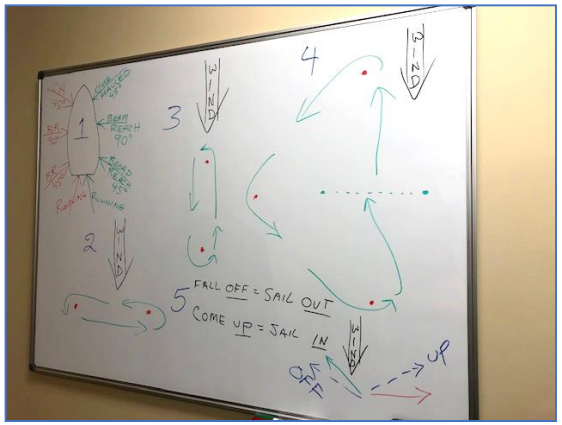


Treatment Protocol

VRSS program:

- 1.5 – 2 hours per session
- 11 sessions
- Sequence of skills
  - Steering
  - Trimming sail
  - Heeling
  - Reading the wind
  - Points of sail
  - Sailing on a course
    - Tacking and jibing
    - With buoys
  - Race-course
- Learning a new “language”
- Instructors:
  - 1 Certified Instructor with US Sailing Association
  - 1 Certified and Licensed in Recreational Therapy





US SAILING

National Council for Therapeutic Recreation Certification

North Carolina Board of Recreational Therapy Licensure

"You must be licensed to practice Recreational Therapy in North Carolina"

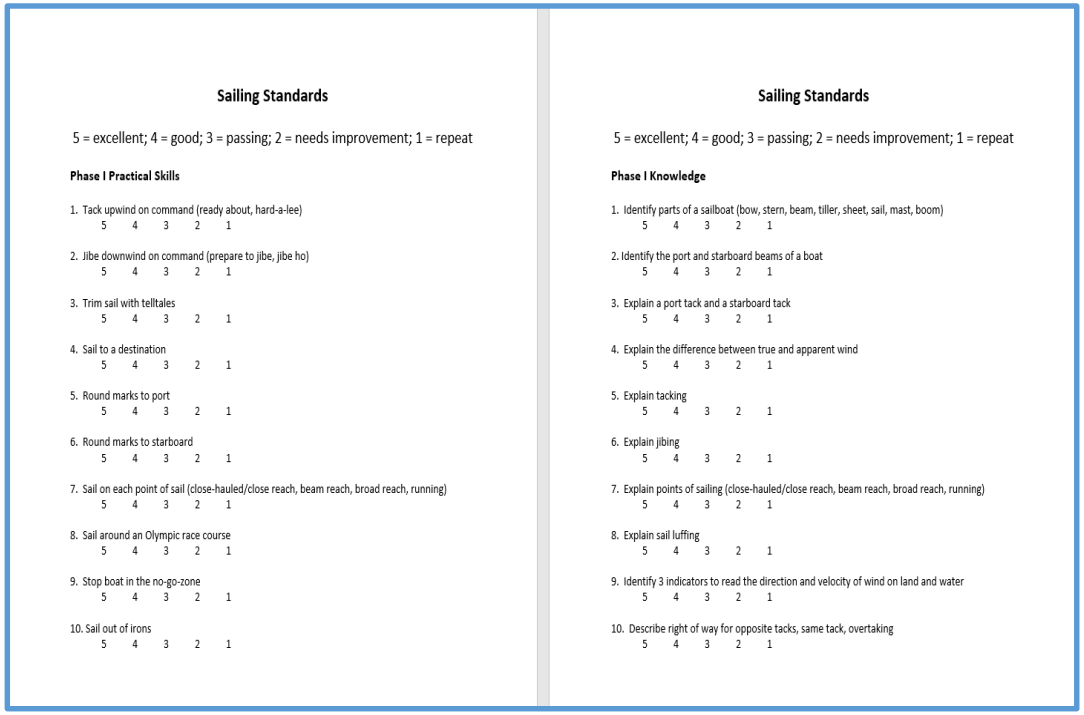
Data Analyses

For the quantitative data, the participants' scores (WHOQOL-BREF, Sailing Standards, Reach, Strength) and session assessment data will be analyzed using SPSS software.

Qualitative data will be analyzed using NVivo software. Various coding methods will be applied including Attribute Coding, Provisional Coding, In Vivo Coding, and Eclectic Coding (Saldaña, 2013).

