

# Effect of STN-DBS frequency on postural performance in Parkinson's disease

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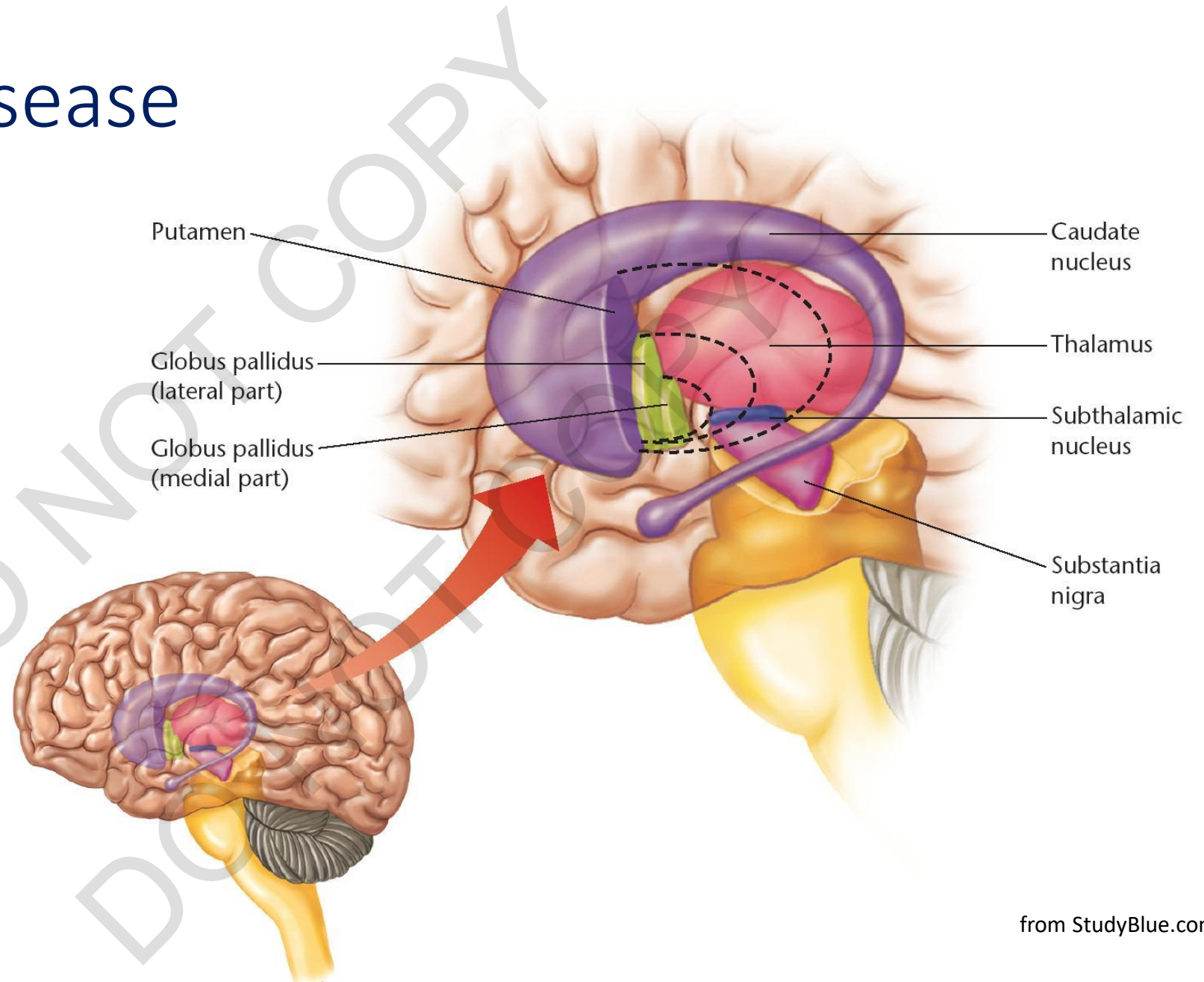
# Parkinson's Disease

What is it?

**Degenerative disease**

**Basal Ganglia**

**Loss of dopamine**



# Treatment

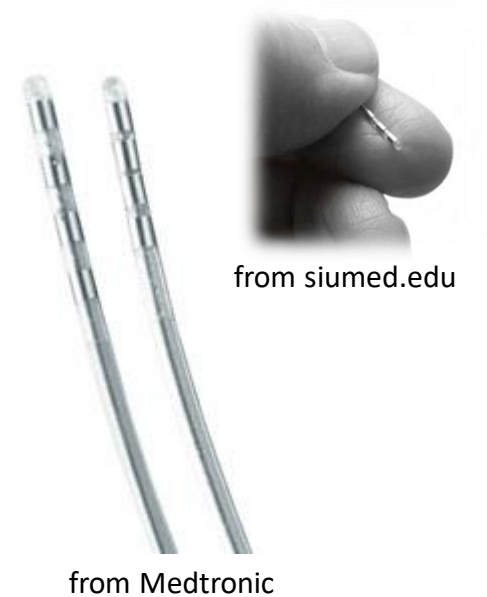
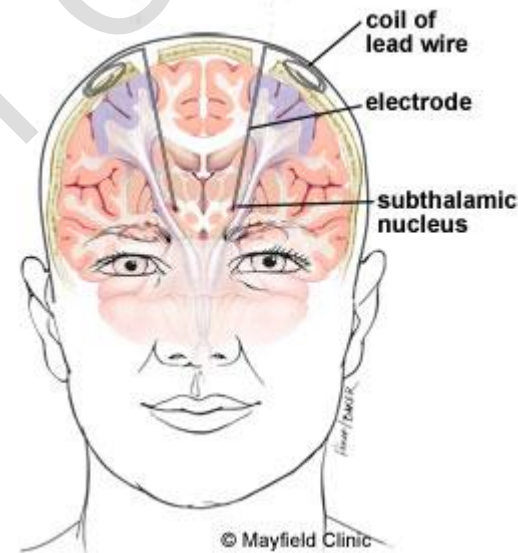
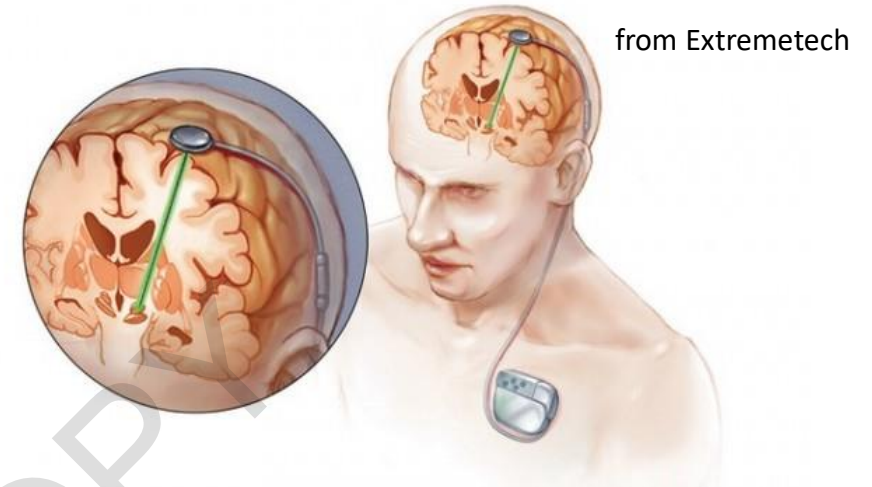
- Levodopa
- Deep Brain Stimulation (STN-DBS)

when:

Symptoms worsen

Response to levodopa decreases

Fluctuations and dyskinesia



# PD postural instability after STN-DBS

## Postural instability

Different aspects

Deterioration with disease progression

Axial symptoms worsen with chronic STN-DBS

(Derost et al., 2007; Krack et al., 2003; Liang et al., 2006; Merola et al., 2011; Ostergaard et al., 2002; Rodriguez-Oroz et al., 2005; St George et al., 2010; Tornqvist et al., 2005; Tripoliti et al., 2011)

**Can axial symptoms be improved by lowering the stimulation frequency?**

From 130Hz to 60-80Hz (Khoo et al., 2014; Moreau et al., 2008; Ramdhani et al., 2015; Xie et al., 2015)

# PD postural instability

In clinic: Pull test

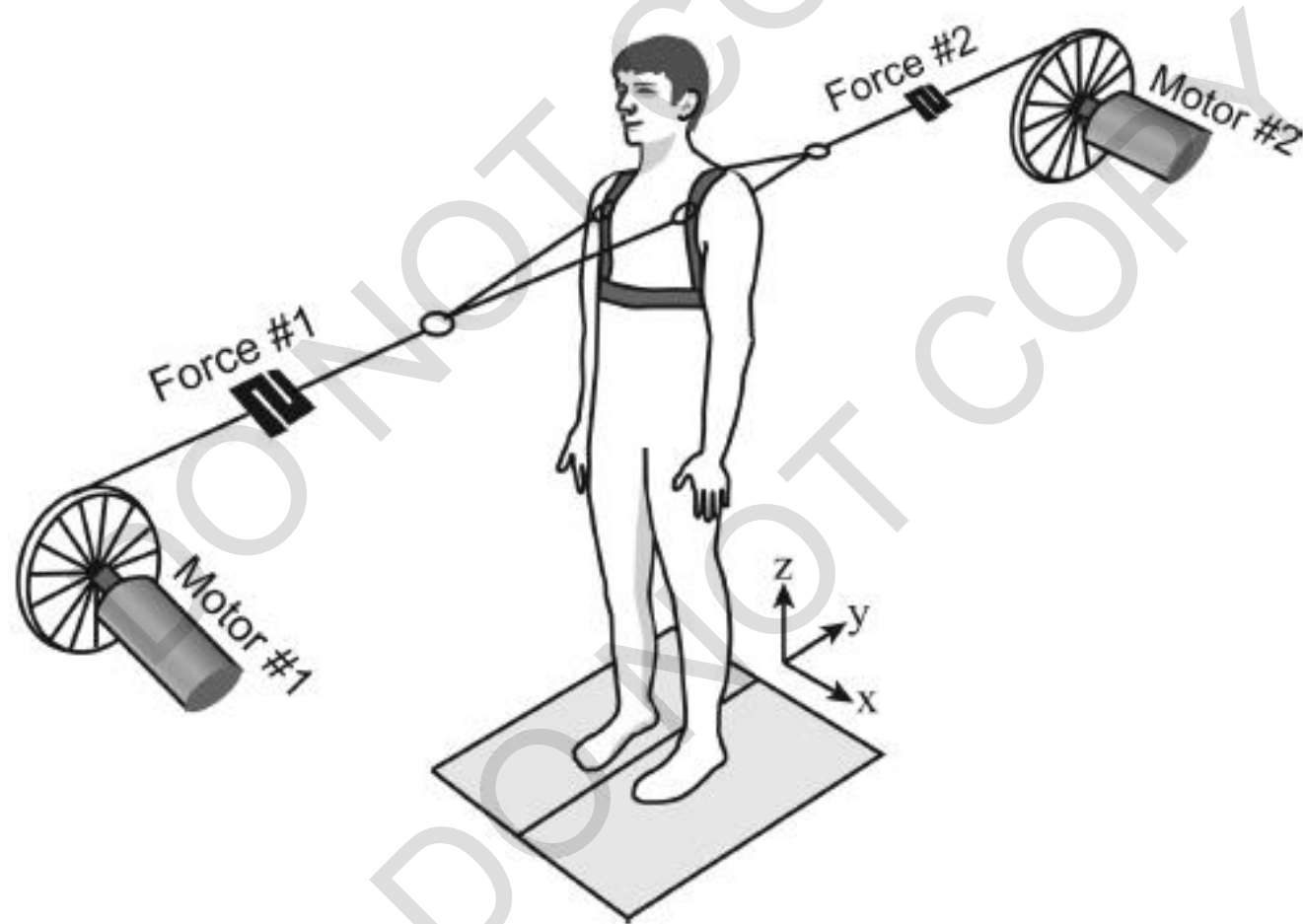
Ability to resist an external force at shoulder level

BUT only recovery stepping measured



- 0** No problems: 1-2 steps
- 1** 3-5 steps, recovers unaided
- 2** >5 steps, recovers unaided
- 3** Stands safely, but with absence of postural response; falls if not caught by examiner
- 4** Very unstable, tends to lose balance spontaneously or with a gentle pull on shoulders

