Wearables for Rehabilitation: What's Available, How PTs Can Use Them, and How PTs Can Improve Them

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Disclosure

- No conflicts of interest to disclose.

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About Me

- Associate Professor
  - Physical Therapy
  - Fashion & Apparel Studies
- Co-Director, Move to Learn Innovation Lab
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Outline

- Define wearables
- Types of wearables relevant for PT
- Design of wearables and why PTs should care about this
- Examples of wearables from my work
- Discuss how PTs can use wearables in practice – important lessons for implementation

Wearables

- Objects that interface and move with users

Lobo et al., 2019

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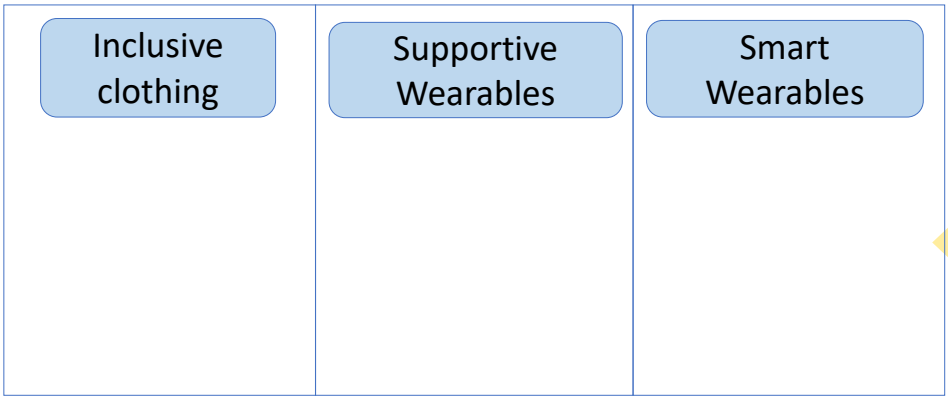
Types of Wearables Relevant for PT



Lobo et al., 2019

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Design of Wearables

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For "Real" Clients, Products Are Designed To Meet Their Broad Needs

Hall et al., 2018; Lobo et al., 2019

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If Not, the Products Will Not Sell

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Should Our "Captive" Rehab Clients Be Treated Differently?

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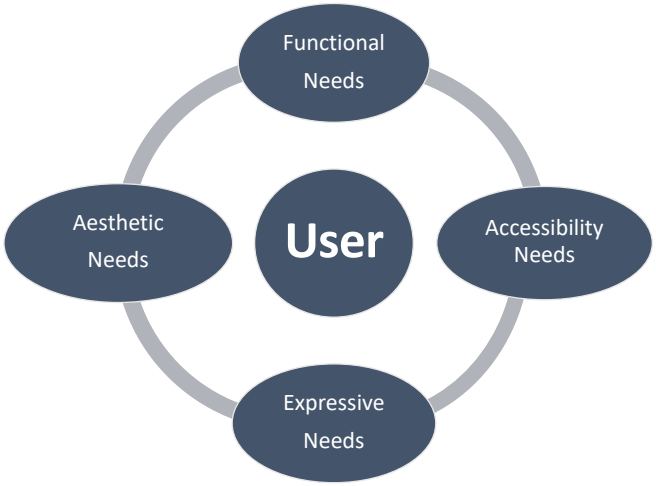
FEA2 Design Model



Hall et al., 2018; Lobo et al., 2019

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This is Interesting, But Why Should I, as a PT, Care About Design?

- Current wearables, even those used for decades, poorly meet the broad needs of end users
- Impacts adherence, dosing, and our ability to improve the lives of our clients

Orlando et al., in preparation

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Adherence for Using Lower Extremity Orthotic Devices

- Across 19 studies reporting on adherence for lower extremity orthotics:
  - 9-55% of users reported total lack of adherence
  - 6-36% of users reported partial adherence

