SCHOOL OF MEDICINE
INDIANA UNIVERSITY

Rehabilitation Hospital of Indiana

Removing the Kid Gloves in Neurologic Rehabilitation

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iKT institute for KNOWLEDGE TRANSLATION

Ascension St. Vincent

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Removing the kid gloves . . . .

- Introduction - T. George Hornby, PT, PhD
- Removing the gloves in neurological rehabilitation – Chris E. Henderson, PT, PhD, NCS
- Application to the real-world environments – Maghan Bretz, MPT, NCS
- Summary

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Removing the kid gloves . . . .

- Introduction – identifying the problem
- Removing the gloves in neurological rehabilitation – Chris E. Henderson, PT, PhD, NCS
- Application to the real-world environments – Maghan Bretz, MPT, NCS
- Summary

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Evolution in PT education and practice . . .
. . . .influenced by research and tradition

1900s
Sherrington

1960-1970s
PNF/Rood

1980-1990s
Task oriented training

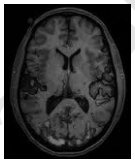
2000s-present
Adjunctive therapies

Way back then

Right about now

1940-1970s
Neurodevelopmental Approaches

- NDT / Bobath
- Brunnstrom



1995-2005
Cortical/spinal reorganization neuroplasticity

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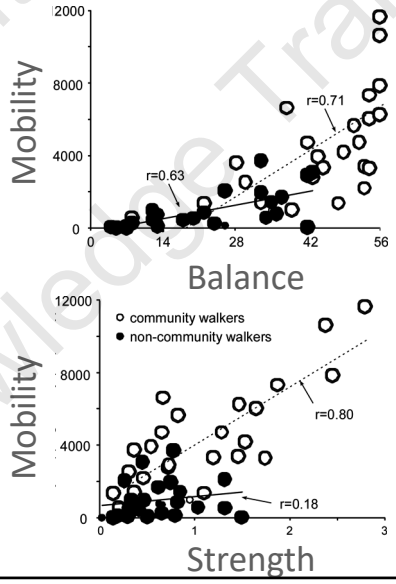
Common themes of neurological therapy education and practice

Targeting impairments in body structure/ function should improve performance in functional activities



(Michael 2005, Patterson 2007, Saraf 2010, Kim and Eng 2002)

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Common themes of neurological therapy education and practice

Targeting impairments in body structure/ function should improve performance in functional activities

Standardized progression of task-difficulty in preparation for advanced mobility tasks

		Stability		Mobility	
constrained	No variability				
	Variability				
un-constrained	No variability				
	Variability				

(Gentile 1987)

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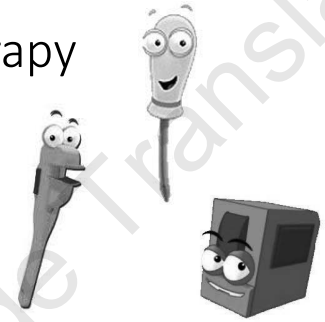
Common themes of neurological therapy education and practice



Normalizing movement practice can best promote functional recovery

sensory information retrains motor output

"perfect practice makes perfect"

Practicing abnormal movement reinforces abnormal patterns

risk of injury

Lower intensities/difficulty (spasticity, cardiovascular risk)

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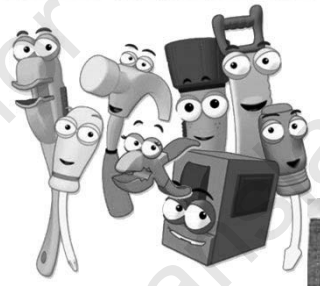
Common themes of neurological therapy education and practice



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Adding some tools to the toolbox . . .

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More tools . . .

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And some more tools . . .

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Our problems are not unique . . .

Value
Efficiency
Cost-effectiveness

Moneyball - Oakland A's professional baseball team ("small market team"), 2001 one win away from league championship

General manager
Billy Beane

Key players with expiring contracts heading to "large market" teams

Jason Isringhausen

Johnny Damon

Jason Giambi

How to replace players without the same resources?

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Replacing players in a "small market"?

Traditional methods of player evaluation

Batting Average (BA)

Home runs (HR) Runs Batted In (RBIs)

"Intangibles"
- mechanics
- contact
- other (attitude, focus, hustle, confidence)

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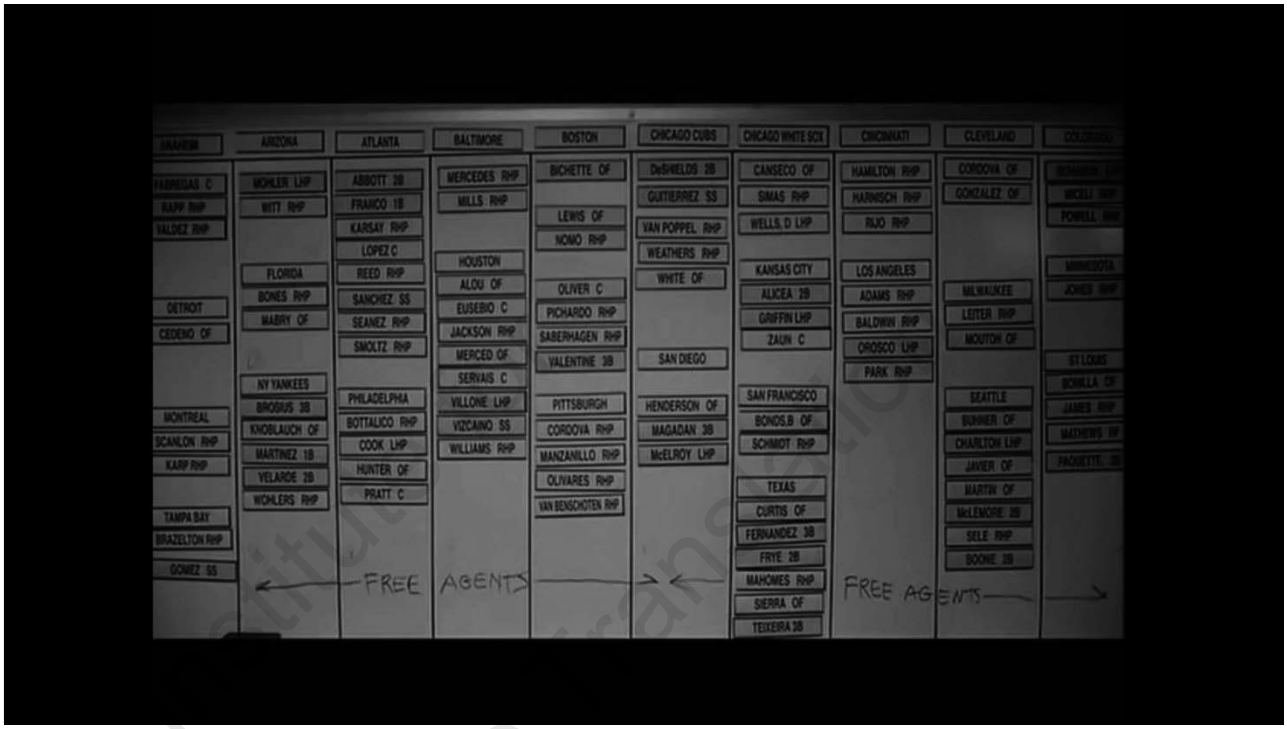

