


The Effects of Exercise
and Wellness
Programming on Person's
with Parkinson's

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On With Life




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Objectives


Upon completion of this program, the participant should be able to:

1. Identify signs and symptoms of Parkinson's (PD) and related functional deficits during lifespan of PD.
2. Identify current research related to Music, Exercise and Neuroplasticity in PD.
3. Understand the benefits of Exercise and Wellness programming by participating in large amplitude movements and voice training via singing.





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What is Parkinson's Disease?




- Described in 1817 by an English physician, Dr. James Parkinson, "Shaking Palsy."
- Affects more than 1.5 million people in the United States.
- Men and women equally affected.
- Affects individuals over the age of 60, only 15% cases are under 50, however the incidence is increasing.
- Higher incidence in developed countries.



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What causes PD?




- **Lack of dopamine**
 - Chemical messenger responsible for transmitting signals between the substantia nigra and the next "relay station" of the brain allowing smooth, coordinated function of the body – we move and do not really think about that movement
 - When there is loss of dopamine producing neurons, we have difficulty with movement
 - Treating the dopamine system is critical to deal with the symptoms
- **Other chemicals disrupted**
 - Serotonin, norepinephrine, acetylcholine
 - Causes changes in mood, behavior, cognition
- **Cholinergic System**
 - Controls movement, gait, balance, memory, sleep



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Theories regarding cause of PD


- **Idiopathic**
 - Basically the cause of PD is not truly known
- **Genetic Factors**
 - Several genes that when mutated can increase risk of PD
 - LRRK2: particularly has been found in North African/Jewish descent
 - Alpha-Synuclein Gene: Mutations found to trigger PD (but rare)
 - GBA Gene
 - Parkin Gene
 - DJ-1 Gene
 - **Overall - no primary genetic cause can be found as of yet
- **Environment Factors**
 - Significant exposure to pesticides, certain heavy metals, repeated head injuries can increase risk
 - No clear environmental cause – because many years can pass between exposure to onset of symptoms
 - It does seem likely that there is a level of environment influence to development of PD
- **Other Risk Factors**
 - Age – more common in older adults (>50 years of age)
 - Men greater risk than women
 - Caucasians more than African Americans or Asians

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Symptomology - Motor

- **Four Main Motor Symptoms:**
(Diagnosis considered when 2 of the 4 main motor symptoms are present over period of time)
 - **Shaking (Tremor)**
 - Present in approximately 70% of people with PD
 - Resting tremor typically present in hand or foot at rest
 - Has a characteristic appearance of "pill rolling" movement (thumb/forefinger)
 - Usually begins in one hand, but also can begin in jaw or foot
 - More obvious typically when individual is under stress, fatigue, or intense emotions
 - 3 out of 4 people have tremor that affects only one side of body (especially during early stages)
 - Usually disappears or lessens during sleep or intention movement
 - **Slowness of movement (Bradykinesia)**
 - Profound slowness of movement
 - Loss of spontaneous/automatic movement
 - Typically very frustrating as this probably interferes mostly with daily activity and is unpredictable
 - One minute you can move easily and the next you can't



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- **Stiffness of arms, legs, trunk (Rigidity)**
 - Seldom main symptom in early diagnosis
 - Mostly seen with normal aging/arthritis changes
 - May be present in the trunk
- **Trouble with balance (Postural instability)**
 - Impaired balance
 - Causes forward or backward lean – increases risk of fall
 - Usually not present at diagnosis
 - One of the most common with progression of disease process



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Other symptoms - Motor



- **Decreased automatic reflexes** (ie. blinking)
- **Freezing**
 - feeling of being stuck in place
- **Loss of facial expression**
 - due to rigidity of facial muscles – aka hypomimia or facial masking
- **Dysarthria**
 - low voice volume or in time speech
- **Reduced arm swing or slight foot drag on affected side**
- **Micrographia**
 - small/cramped handwriting
- **Retropulsion**
 - tendency to fall backwards
- **Festination**
 - walking with a series of quick, small, shuffling steps




