



Implicit sequence learning in Parkinson's disease: Intraindividual variability in reaction time



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Introduction

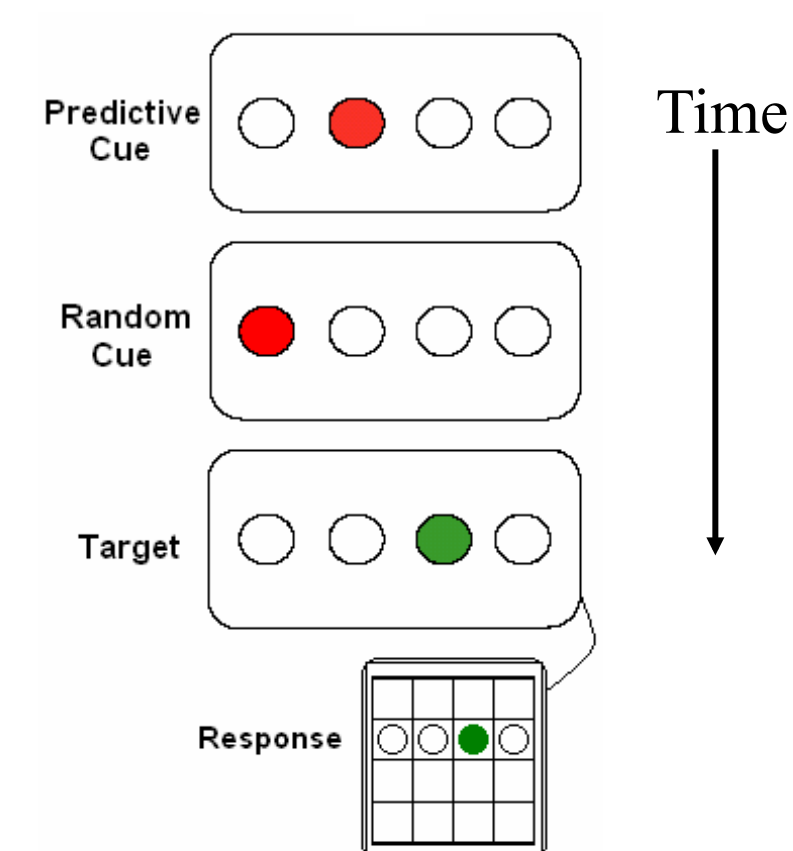
- Parkinson's disease** is characterized by motor deficits
- Motor deficits allow categorization into Hoehn and Yahr stages (Hoehn & Yahr, 1967) and ratings on the Unified Parkinson's disease Rating Scale (UPDRS; Fahn & Elton, 1987)
 - Deficits include bradykinesia, rigidity, tremor and postural gait/instability
 - Motor symptoms do not appear until there is an 80% dopamine (DA) loss in the substantia nigra (Fearnley & Lees, 1991) that results in a 50% DA loss in the striatum (Kish et al., 1988)
 - Response times are more variable than that of older healthy controls (HC; Burton et al., 2006; Camicioli et al., 2008)
- Intraindividual variability** has been shown to be an indicator of neurological dysfunction (de Frias et al., 2007)
- Neurological insult may further increase variability (Burton et al., 2006)
 - *Individual Standard Deviation* measures an individual's variation, or spread of performance, around their average performance (Stuss et al., 2003)
 - ISD = each individual's standard deviation
 - *Coefficient of Variation* measures an individual's variability by taking their average performance into account (Wegesin & Stern, 2004)
 - CoV = each individual's standard deviation / their mean
- Triplets Learning Task (TLT)** measures implicit associative learning (Howard et al., 2008), or how probabilistic regularities are acquired from the environment
- The task is self-paced – a trial does not end until a response is made, allowing for a good measure of how individuals' RTs change over the course of the task
- Do people with PD have more intraindividual variability than healthy controls (HC)? Does this difference increase across a training session?**

Participants

- 27 people with Parkinson's disease (PD; 10 females)
- Aged 64.55 ± 5.77
 - Diagnosed with mild to moderate PD by a neurologist; Hoehn and Yahr stage Range 1 – 2.5, UPDRS Motor score 8.55 ± 6.53 (0 - 29), disease duration of 6.59 ± 4.55 (1 – 18) years
 - All participants were receiving dopaminergic medication and were tested while ON
- 30 healthy older adult controls (HC; 20 females)
- Aged 66.47 ± 5.32