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Replacing players in a "small market"?

Traditional methods of player evaluation

Batting Average (BA)

Home runs (HR) Runs Batted In (RBIs)

"Intangibles"
- mechanics
- contact
- other (attitude, focus, hustle, confidence

General manager
Billy Beane

Asst GM
"Peter Brand"

Society for American Baseball Research ("Sabermetrics")

What creates wins?
What creates runs?

On-base percentage (hits + walks)

Slugging percentage (bases per hit)

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"Sabermetrics" in rehabilitation?

Principles of Experience-dependent Neural Plasticity (Kleim and Jones 2008)

1. Use It or Lose It
2. Use It and Improve It
3. Specificity
4. Repetition Matters
5. Intensity Matters
6. Time Matters
7. Salience Matters
8. Age Matters
9. Transference
10. Interference

Traditional physical therapy practice?

< 500 steps/session (Lang 2009, Kimberley 2010, Zbogar 2016)

Rarely reach aerobic thresholds (MacKay-Lyons 2002, Kuys 2006, Prajapati 2013, Zbogar 2017)

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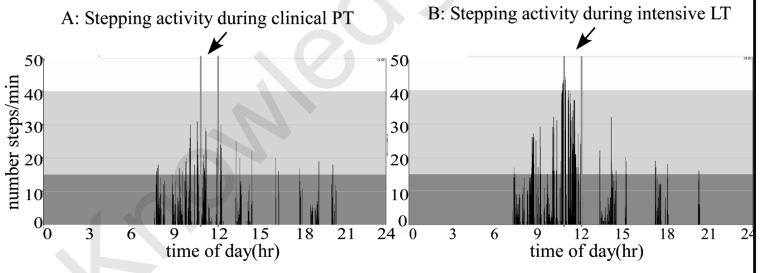
Moore Stroke 2010 – why do patients plateau?

Patient activities and outcomes during last 4 weeks of clinical PT

versus

Activities/outcomes with 4 weeks high-intensity treadmill walking
- Assist-as-needed
- Targeting ~85% Hr_{max}



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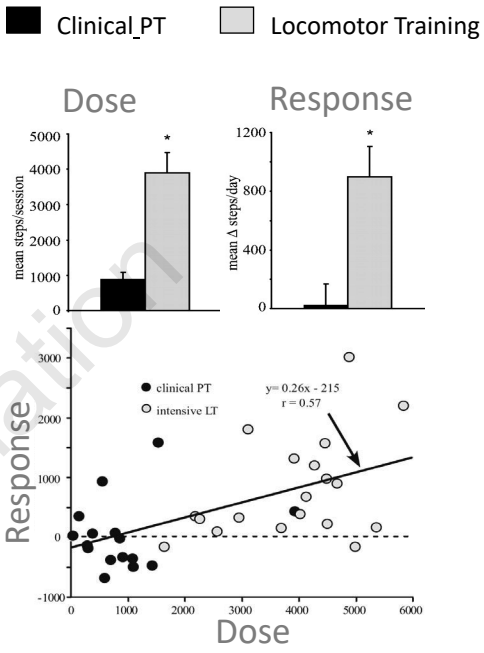
Moore Stroke 2010

Greater amounts of stepping practice with focused activities (900 to ~4000 steps/session) and better outcomes

Changes in mobility (steps/day) related to steps/session

Specificity
Amount
Intensity



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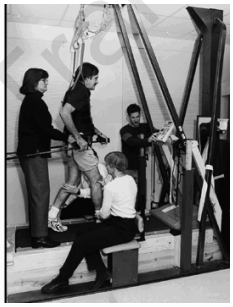
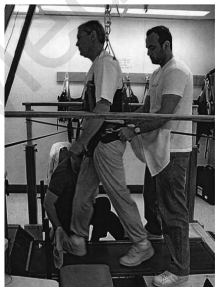
What about those walking trials that failed?

- LEAPS trial? (Duncan NEJM 2011) - No difference between walking vs non-walking training

  Heart rates (HRs) purposely kept < 110 beats/min; lower than 6 min walk tests (Woodward PTJ 2019)





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What about those walking trials that failed?

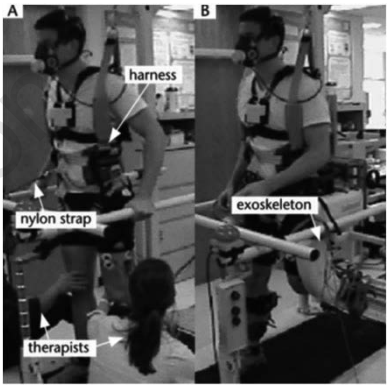
- LEAPS trial? (Duncan NEJM 2011) - No difference between walking vs non-walking training

  Heart rates (HRs) purposely kept < 110 beats/min; lower than 6 min walk tests (Woodward PTJ 2019)

- Robotic locomotor devices? (Hornby Stroke 2008, Hidler NNR 2009)

  VO_2/ HRs lower during robotic vs PT assist-as-needed (Israel PTJ 2006, Hornby PTJ 2012, Lefeber NNR 2018)

Specificity
Amount
Intensity



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Putting the principles into practice?