Orlando et al., in preparation

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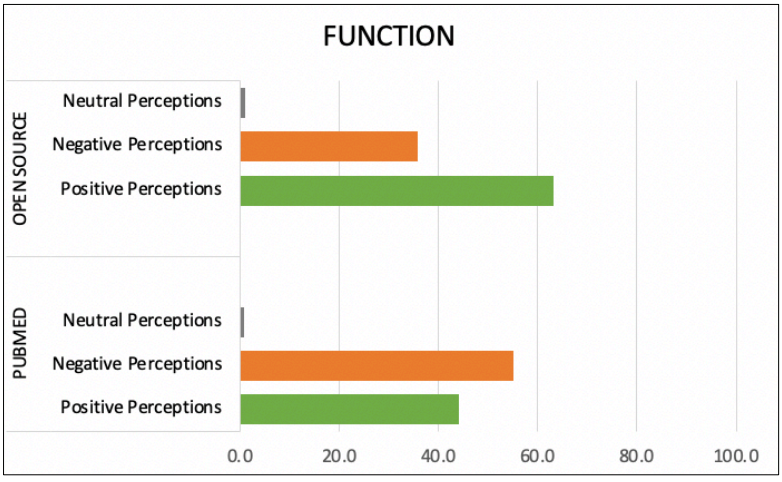
Function of Lower Extremity Orthotic Devices: Mixed Positive & Negative Perceptions



Orlando et al., in preparation

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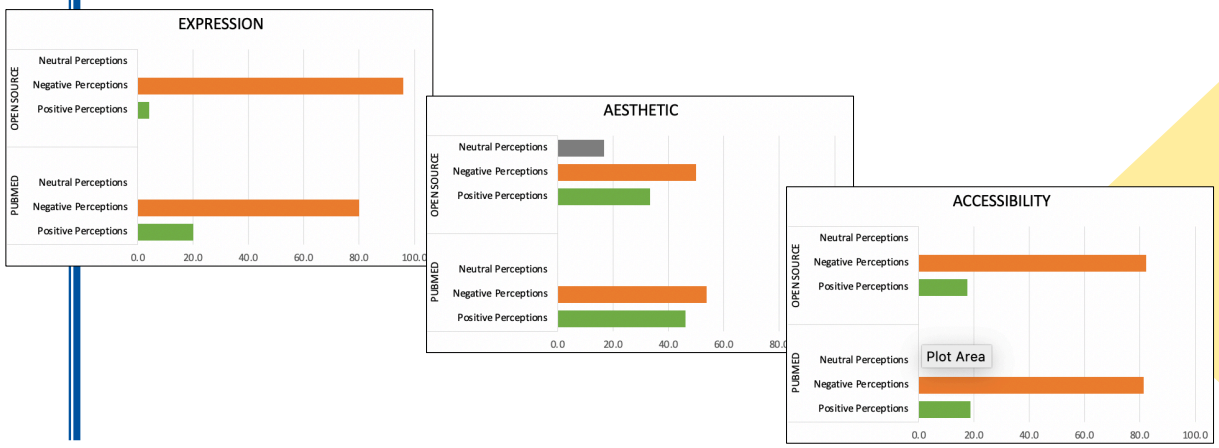
Expression, Aesthetics, & Accessibility of Lower Extremity Orthotic Devices: Primarily Negative Perceptions



Orlando et al., in preparation

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How Can You, as a PT, Impact & Improve the Design of Wearables?

- Advocate for end users
- Share user needs with those commercially and medically fabricating and distributing wearables
  - Orthotists, prosthetists, industry
- Engage with designers within your community and across the global community
  - Academia - universities, schools
  - Organizations and maker groups
- Be informed and share connections with your clients

Lobo et al., 2019

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Inclusive clothing

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Dressing is a Challenge for Individuals with Physical Disabilities

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Simple Solutions = Big Difference

