# Quantitative Parkinson's Gait Assessment: A high resolution measure of change in impairment

Tuesday July 22th, 2014

Starts at 12:00 PM EST

Presented by

Elizabeth Brokaw, PhD

GREAT LAKES NEUROTECHNOLOGIES

# Outline

- Impairment due to Parkinson's Disease
- Deep Brain Stimulation
- Evaluations with wearable sensors
- DBS cessation research
- Role of Kinesia to improve gait outcomes

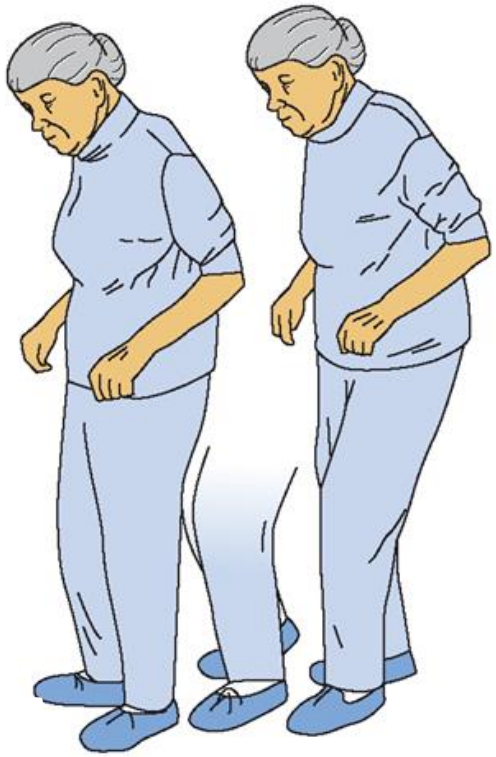
# Parkinson’s Disease Motor Impairments

# Parkinson's Disease

- Wide range of motor symptoms
- Treatments outcomes often focus on the upper extremity
- Mobility is important for quality of life
- Increased fall risk after PD
  - 68.3% fell during one year

# Parkinson's Disease

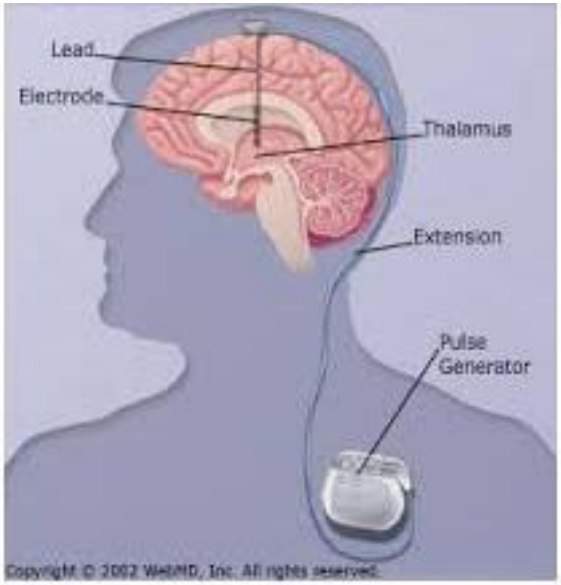
- Gait
  - Freezing of gait
  - Slowed movement
  - Shortened stride length
  - Flat foot strike (shuffled steps)
  - Impaired balance and posture



# Deep Brain Stimulation

# Deep Brain Stimulation

- Became a standard treatment for PD in the 1990's
- Effective method for improving symptoms and reducing medication burden
- Typically indicated for
  - Tremor
  - Bradykinesia
  - Rigidity



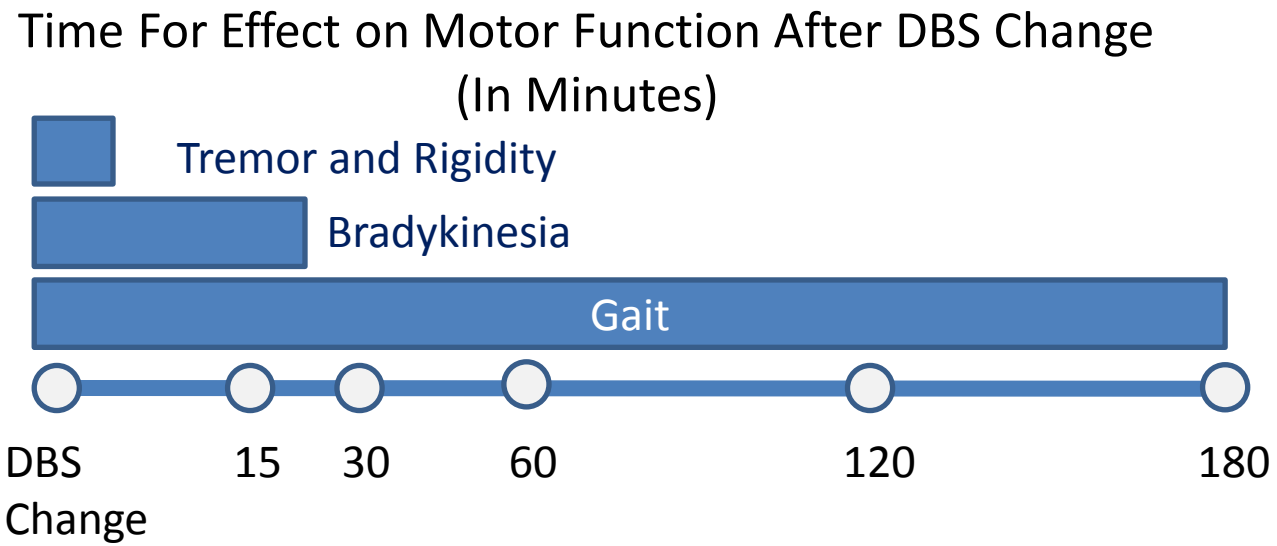
# Deep Brain Stimulation for Gait Impairment

