Is There a Best Way to Follow-Through Between Pushes?

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Follow-Through Example

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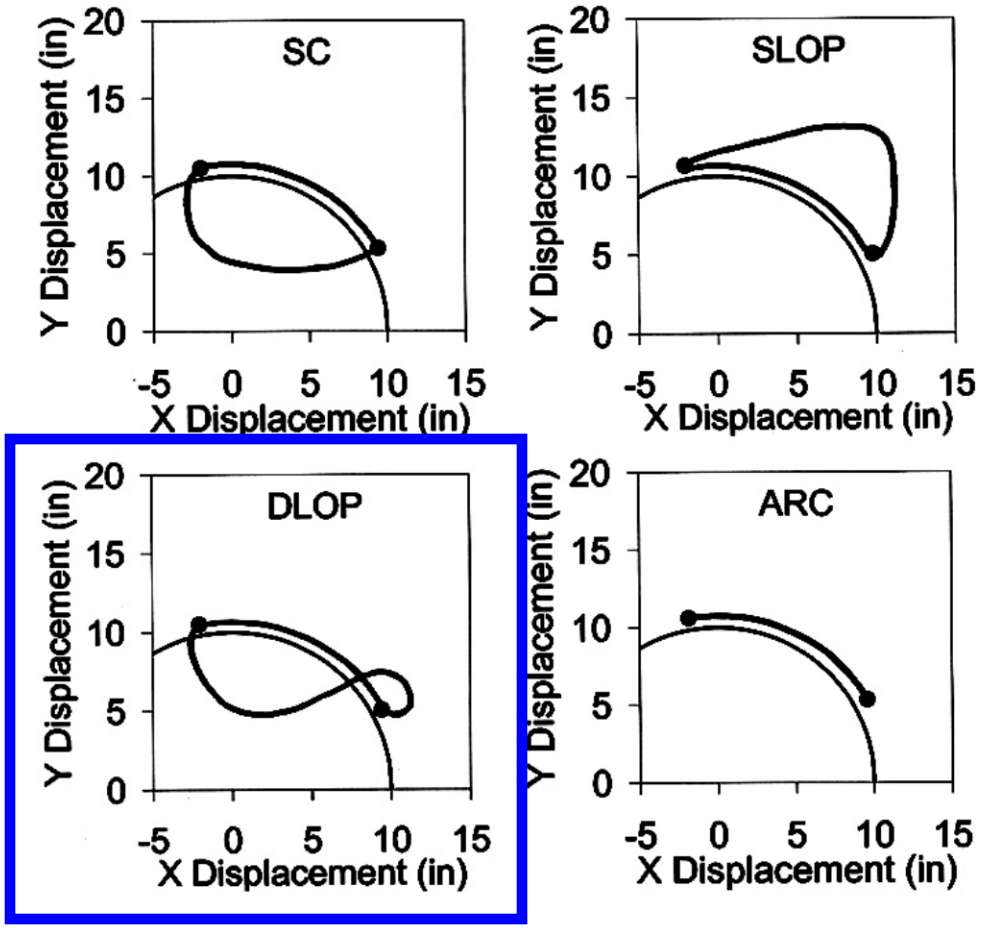
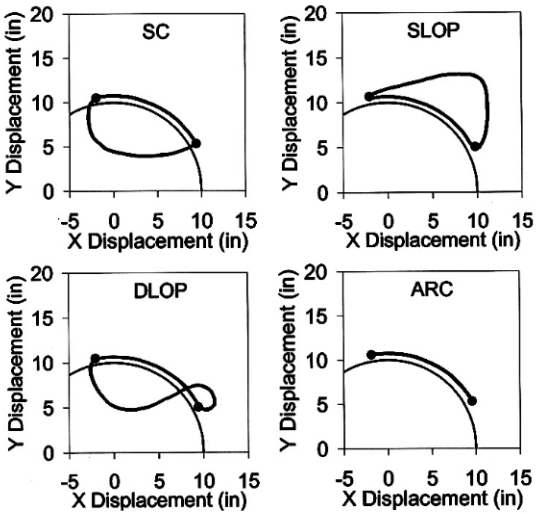
Pattern Classifications

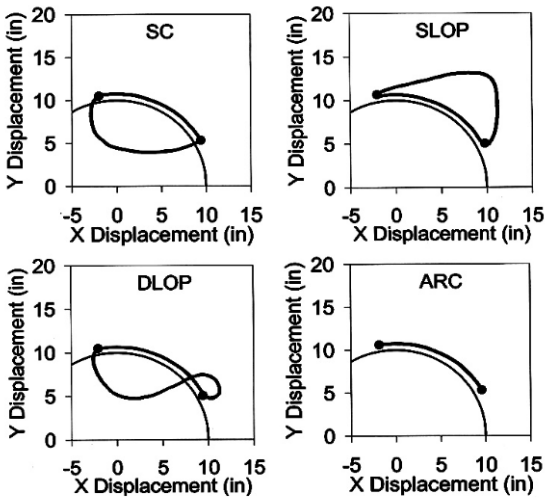


Semi-Circular Pattern (SC)



- Decreased push cadence and longer push times
  - (Boninger *et al*., 2002)
- PVA Guidelines recommends teaching this technique
  - Based solely on these results
  - (PVA 2005)

Arc Pattern (ARC)



Decreased metabolic demand over the SC pattern

(DeGroot *et al*., 2004)