# Lab-based pull test



# Lab-based pull test

## 24 patients with STN-DBS, off-dopa



Pulls delivered by motors

Full Body Kinematics  
Force platforms

*DBS frequency random order*

40 Hz

60 Hz

80 Hz

100 Hz

120 Hz

140 Hz

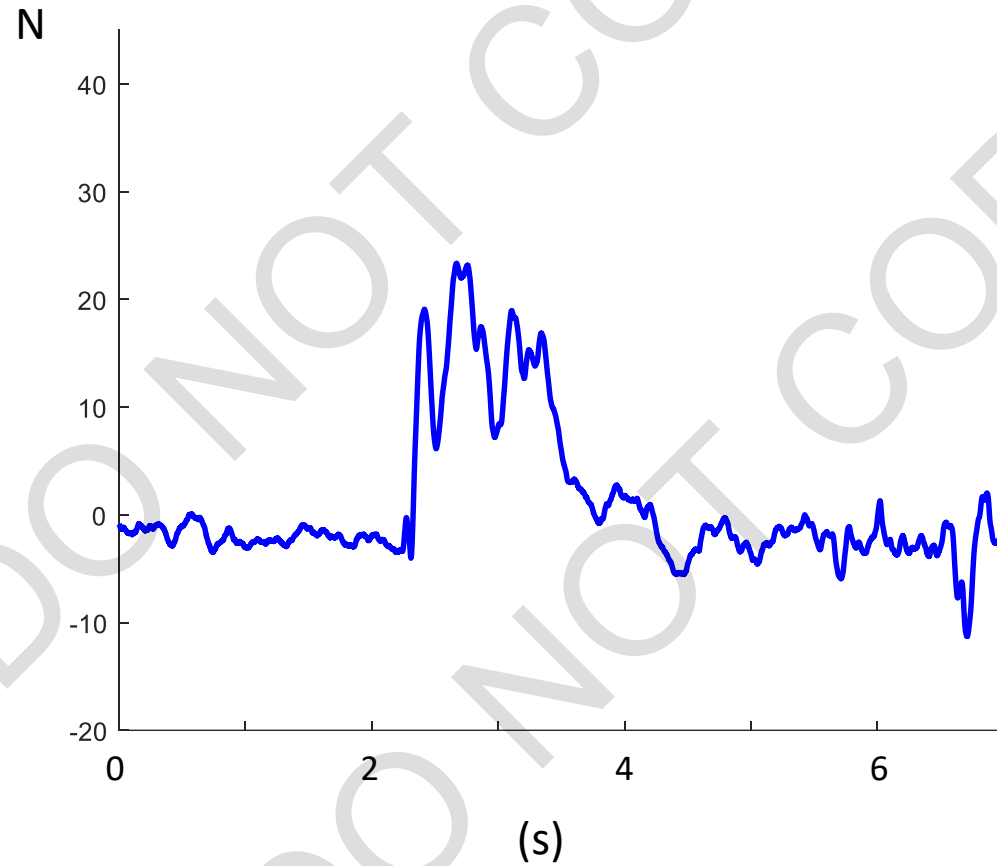
(130 Hz post surgery)

# Key measures

- AP reaction force
- Step length
- Back length (stoop)

