



Impaired Motor Preparation Under Conditions of Response Uncertainty in Parkinson's disease



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BACKGROUND

- People with early-stage Parkinson's disease (PD) tend to have executive function problems, whereas later-stage patients have a broader range of cognitive deficits.
- However, cognitive impairment is not consistent across patients.
- To assay executive function, we measured stimulus response uncertainty, a state in which the responder cannot predict which of two or more responses associated with a particular stimulus will be required.
- Stimulus response uncertainty has been shown to exert a cost on performance in normal subjects, with increased response latency and decreased accuracy that rises as a logarithmic function of the degree of uncertainty.

Hypothesis:
PD results in increased cost of response uncertainty.

METHODS

- Each participant completed the following:
 - ✓ The *Test of Everyday Attention (TEA)* was used to measure attentional switching in everyday life.
 - ✓ *Geriatric Depression Scale (GDS)* (depression)
 - ✓ *WAIS-III Digit Span* (attention and working memory)
 - ✓ *Functional Dexterity Test (FDT)* (motor behavior)
 - ✓ *Mini-Mental State Examination (MMSE)* (mental status)
 - ✓ *North American Adult Reading Test, Revised (NAART-R)* (premorbid IQ)
 - ✓ *Symbol Digit Modality Test (SDMT)* (processing speed)

• Analysis
PD subjects were divided into impaired and unimpaired groups based on control group mean task performance. Group comparisons were made with multivariate ANOVA using SPSS.

Table 1. Parkinson's Disease Severity

	DA (mg)	DISEASE DURATION (years)	AGE OF DIAGNOSIS (years)	UPDRS	H & Y
	M(SD)	M(SD)	M(SD)	M(SD)	M(SD)
Impaired PD	505.2(301.2)	7(4.0)	64.9(6.0)	122.9(13.5)	1.3(1.0)
Unimpaired PD	245.8(318.9)	4.8(2.6)	58.8(5.5)	99.6(38.3)	1.5(0.7)

METHODS (continued)

