

# How Does Muscle Synergy Recruitment Change with Knee Exoskeleton Gait Training ?



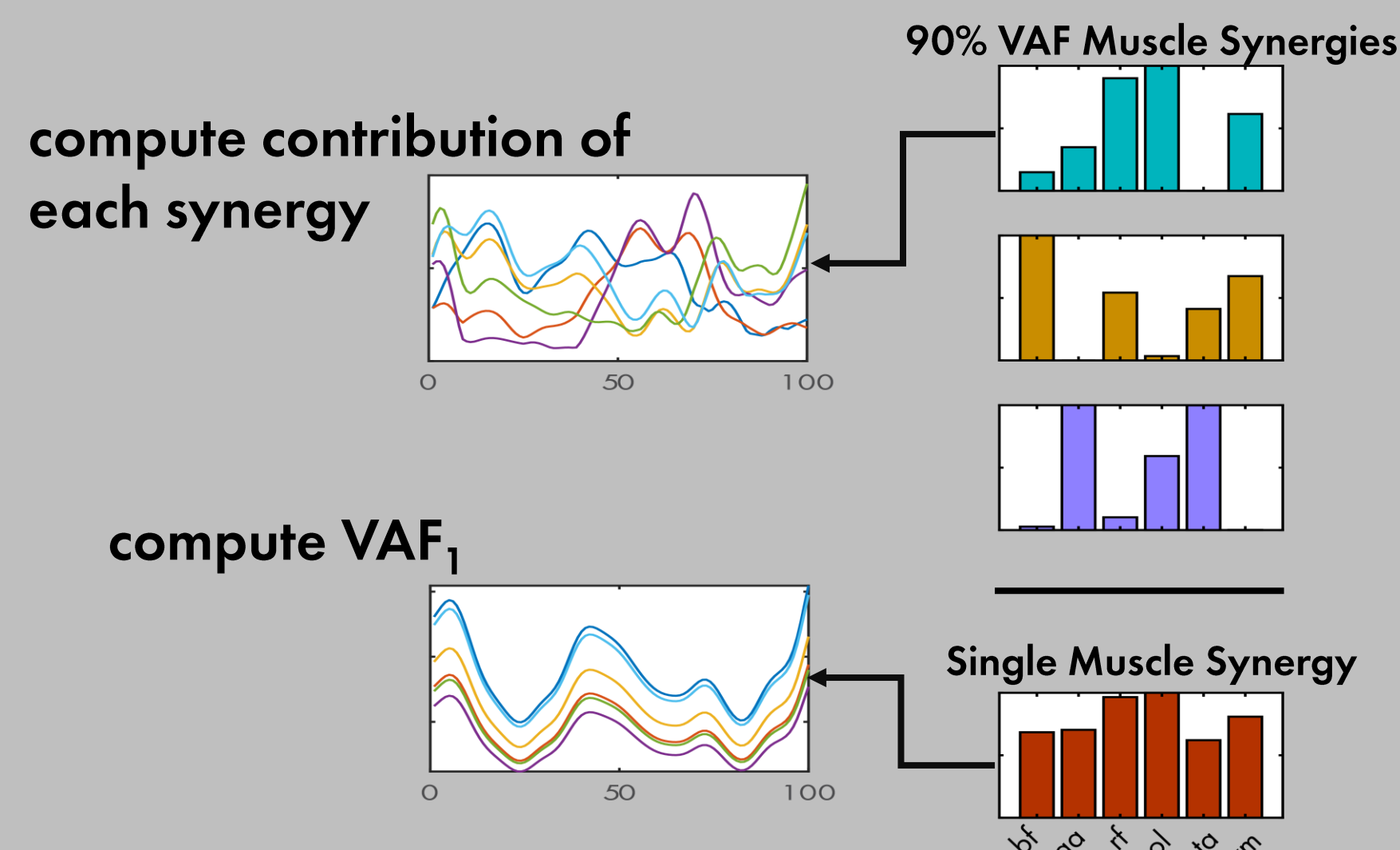
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## BIG PICTURE: Can we improve muscle coordination with exoskeleton training?