Outcomes good but not great (Macko Stroke 2005, Moore Stroke 2010, Globas NNR 2012)

Gains in 6 min

Limited gains in speed, balance, transfers, steps/day

Principle
1. Use It or Lose It
2. Use It and Improve It
3. Specificity
4. Repetition Matters
5. Intensity Matters
6. Time Matters
7. Salience Matters
8. Age Matters
9. Transference
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Putting the principles into practice?

Outcomes good but not great (Macko Stroke 2005, Moore Stroke 2010, Globas NNR 2012)

- Gains in 6 min
- Limited gains in speed, balance, transfers, steps/day

Rethinking the principles??

(Ada/Dean Stroke 2010)

(Miller Clin Rehabil 2014)

Principle
1. Use It or Lose It
2. Use It and Improve It
3. Specificity
4. Repetition Matters
5. Intensity Matters
6. Time Matters
7. Salience Matters
8. Age Matters
9. Transference
10. Interference

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Dimensions of community mobility (Shumway-Cook PTJ 2002)

Variable, difficult tasks!!

- Kinematics
- Tasks
- Environments

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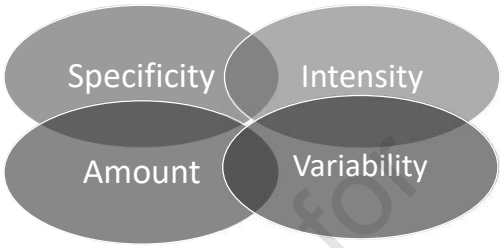
What does that look like?



Pilot studies, small RCT
(Holleran NNR 2014, Straube PTJ 2014 Hornby NNR 2016, Leddy JNPT 2016)

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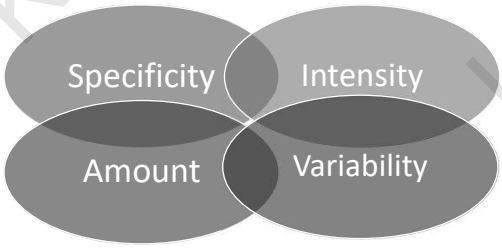
What does that look like?



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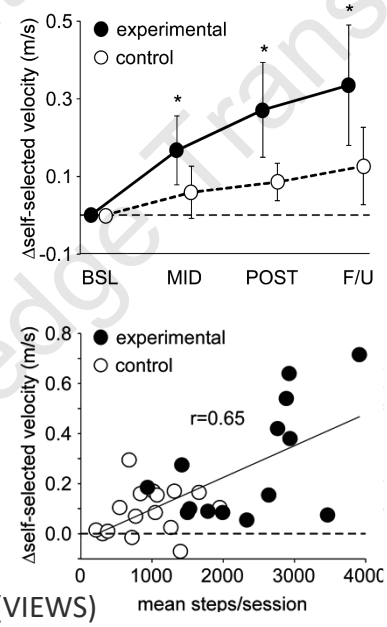

Very Intensive Early Walking post-Stroke (VIEWS)

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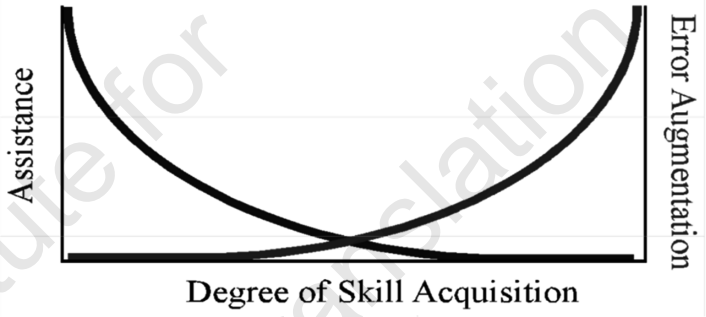
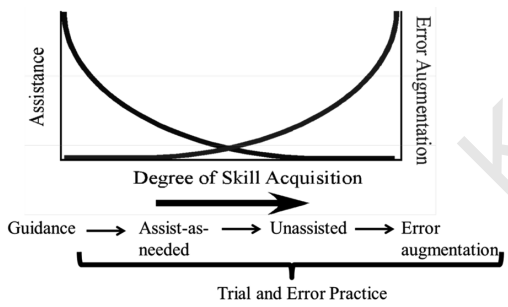
Targeting Biomechanical Subcomponents in Gait Training



Protocol

- Biomechanical demands of walking (Kuo/Donelan PTJ 2010)
  - Propulsion
  - Limb swing advancement
  - Stance control
  - Lateral/frontal stability

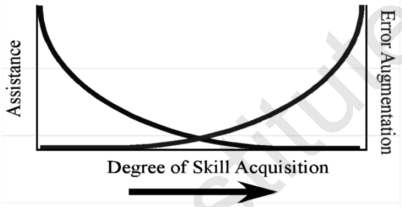


- Define successful walking (Holleran NNR 2014)
  - Directional advancement
  - Positive step length
  - Limited limb/trunk collapse
  - Maintain upright

- *Success = Continuous stepping*
- *Failure = 3-5 consecutive errors*
- *Gait kinematics not a primary concern*

Progressing Biomechanical Subcomponents of Walking

- Limb Advancement
- Stance Stability
- Propulsion
- Lateral Stability



Contributions of Stepping Intensity and Variability to Mobility in Individuals Poststroke

Chris Henderson, Abbey Plawecki, Emily Lucas, Jennifer Lotter, Molly Holthus, Gabrielle Brazg, Meghan Fahey, Jane Woodward, Marzieh Ardestani, Elliot Roth, T George Hornby

Institute for Knowledge Translation

Rehabilitation Hospital of Indiana

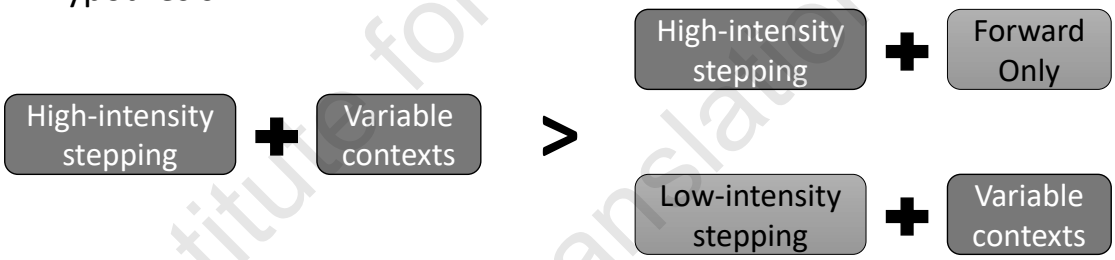
Northwestern University

Shirley Ryan Abilitylab

Background and Motivation

- Purpose of current study
  - Examine the relative contributions of stepping intensity and variability on mobility outcomes in ambulatory individuals with chronic stroke