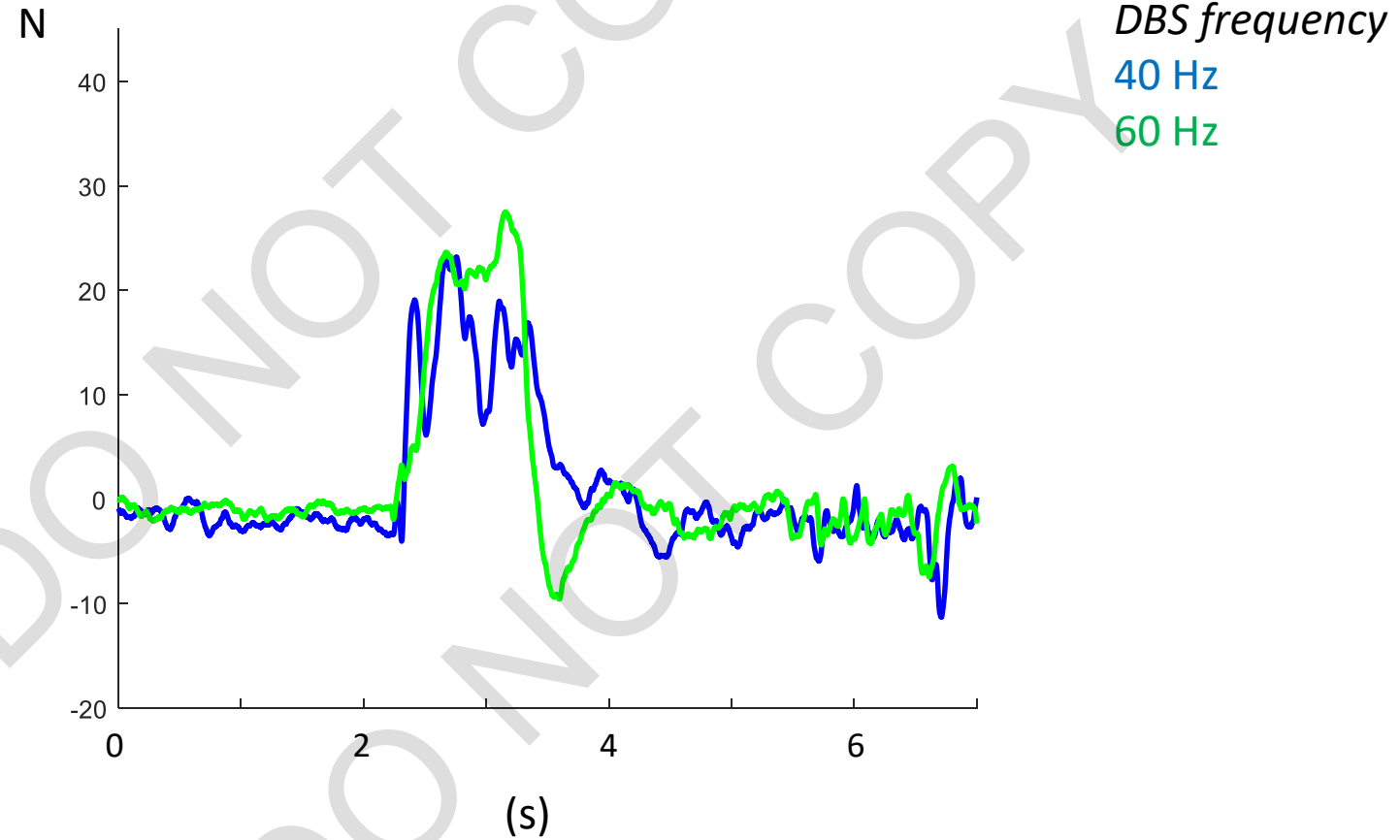


# In – place responses Backward pulls (17N)

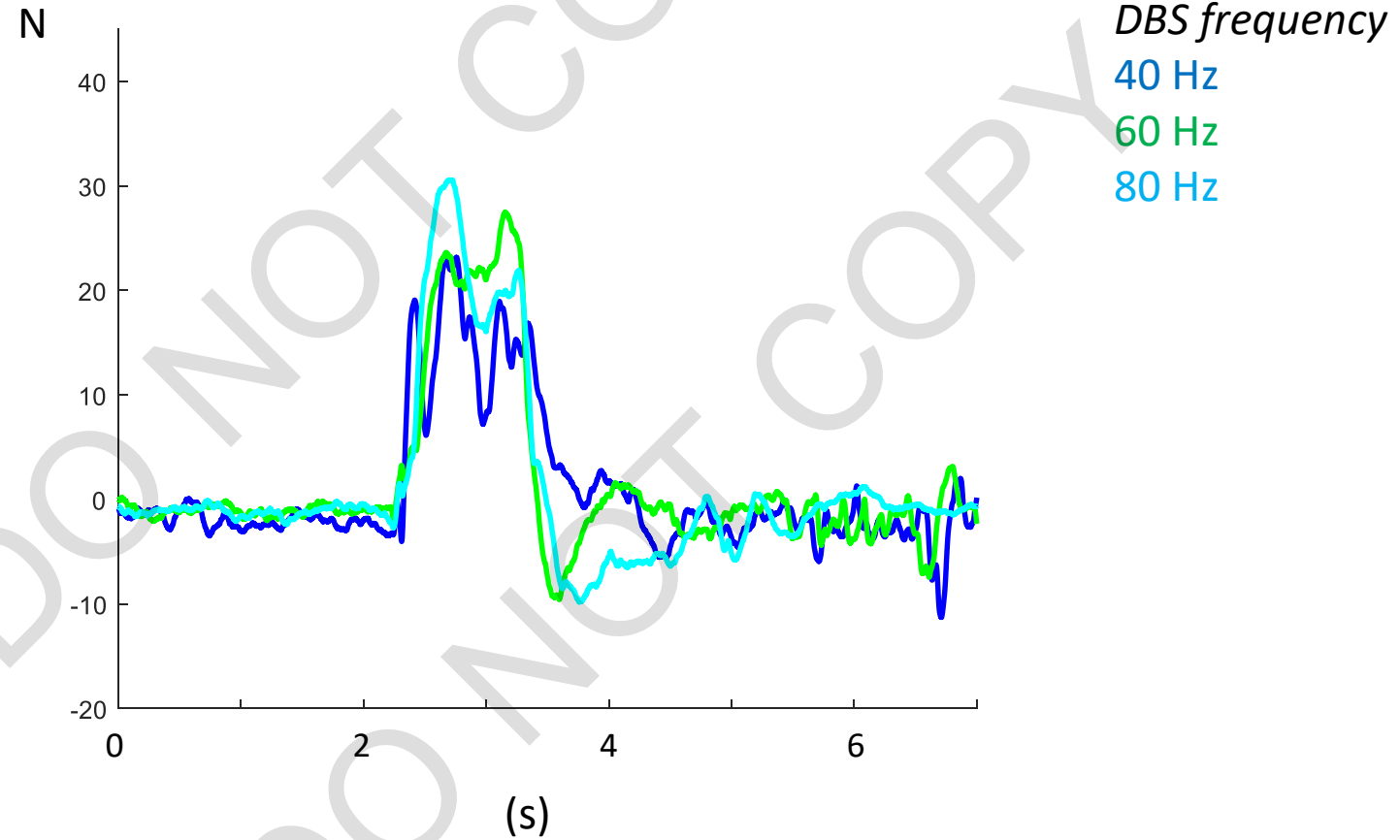


*DBS frequency*  
40 Hz

# In – place responses Backward pulls

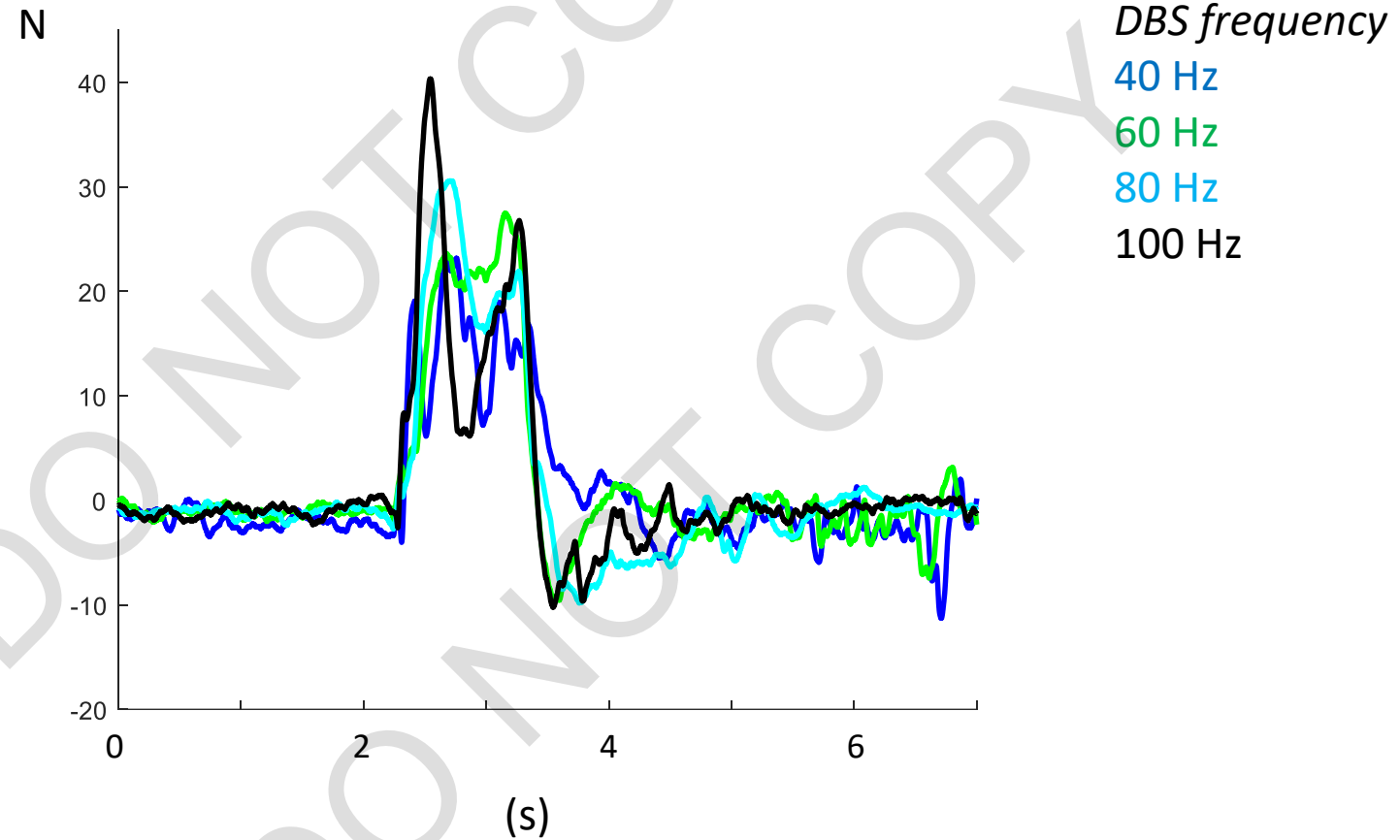


# In – place responses Backward pulls



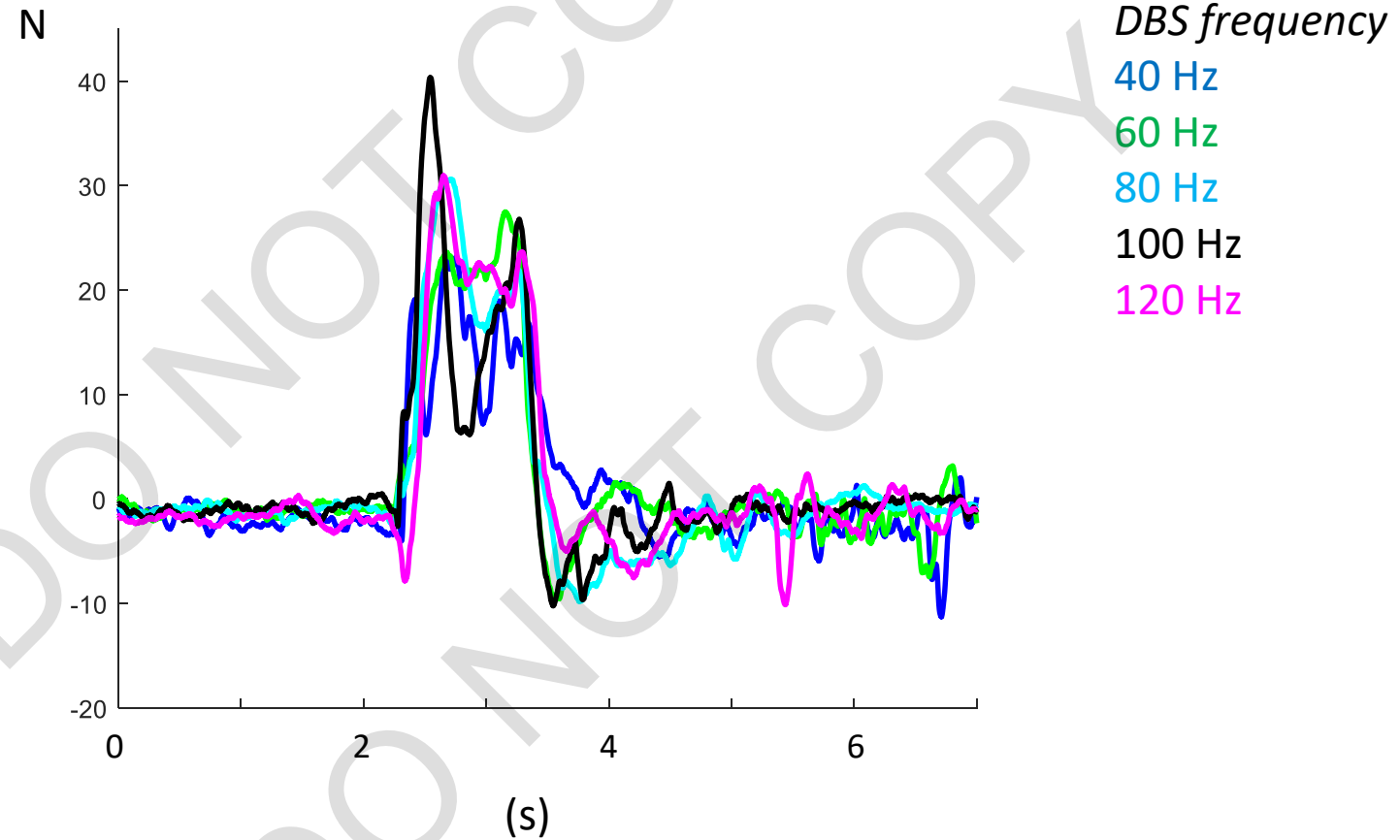
# In – place responses

## Backward pulls



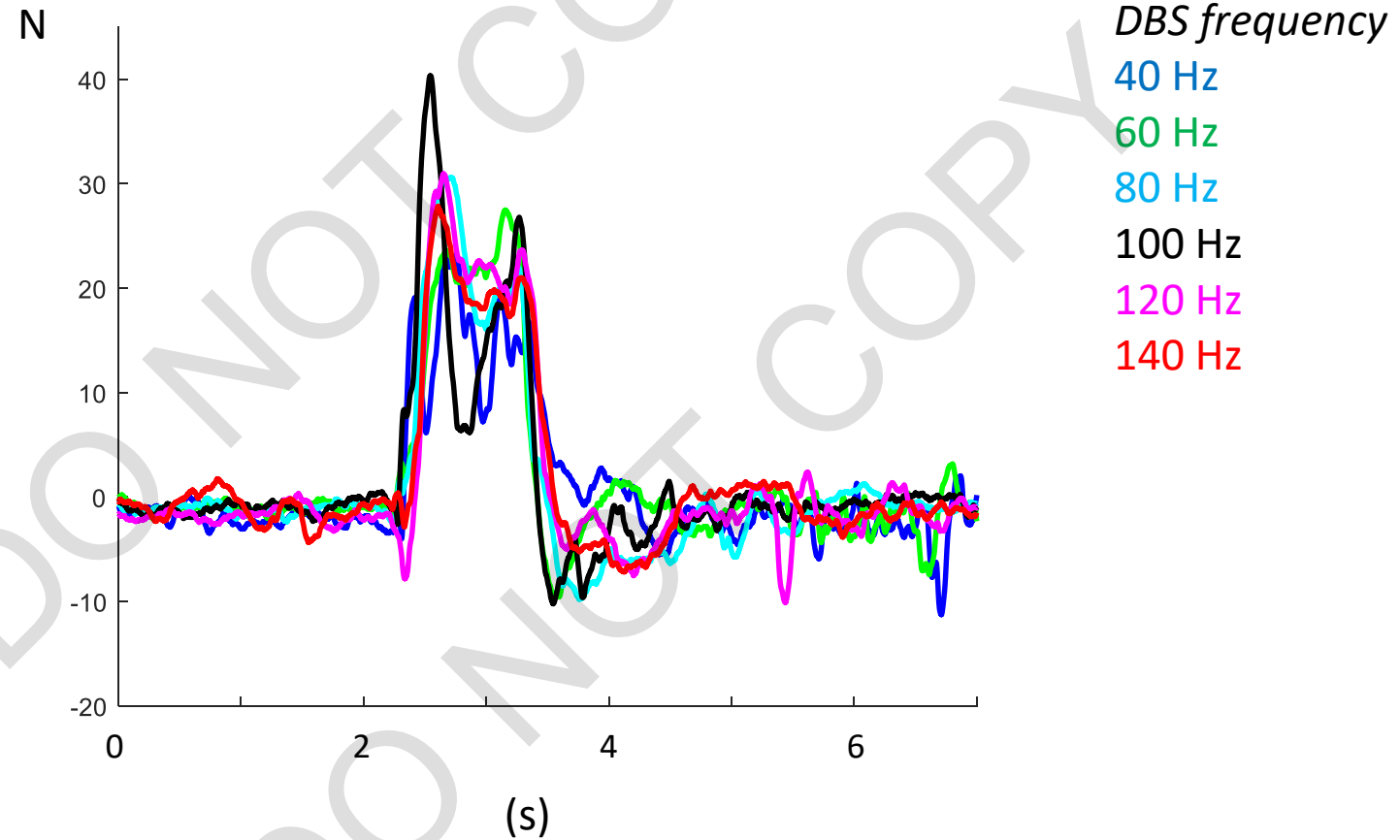
# In – place responses

## Backward pulls

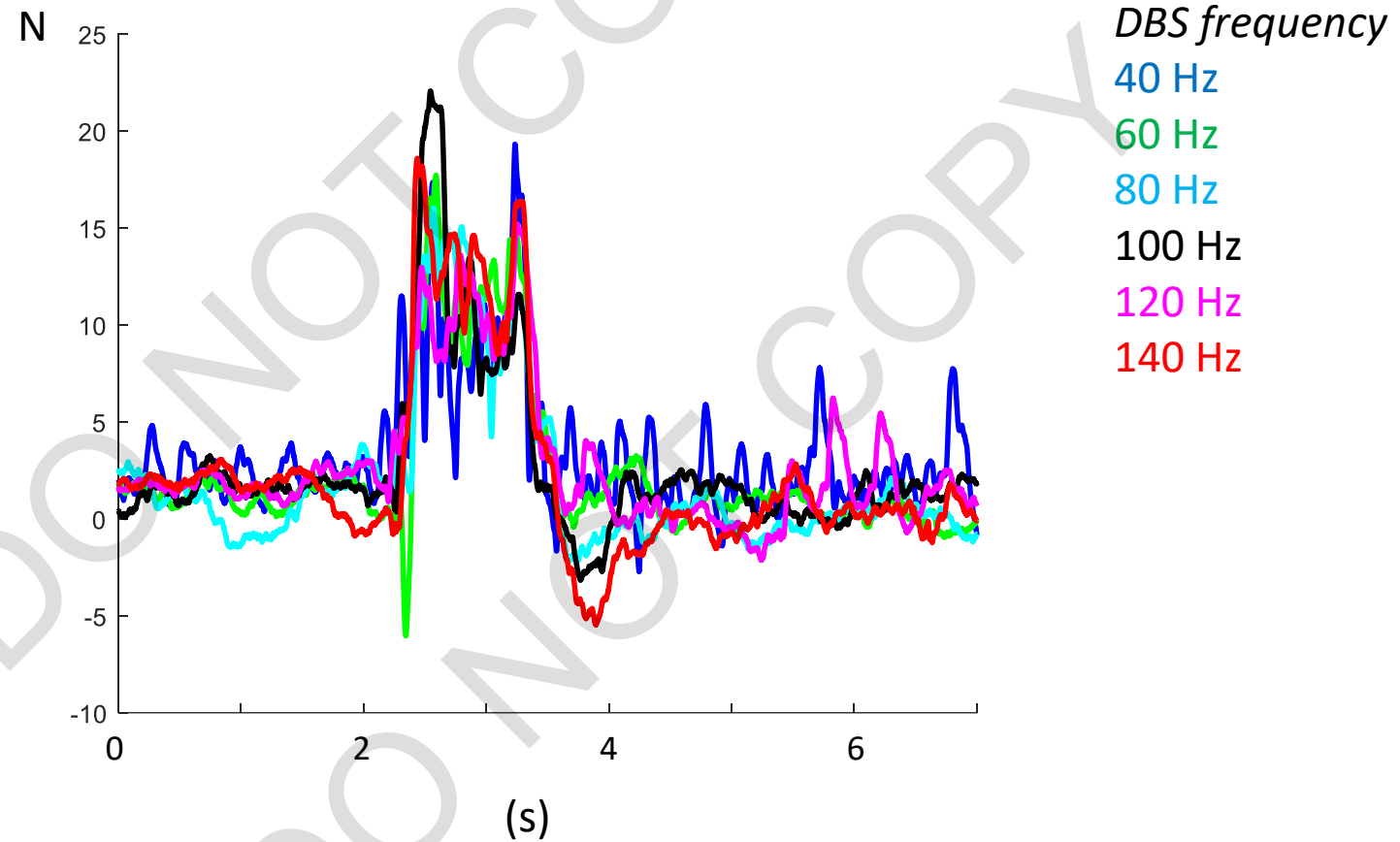