- Researcher have observed STN stimulation induced improvement in
  - Stride length
  - Walking speed
  - Freezing of gait
- Evaluation of settings and location is ongoing
  - Frequency effects
  - Pedunculopontine nucleus (PPN)

# Deep Brain Stimulation Response Time

## Deep Brain Stimulation

- Effects some symptoms quickly




- Effect on gait is slow and less predictable
  - Unknown final effect on gait and balance
  - Not optimized to improve gait and balance

# Wearable Sensors

# Wearable Sensors

- Quantitative Evaluation of Movement
  - Acceleration
  - Angular Velocity

# Benefits of Wearable Movement Sensors

- Objective measure of impairment
- High resolution
- Not confined to in clinic evaluations

# Quantifying Effect of DBS Cessation With the Kinesia Sensors

The goal is to examine changes in impairment related to changes in to DBS settings

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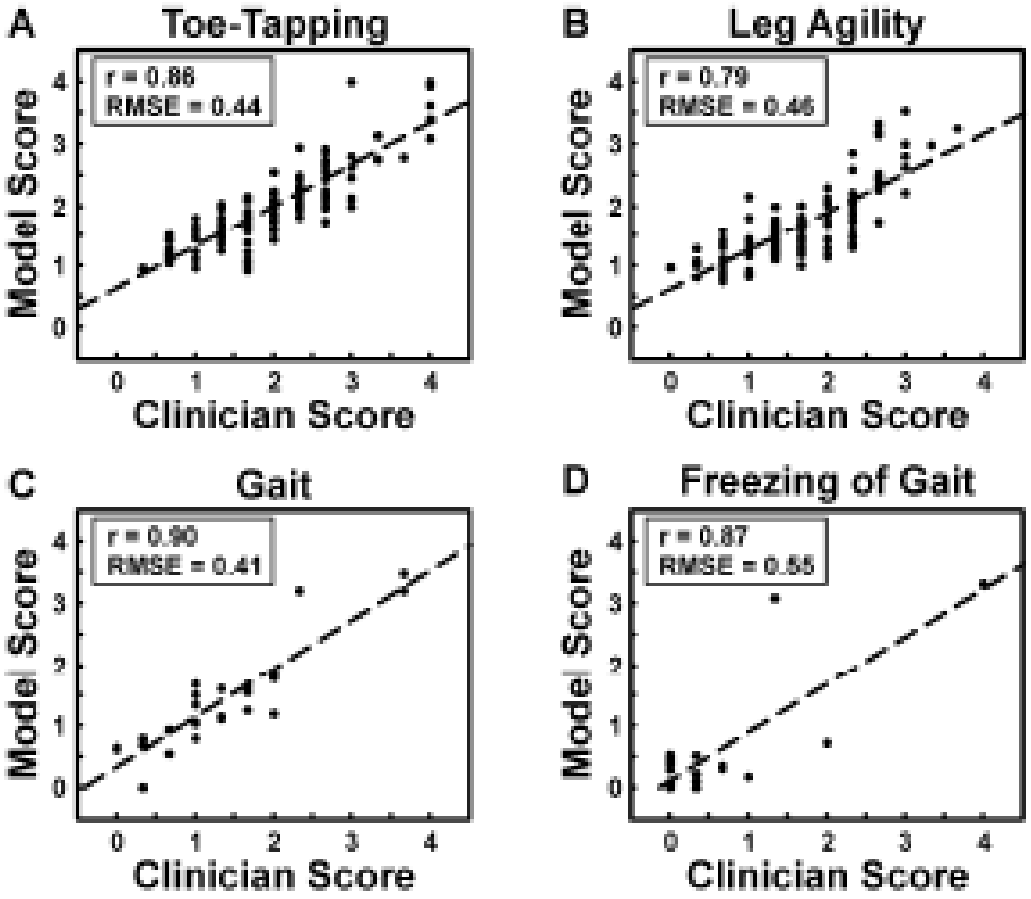
# Kinesia

- Quantitative assessment of
  - Tremor
  - Bradykineisia
  - Dyskinesia
  - Gait
  - Freezing of gait