- Hypothesis



Methods

Inclusion Criteria
> 6 months poststroke
Unilateral hemiparesis
Able to walk ≥ 10m at speeds < 1.0 m/s with customary AD and below knee bracing PRN

Exclusion Criteria
Additional neurologic or orthopedic injury that limits ambulation
Evidence of cerebellar ataxia
Currently participating in PT

- Randomly assigned to 1 of 3 training groups
- Up to (30) one hour training sessions in ≤ 9 weeks

High Intensity Variable Training

High-intensity stepping + Variable contexts

Target Intensity	≥ 70% $HR_{reserve}$ ≥ 15 RPE

Treadmill Training	Forward (10 min)
	Variable (10 min)
Overground Training	Stairs (10 min)
	Variable (10 min)

High Intensity Forward Training

High-intensity stepping + Forward Only

Target Intensity	≥ 70% $HR_{reserve}$ ≥ 15 RPE

Treadmill Training	Forward (20 min)
Overground Training	Forward (20 min)

Low Intensity Variable Training

Low-intensity stepping ✚ Variable contexts

Target Intensity	≤ 40% $HR_{reserve}$ ≤ 13 RPE

Treadmill Training	Forward (10 min)
	Variable (10 min)
Overground Training	Stairs (10 min)
	Variable (10 min)

Outcomes

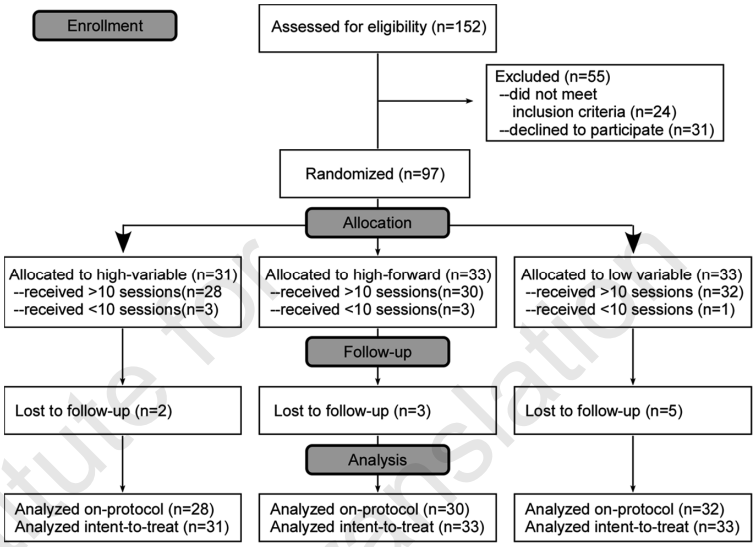
- BSL, POST, 3 month f/u

Primary outcomes
SSS
FS
6MWT (FS)

	Secondary outcomes
Spatio-temporal	Temporal symmetry = % SLS
	Spatial symmetry = $100\% \times \left(1 - \left|\left(1 - \frac{\text{nonparetic step length}}{\text{paretic step length}}\right)\right|\right)$
Clinical	FGA
	5XSTS
	ABC Scale

- Adverse events (serious vs minor)

Results: CONSORT Diagram

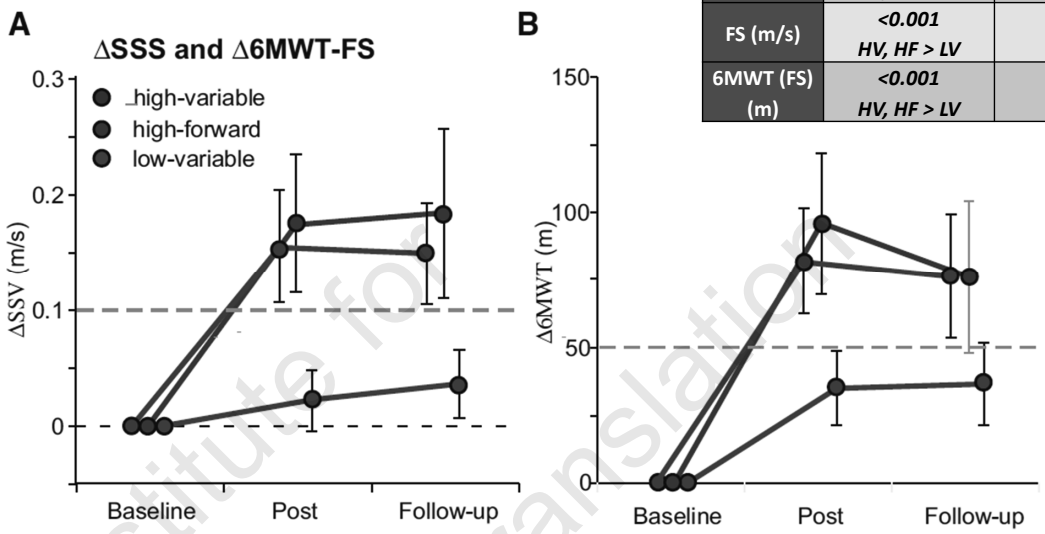


Results: Demographics and Trainings

	High-Variable (n=28)	High-Forward (n=30)	Low-Variable (n=32)	group effects
Sessions	27 (26-29)	27 (25-28)	27 (25-29)	0.79
Duration/session (min)	34 (33-35)	33 (32-35)	37 (36-38)	***<0.001 LV > HV, HF***
%HRR (predicted HR_{max})	67 (61-72)	61 (54-67)	40 (35-44)	***<0.001 HV, HF > LV***
RPE	16 (16-17)	17 (16-18)	14 (13-14)	***<0.001 HV, HF > LV***
Steps/session	2675 (2368-2982)	3156 (2822-3491)	2164 (1798-2530)	***<0.001 HF > HV > LV***
Steps/min	62 (57-66)	75 (71-80)	48 (42-54)	***<0.001 HF > HV > LV***