Calls the SC recommendation into question

Research Questions

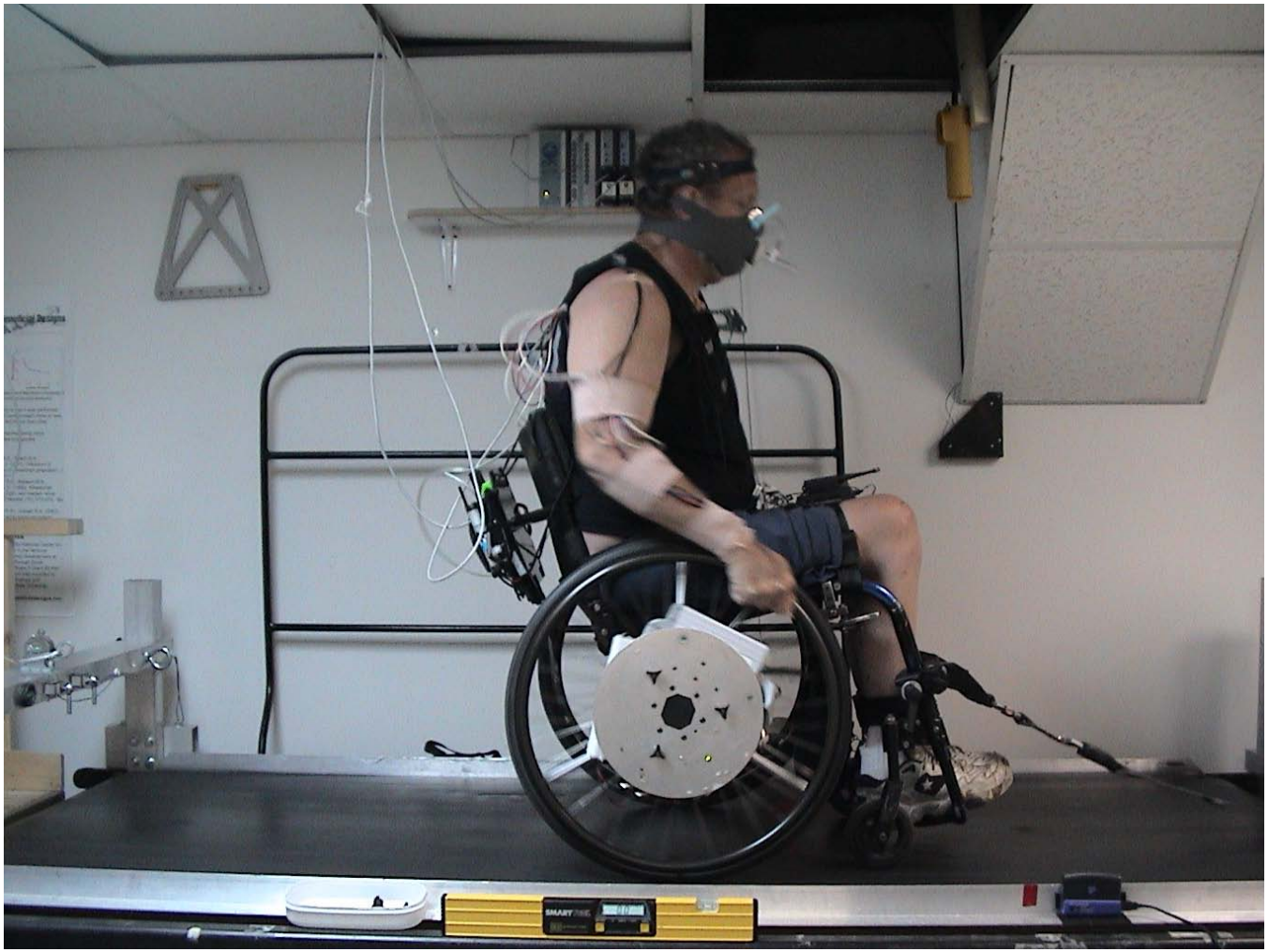
1) Previous studies are not in agreement on which pattern is best to use

Is there a best way to follow through between pushes?

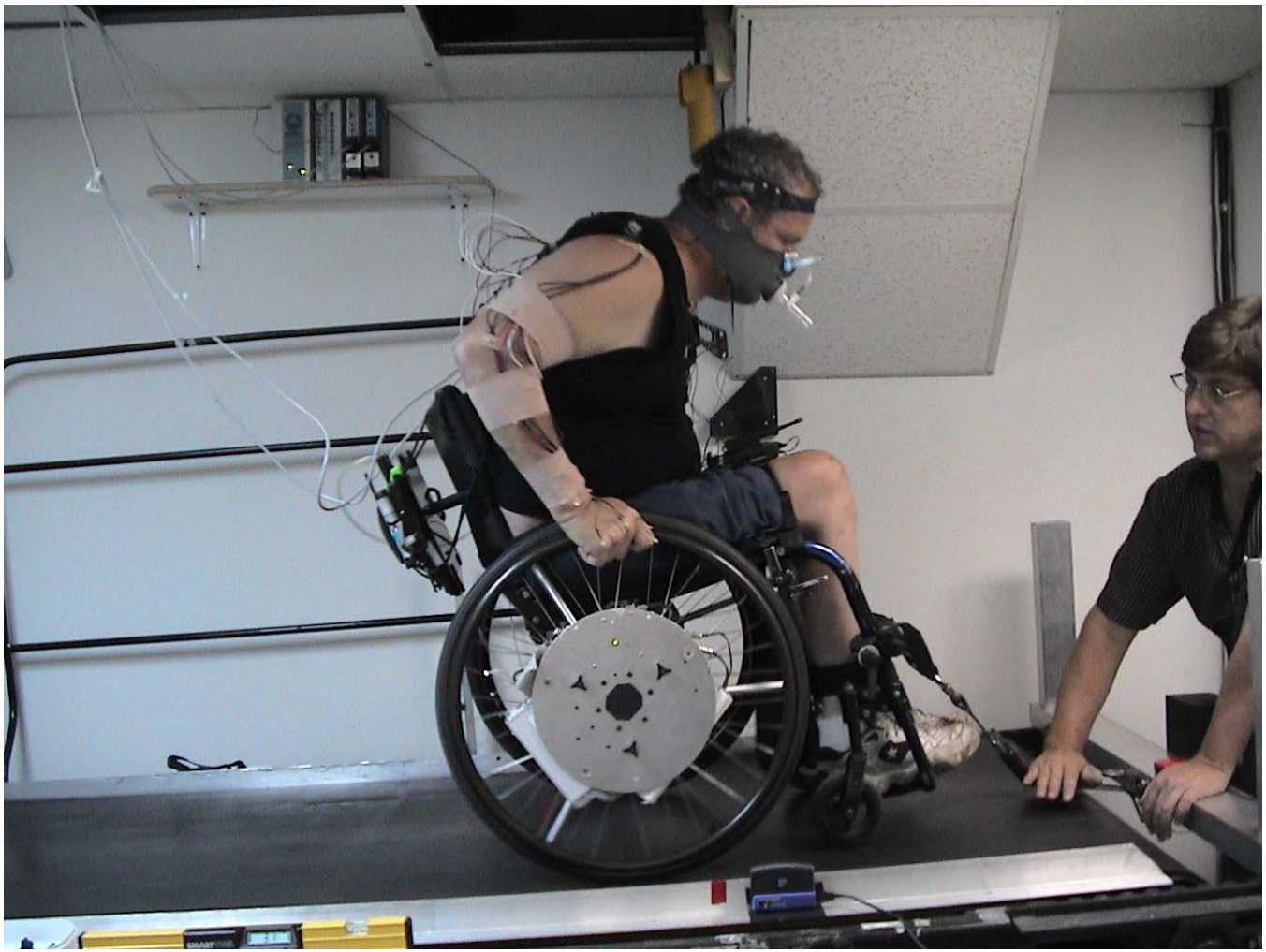
2) Previous studies were conduced on stationary dynamometers that simulate level propulsion

Do results differ for everyday pushing environments?