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Motor Fluctuations

- **Motor Fluctuations/Dyskinesia**
 - Sudden, unpredictable changes in ability to move
 - “On-Off” times
- **Dyskinesia**
 - Involuntary movement, often fluid and dance like, but can also be rapid jerking or slow extended muscle spasms of any part of body
 - Usually noted at “peak dose” – when concentration of levodopa in blood is highest (usually 1-2 hours after administration)
- **Dystonia**
 - Muscles continuously contract – causing body to twist, toes curl
 - Leads to repetitive movements or abnormal postures – often cause pain/discomfort





Pisa Syndrome




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THE FIVE STAGES OF PARKINSON'S DISEASE



- **Stage 0:** No signs of disease
- **Stage 1:** Unilateral Disease
- **Stage 1.5:** Unilateral plus axial involvement
- **Stage 2:** Bilateral disease without impairment of balance
- **Stage 2.5:** Mild Bilateral disease with recovery on pull test
- **Stage 3:** Mild to moderate bilateral disease; some postural instability; physically independent
- **Stage 4:** Severe disability; still able to walk or stand unassisted.
- **Stage 5:** Wheelchair bound or bed ridden unless aided



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Parkinson's Outcome Project

Started in 2009, the *Parkinson's Outcomes Project* is the largest-ever clinical study of Parkinson's disease with over 12,000 participants in five countries.

Key findings:


- Regular exercise is associated with better quality of life and mobility in people with PD
- 2.5 hours of weekly exercise is associated with slower decline in quality of life in PD

<https://parkinson.org/research/Parkinsons-Outcomes-Project>

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Exercise in PD



Shulman LM, et al. *JAMA Neurol.* 2013

1. Higher-intensity treadmill exercise vs. Lower-intensity treadmill
2. Exercise vs. Stretching and Resistance exercises

- Both treadmill groups improved cardiovascular fitness
- Stretch/resistance group improved strength
- **All groups** increased distance on 6 minute walk test

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BIGGER is Faster!






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Exercise in PD



Meng NI, et al. Neurorehabilitation and Neural Repair 2018
Systematic review and meta-analysis targeting walking function for adults with Parkinson's disease
40 randomized controlled trials, 1656 subjects
Exercise groups had biggest improvement in Timed Up and Go, comfortable walking speed, fast walking speed, stride or step length, and cadence



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Exercise in PD

Kelly et al., J Appl Physiol 2014
16 weeks **high-intensity exercise training** designed to simultaneously challenge strength, power, endurance, balance, and mobility function
“Persons with moderately advanced PD adapt to high-intensity exercise training with favorable changes in skeletal muscle at the cellular and subcellular levels that are associated with improvements in motor function, physical capacity, and fatigue perception.”

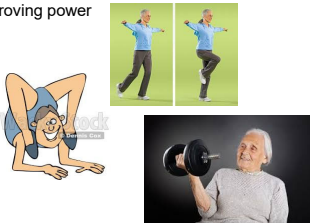



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Exercise Guidelines-ACSM

- Aerobic exercise**
 - ACSM guidelines- 30 minutes/day, 5 days/week, moderate intensity
- Strengthening**
 - ACSM guidelines- 2 days/week, 8-10 exercises, 10-15 repetitions
 - Consider extensors, improving power
- Stretching**
 - Address shortened muscles
- Balance training**
 - Start early

Haskell WL, 2007

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Exercise and Wellness Programs


<p>Specific to PD :</p> <ul style="list-style-type: none"> LVST B I G /LO UD B I G for Life Dance for Parkinson's Delay the Disease PW R! Rock Steady Boxing Virtual-Move It! Online Live Streaming Exercise Class via Parkinson & Movement Disorder Alliance 	<p>Non-Specific to PD :</p> <ul style="list-style-type: none"> TaiChi Yoga Water Aerobics Zumba Silver Sneakers Walking Groups Spin/Cycling
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LSVT-How it came about...