# In – place responses

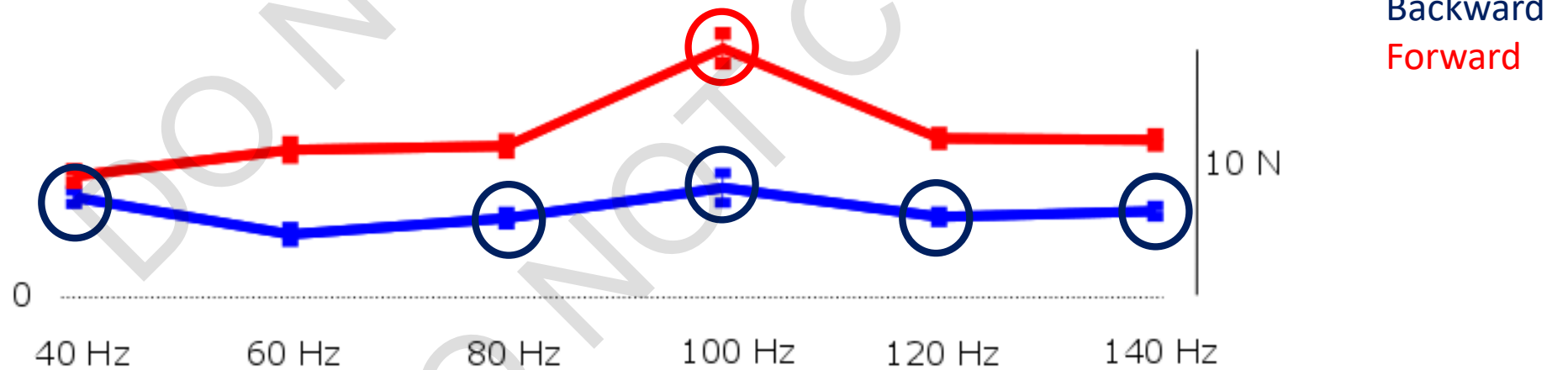
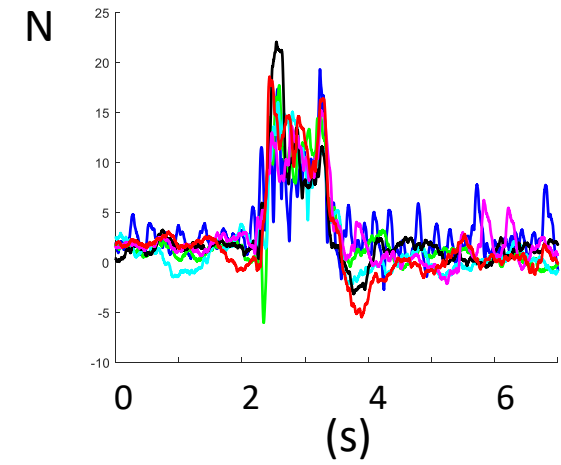
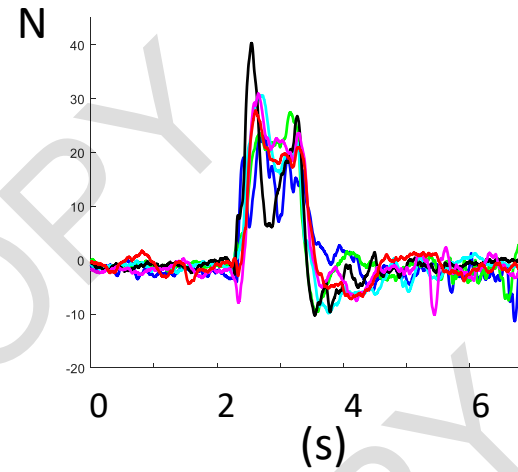
## Backward pulls



# In – place responses Forward pulls (10N)



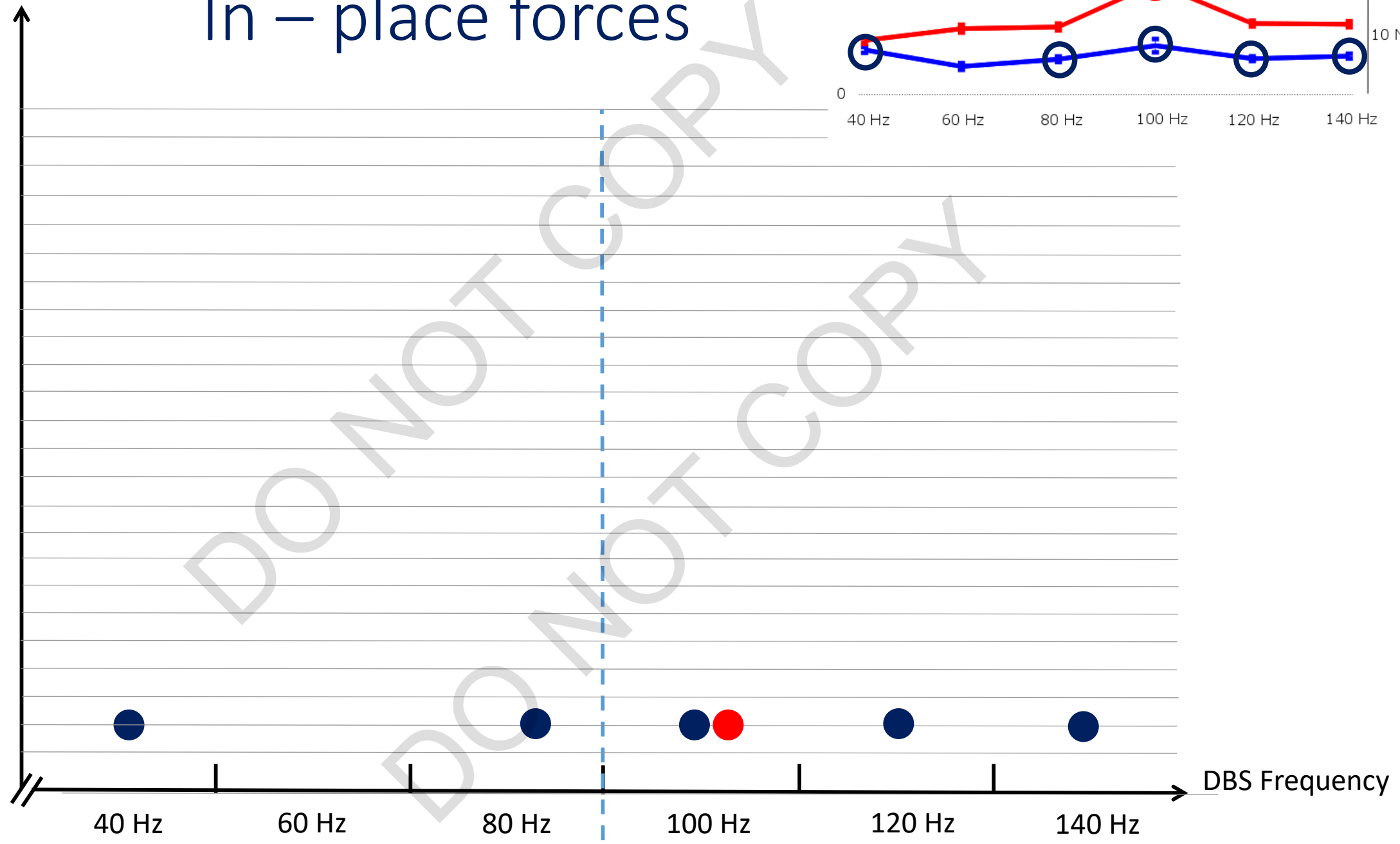
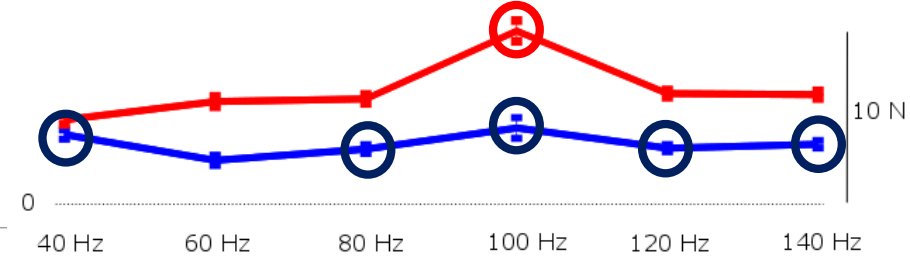
# In – place responses





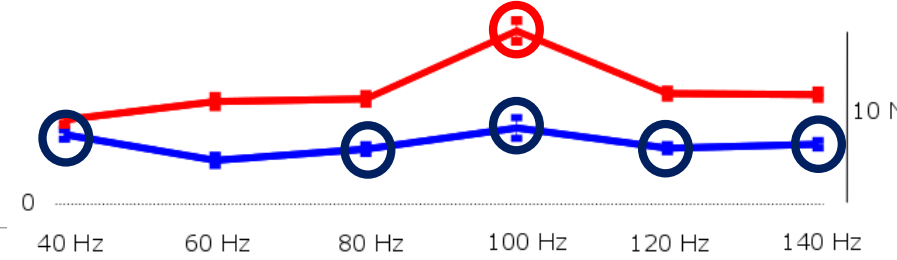
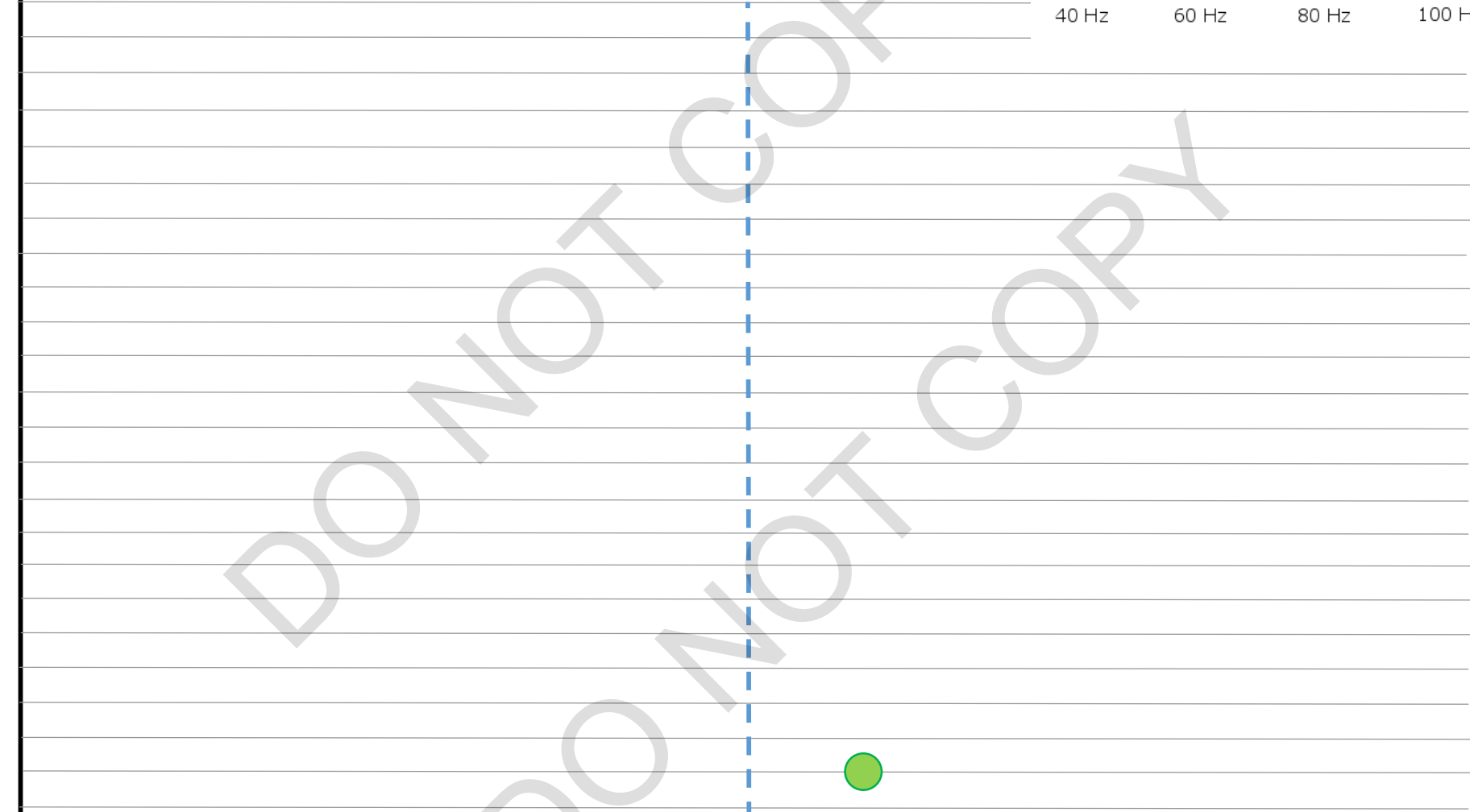
Participant