Populations with neurological injuries

- Fewer muscle synergies (reduced motor control complexity)
- # of muscle synergies not sensitive to real-time changes



5 Pediatric Subjects, exhibiting crouch gait or knee hyperextension

4 – 6 visits with robotic knee exoskeleton and visual biofeedback training

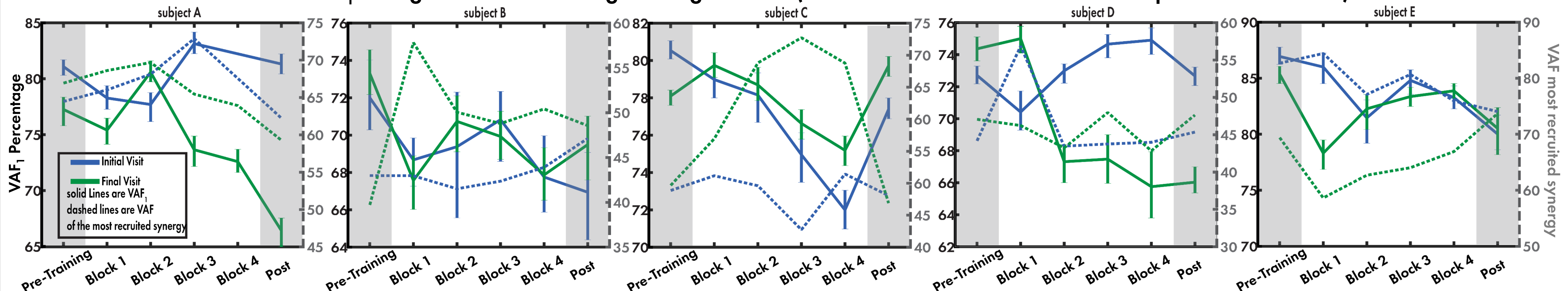
EMG data collected at 3 intermittent visits

## How to evaluate motor control during training?

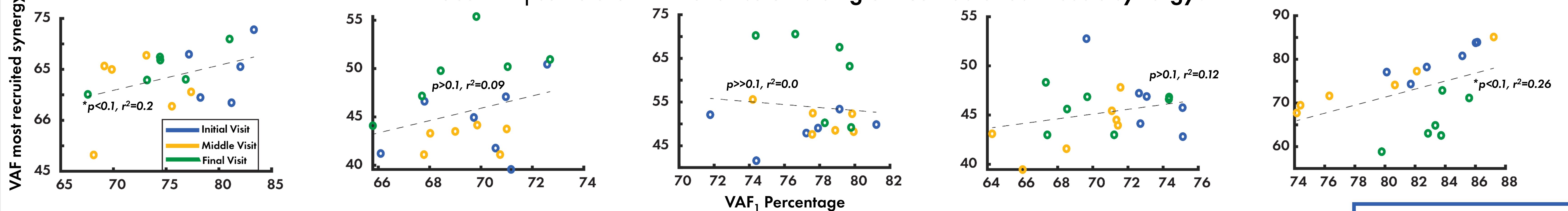
Variance accounted for by a single muscle synergy (VAF<sub>1</sub>) intends to measure motor control complexity, without potential inconsistencies from using # of synergies present<sup>1,2</sup> (e.g., @ 90% VAF, R<sup>2</sup>>0.8)

**We aim to see if changes in VAF<sub>1</sub> during an exoskeleton gait training session are indicative of changes in a patient's reliance on a specific muscle synergy.**

## VAF<sub>1</sub> changes observed during training sessions (Lower is associated with more complex motor control)



## Does VAF<sub>1</sub> correlate with reliance on a single most recruited muscle synergy?



## Results & Discussion

- Decreases in VAF<sub>1</sub> observed during several visits; not necessarily indicative of reduced reliance on a specific muscle synergy.
- For subject with which there is a correlation, VAF<sub>1</sub> may represent specific changes to recruitment of a single underlying muscle synergy.
- While VAF<sub>1</sub> may be helpful for measuring motor complexity in conjunction with other metrics, during an active robotic therapy session, **current methods for computing muscle synergies may not be sufficient for robust, real-time evaluation of motor control complexity.**

## Up Next →

- Best way to evaluate motor learning in real-time?
- Is real-time evaluation necessary?
- How can we adapt robotic therapy to motor control changes?
- More robust methods for computing muscle synergies?

**Correlation is not consistent across subjects.**  
Some show weak-moderate correlation, others show no significant correlation (at low significance).

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[1] B.C. Conner et al. (2021), Journal of Biomechanics  
[2] M.H. Schwartz et al. (2016), Developmental Medicine & Child Neurology