- For more information
  - http://glneurotech.com/publications/

# Kinesia Lower Extremity and Gait Evaluation




Published:

Heldman, D., Filipkowski, D. E., Riley, D. E., Whitney, C. M., Walter, B. L., Gunzler, S. a, Giuffrida, J.P. & Mera, T (2012). Automated motion sensor quantification of gait and lower extremity bradykinesia. *International conference of the IEEE EMBS. 2012.*

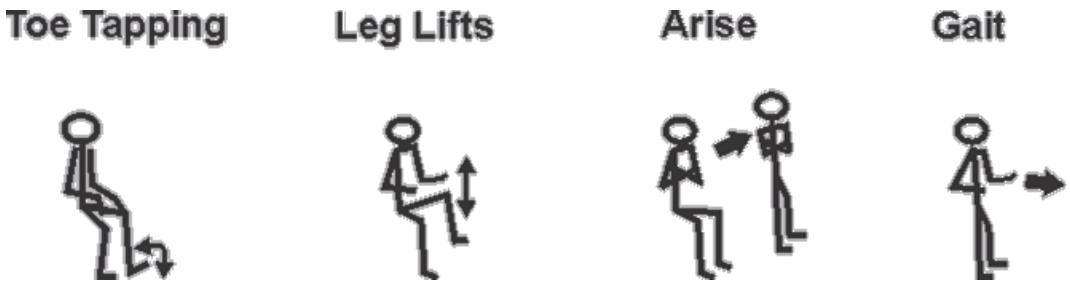
# Kinesia Sensor Placement

- Sensors placed on the more affected thigh, back and top of feet.

# Protocol

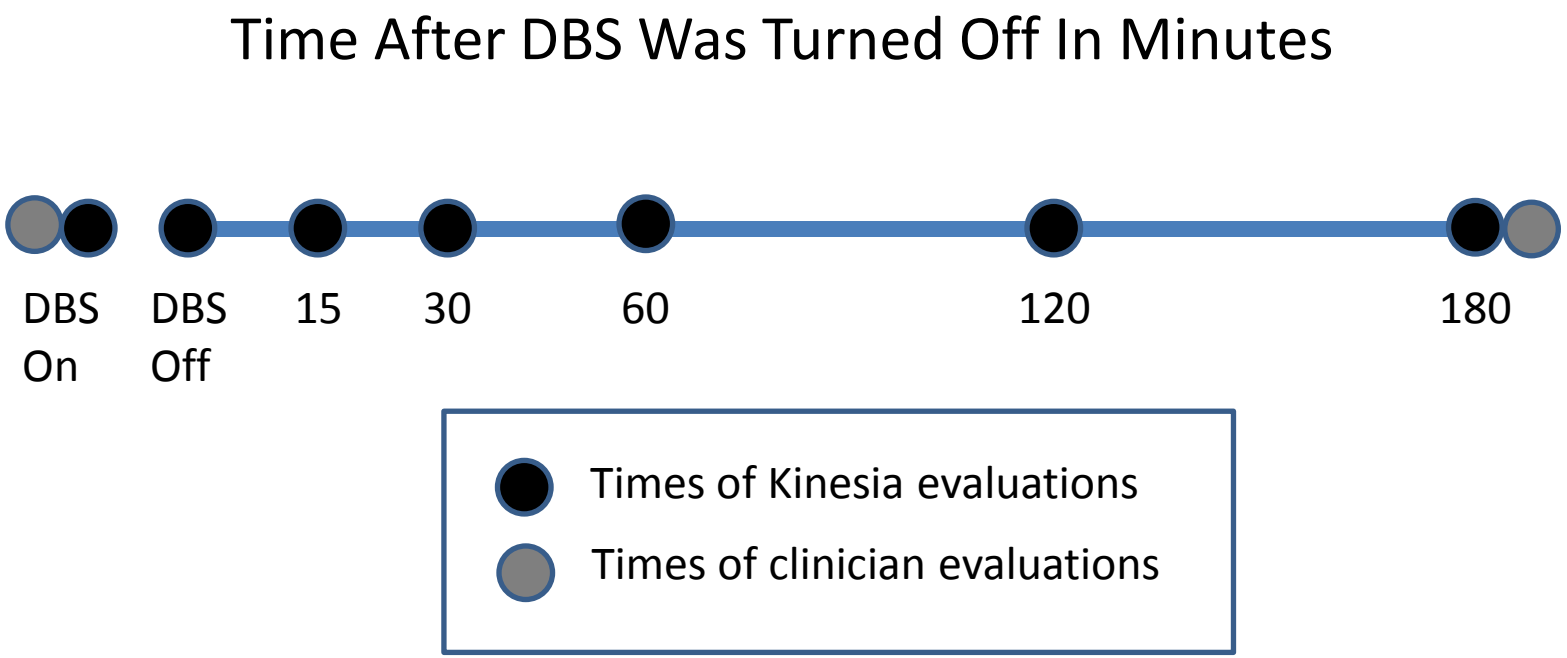
- Individuals with Parkinson's Disease and DBS
  - Started off medication  and with DBS on