# In – place forces



# In – place forces

Participant



40 Hz

60 Hz

80 Hz

100 Hz

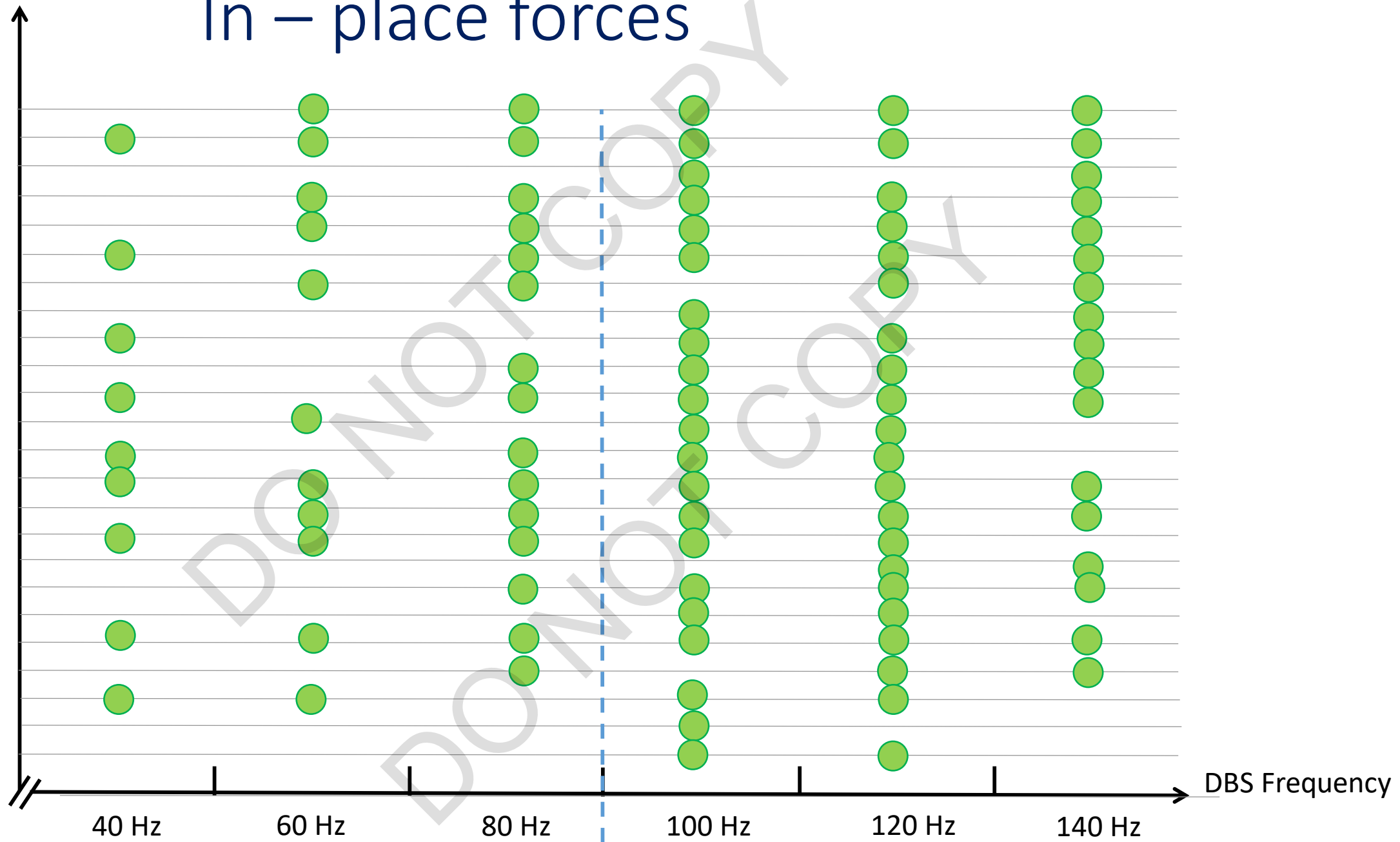
120 Hz

140 Hz

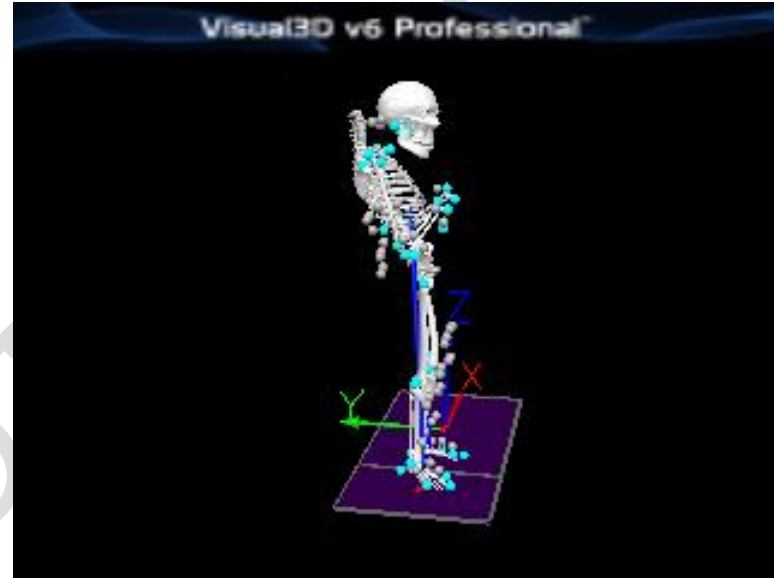
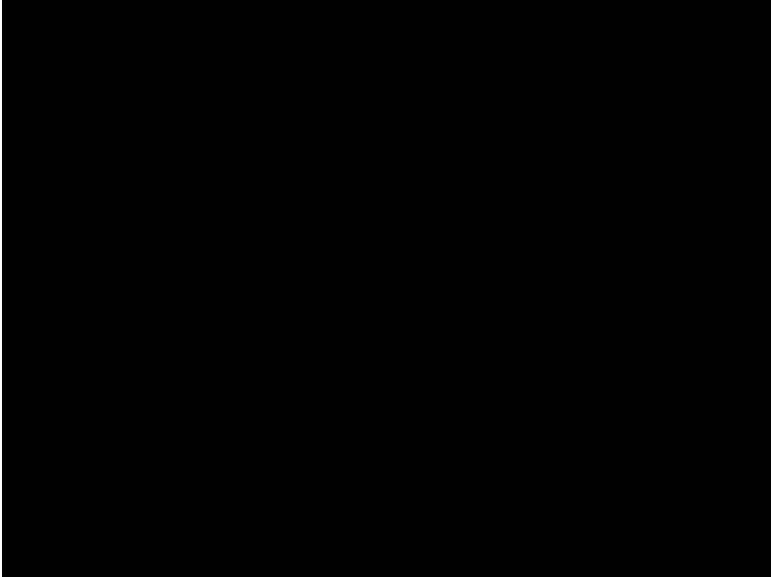
DBS Frequency