Uncertainty Task

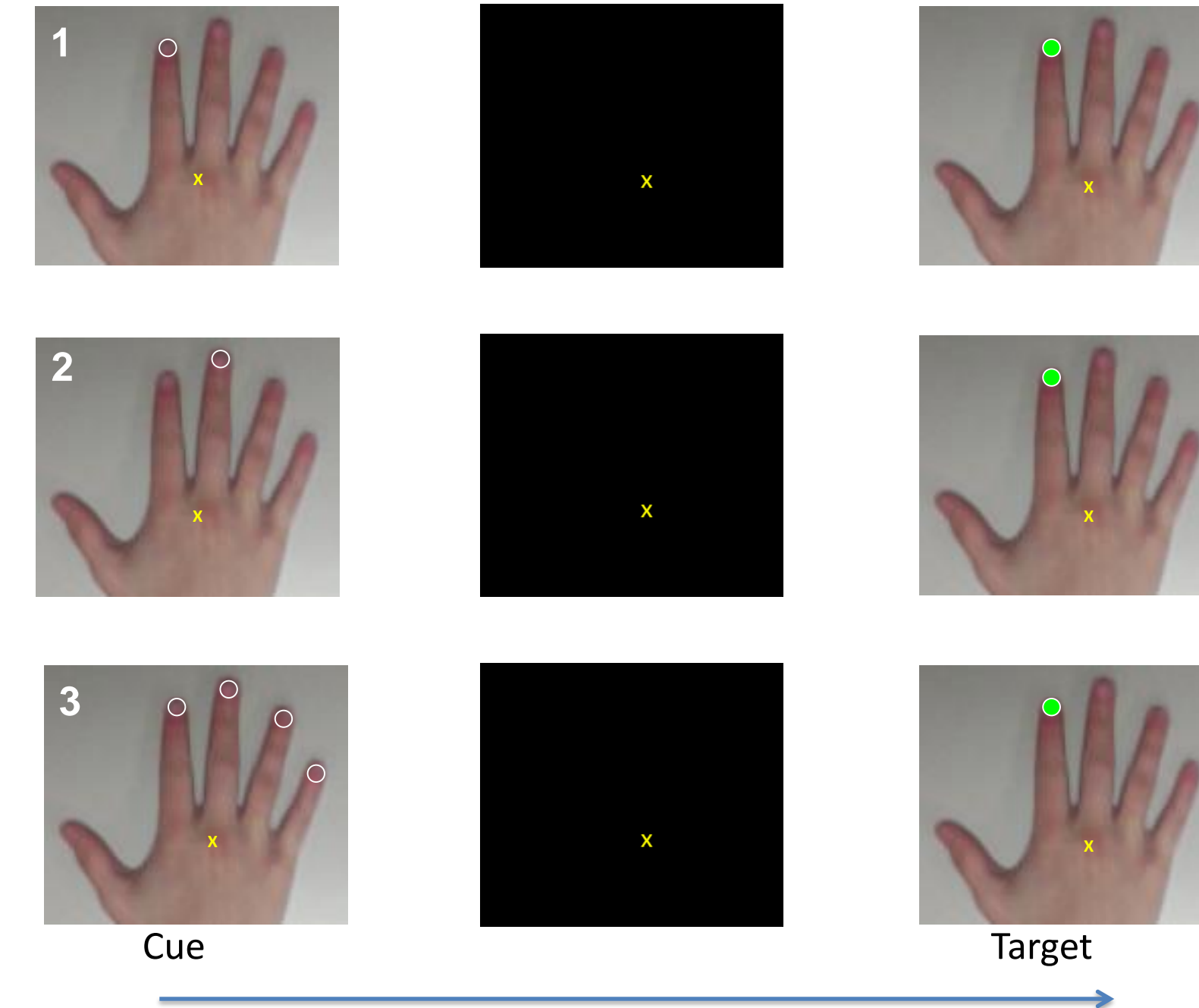


Figure 2. Examples of the 3 trial types

- 1) Control trials consist of a matching cue (white circle) and target (green circle).
- 2) Switch trials consist of mismatched cue and target.
- 3) Uncertainty trials consist of two or more cues and a single target. Note that, while the cues were manipulated across trials, motor output was matched. This design allows us to isolate the motor planning aspects of the task.

RESULTS

- Demographic data was similar across groups (Table 2).

Table 2. Demographic and Descriptive Data

	N	AGE	SEX	EDUCATION	MMSE	NAART FSIQ	GDS	DIGIT SPAN	FDT	TEA Time/Switch
		M(SD)		M(SD)	M(SD)	M(SD)	M(SD)	M(SD)	M(SD)	M(SD)
Impaired PD	10	69(5.5)	7M	16.7(3.5)	29.3(0.7)	113.6(8.4)	6.3(5.9)	16.4(3.1)	21.7(4.8)	4.7(1.1)
Unimpaired PD	5	62.8(4.9)	2M	16(2)	29(1.7)	118.1(3.4)	4.6(5.0)	18.0(4.0)	16.5(2.8)	3.6(0.5)
Control	12	64.8(5.8)	7M	17.2(3.7)	29.3(1.0)	116.0(7.2)	4.7(5.3)	18.4(4.7)	16.9(7.4)	3.9(1.0)

- There were significant differences in reaction time for two and three cue trials compared to control (one cue) trials.
- We found significant differences in reaction time between all three subject groups (CO, unimpaired PD, impaired PD) for all trial types (control, two digit cue, three digit cue, four digit cue; Fig. 2).