Preliminary Findings

- Seven participants (to date) completed and passed the sailing standards (cognitive and physical/practical skills).
- All reported that the VRSS Program: Learning to Sail on Land contributed to their quality of life.
- Six (to date) qualify to move on to Phase II: Adapted Sailing Program on the water with a Martin 16.



Sailing Standards

5 = excellent; 4 = good; 3 = passing; 2 = needs improvement; 1 = repeat

Phase I Practical Skills

1. Tack upwind on command (ready about, hard-a-lee)
   5 4 3 2 1
2. Jibe downwind on command (prepare to jibe, jibe ho)
   5 4 3 2 1
3. Trim sail with telltales
   5 4 3 2 1
4. Sail to a destination
   5 4 3 2 1
5. Round marks to port
   5 4 3 2 1
6. Round marks to starboard
   5 4 3 2 1
7. Sail on each point of sail (close-hauled/close reach, beam reach, broad reach, running)
   5 4 3 2 1
8. Sail around an Olympic race course
   5 4 3 2 1
9. Stop boat in the no-go-zone
   5 4 3 2 1
10. Sail out of irons
    5 4 3 2 1

Sailing Standards

5 = excellent; 4 = good; 3 = passing; 2 = needs improvement; 1 = repeat

Phase I Knowledge

1. Identify parts of a sailboat (bow, stern, beam, tiller, sheet, sail, mast, boom)
   5 4 3 2 1
2. Identify the port and starboard beams of a boat
   5 4 3 2 1
3. Explain a port tack and a starboard tack
   5 4 3 2 1
4. Explain the difference between true and apparent wind
   5 4 3 2 1
5. Explain tacking
   5 4 3 2 1
6. Explain jibing
   5 4 3 2 1
7. Explain points of sailing (close-hauled/close reach, beam reach, broad reach, running)
   5 4 3 2 1
8. Explain sail luffing
   5 4 3 2 1
9. Identify 3 indicators to read the direction and velocity of wind on land and water
   5 4 3 2 1
10. Describe right of way for opposite tacks, same tack, overtaking
    5 4 3 2 1

Virtual Reality to Reality: Adapted Sailing Program

Treatment Protocol

- 2 hours per session
- 6 sessions
  - Session(s) for pre data collection and refresher in Bonny (VRSS)
  - 4 on the water
  - Session for post data collection
- Sequence of skills: knowledge and physical
  - Preparation on land
  - Reading the wind and weather
  - Navigation
  - Transferring with lift
  - Leaving and returning to dock
  - Steering and trimming sail
  - Heeling
  - Points of sail
  - Sailing on a course
    - Tacking and jibing with buoys
    - Olympic race-course

- Practicing/immersion in “language”
- Instructors:
  - 1 Certified Instructor with US Sailing Association
  - 1 Certified and Licensed in Recreational Therapy
  - Volunteers- LWSS

The Martin 16, *Roberta*: Pre-COVID-19
Sailing her to Little Washing Sailing School (LWSS)
Pamlico River, NC

References

Autry, C., & Anderson, S. (2016). Therapeutic use of sailing. In J. Dattilo & A. McKenney (Eds.), *Facilitation techniques in therapeutic recreation* (3rd ed.). College State, PA: Venture Publishing, Inc.

Chi, B., Chau, B., Yeo, E., Ta, P. (2019). Virtual reality for spinal cord injury-associated neuropathic pain: Systematic review. *Annals of physical and rehabilitation medicine 62*(1):49-57. DOI: 10.1016/j.rehab.2018.09.006.

Katz-Leurer, M., Fisher, I., Neeb, M., Schwartz, I., & Carmeli, E. (2009). Reliability and validity of the modified functional reach test at the sub-acute stage post-stroke. *Disability and Rehabilitation,* 31(3), 243-248. DOI: 10.1080/09638280801927830

Recio, A., Becker, D., Morgan, M., Saunders, N., Schramm, L., McDonald, J. (2013). Use of a virtual reality physical ride-on sailing simulator as a rehabilitation tool for recreational sports and community reintegration: A pilot study. *American Journal of Physical Medicine & Rehabilitation*, *92*(12), 1104-1109.

Saldaña, J. (2013). *The coding manual for qualitative researchers.* Los Angeles, CA: Sage

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Thank you!

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