- Kinesia Evaluation: Unified Parkinson's Disease Rating Scale tasks



# Protocol

- Clinician UPDRS at study start DBS on and 3 hours after DBS off
- 2 Kinesia evaluations at each time point



# Study Goals

- Evaluate changes in impairment over time
- Evaluate ability to minimize sensor number to reduce user burden
  - Sensors data from both legs
  - Sensor data from just the subject reported more affected limb

# Results

- 8 Individuals with Parkinson's Disease
- STN DBS implanted
- DBS surgery average of 1.8 ± 2.3 years prior
- Average of 14 ± 1.5 hours off medication

# Overall Effect of DBS Cessation

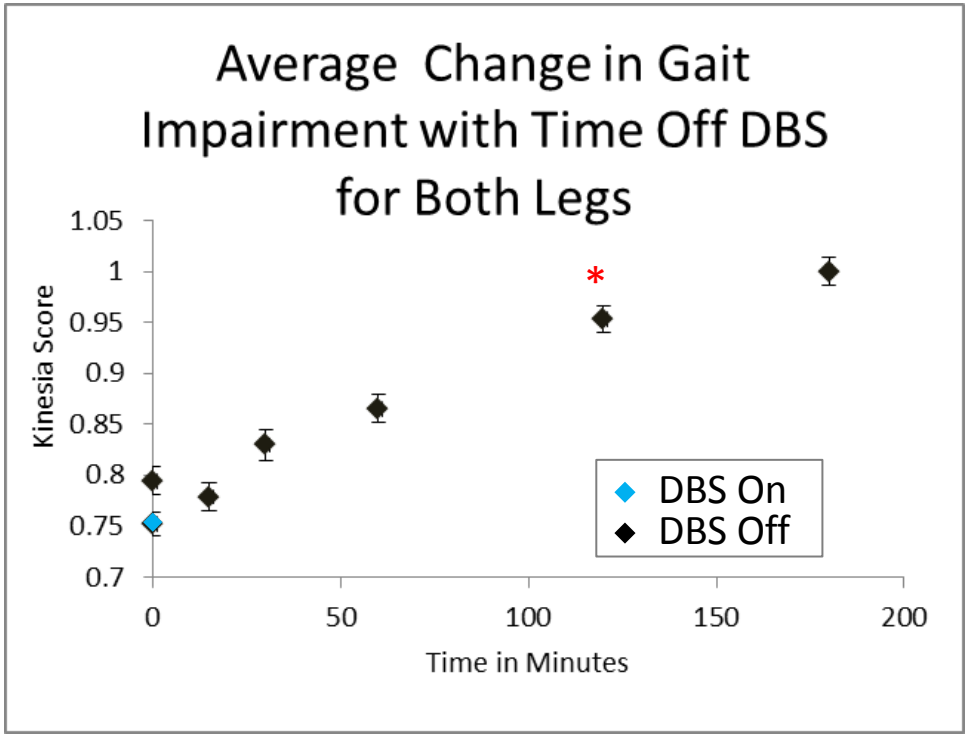
| | | Average Kinesia Score | Average Clinician Score |
|---|---|---|---|
| **Gait** | DBS on | 0.77 ± 0.38 | 0.5 ± 0.53 |
| | DBS off 3 hr | 1.00 ± 0.45 | 0.88 ± 0.99 |
| P value | | **0.001 *** | 0.28 |
| **Toe Taps** | | | |
| | DBS on | 2.19 ± 0.57 | 1.63 ± 0.92 |
| | DBS off 3 hr | 2.58 ± 0.49 | 2.38 ± 1.06 |
| P value | | **<0.0001*** | **0.02*** |
| **Leg Lifts** | | | |
| | DBS on | 1.67 ± 0.76 | 0.57 ± 0.53 |
| | DBS off 3 hr | 2.54 ± 0.94 | 2 ± 0.58 |
| P value | | **<0.0001*** | **0.003*** |

# Effect of DBS Cessation Over Time
# Gait

<u>Both Legs</u>

Paired t-tests

- DBS On to 120 min (p=0.002)
- 120 to180 min (p=0.53)