Participant

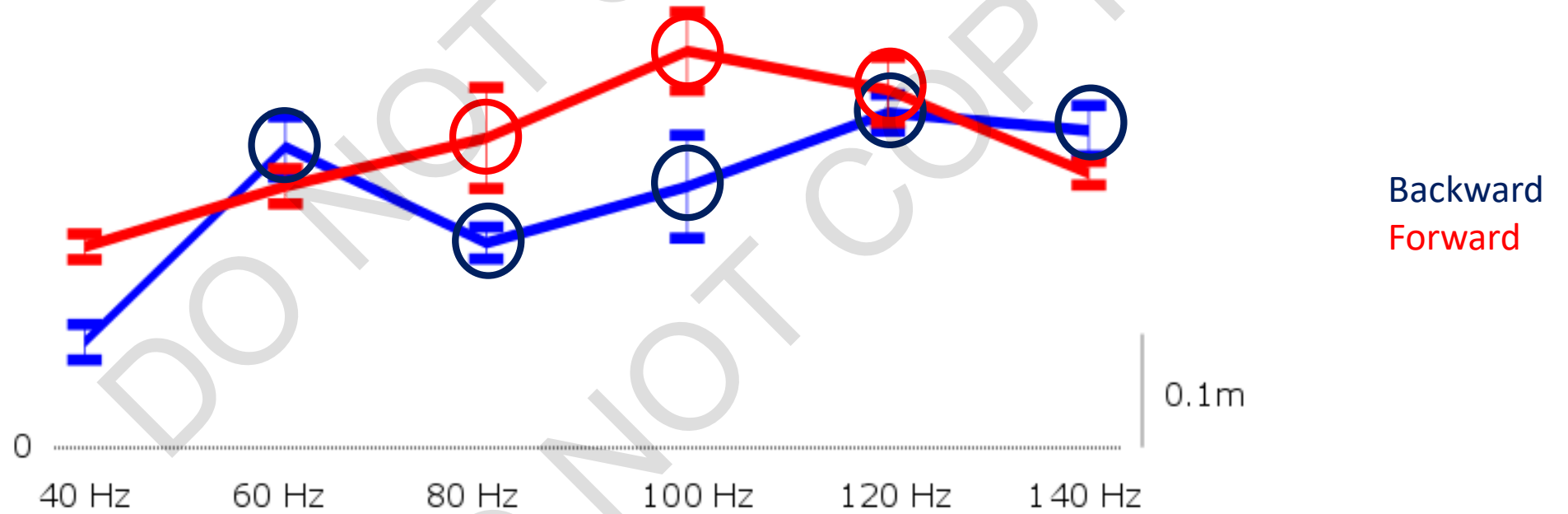
# In – place forces



# Step Length

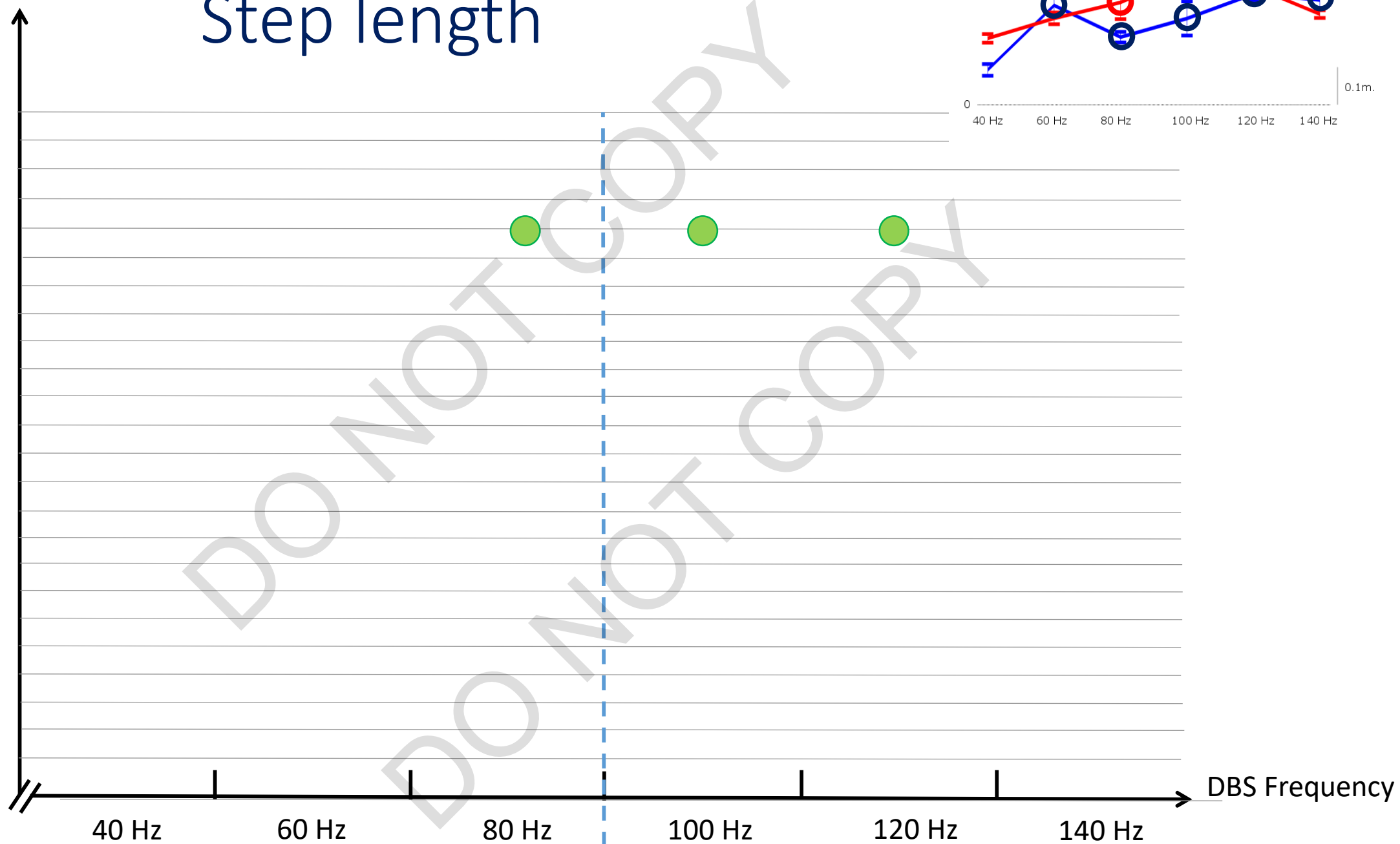


# Step Length



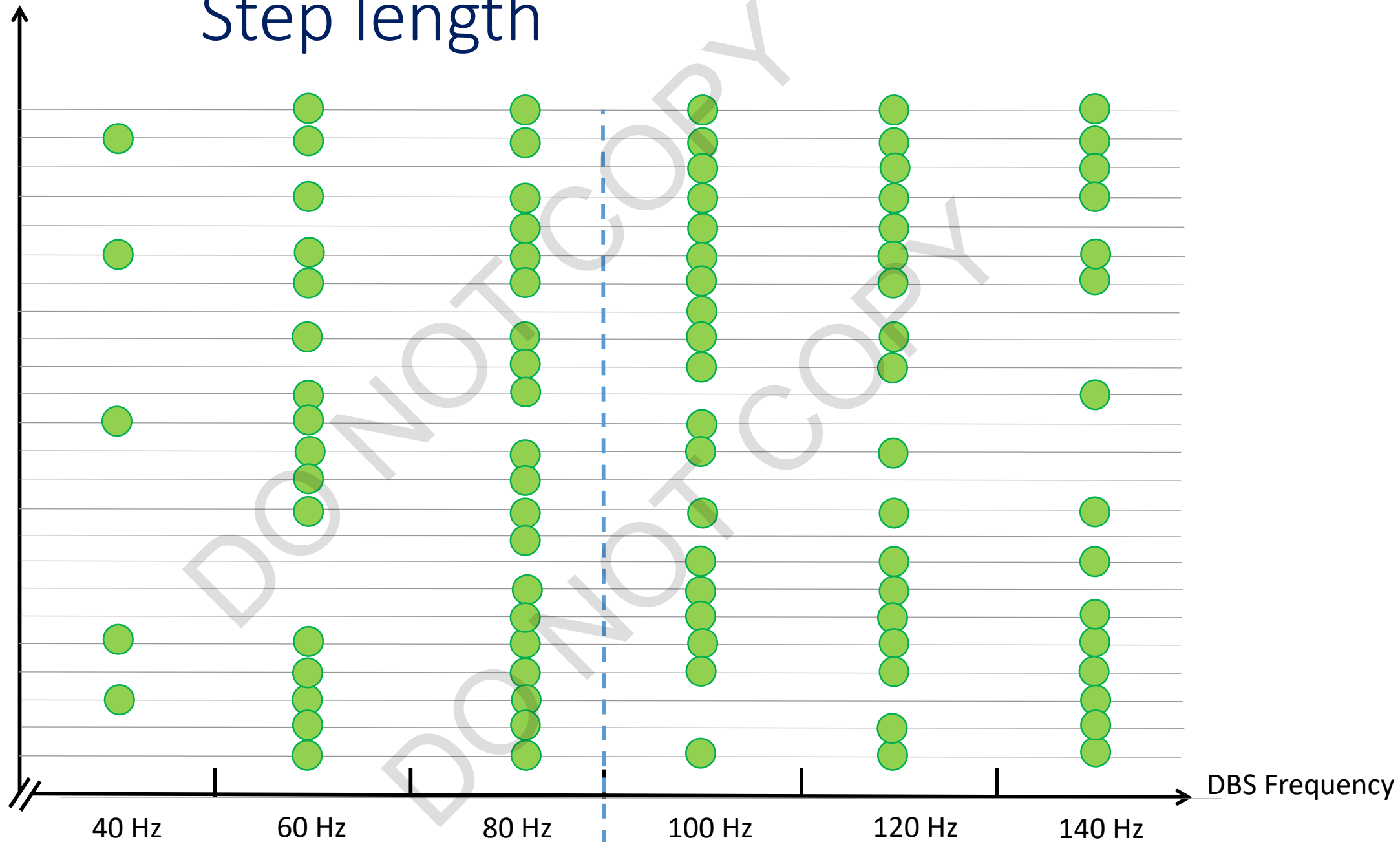
Participant

# Step length

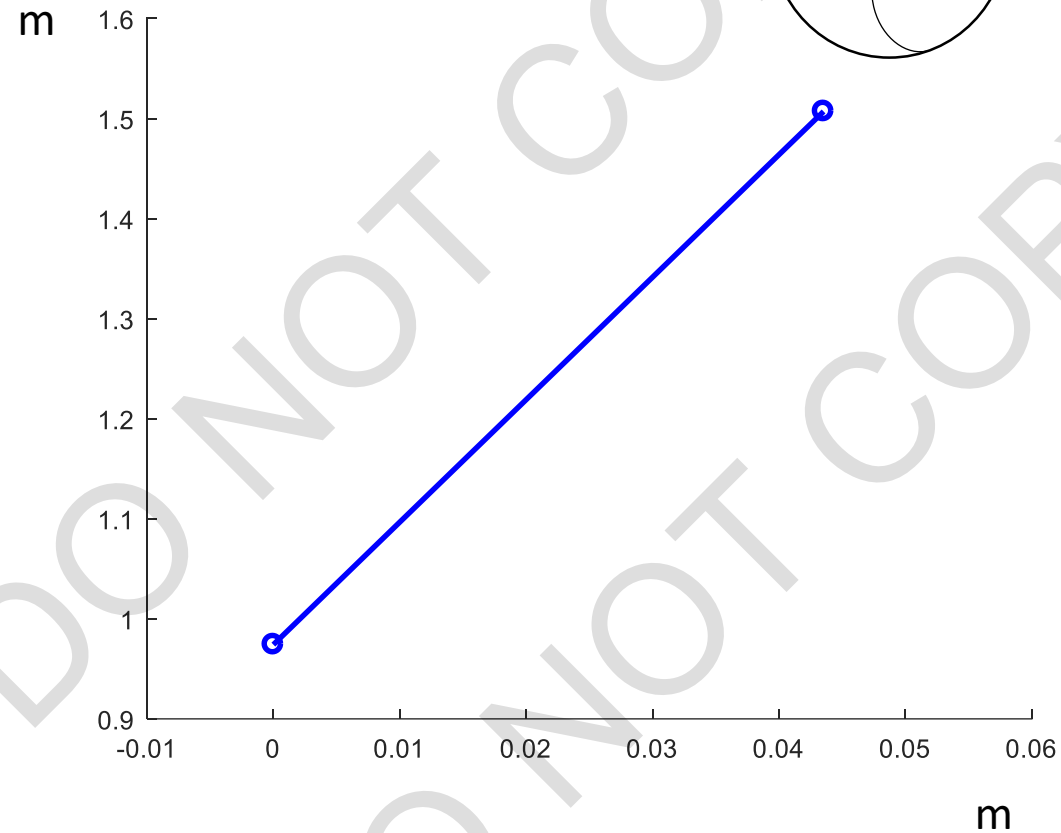


Participant

# Step length



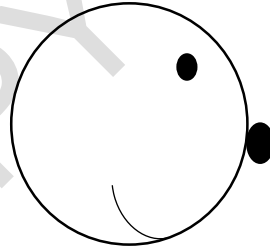
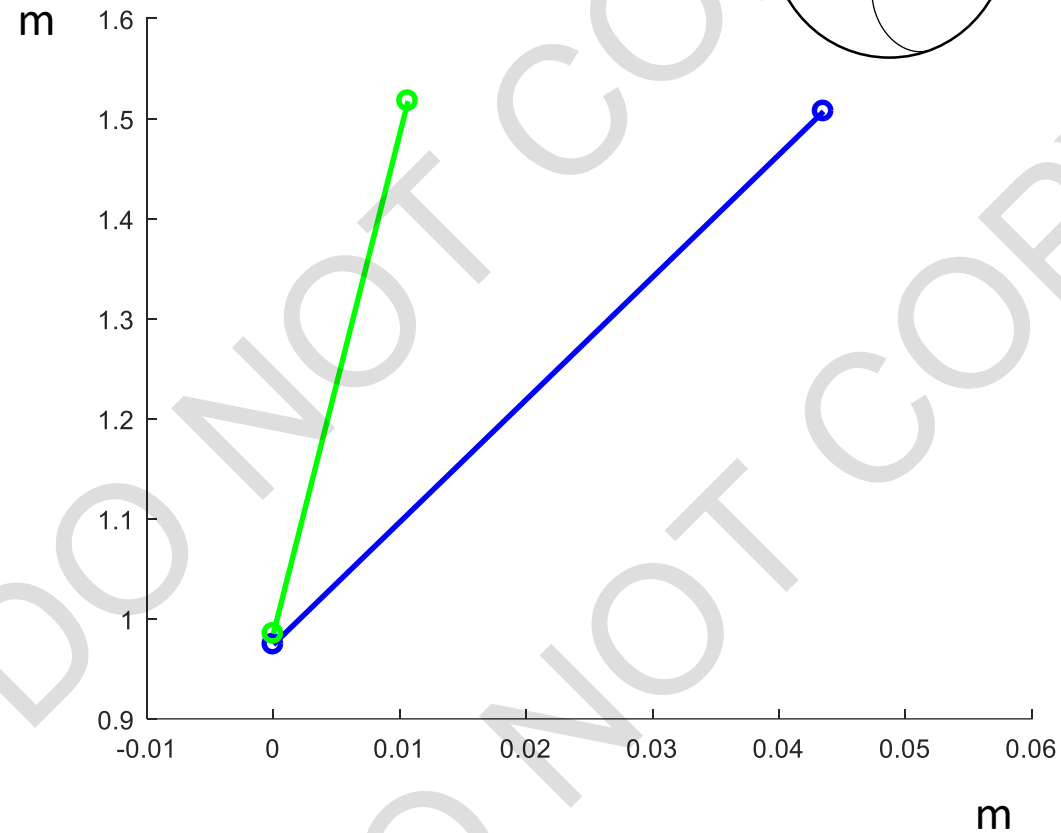
# Upper Body – Stoop?