Figure 2. Reaction Time data

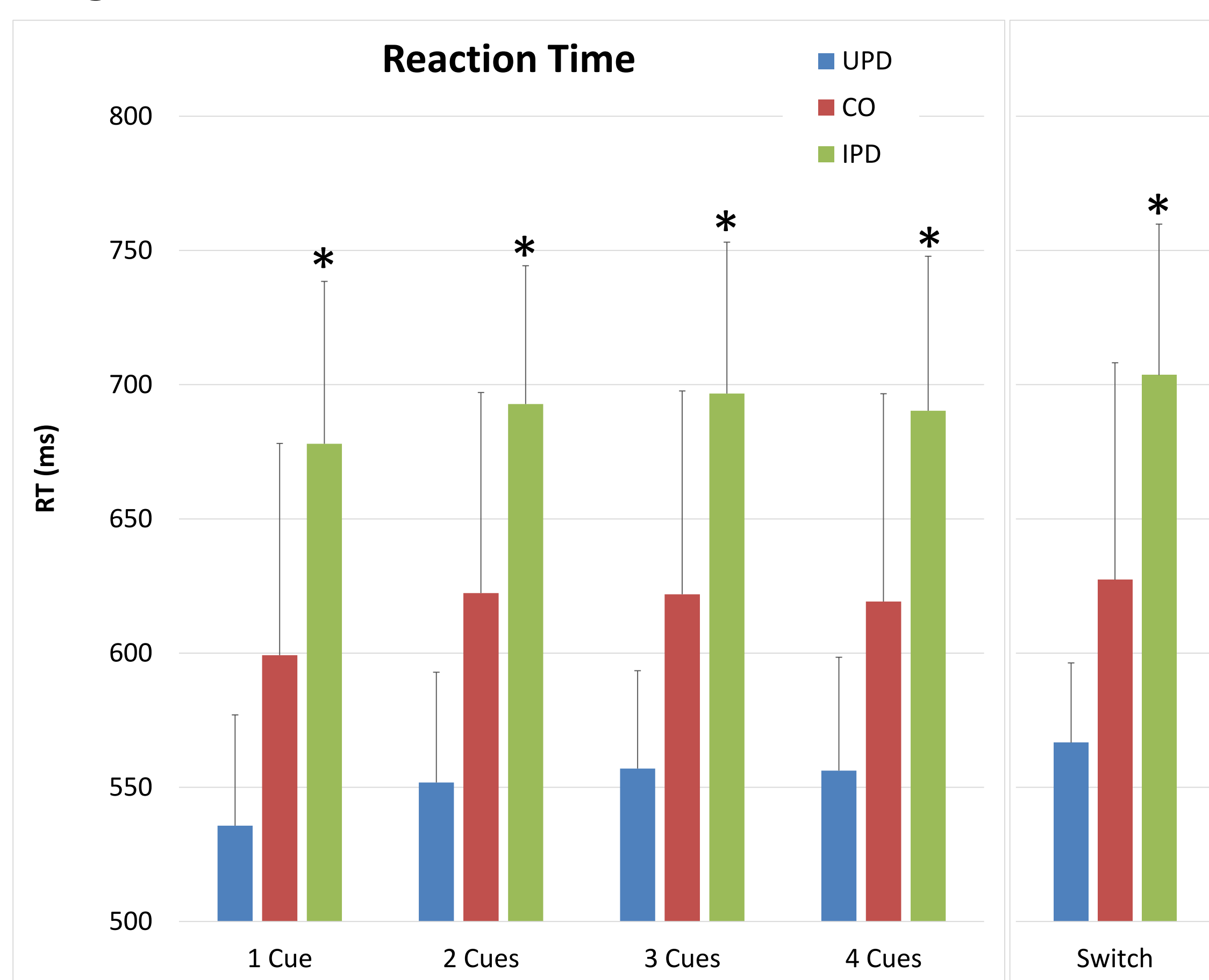