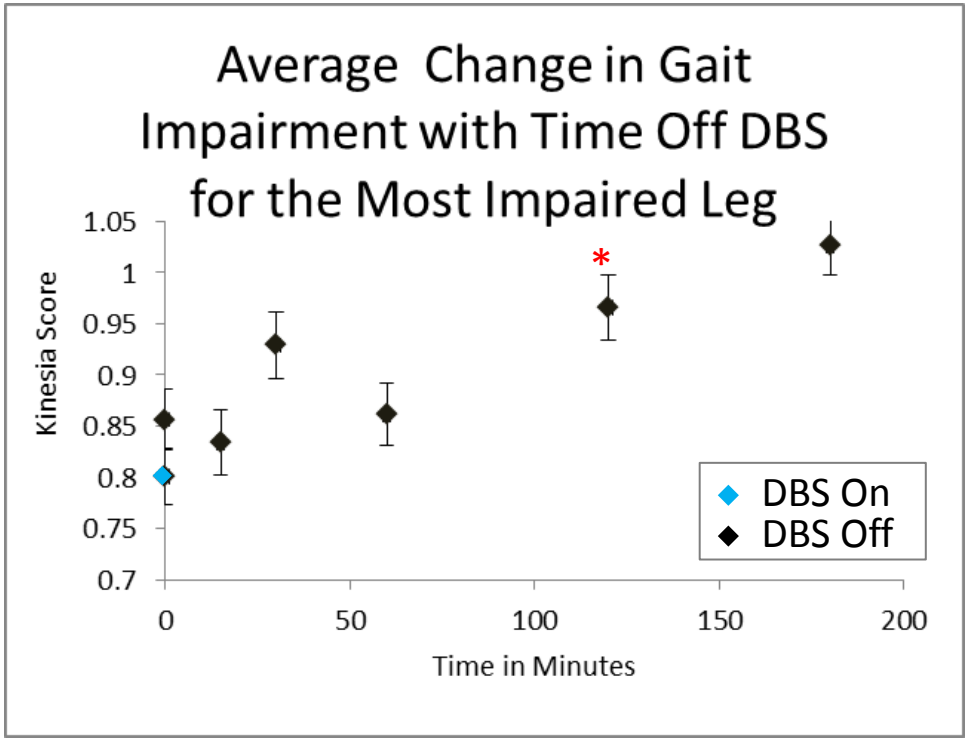


# Effect of DBS Cessation Over Time
# Gait

<u>More Impaired Leg</u>

Paired t-tests

- DBS On to 120 min (p=0.04)
- 120 to 180 min (p=0.25)

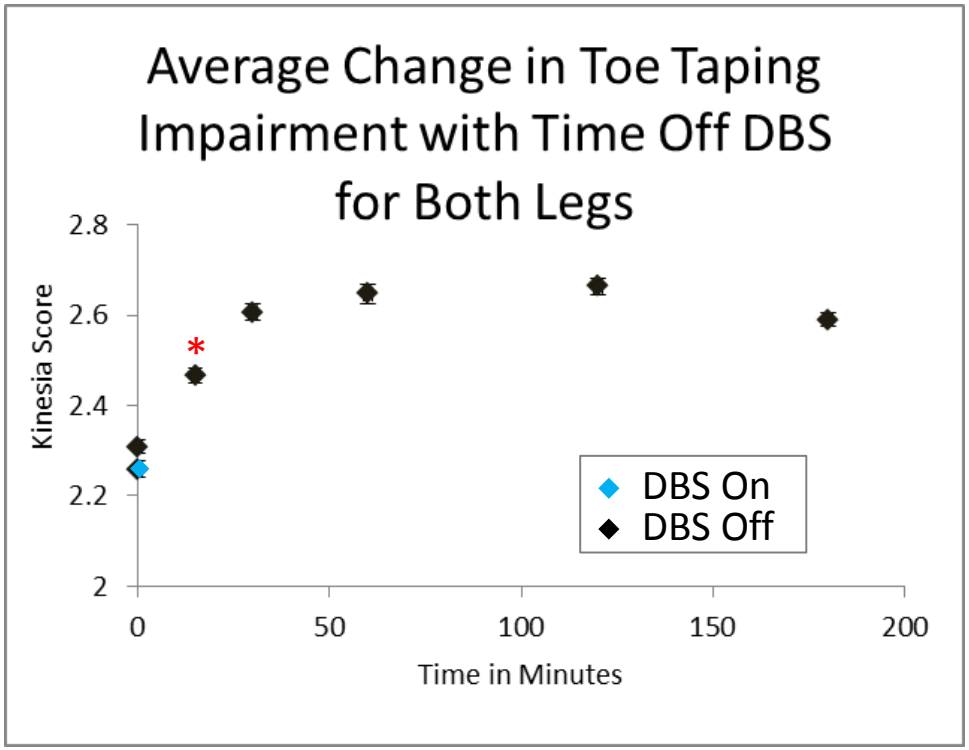


# Effect of DBS Cessation Over Time
# Toe Tapping

<u>Both Legs</u>

Paired t-tests

- DBS On to 15 min (p=0.016)
- 15 to 180 min (p=0.1)