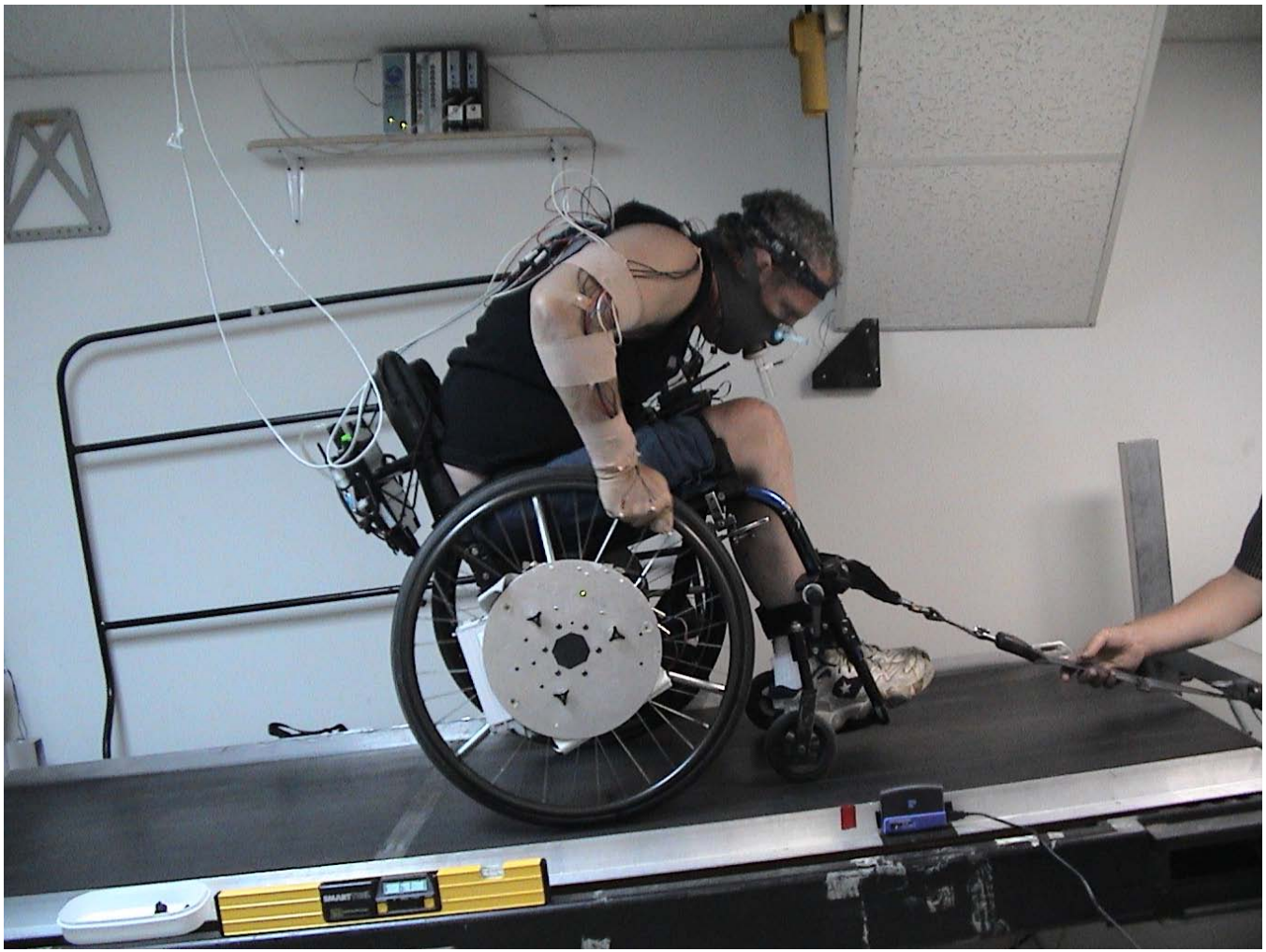
Propulsion environment



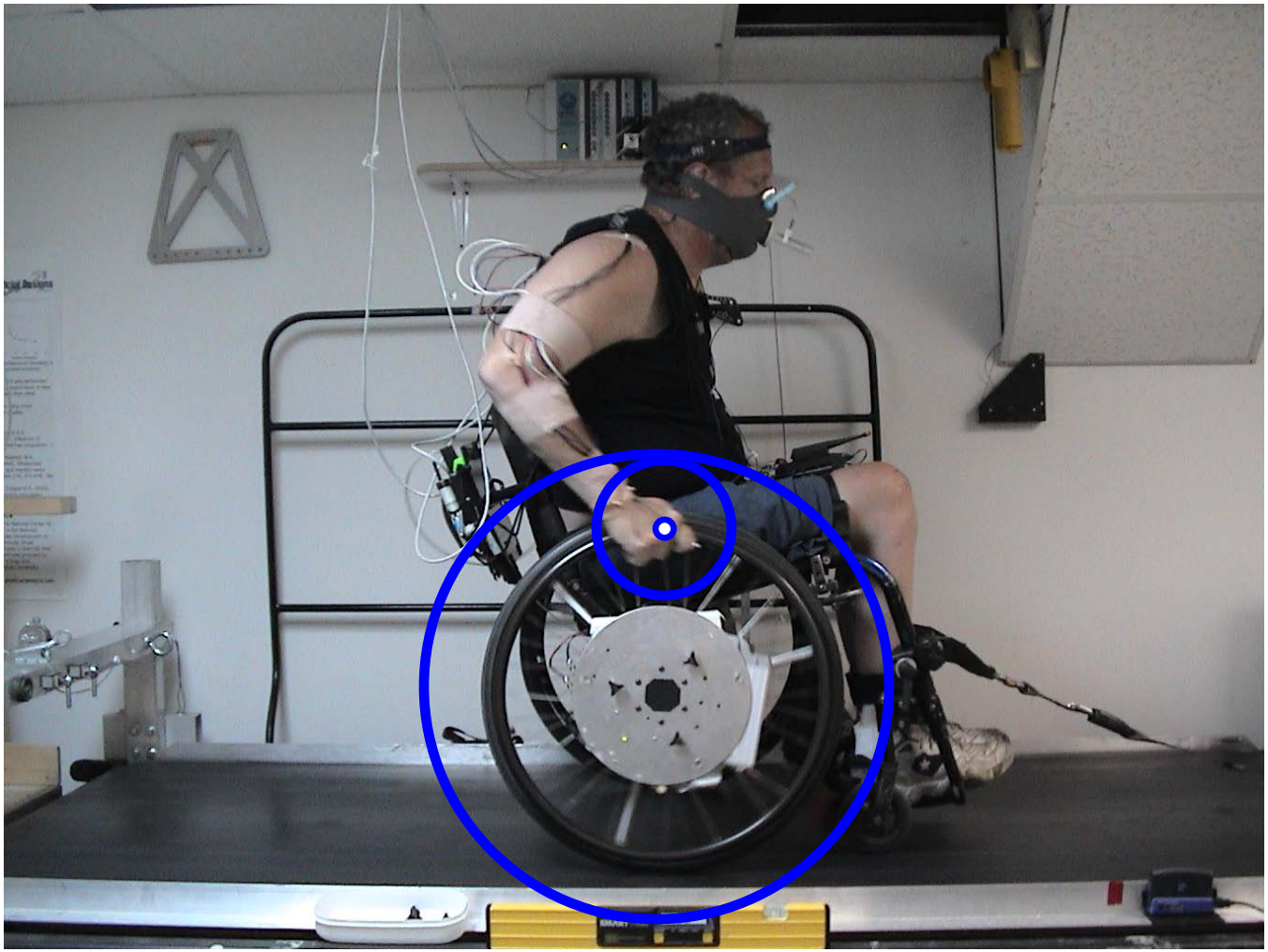
Moderate slope (3-deg)