*DBS frequency*  
40 Hz

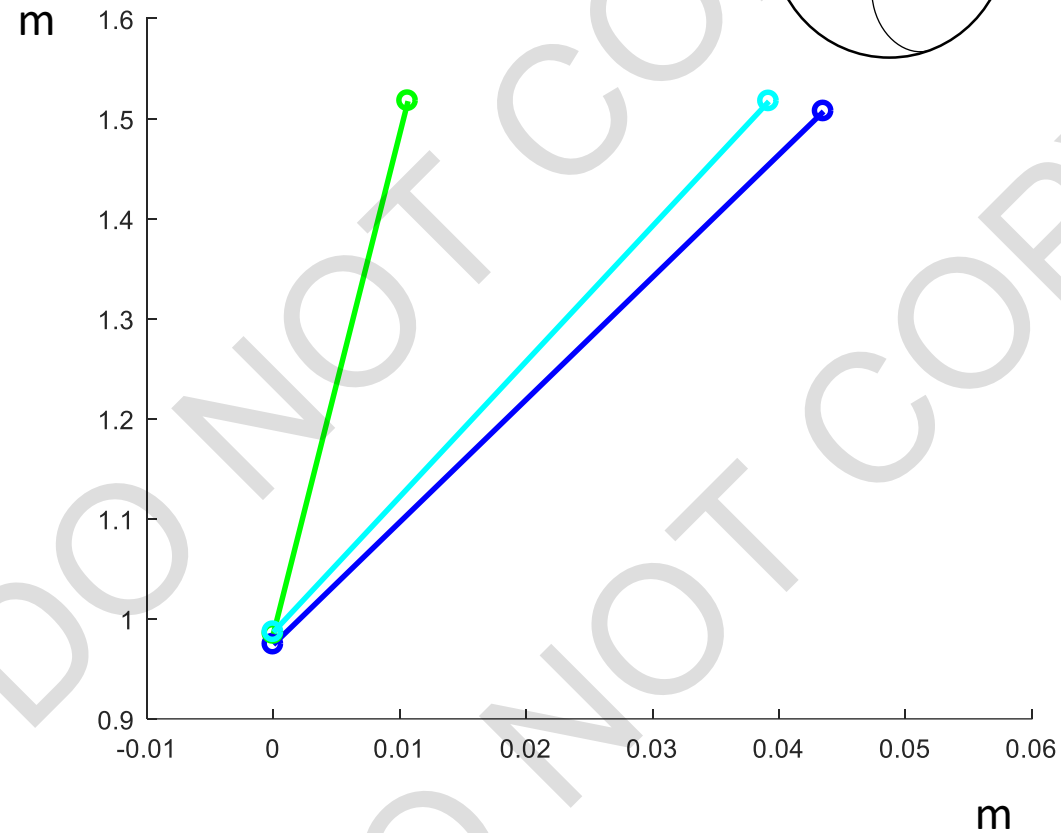
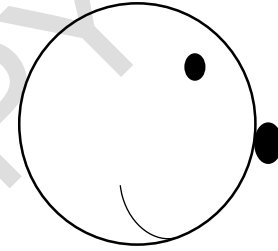


# Upper Body – Stoop?



*DBS frequency*  
40 Hz  
60 Hz

# Upper Body – Stoop?



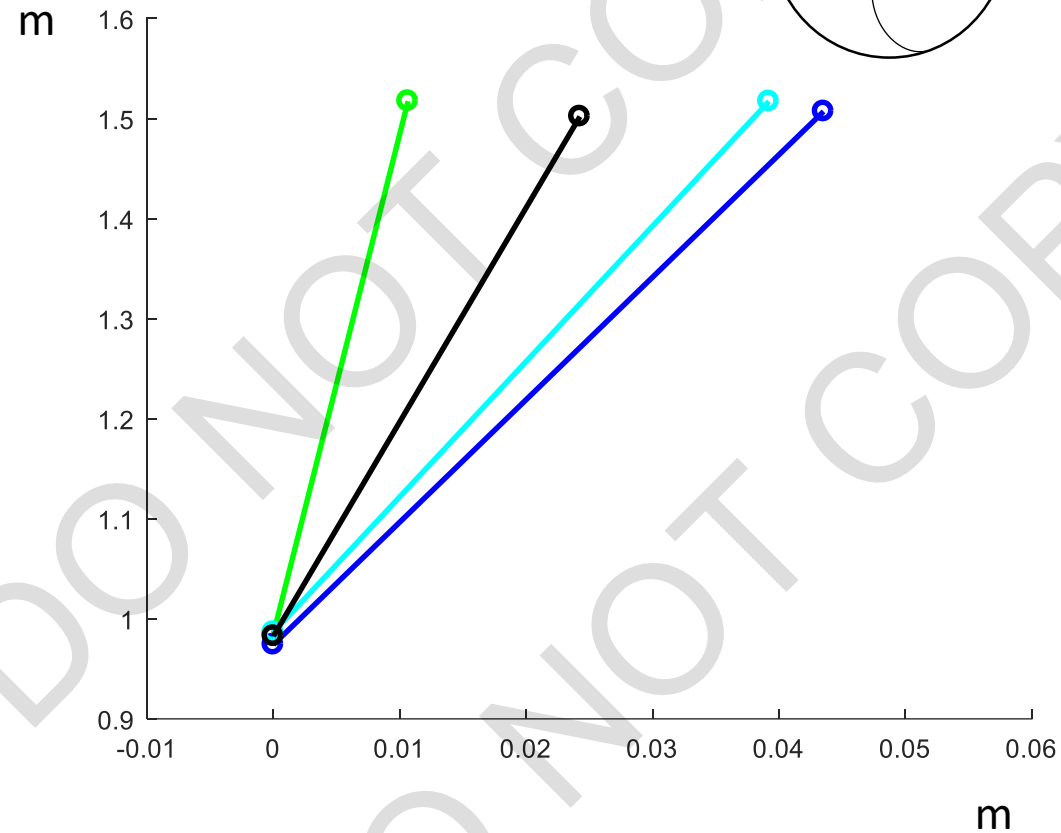
*DBS frequency*

40 Hz

60 Hz

80 Hz

# Upper Body – Stoop?



*DBS frequency*

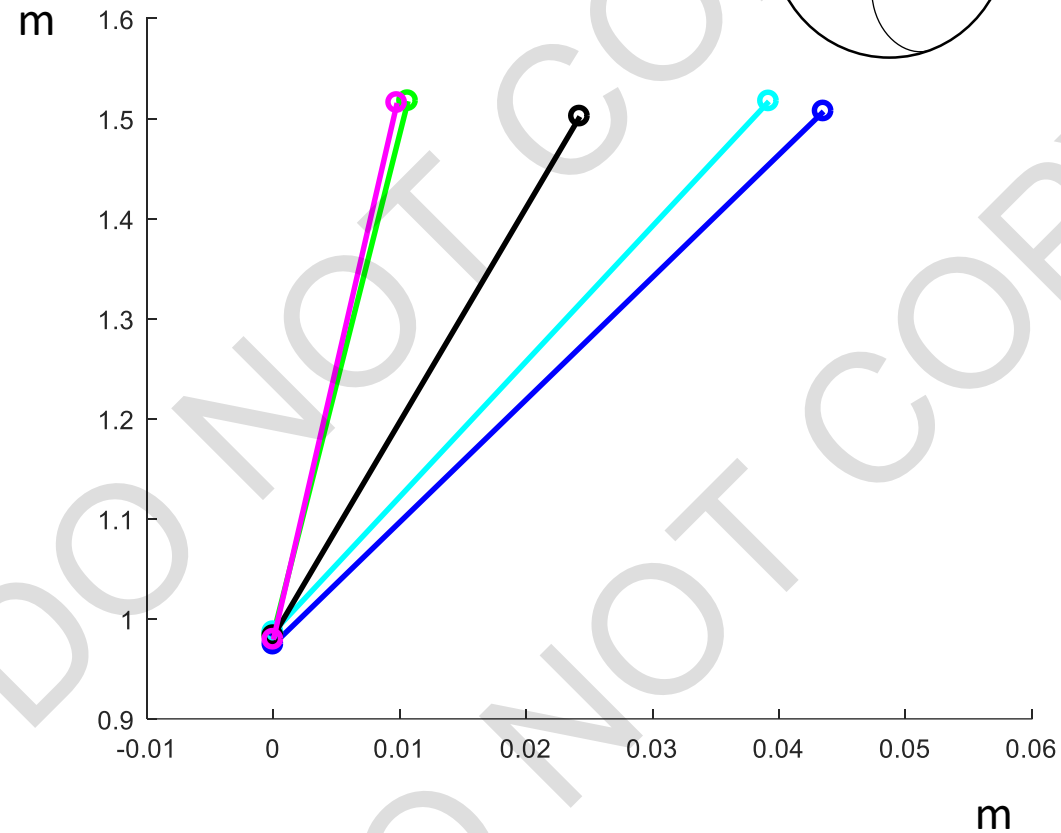
40 Hz

60 Hz

80 Hz

100 Hz

# Upper Body – Stoop?



*DBS frequency*

40 Hz

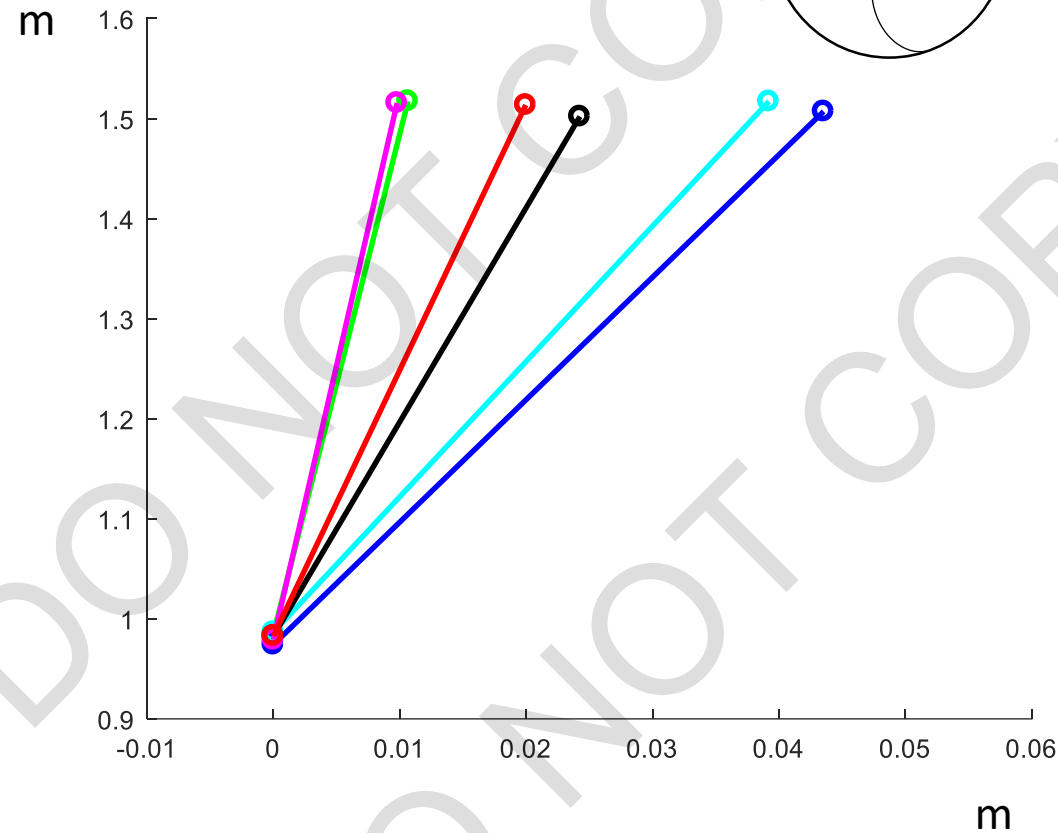
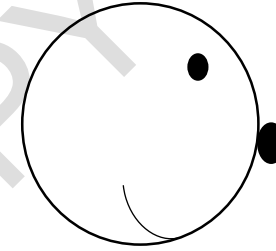
60 Hz