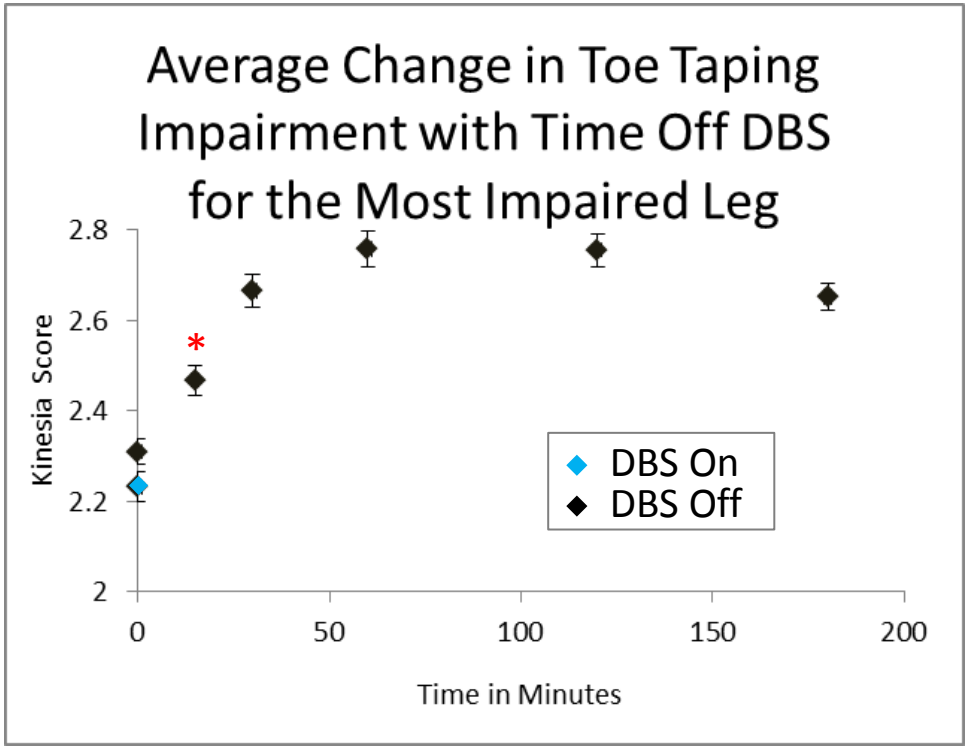


# Effect of DBS Cessation Over Time
# Toe Tapping

<u>More Impaired Leg</u>

Paired t-tests

- DBS On to 15 min (p=0.02)
- 15 to 180 min (p=0.13)

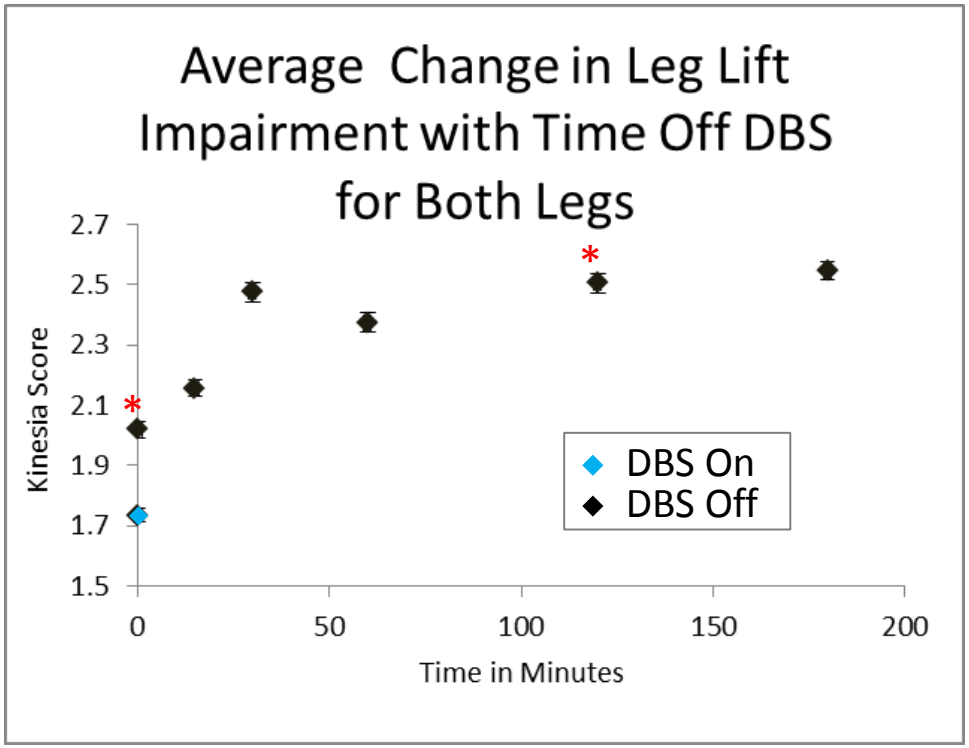


# Effect of DBS Cessation Over Time
# Leg Lifts

<u>Both Legs</u>

Paired t-test

- DBS On to Off (p=0.002)
- Off to 120 min (p<0.001 )
- 120 to 180 min (p=0.4)