Steep slope (6-deg)



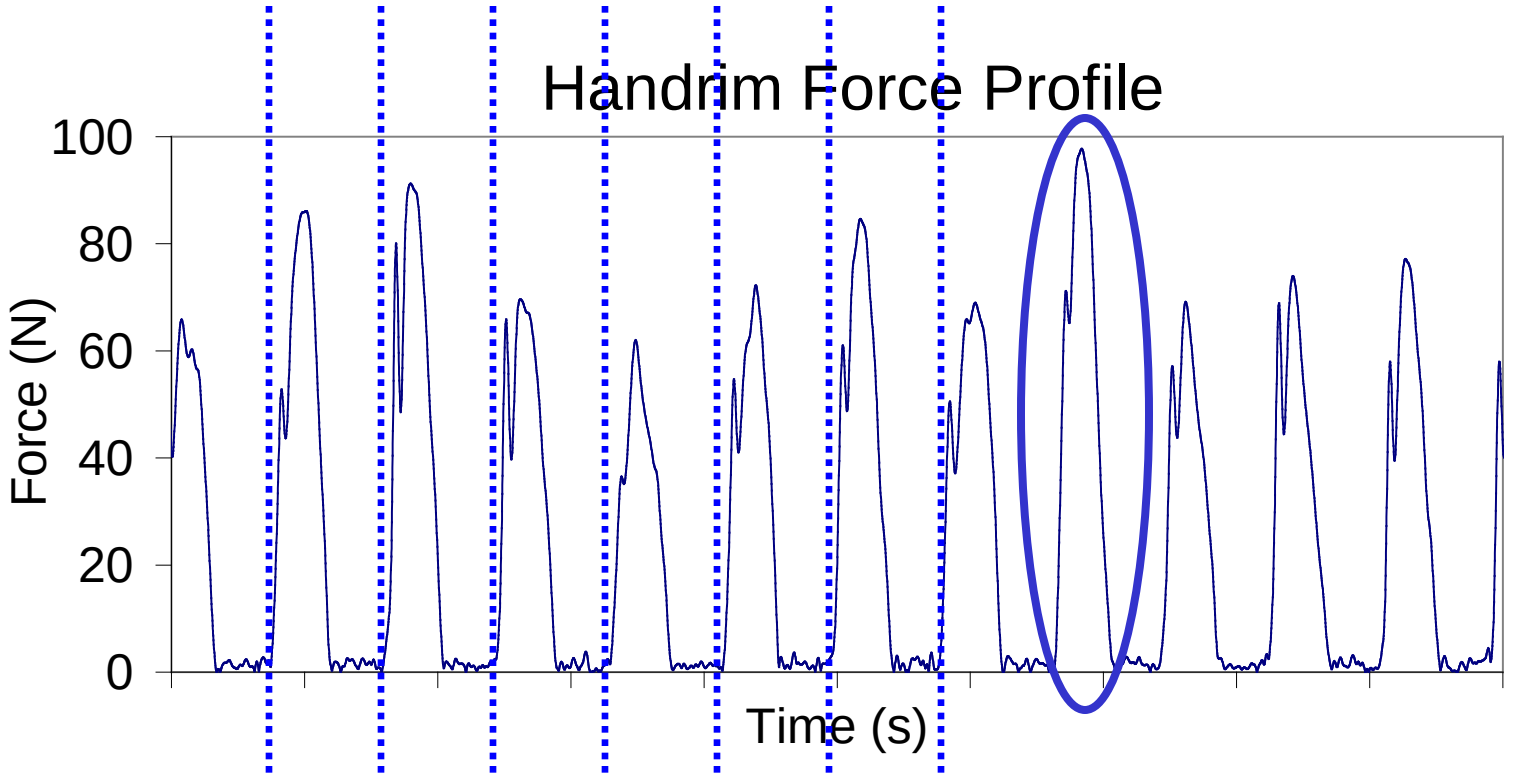
Instrumentation



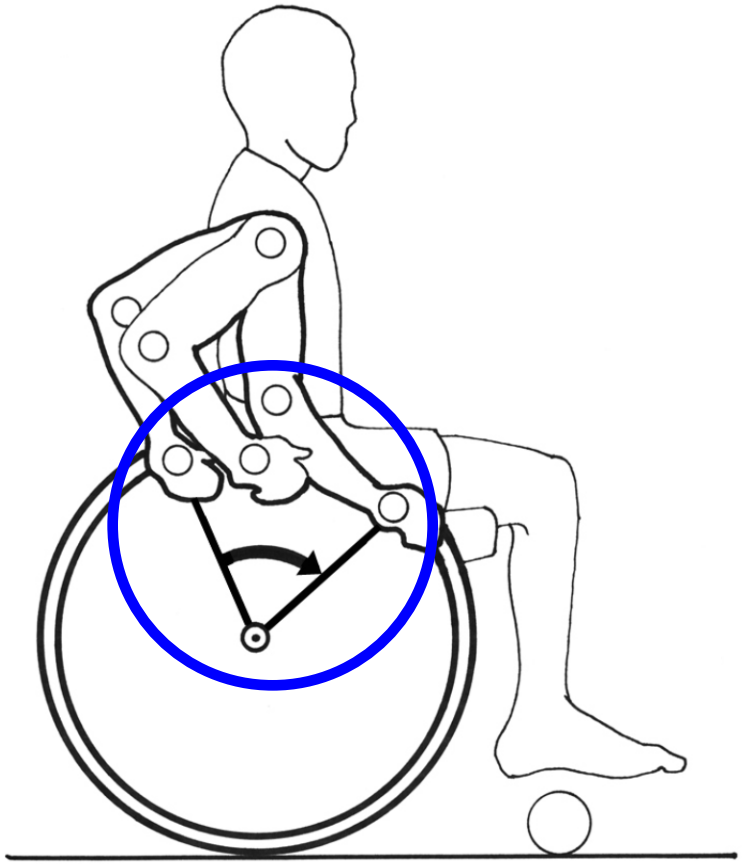
Propulsion bouts

- Determine the comfortable speeds for each subject on each grade condition
- Subjects then push at their comfortable speeds
  - 35 pushes on level
  - 30 pushes on the moderate slope
  - 25 pushes on the steep slope
- Analyzed the last 20 pushes on each grade
  - Allows subjects to reach steady-state (get into a groove)