- LSVT = Lee Silverman Voice Training
 - Family of Lee Silverman Parkinson's Patient stated "If only we can hear and understand her"
 - Initial development of this program was the LSVT LOUD component in 1987-1989 by Lorraine Ramig, PhD, CCC-SLP and Carolyn Mead Bonitati, M.A., CCC-SLP



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Legitimate Therapeutic Options
To provide symptomatic relief; improve function

Pharmacological (L-dopa) Neurosurgical (DBS-STN)

Voice and Body Exercise

Zigmond et al, 2009

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LSVT BIG

- Intensive amplitude based exercise program for the LIMB motor system
- Re-education of the sensorimotor system
- Based off the principles of LOUD
- Consists of a standardized exercise protocol
- Completed over a period of 4 weeks – 4 times a week for 60 minutes each.
- It is administered in an intensive manner to challenge the impaired system
- Techniques are specific to PD-specific deficits such as bradykinesia/hypokinesia and kinesthetic (sensory) awareness



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Pre/Post LSVT

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LSVT BIG Concepts



- Standardized, research-based, specific protocol
- **TARGET:** *Bigness (amplitude)*
- **MODE:** *Intensive and High Effort*
- **CALIBRATION:** *Generalization*
 - *Sensory*
 - *Internal cueing*
 - *Neuropsychological changes*

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TARGET/AMPLITUDE

- BIG (Large amplitude whole body movement)
- Single Target - Triggers Activation across motor systems (task specific)
- Overrides bradykinesia / hypokinesia
- Increases ROM
- Takes advantage of speed/distance – BIGGER = FASTER
- Trains self cueing – anytime/anywhere
- Internal focus – allows for maximal repetition in your everyday living

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Wellness

Monthly Support Group with group exercise for carryover and repetition.

Group activities can increase self reported Quality of Life through socialization and comradery.





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- Shulman LM, et al. *JAMA Neurol.* 2013; 70(2):183-190.
- Meng NJ, et al. *Neurorehabilitation and Neural Repair* 2018; 32(10), 872-886.
- Kelly et al., *J Appl Physiol* 2014; 116:5, 582-592
- Uc EY, et al. *Neurology*, 2014; Vol.83(5), p.413-425
- Haskell WL, et al. American College of Sports Medicine and the American Heart Association. *Circulation*, 2007; 116(9), 1081-1093.
- <https://www.apdaparkinson.org/pd-fitness-training/>
- <https://www.pmdalliance.org/online-programs/move-it/>
- <https://parkinson.org/research/Parkinsons-Outcomes-Project>
- <https://www.lsvtglobal.com>





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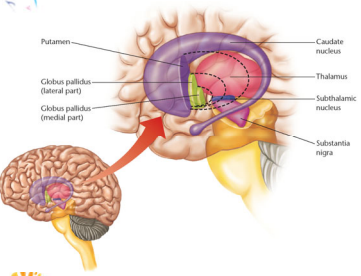
Music and Singing in Parkinson's Disease

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What is Parkinson's Disease?



CARDINAL SYMPTOMS:

- Tremor
- Rigidity
- Bradykinesia
- Gait Disturbances
- Postural Instabilities



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Other Symptoms

Not all symptoms respond to current medication and surgical treatment (such as gait impairment).

There are other non-motor symptoms that affect quality of life and are factors that lead to death in PD.

There remains a need to find alternative treatments that have a pervasive effect on ALL symptoms of PD.

Parkinson's disease
non-motor disorders caused by Parkinson's disease

- Depression, sleep disorders, weight loss
- Constipation, motor fluctuations, social problems
- Increased sweating
- Hoarseness of the voice, weakness of the feet
- Lossing of the shoulders, weakness of the feet
- Excessive daytime sleepiness, difficulty in swallowing, respiratory problems
- Orthostatic hypotension
- Excessive daytime sleepiness, difficulty in swallowing, respiratory problems
- Excessive daytime sleepiness, difficulty in swallowing, respiratory problems
- Excessive daytime sleepiness, difficulty in swallowing, respiratory problems

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What is Music Therapy?

“The clinical and evidence-based use of music interventions to accomplish individual goals within a therapeutic relationship by a credentialed profession who has completed an approved music therapy program.”
- American Music Therapy Association

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Why Music?

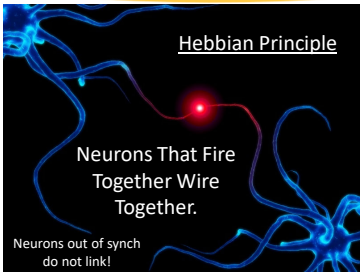
-12 VTA

- Increases Dopamine

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Why Music?