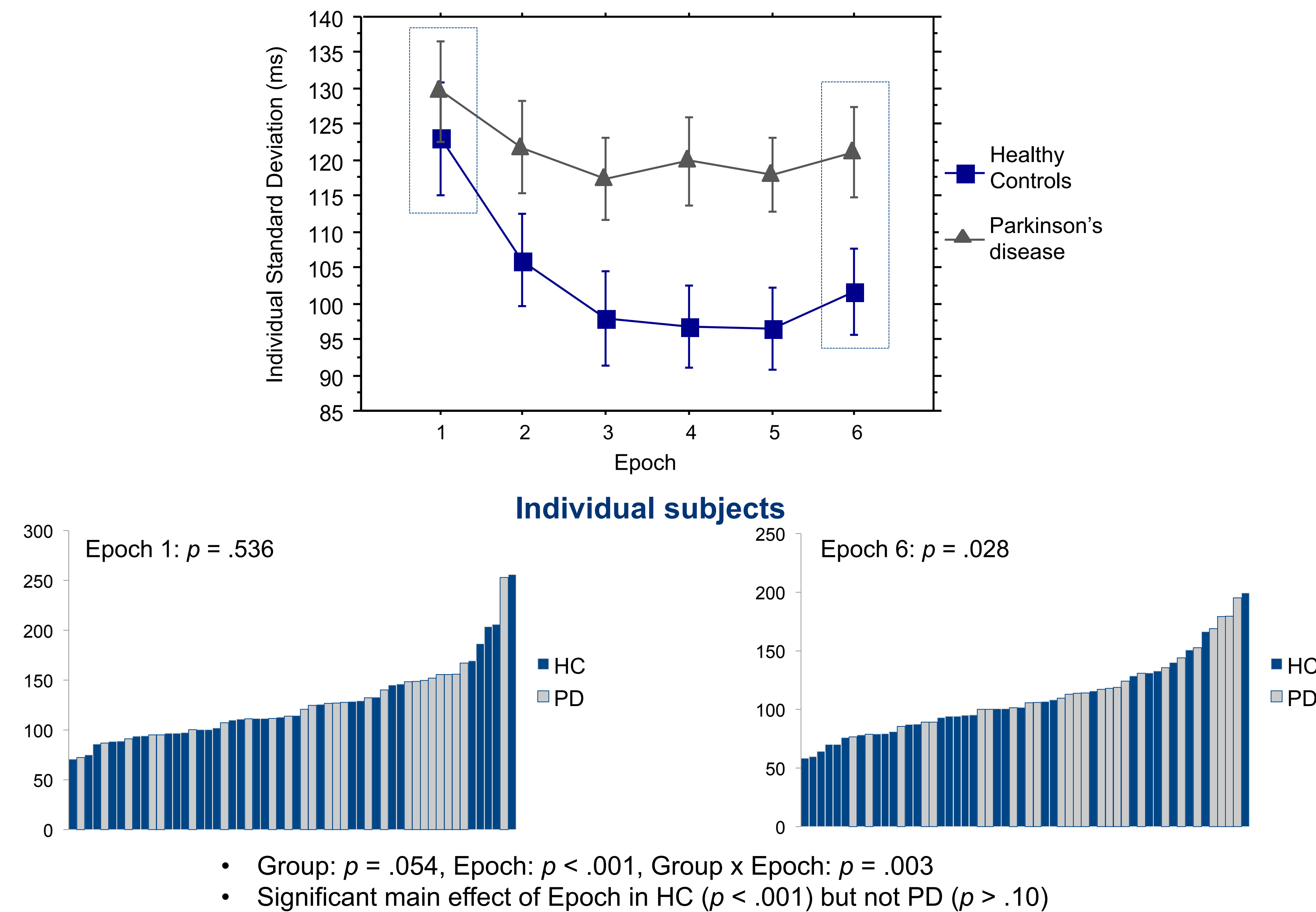
Triplets Learning Task

- Two red cues are shown, followed by a green target to which participants respond
- Unbeknownst to participants, the 1st red cue predicts the location of the green target on 80% of the trials
- Data are collapsed across triplet type