Deeper armhole
Wider neck
for ease of
donning/doffing

Higher back rise
for fit & comfort

Wider leg to fit
over orthoses

Magnetic closures
for independent
dressing

Lobo et al., 2019

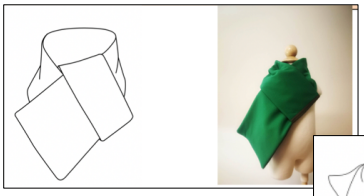
Resources for Inclusive Clothing

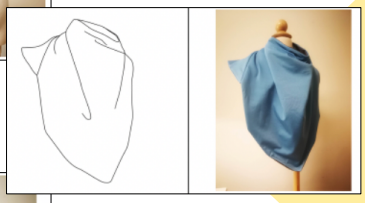
- Target: https://www.target.com/c/men-s-adaptive-clothing/-/N-bints, https://www.target.com/c/women-s-adaptive-clothing/-/N-r23zu, https://www.target.com/c/kids-adaptive-clothing/-/N-1laue
- Tommy Hilfiger: https://usa.tommy.com/en/tommy-adaptive
- IZ Adaptive Clothing: https://izadaptive.com/
- Adaptive Clothing Showroom: https://adaptiveclothingshowroom.com/
- Adaptations by Adrian: https://www.adaptationsbyadrian.com/default.asp
- Professional Fit Clothing: https://www.professionalfit.com/
- Myself Belts (belts easy to fasten): https://www.myselfbelts.com/
- Rebound Wear: https://www.reboundwear.com/
- Easy Access Clothing: https://easyaccessclothing.com/
- Special Kids Company: https://specialkids.company/
- Hatch Backs Footwear: https://www.hatchbacksfootwear.com/

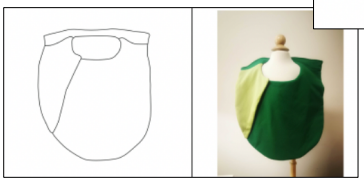
Saliva Wicking Scarves

Traditional Solutions

User-Centered Design Solutions







https://sites.udel.edu/move2learn/how-todiy/

Ren et al., in preparation

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Supportive Wearables

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Soft Ankle Support (SAS)

Traditional Solution	User-Centered Design Solution
	

Civil, 2019

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Barefoot

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With an AFO

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With the Soft Ankle Support (SAS)

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What We Have Learned From the SAS Project

- SAS & AFO similarly supported function but the SAS was less bulky, lighter weight, more adjustable, easier to use, and comfortable
  - Less bulk means users can select a greater variety of shoes
- We should be innovating with soft materials to design more comfortable, aesthetically appealing, expressive, and accessible support devices for individuals with disabilities
- SAS DIY Manual is available at: https://sites.udel.edu/move2learn/how-todiy/

UD Magazine: Volume 23, 3, 2019 page 20

Hug n' Move Postural Support Garment

Smart Wearables

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Exoskeletal Garments

Traditional Solution	User-Centered Design Solutions Playskin Lift™ Playskin Air™

http://sites.udel.edu/move2learn/how-todiy/

Babik et al., 2016, 2019, in press; Li et al., 2019; Lobo et al., 2016, 2019; Lobo & Li, in press

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Sensor-Based Wearables

http://iothought.com

Greenspan et al., 2018; Greenspan & Lobo, 2020

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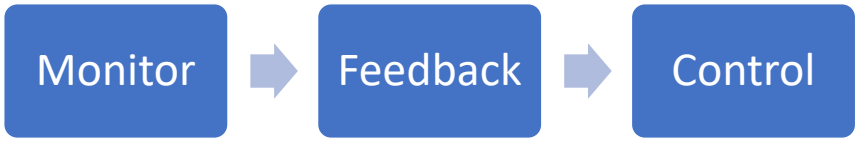
Sensor-Based Wearables



Lobo et al., 2019

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What Should PTs Consider When Implementing Wearables?

- Device selection
  - User-centered based on broad needs
- Usability and adherence
  - How/what the device helps
  - How/what the device hinders
- Rehabilitation goals

Babik et al., 2016, 2019, in press; Li et al., 2019; Lobo et al., 2016, 2019; Lobo & Li, in press

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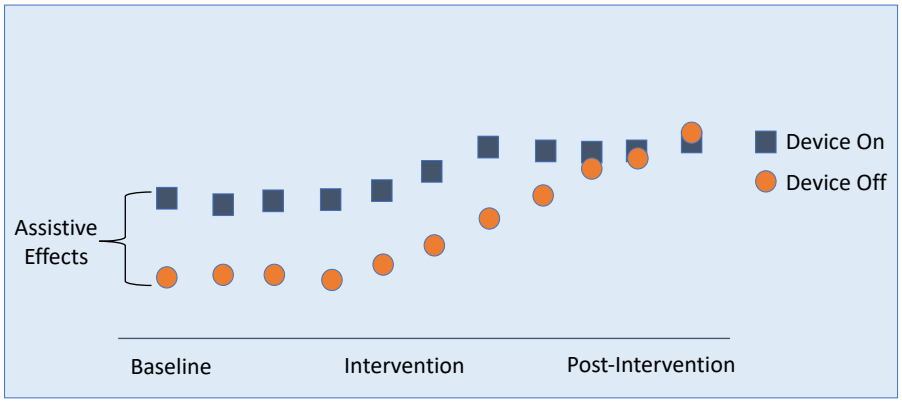
Goal to Assist Performance



Lobo et al., 2017

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Assistive Effects of the Playskin Lift™

Without the Playskin Inserts

With the Playskin Inserts

Increased bimanual contact, object lifting, manipulation, visual-manual activity, multimodal activity, intensity of activity, and behavioral variability.