Hebbian Principle

Neurons That Fire Together Wire Together.

Neurons out of synch do not link!

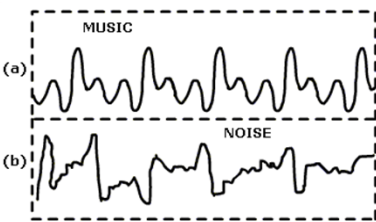
- Increases Dopamine
- Neural Synchrony



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Why Music?




MUSIC

(a)

(b)

NOISE

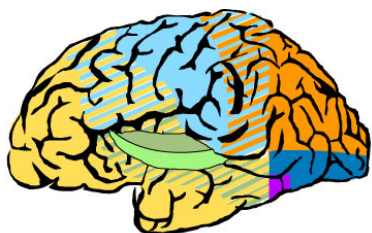
- Increases Dopamine
- Neural Synchrony
- Clear Signal




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Why Music?



- Increases Dopamine
- Neural Synchrony
- Clear Signal
- Activates the Whole Brain



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Why Music?



- Increases Dopamine
- Neural Synchrony
- Clear Signal
- Activates the Whole Brain

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Effects of Singing in PD



- 8 Week Program
- 30 Participants from across Iowa (4 singing groups)
- Intervention lead by music therapists
- Intervention included vocal exercises and group singing

Voice:
Duration
Vocal Loudness
Pitch Range

Respiratory:
Maximum Inspiratory Pressure
Maximum Expiratory Pressure

Swallow:
EMG Timing
EMG Amplitude

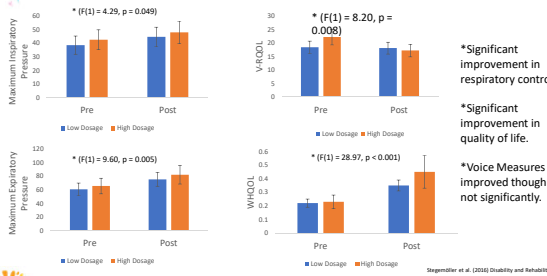
QOL:
V-RQOL
SWAL-QOL
WHQOL

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Effects of Singing in PD



Maximum Inspiratory Pressure
* (F(1) = 4.29, p = 0.049)

Maximum Expiratory Pressure
* (F(1) = 9.60, p = 0.005)

V-RQOL
* (F(1) = 8.20, p = 0.008)

WHQOL
* (F(1) = 28.97, p < 0.001)

*Significant improvement in respiratory control.
*Significant improvement in quality of life.
*Voice Measures improved though not significantly.

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Stegemiller et al. (2018) Disability and Rehabilitation

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Effects of Singing in PD

EMG rise time and fall time are significantly increased ($F(1) > 5.96, p < 0.02$). There were no significant differences in EMG amplitude.

With the larynx elevated for a longer period, airway closure is improved.

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Stegemöller et al. (2017) Complementary Therapies in Medicine

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Effects of Singing in PD

Participants also reported feeling less stressed and depressed after singing.

Stegemöller et al. (2017) Journal of Music Therapy

Measure motor symptoms, stress, inflammation, and depression after acute session of singing.

(Grammy Foundation)

Subjective reports of anxiety and sadness significantly reduced.

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Effects of Singing in PD

Singing also changes motor cortical activity!



Location	Non-singer (µV)	singer (µV)
Left Submental	~42	~60
Right Submental	~10	~48

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Effects of Singing in PD

- Singing improves respiratory control and muscle activity associated with swallow.
- Singing improves clinical motor symptoms which is associated with reduced cortisol.
- Singing improves subjective reports of anxiety and sadness.
- Singing may change associated motor cortical activity.

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Outreach





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Thank You!

Questions?

Funding:


- Parkinson's Study Group
- ISU Extension and Outreach
- ISU College of Human Sciences
- Grammy Foundation



Collaborators:

- Dr. Ann Smiley
- Dr. Marion Kohut
- Dr. Elizabeth Shirtcliff
- Dr. David Brown
- Dr. Judy Wingate

Contact: esteg@iastate.edu, www.neuromotorlab.com



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