Results: Primary Outcomes

	group x time interaction	group x severity x time interaction
SSS (m/s)	*<0.001 HV, HF > LV*	0.21
FS (m/s)	*<0.001 HV, HF > LV*	0.43
6MWT (FS) (m)	*<0.001 HV, HF > LV*	0.96



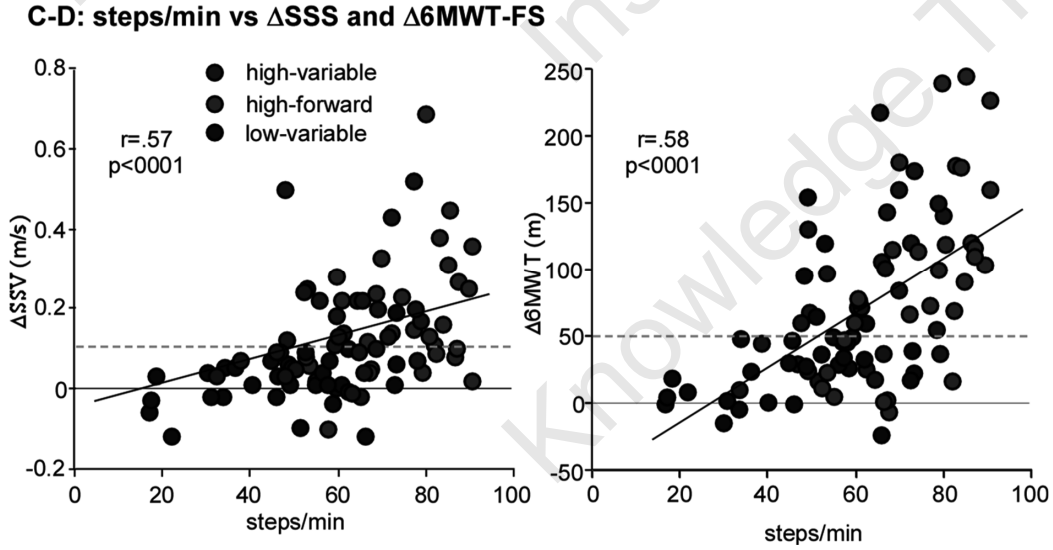
Results: Spatiotemporal Outcomes

		High-Variable	High-Forward	Low-Variable	group x time interaction	group x severity x time interaction
Single limb stance-SSS (% gait cycle)	BSL	21 (19-24)	22 (19-24)	22 (19-25)	*<0.001 HV, HF > LV*	*<0.001 HV/HF-severe> others*
	ΔPOST	2.1 (0.7-3.4)	3.5 (1.9-5.0)	0.5 (-0.4-1.4)		
	ΔF/U	2.6 (0.9-4.3)	3.8 (2.0-5.5)	0.9 (-0.4-1.6)		
Step length asymmetry-SSS (%)	BSL	72 (60-83)	76 (68-83)	69 (60-78)	0.95	0.45
	ΔPOST	4.9 (-1.1-11)	1.7 (-6.2-9.7)	2.4 (-5.4-10)		
	ΔF/U	3.9 (-4.3-12)	3.6 (-4.2-11)	3.8 (-4.3-12)		

Results: Secondary Clinical Outcomes

		High-Variable	High-Forward	Low-Variable	group x time interaction	group x severity x time interaction
FGA	BSL	13 (11-15)	12 (9.9-14)	11 (9.2-13)	0.06	0.46
	ΔPOST	2.2 (1.1-3.3)	0.7 (-0.6-2.0)	1.8 (0.3-3.4)		
	ΔF/U	2.6 (1.2-3.9)	1.4 (0.3-2.5)	0.4 (-0.9-1.6)		
ABC Scale	BSL	61 (51-70)	53 (46-61)	49 (40-57)	0.13	***0.03 HV-severe > others***
	ΔPOST	10 (4.9-16)	4.1 (-0.1-8.4)	7.4 (3.3-11)		
	ΔF/U	9.6 (3.4-16)	2.6 (-1.4-6.7)	4.0 (-1.1-9.1)		

Results: Dose/Response Relationships



Results: Adverse Events

- Serious adverse events not observed in any group
- Minor adverse events not different between groups (p = 0.73)

	High-Variable	High-Forward	Low-Variable
Musculoskeletal pain	27	20	18
Falls w/o injury	8	10	16
HTN, angina, SOB	6	4	8
Dizziness/LOC	2	3	0

Discussion and Conclusions

- Contributions of intensity of training are clear
- Contributions of task variability and difficulty are less clear
- Spatiotemporal differences despite limited focus on kinematics
- No group differences in adverse events

Institute for Knowledge Translation

Potential Role of Task-Specific Training on Locomotor Recovery Following Incomplete Spinal Cord Injury

Jennifer K. Lotter, DPT, Christopher E. Henderson, PT, PhD, NCS, Abbey Plawecki, MPT, Molly E. Holthus, DPT, Emily H. Lucas, SPT, Marzieh M. Ardestani, PhD, Brian D. Schmit, PhD, T. George Hornby, PT, PhD

INDIANA UNIVERSITY
DEPARTMENT OF PHYSICAL MEDICINE AND REHABILITATION
School of Medicine

Rehabilitation Hospital of Indiana

Background and Motivation

- Stepping practice not emphasized in inpt PT (Zbogar 2016)
  - ~100 steps/session in ambulatory iSCI
  - ~200 non-walking leg movements

- Intensity may be important
  - High intensity strengthening (Gregory 2007; Jayaraman 2013)
  - Aerobic cycling (McLeod 2019; DiPiro 2016)
  - Circuit training (Gant 2017)

Does greater amounts of stepping practice improve stepping, or do we just need to work hard?