Force applied to the handrim during propulsion



Push angle



Statistical analysis

Group subjects by stroke pattern

Outcomes compared across stroke pattern groups using ANOVA

Statistical strength tested using Bonferroni post hoc tests

Statistical significance for $p<0.05$

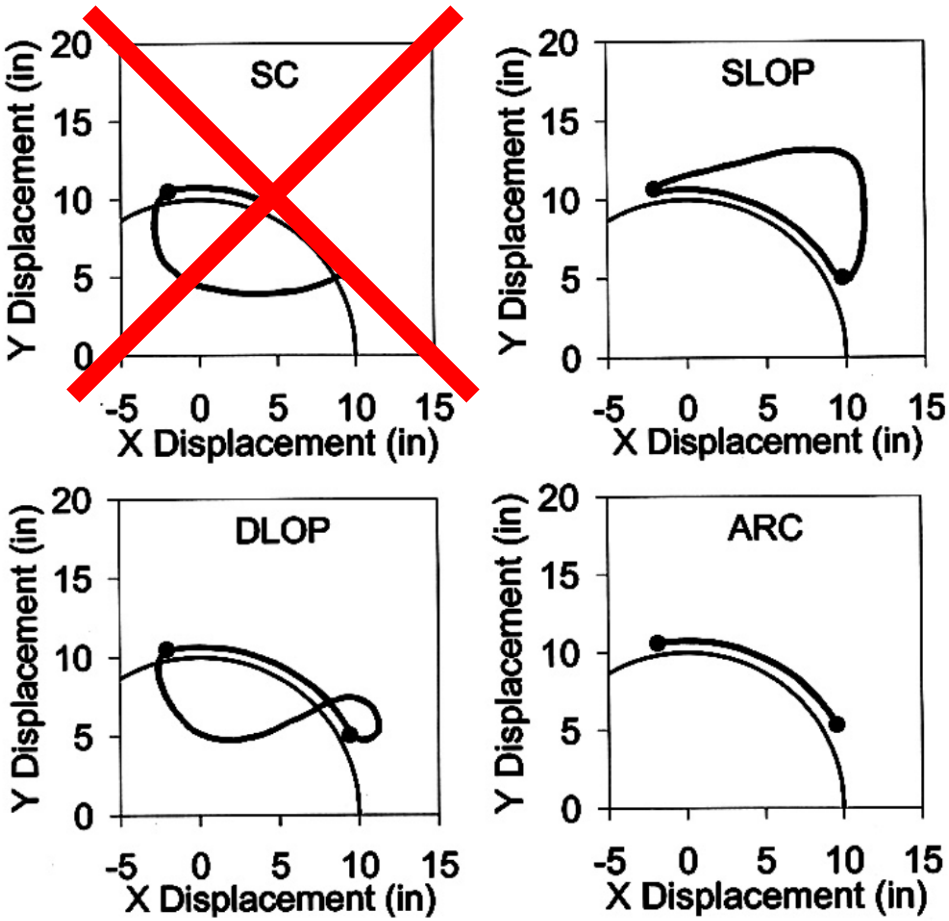
Subjects

N: 25 subjects (18 male, 7 female)
(22 SCI, 3 spina bifida)

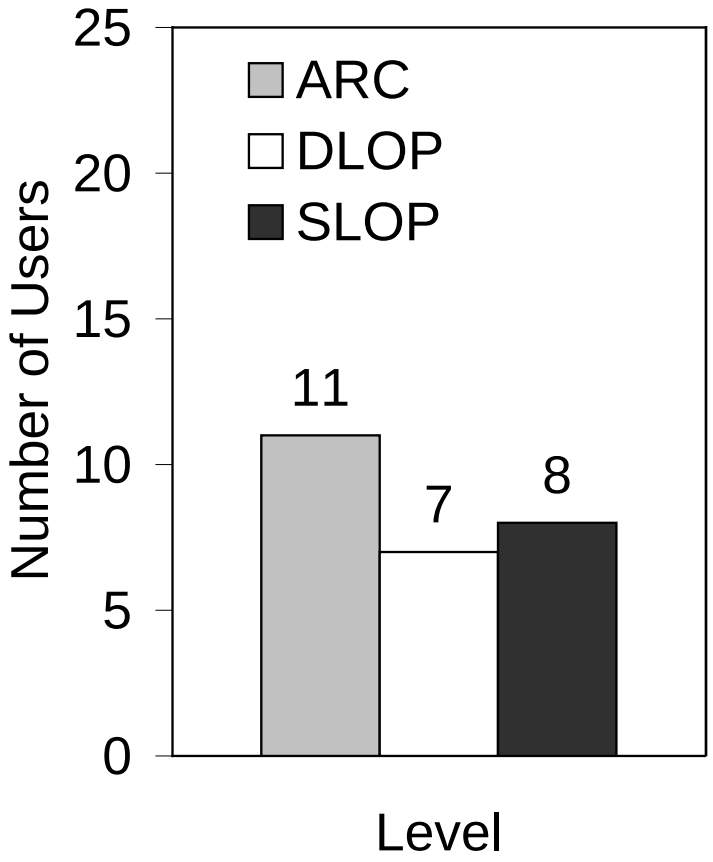
Age: 36 yrs (sd=11)

WC use: 17 yrs (sd=11)