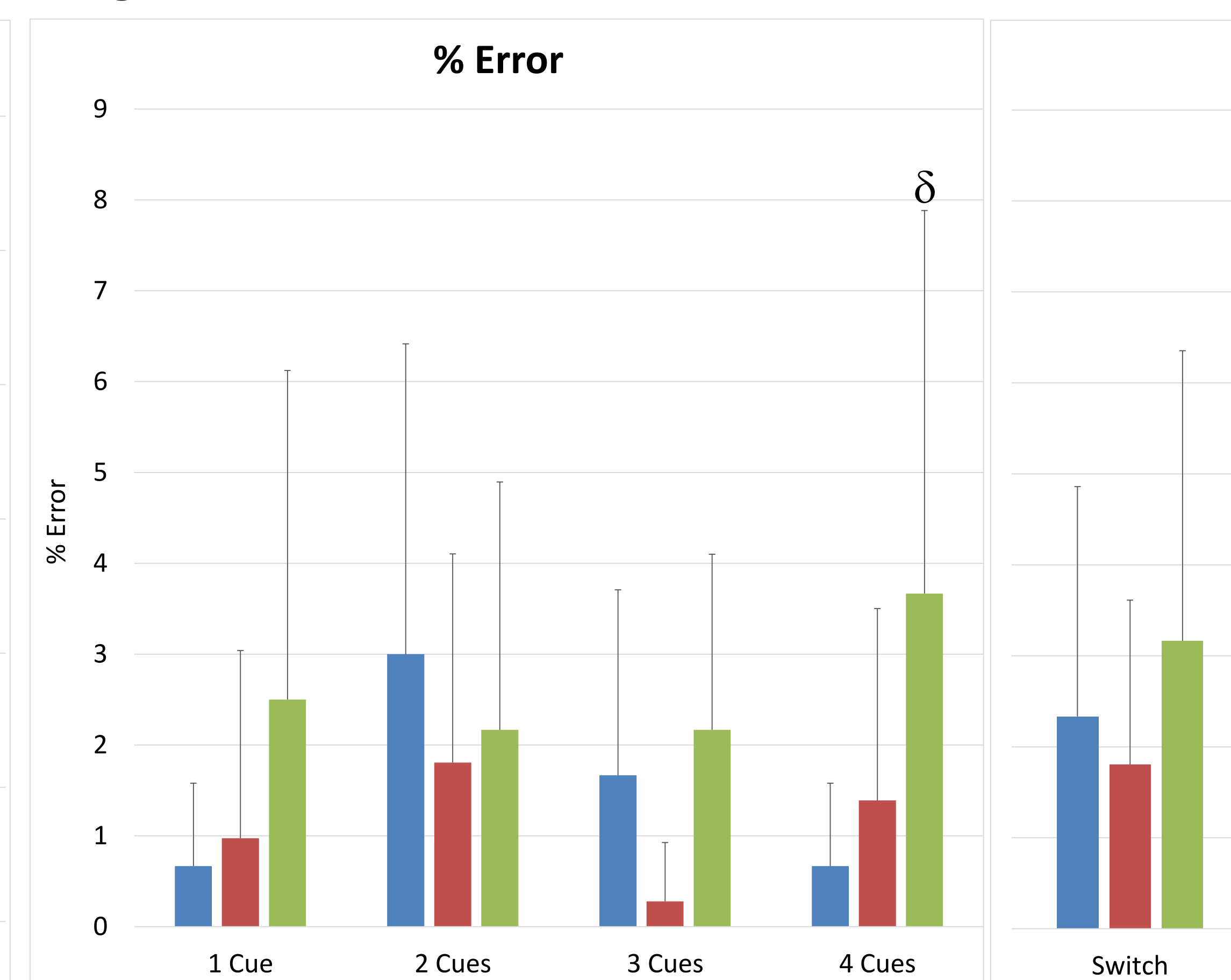