Institute for Knowledge Translation

Background and Motivation

Purpose: investigate the role of specificity of training on locomotor outcomes in iSCI

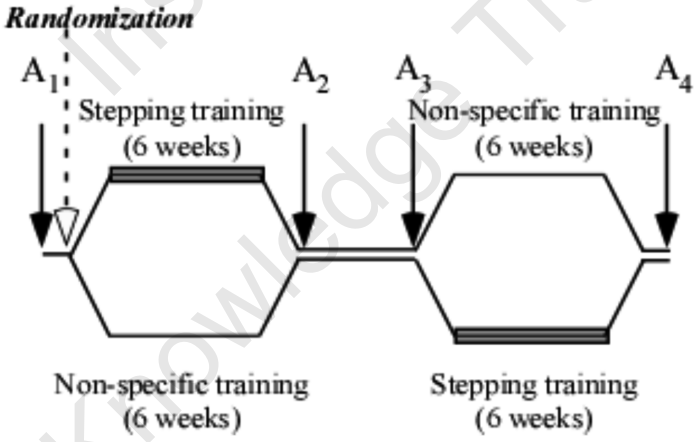
Hypothesis:

High-intensity + Stepping Practice > High-intensity + Non-Stepping Practice

Methods

Inclusion Criteria
> 1 year post iSCI
Motor iSCI T10 or higher
Able to walk ≥ 10m at speeds < 1.0 m/s with customary AD and below knee bracing PRN

Exclusion Criteria
Additional neurologic or orthopedic injury that limits ambulation
Currently participating in PT



Task-Specific Training

High-intensity + Stepping Practice

Target Intensity	≥ 70% $HR_{reserve}$ ≥ 15 RPE

Treadmill Training	Forward (10 min)
	Variable (10 min)
Overground Training	Stairs (10 min)
	Variable (10 min)

Non-Specific Training

High-intensity + Non-Stepping Practice

Target Intensity	≥ 70% $HR_{reserve}$ ≥ 15 RPE

Interventions	LE strengthening (10 min)
	Balance (10-15 min)
	Aerobic training (10 min)
	Transfer training (5 min)

Outcomes + Analysis

Primary Outcomes
Fastest walking speed
Peak TM Speed

Secondary Outcomes
Self-selected speed
6MWT
Berg Balance Scale
5XSTS
ABC Scale
Peak RST Power

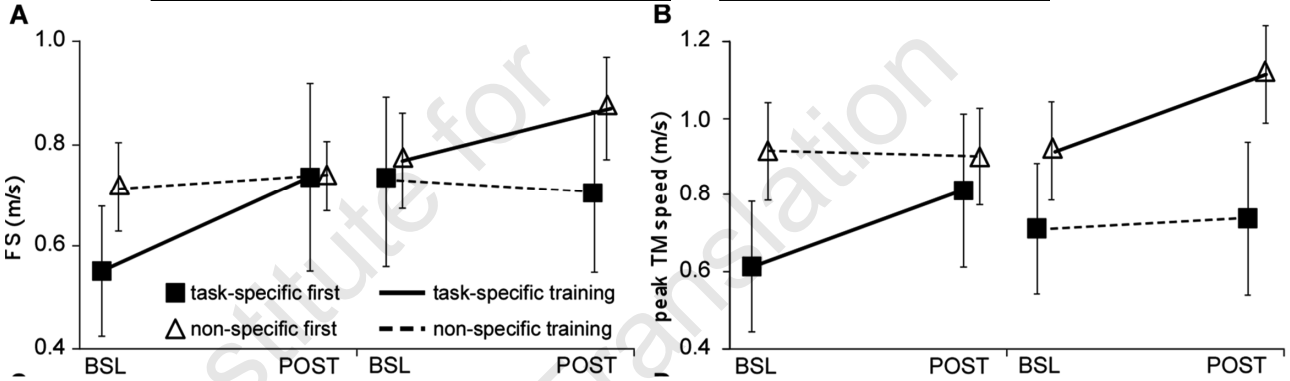
Results

- N=16
- No group differences in demographics

	Non-specific	Task-specific	p-values
Number of sessions	18±3.0	18±1.5	0.84
Steps per sessions	693±437	2206±988	<0.001
% HRR Average	57±10	70±11	<0.001
RPE Average	18±1.3	17±1.2	0.20

Results: Outcomes

	Non-Specific	Task-Specific	time	time x group
FS (m/s)	0.02±0.08	0.14±0.18	<0.01*	0.01*
Peak TM speed (m/s)	0.01±0.09	0.20±0.15	<0.01*	<0.01*

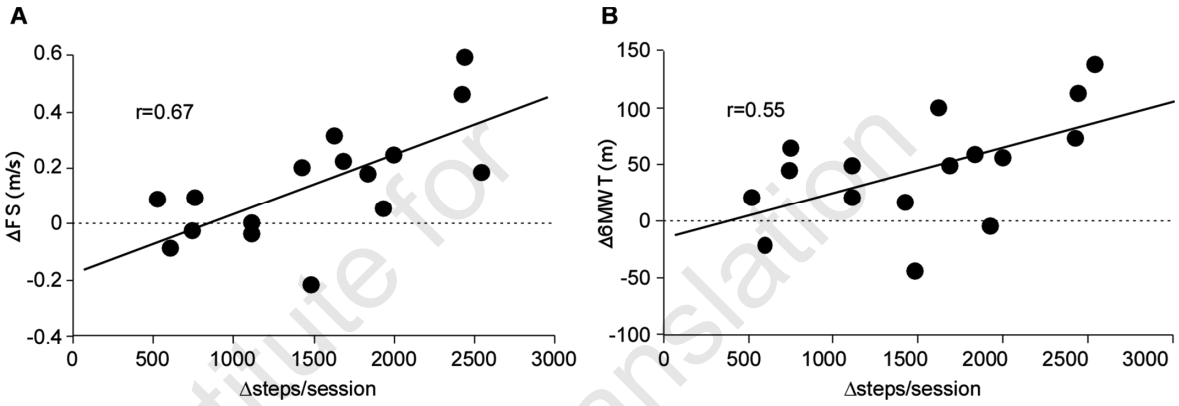


Results: Outcomes

	Non-specific		Task-specific		p-values	
	BSL	POST	BSL	POST	time	time X group
SSS (m/s)	0.53±0.28	0.53±0.25	0.51±0.26	0.58±0.30	0.10	0.12
6MWT (m)	192±97	195±94	191±110	239±123	<0.01*	<0.01*
BBS	32±12	33±11	32±14	35±14	0.03*	0.39
ABC	55±21	57±21	48±22	58±23	0.02*	0.01*
Peak RST power (W)	103±43	134±48	110±45	110±43	0.10	0.04*