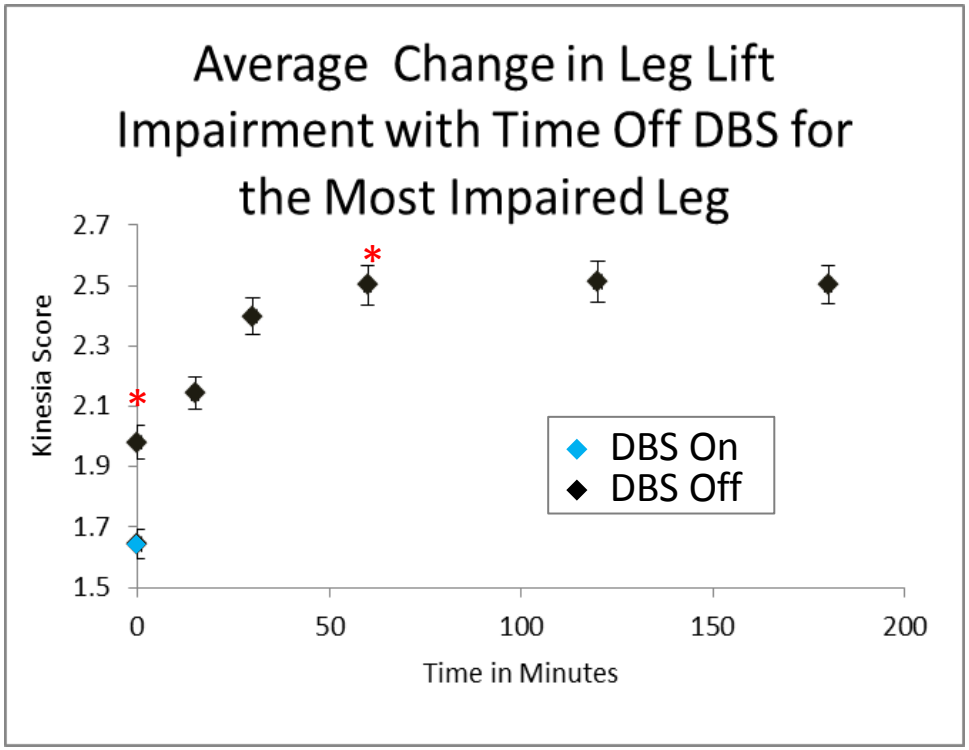


# Effect of DBS Cessation Over Time
# Leg Lifts

<u>More Impaired Leg</u>

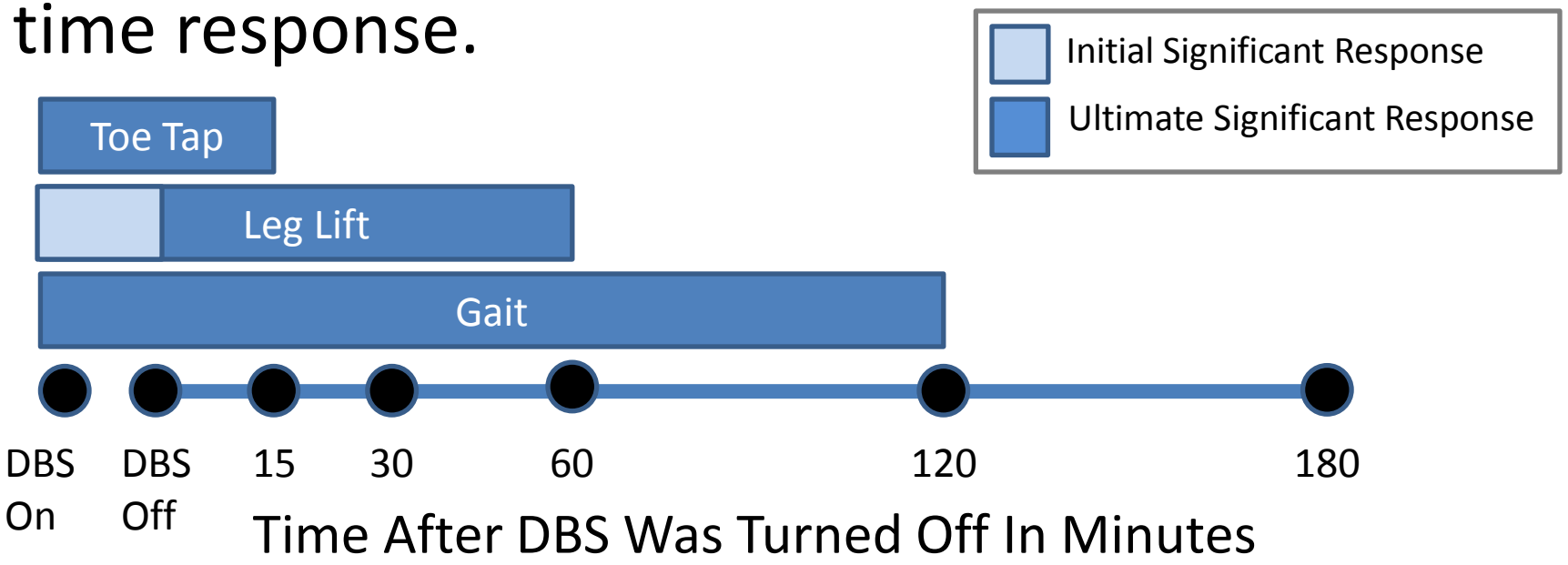
Paired t-test

- DBS On to Off ($p=0.007$)
- Off to 60 min ($p<0.001$)
- 60 to 180 min ($p=0.99$)



# Summary of DBS Cessation

- Increase in impairment after off 3 hour with DBS off
  - Except clinician gait score
- Different movements showed very different time response.