Figure 3. Error data



* Impaired PD group significantly different from Control group $p < 0.05$
 δ Impaired PD group significantly different from Control and unimpaired PD group $p < 0.05$

- We also found a significant difference in error rate between the impaired PD group and both the control and unimpaired PD groups for four digit cue trials (Fig. 3).

RESULTS (continued)

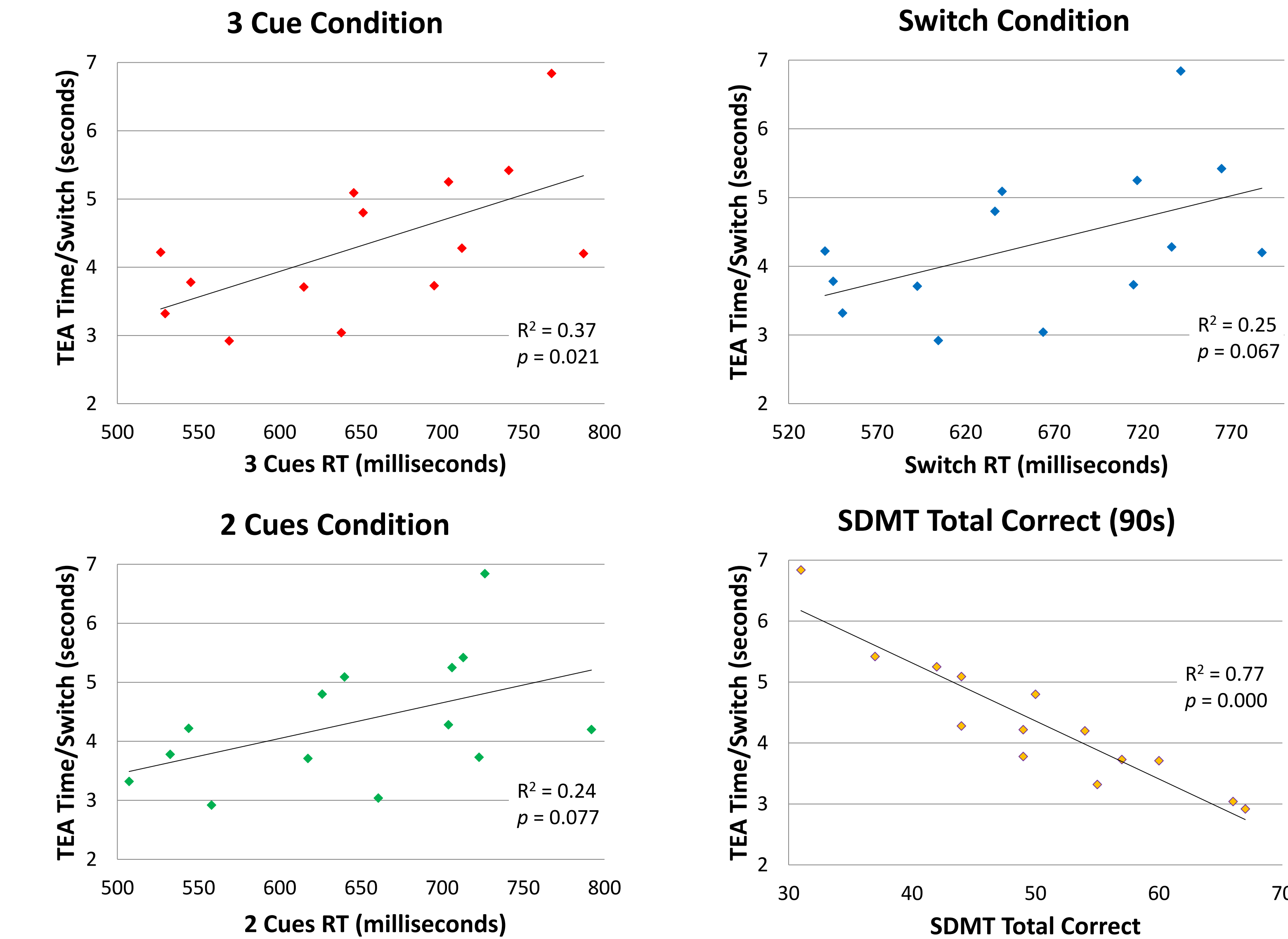


Figure 4. Correlations between TEA switch time and task performance.