Results: Correlations

Δ = task-specific training – non-specific training

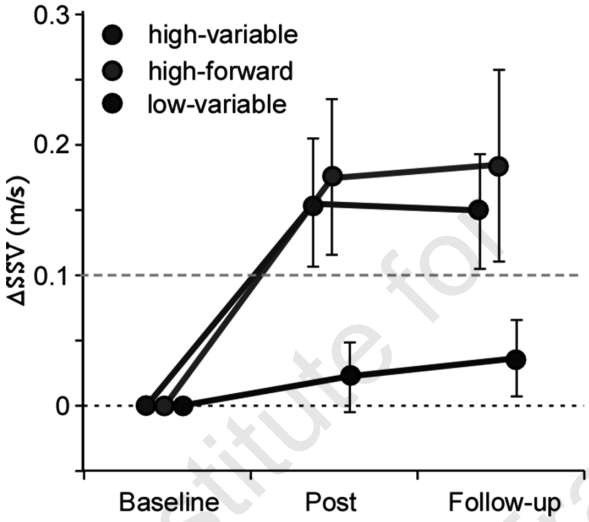


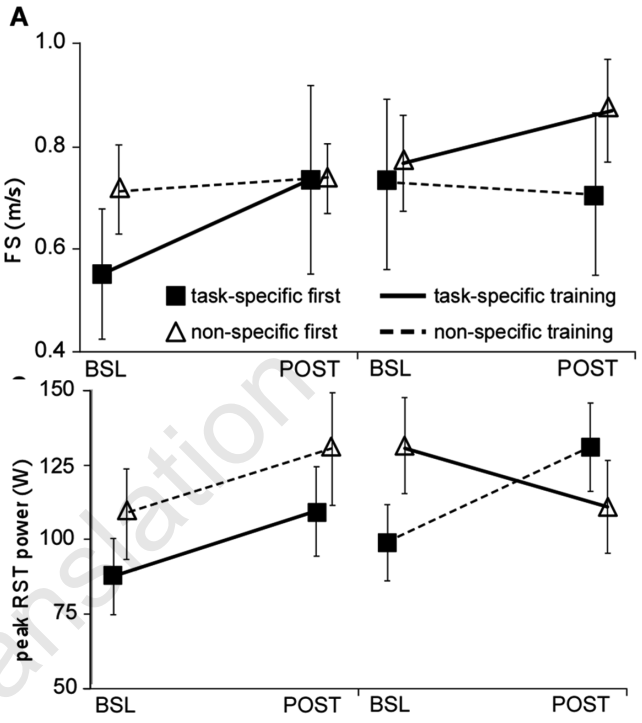
Discussion and Conclusions

- Greater gains in locomotor outcomes in task-specific versus non-specific training

- Limited walking gains with impairment-based strategies, but gains in recumbent stepping power

Summary





Knowledge Translation Institute for

Implementation of high intensity gait training

Real world application

Maghan Bretz, PT, MPT, NCS
Ascension St. Vincent Evansville
Evansville, Indiana

1

Ascension St. Vincent

- Community-based hospital system located in southwestern Indiana
- Trials and tribulations of implementing HIT

2

PT Practice in 2012

Two approaches:

- NDT/ traditional strategies:
  - Movement quality
  - Handling
  - Simpler → complex tasks
- Impairment-based interventions

Hindsight 20/20 . . but . . .

- Amount?
- Intensity?
- Outcome measures?

3

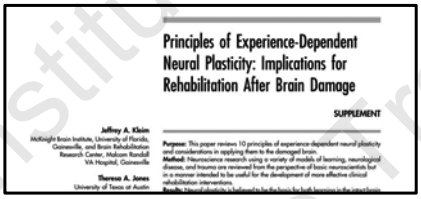
The turning point

Planned presentation

- Focus on post-stroke rehabilitation
- Attention to NDT principles

Consultation with colleague

- Observation of high intensity training in lab
- Attendance at "Walk the Walk"



Principles of Experience-Dependent Neural Plasticity: Implications for Rehabilitation After Brain Damage

SUPPLEMENT

Jeffrey A. Klein
McKnight Brain Institute, University of Florida, Gainesville, and Brain Rehabilitation Research Center, Malcom Randall VA Hospital, Gainesville

Theresa A. Jones
University of Texas at Austin

Kleim and Jones, 2008

"The time has come to let go of the neurophysiologic approaches as a basis for neurologic physical therapy education and practice.

Instead, we should discuss the therapeutic principles that drive the nervous system to respond and adapt"

K. Sullivan JNPT 2009 editorial

4

Changing direction

- Prioritize walking
- Monitor vitals and target high intensities
- Decrease focus on movement quality and isolated impairments
- Start utilizing outcome measures

5

Early years: figuring it out

- Knowledge sharing
  - "Active ingredients"
  - Biomechanical subcomponents
  - Safety, feasibility, translation

TASK SPECIFICITY
REPETITION
INTENSITY

6

Early years: figuring it out

- Knowledge sharing
  - "Active ingredients"
  - Biomechanical subcomponents
  - Safety, feasibility, translation
- Clinician resources and guides

Rating of Perceived Exertion
Borg RPE Scale

6		How you feel when lying in bed or sitting in a chair relaxed. Little or no effort.
7	Very, very light	
8		
9	Very light	
10		
11	Fairly light	
12		Target range: How you should feel with exercise or activity.
13	Somewhat hard	
14		
15	Hard	
16		
17	Very hard	How you felt with the hardest work you have ever done.
18		
19	Very, very hard	
20	Maximum exertion	Don't work this hard!

Initials: Room #: [Type text] THRR: Weight:

Date	Pre vitals	Post vitals	Intensity	Gait Subcomponents				DF assist	Speed range	Rest breaks	Total feet / Total time
				Limb Adv	Stance	Propulsion	Post Stab				

7

Early years: figuring it out

- Modeling myself
- Team skepticism
- New clinician mentoring
- More equipment
  - Lift system upgrades
  - New walking harnesses
  - Overhead ceiling harness

8

Early years: figuring it out

- 35 y.o. female
  - Infection → spinal cord injury
  - Categorized as a C4 ASIA B
  - Total assist with all self care and mobility
- 2-week reassessment: flickering LE movement

Old way:

Bed mobility, t… f… w/c mobility
Sitting → standi… re-gait → gait
Not measuring HR

New way:
Prioritized gait
Targeted high intensity HR range

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Early years: figuring it out

10

Early years: figuring it out

11

Early years: figuring it out

12

Over the next several years...