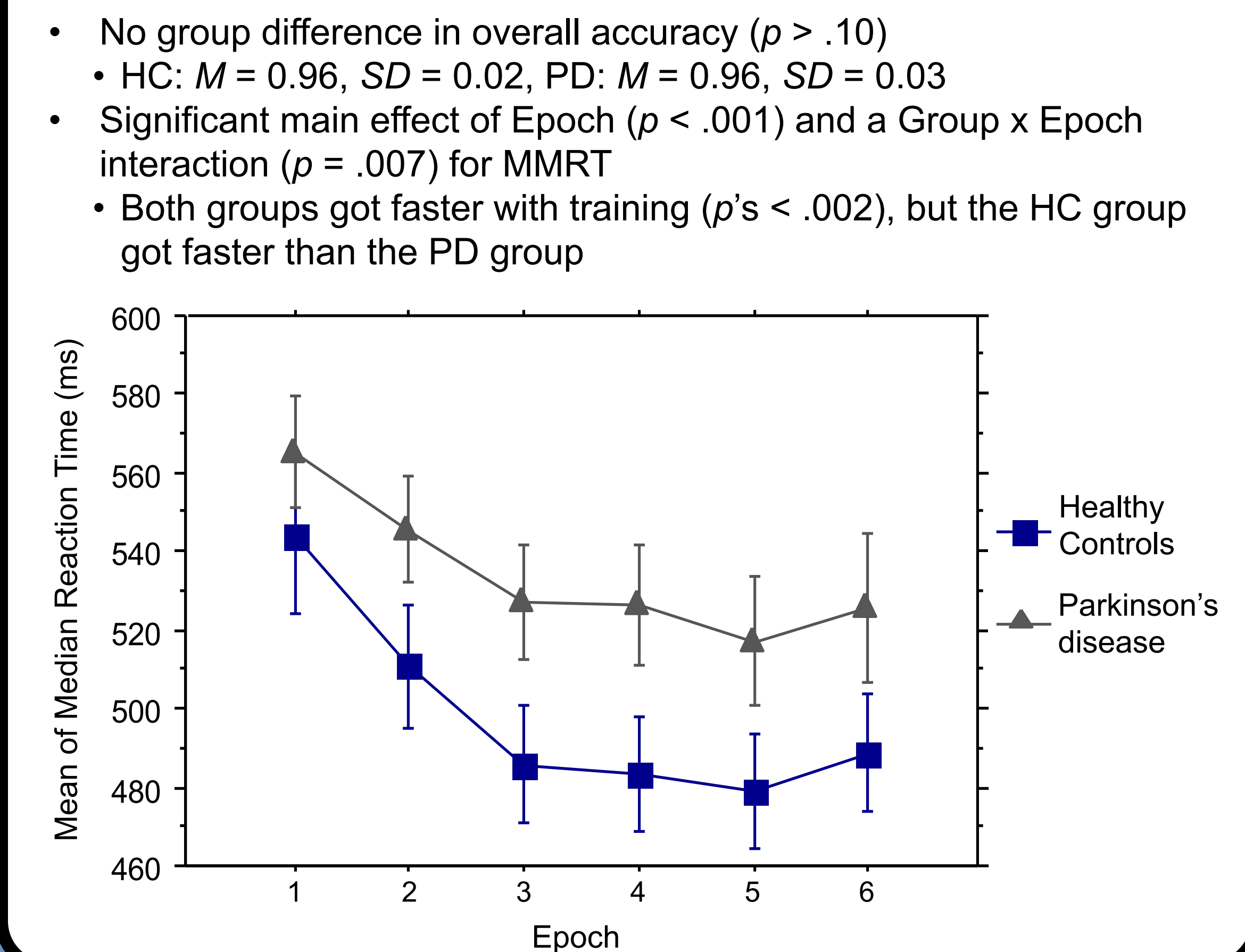


- 50 trials/block
- 250 trials/epoch
- 500 trials/session
- 3 sessions

Results: Individual Standard Deviation



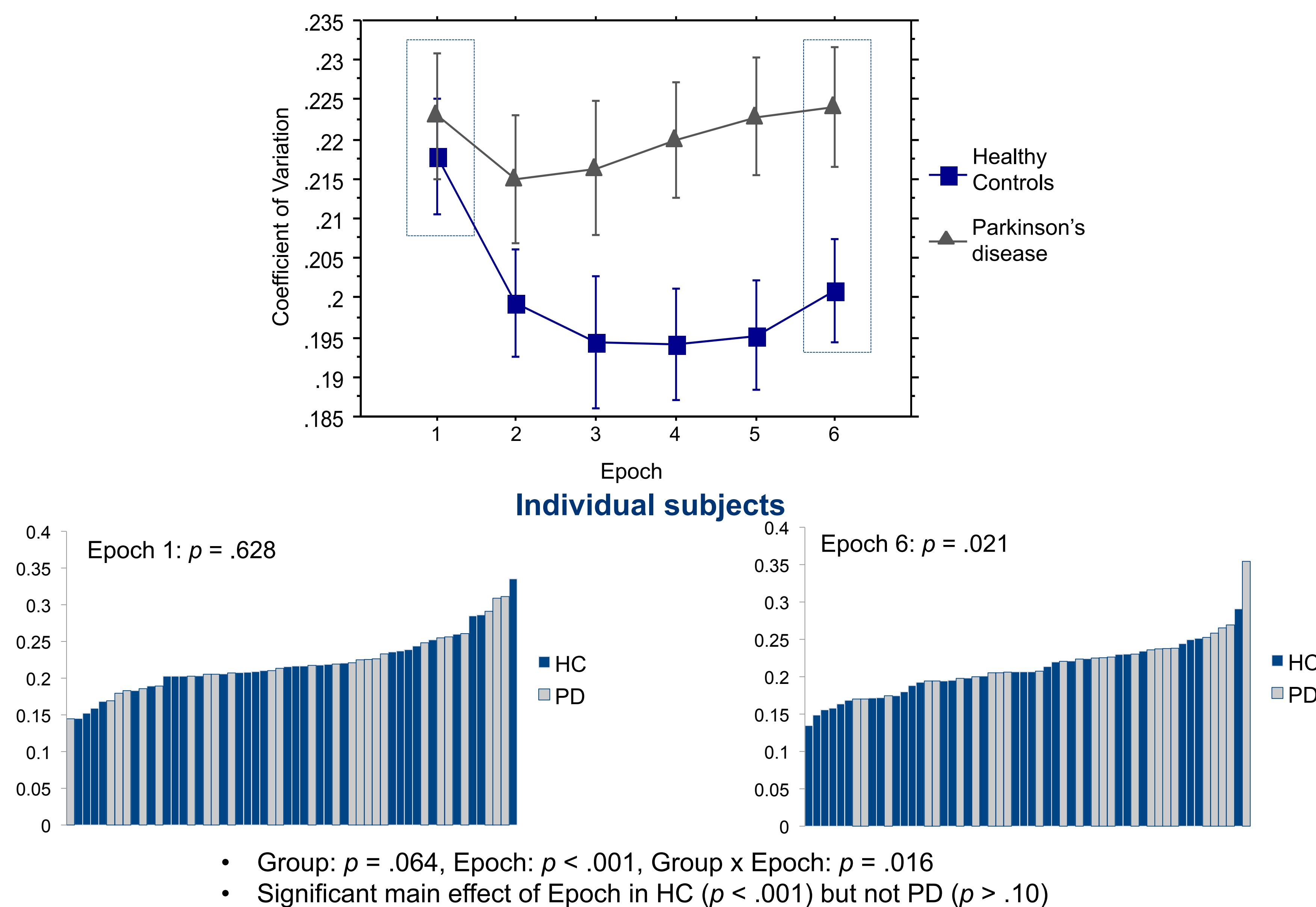
Results: Overall Performance



Conclusions & Implications

- People with PD had more intraindividual variability than HCs on both measures
- These group differences increased with training
- People with PD were overall slower than HCs, but both groups got faster with training, suggesting variability was not due to fatigue in the PD group
- Dopamine decline in PD and the resulting fluctuation in DA levels from medication may increase neural noise, which has been shown to increase intraindividual variability (de Frias et al., 2007)
- To our knowledge, this is the first study to show a group difference in intraindividual variability between healthy controls and a group of people with PD in a single task in a single day of training
- This is the first study to examine intraindividual variability in people with PD in an implicit sequence learning task
- Although people with PD showed less learning (RT difference between High and Low probability triplets) than HCs in the TLT (Gamble et al., 2014), there were no group differences in intraindividual variability in learning

Results: Coefficient of Variation



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