- Stepwise linear regression was used to examine the relationship between TEA time/switch and both the uncertainty and switch tasks.
- Switch trial RT was not significantly correlated with TEA switch time.
- Both 3 and 2 cue trials were entered into the regression for TEA switch time ($\beta = -.2037$, $t(11) = -2.410$, $p < .035$)

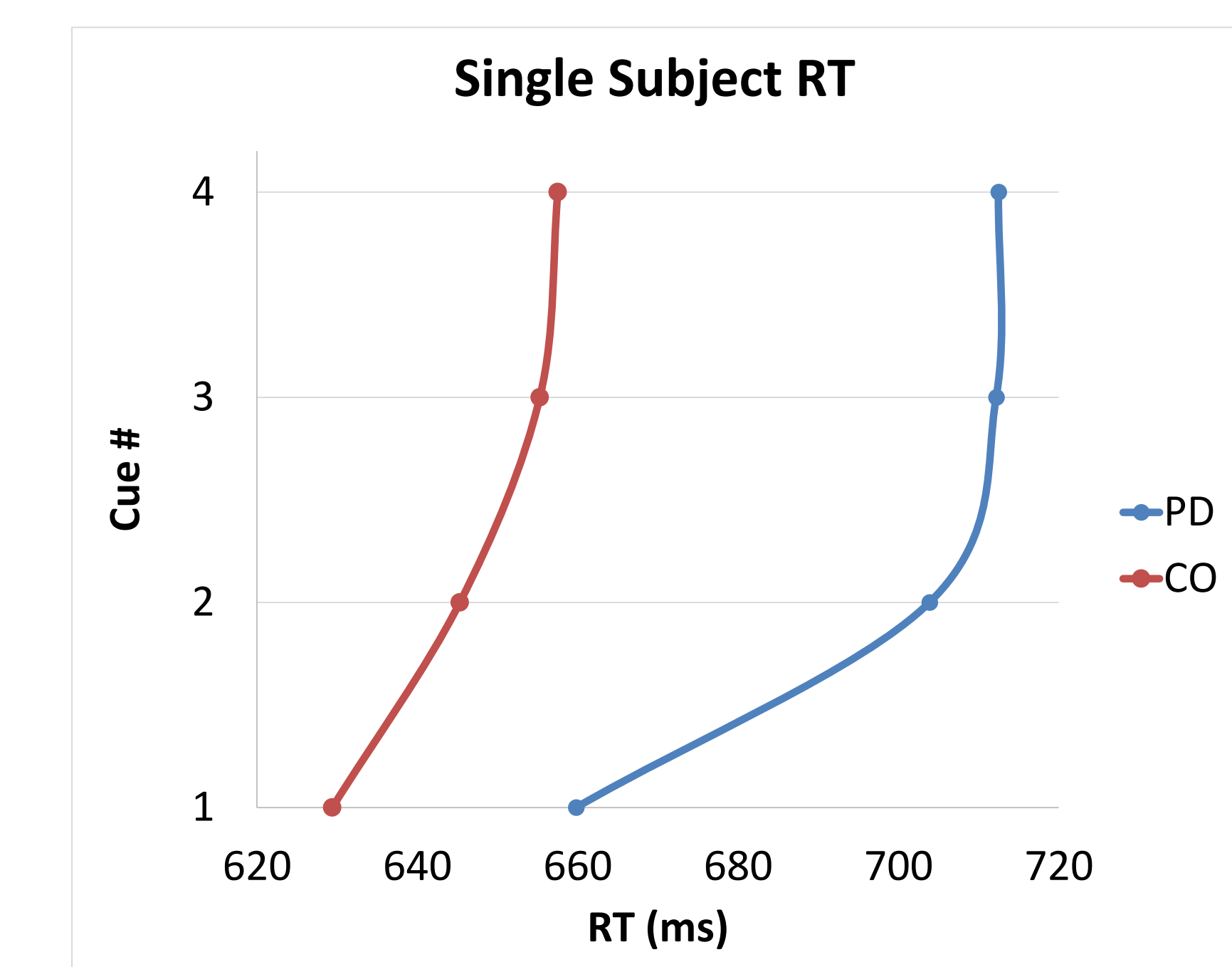


Figure 5. A shift to the right indicates deteriorating performance.

CONCLUSIONS

- Parkinson's disease can result in increased uncertainty costs
- Performance was correlated with neuropsychological measures of switching
- Response uncertainty performance may provide a robust indicator of executive dysfunction in PD
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