Integrating knowledge early . ..
- Adjunct faculty position
- Training future colleagues

Knowledge seeking
- Mentors
- ANPT Locomotor CPG Task Force

Knowledge sharing
- Mentoring and modeling
- Staff presentations
- Hospital symposiums
- Local district meetings
- INAPTA Fall Conference

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Over the next several years...

Leadership role
- Clinical practice leader with KT responsibilities
- Moving to outpatient setting & using what we have
- Residency development

Equipment and processes
- New treadmill, new site
- Continuous HR monitoring
- Measuring outcomes

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Today: taking it up a notch

	Admission
Transfers	Dependent x 2
Gait	N/A
Stairs	N/A
10MWT	0 m/s
6MWT	0’
Berg Balance Scale	3/56

- 51 y.o. male
- Motor vehicle accident → spinal cord injury
- Categorized as a C4 ASIA D (LEMS 33/50)
- Total assist with self care & mobility

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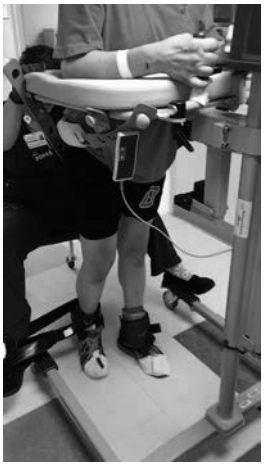
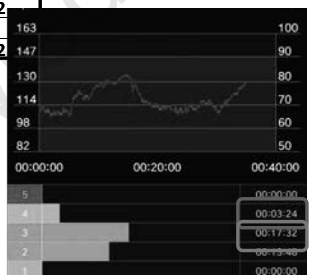
Today: taking it up a notch



Age	51
Beta	n
Low Intensity	
65%	112
Moderate Intensity	
75%	129
High Intensity	
85%	146
HR max	172
Polar HR	162



Peak HR:
135 (79% HRmax)
RPE:
18

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Today: taking it up a notch

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Outcomes

	Admission	Discharge
Transfers	Dependent x 2	Min assist
Gait	N/A	>1000 feet, RW/min
Stairs	N/A	Flights, mini assist, rail
10MWT	0 m/s	0.52 m/s SSV 0.88 m/s FV
6MWT	0’	669’
Berg Balance Scale	3/56	29/56

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What's changed?

- Intensity of practice
- Clinician efficiency
- Clinician confidence and skill
- Patient education

	ADM	D/C
Berg	23	45
10mWT	0.26 m/s	1.1 m/s
6MWT	211'	781'

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What's changed?

20

Take Home Messages

- Recognizing the gap
- Actually doing something about it
- Realizing that change takes time and effort
- Leadership support is huge

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Push back . . . .

Society for American Baseball Research

General manager
Billy Beane

Asst general manager
"Peter Brand"

27

Push back . . . .

I've been practicing physical therapy for 23 years . . .

Everyone does it this way . . .

This is how I learned to do it . . .

. . . so I know because I know

. . . and I was taught by experts

. . . I've rehabilitated thousands of patients . . .

And my patients get better . . .

28

"I don't want to hurt my patient"

29

"I don't want to hurt my patient"

No increased risk of cardiovascular/ orthopedic injury with high intensity training (Pang J Stroke Cerebrovas Res 2013; Hornby NNR 2015, Moore Stroke 2020)

Strategies

- ACSM guidelines (< 85% HR_{max}, measure BP)
- MD approval with concerns
- AFO, taping, knee cage and gait belts

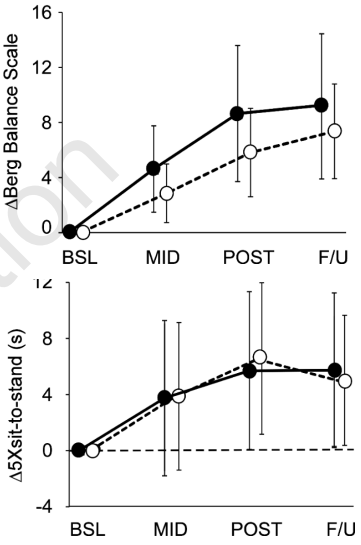
30

"You're ignoring their impairments"

Strength, balance, transfers improve with high intensity variable stepping

Controlled interventions (Straube PTJ 2014; **Hornby NNR 2016**)

Clinical studies (Horn APMR 2005; Hornby NNR 2015)



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"Well … they aren't ready for walking"

Impairment-based interventions often don't improve walking function (CPG Locomotor Function JNPT 2020)

Winstein APMR 1989 – "failure of part-whole practice"

" . . .. appealing to think that practice of an element of a complex skill will enhance performance, research has found little support . . ."

". . . elements when practiced separately may not be the same when performed within the entire skill"

"Pre-gait" is neither "pre" nor "gait" . . . discuss

32

"Fine, but I can't facilitate normal kinematics alone"

Practicing "normal" may result in limited gains in function or kinematics
(Dobkin Neurol 2006, Hornby Stroke 2008, Hidler NNR 2009, Lewek PTJ 2009 Duncan JAMA 2011)

Practicing normal is not sufficient

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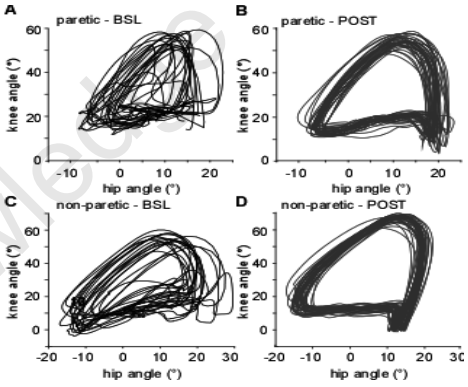
"Their gait patterns look horrible"

Distinction between "performance" and "learning"

Gait quality improves with high intensity variable training (Hornby NNR 2016, Mahtani PTJ 2017, Ardestani NNR 2019, J Neurotrauma 2019)

Effects of errors/variability (Schmidt and Lee 2003, Bastian Curr Opin Neurol 2006, Reisman PTJ 2010),

Practicing normal is not necessary



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Removing the kid gloves . . . .

- Introduction – why do we do what we do? - T. George Hornby, PT, PhD
- Removing the gloves in neurological rehabilitation – Chris E. Henderson, PT, PhD, NCS
- Application to the real-world environments – Maghan Bretz, MPT, NCS
- Summary

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