# Limitations

- Small sample size (study is ongoing)
- DBS cessation as a model for change in DBS settings

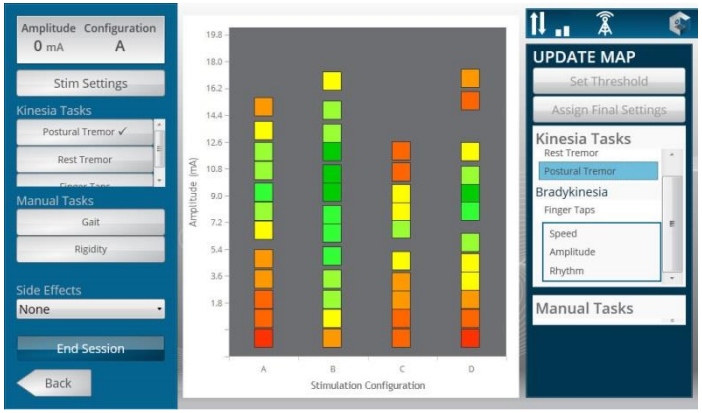
# Role of the Kinesia Systems



# Kinesia

Kinesia ProView™

Tune DBS settings in the clinic




Kinesia HomeView

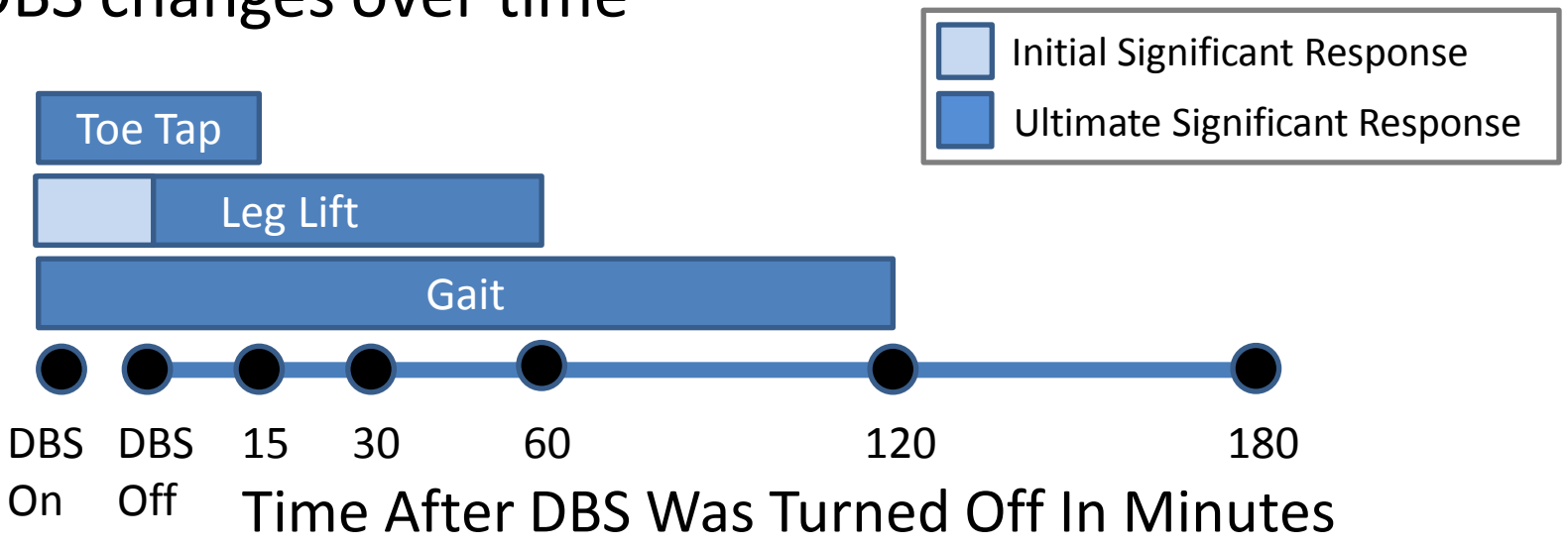
Independent home assessments

# Kinesia for DBS

- Integrate remote evaluation and DBS tuning
  - This will improve knowledge of DBS effects
  - Allow for tuning of gait parameters

# Conclusions

- DBS changes over time




- Kinesia system
  - High resolution quantitative evaluation
  - Not limited to use in the clinic
  - Integration of Kinesia and DBS tuning could improve gait outcomes

# Acknowledgements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# Questions

For more information contact:

Elizabeth Brokaw

Ebrokaw@glneurotech.com