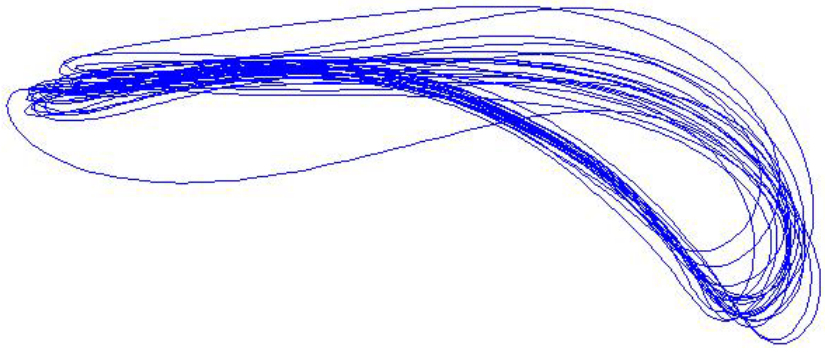
Stoke patterns found



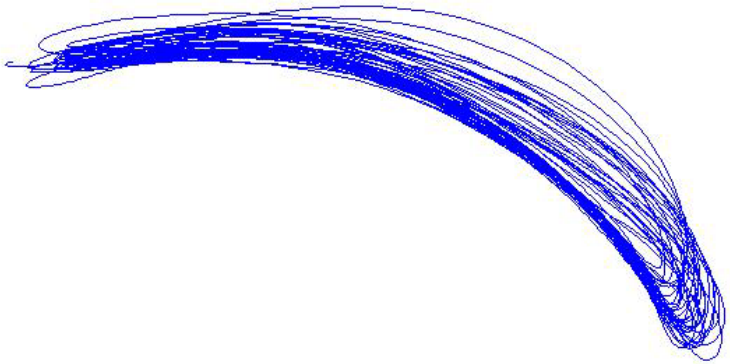
Stroke pattern histogram



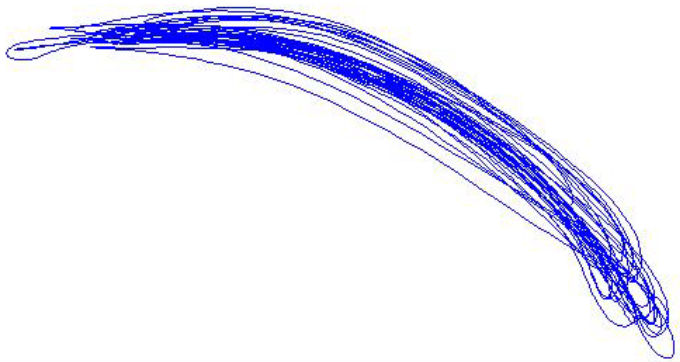
0 deg



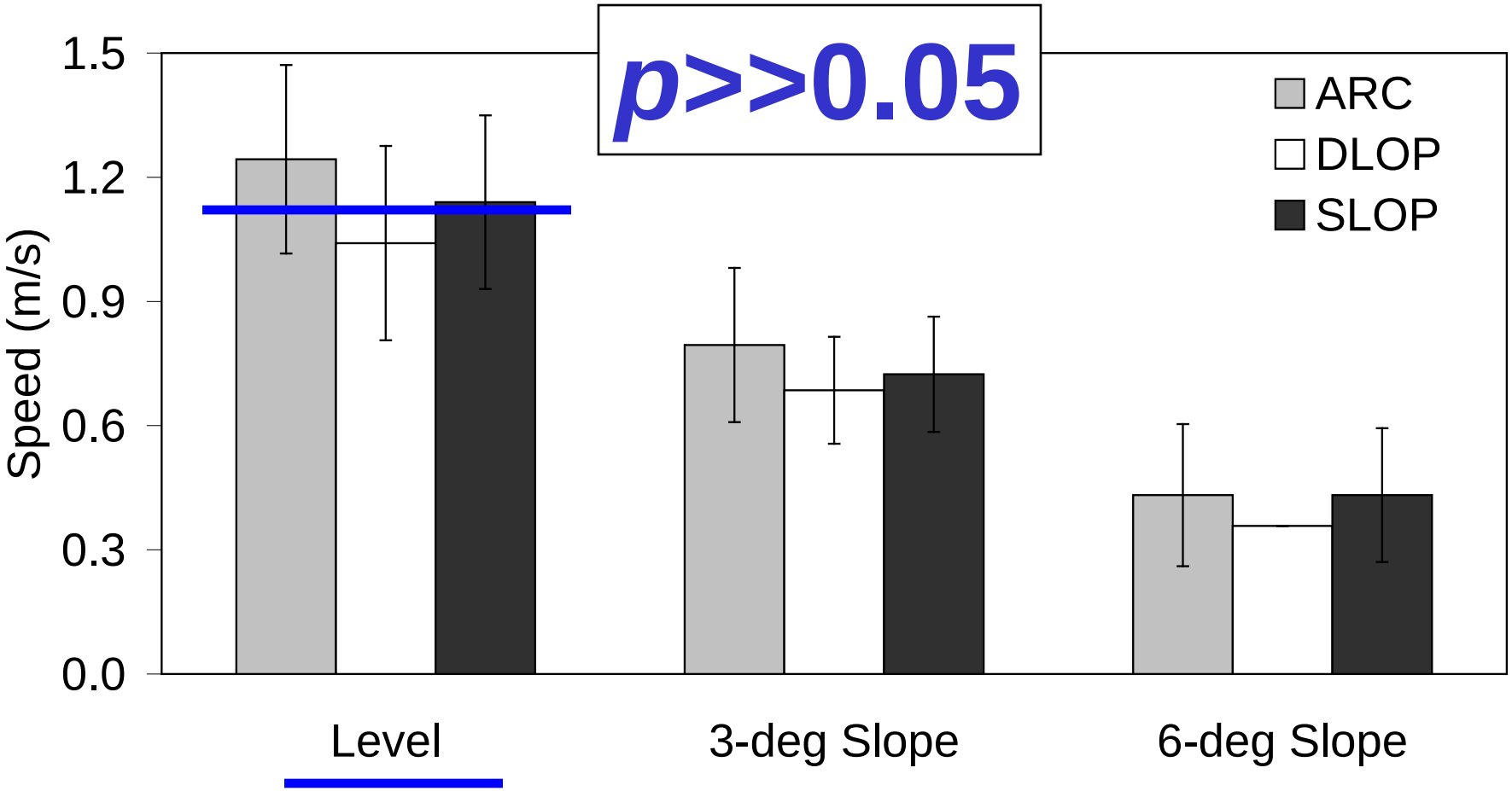
3 deg



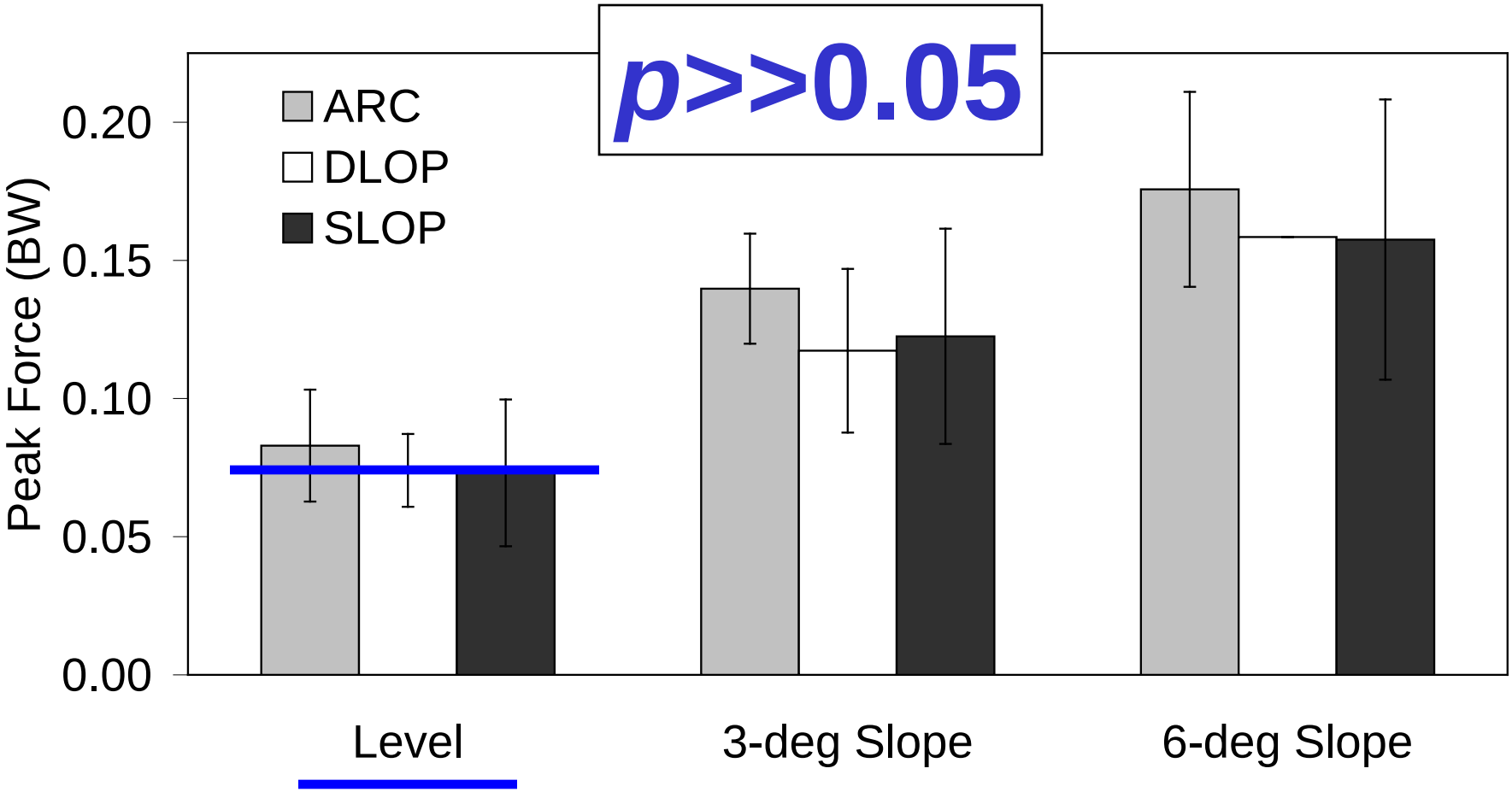
6 deg



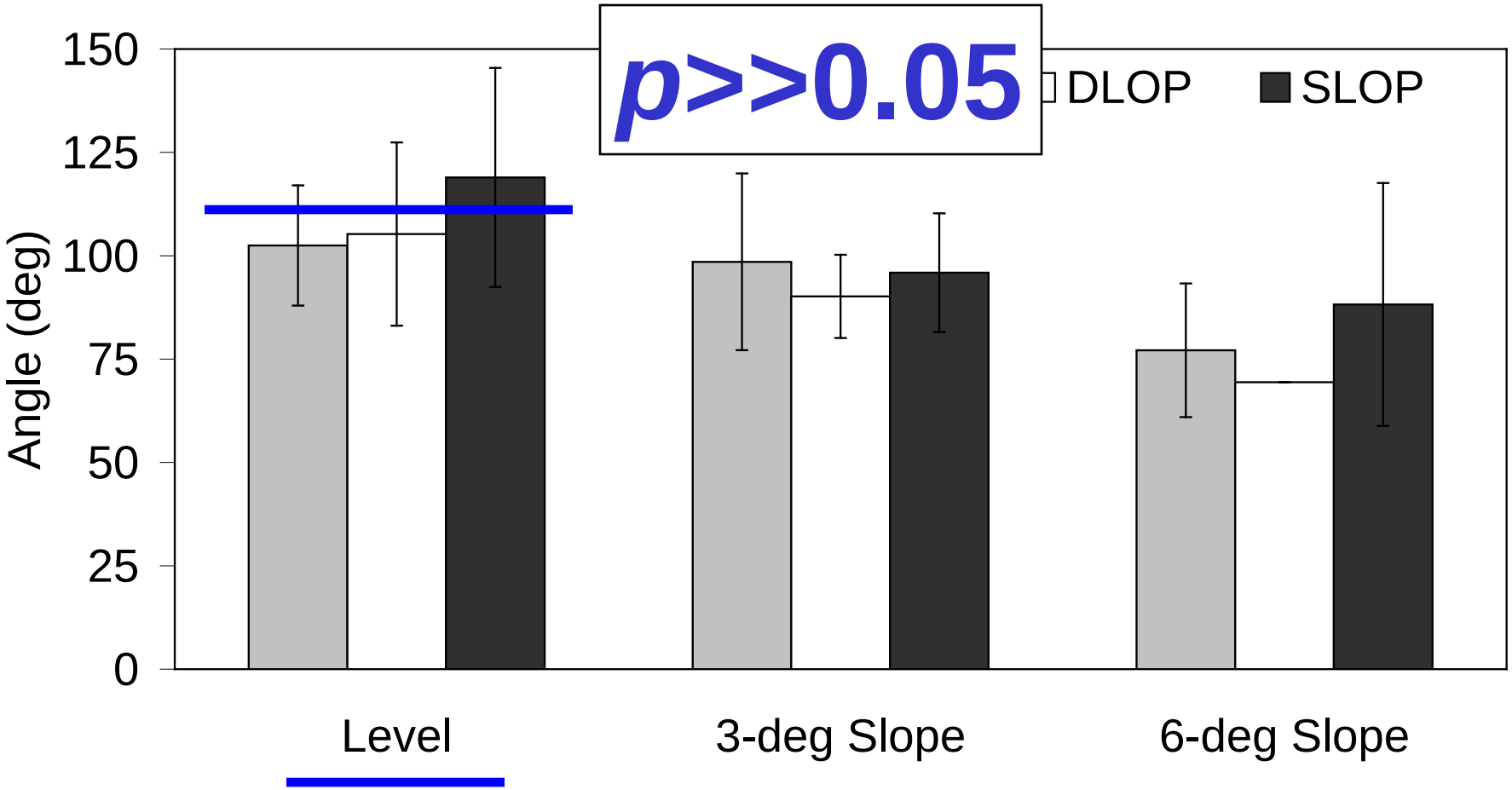
Propulsion speed



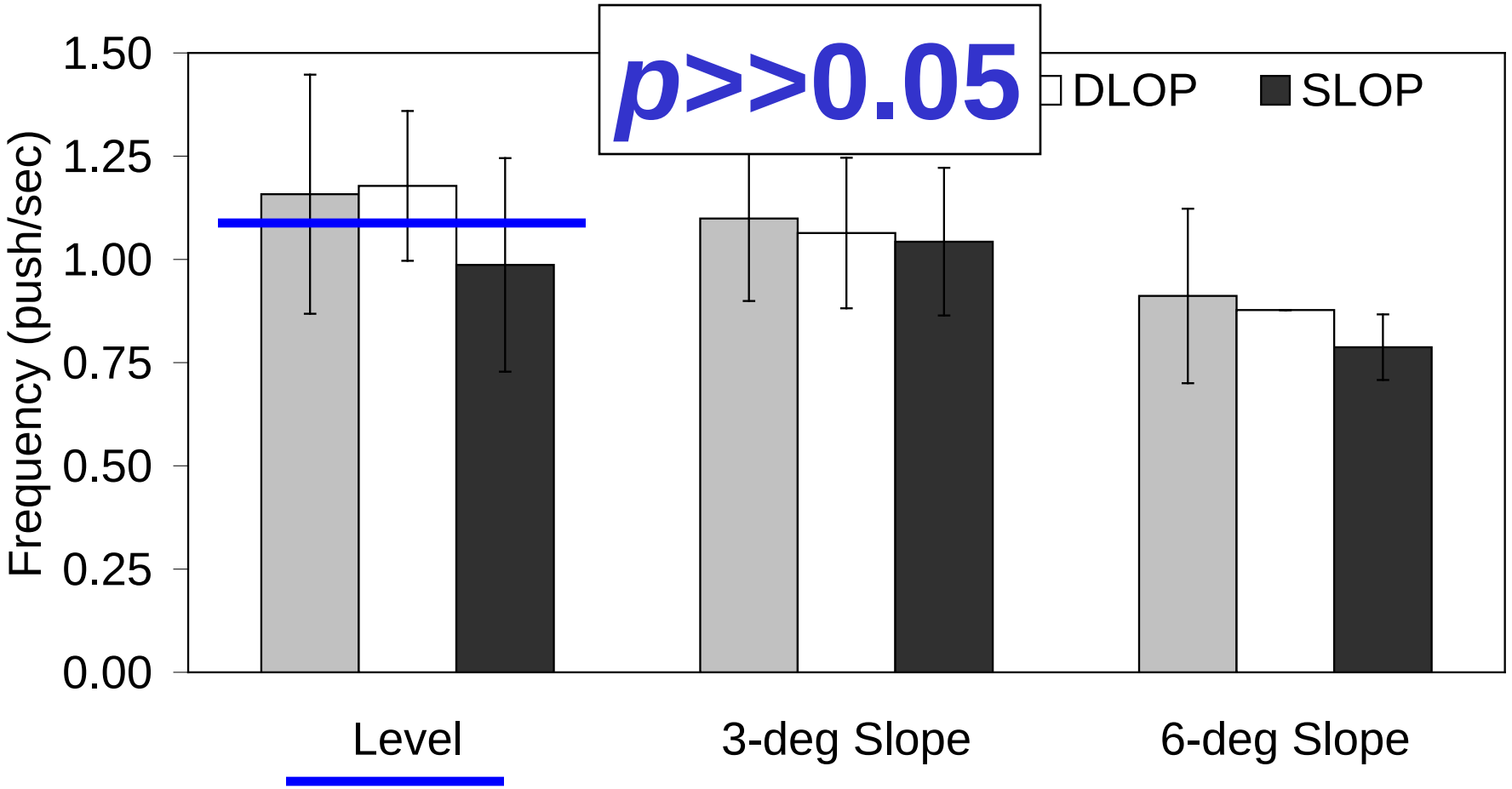
Peak force


p>>>0.05
ARC
DLOP
SLOP
Peak Force (BW)
0.20
0.15
0.10
0.05
0.00
Level
3-deg Slope
6-deg Slope

Push angle


p>>>0.05
DLOP
SLOP
Angle (deg)
150
125
100
75
50
25
0
Level
3-deg Slope
6-deg Slope

Push cadence



Conclusion

1) None of the 25 subjects used the SC pattern

Are there benefits that users are simply not aware of?

OR

Are the benefits of the SC pattern limited to propulsion on a stationary dynamometer?

2) The ARC pattern was chosen by 19 of the 25 subjects for pushing up a steep hill

Is this a reflection of a decreased metabolic demand?

OR

Are there other benefits to the ARC pattern that are specific to pushing uphill?

Conclusion

3) None of the patterns were found better than the others w.r.t propulsion biomechanics outcomes

Is there one best propulsion pattern for everyone?

OR

Is the best propulsion pattern is specific to each individual and propulsion environment?

Final remarks

It is clear that we do not fully understand the advantages and disadvantages of the various propulsion patterns

There is a need for further research in this area

AND

Training users to push with the SC pattern as recommended by the PVA Guidelines is likely short-sighted and may even adversely effect on the user's upper limb health.

Acknowledgements

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