80 Hz

100 Hz

120 Hz

# Upper Body – Stoop?



*DBS frequency*

40 Hz

60 Hz

80 Hz

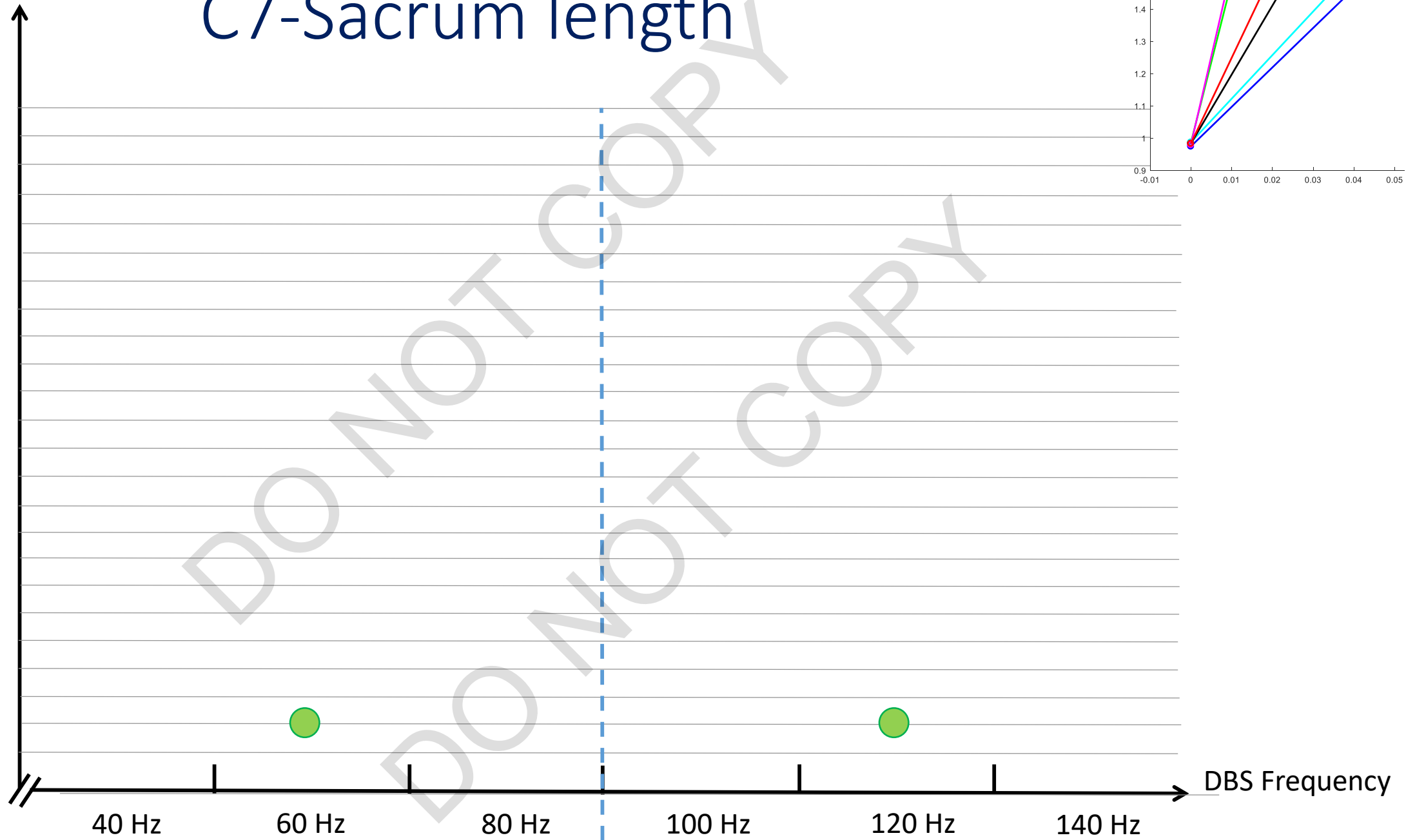
100 Hz

120 Hz

140 Hz

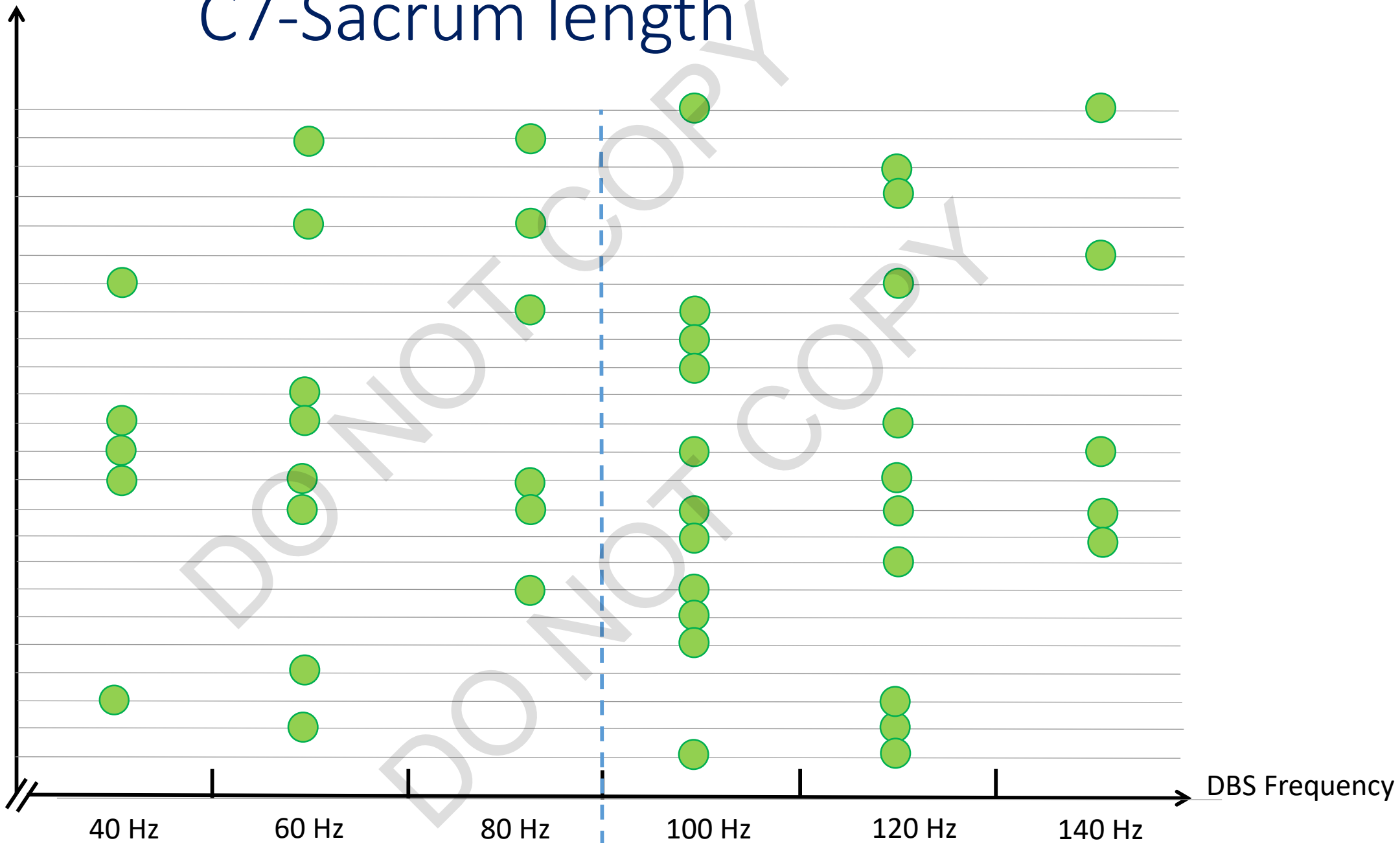
Participant

# C7-Sacrum length

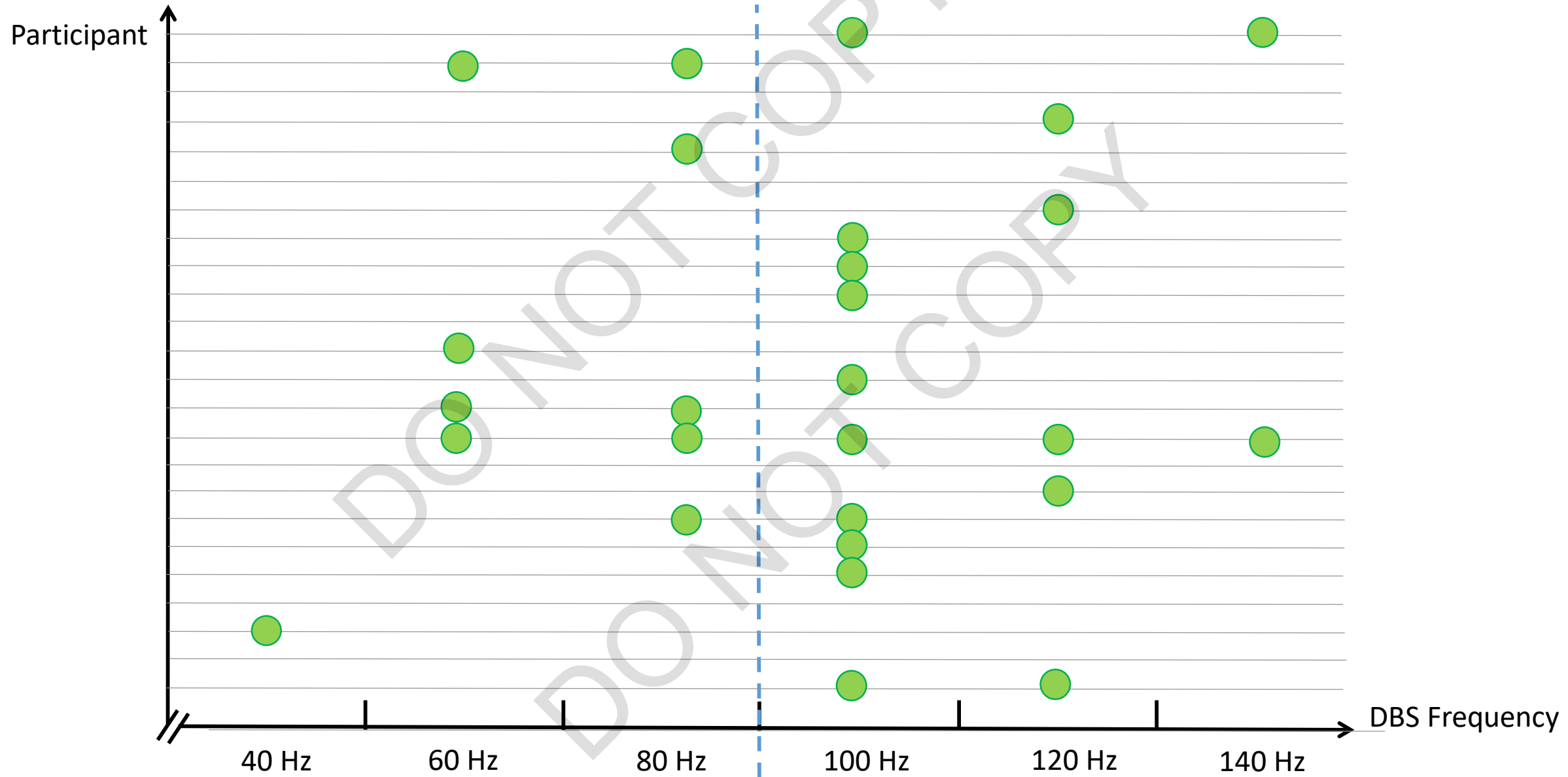


Participant

# C7-Sacrum length



# In-place, stepping, posture





# Conclusions

- PD postural performance changes with STN-DBS frequency
- Not all postural aspects show the same response to DBS frequency
- Lowering stimulation to 100 Hz better?

# Thanks to

Dejan Georgiev

Eirini Kalliolia

Amy L. Peters

Daniel C. Voyce

Patricia Limousin

Brian L. Day

Participants

You for listening