Babik et al., 2019, in press

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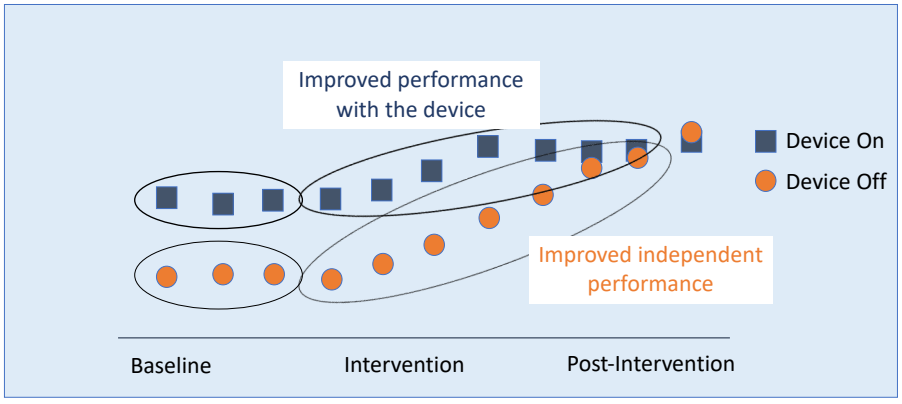
Goal to Improve Assisted and/or Independent Performance Across Time



Lobo et al., 2017

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Rehabilitative Effects – Improved Independent Performance

Without the Playskin Inserts
Before Daily Home Intervention

Without the Playskin Inserts
After Daily Home Intervention

With intervention early enough in development, Playskin Lift™ may allow for improved arm function & greater independence from support devices.

Babik et al., 2019, in press

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Important Lesson #1: A Tool, However Wonderful, Is Just a Tool

- Tools can complement activity-based interventions
- Technology use should be guided by scientific theory, clinical goals, & user's abilities & needs
  - Impact and optimal usage may differ:
    - Among populations
    - Among individuals within the same population
    - Within an individual across time

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Important Lesson #2: Don't Give Up Before Trying

Initial Independent Performance

After 2 Weeks with P-WREX

Do Not Underestimate the Learning Potential of Users

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Important Lesson #3: Let Users Have Time To Learn to Use Devices Before Determining Whether the Tools May Be Useful for Them

With the Playskin Inserts
Beginning of Intervention

With the Playskin Inserts
2 Weeks Later

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Important Lesson #4: Do Not Over Control

Stability

Flexibility

The initial impulse is to overcontrol but that might impede learning

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Technology Resources

- Lobo Move to learn DIY: http://sites.udel.edu/move2learn/how-todiy/
- Assistive Technology for Kids: https://at4kids.com/
- Assistive Technology Industry Association: https://www.atia.org/home/at-resources/alliance-partners/
- Association of Assistive Technology Act Programs: https://www.ataporg.org/
- Makers Making Change: https://www.makersmakingchange.com/
- Web interaction: https://www.w3.org/WAI/people-use-web/tools-techniques/
- https://www.taat.org/at-links
- Enable: https://www.microsoft.com/en-us/research/group/enable/
- ATMakers: http://atmakers.org/
- Go Baby Go: https://sites.udel.edu/gobabygo/
- Ashley Pigford Accessible AT: http://www.digfy.com/
- UD Maker Gym: https://www.udel.edu/research-innovation/maker/spaces/makergym/
- Able Gamers: https://ablegamers.org/
- UD assistive technology library: https://guides.lib.udel.edu/c.php?g=85328&p=548509
- https://library.udel.edu/erc/erc-services/assistive-technology/
- Pinterest and Facebook can also be helpful for ideas and instructions

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Thank you!