Investigating the relationship between reaction time and cognition in Parkinson's disease

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Objective: To test the hypothesis that simple reaction time (SRT) is associated with global cognition in Parkinson's disease (PD) after controlling for motor function.

Background: Cognitive impairment is a common non-motor feature of PD. It is often sub-classified into PD-mild cognitive impairment (PD-MCI) and PD dementia (PDD). A major global research aim is to identify simple biomarkers that can predict those with PD most likely to develop PDD[1].

SRT is reaction time when a stimulus elicits a known, or predetermined, response. It comprises movement preparation and execution and is prolonged in PD compared to HC. SRT is associated with bradykinesia severity[2] and some studies suggest a link between SRT and cognition in PD [3].

Methods: Fifty-eight PD subjects wearing movement sensing equipment, tested whilst on, reached and grasped a cylindrical object as quickly as possible after an auditory stimulus (Figure 1).

SRT, calculated as the delay between auditory tone and movement initiation, was recorded (Figure 2). Reach and grasp was repeated five times with each hand and a mean value was computed for each participant.

Multiple linear regression was used to look for associations between SRT and global cognition – defined using total Montreal Cognitive Assessment (MoCA) score – after controlling for age, disease duration and MDS-UPDRS Motor Score.

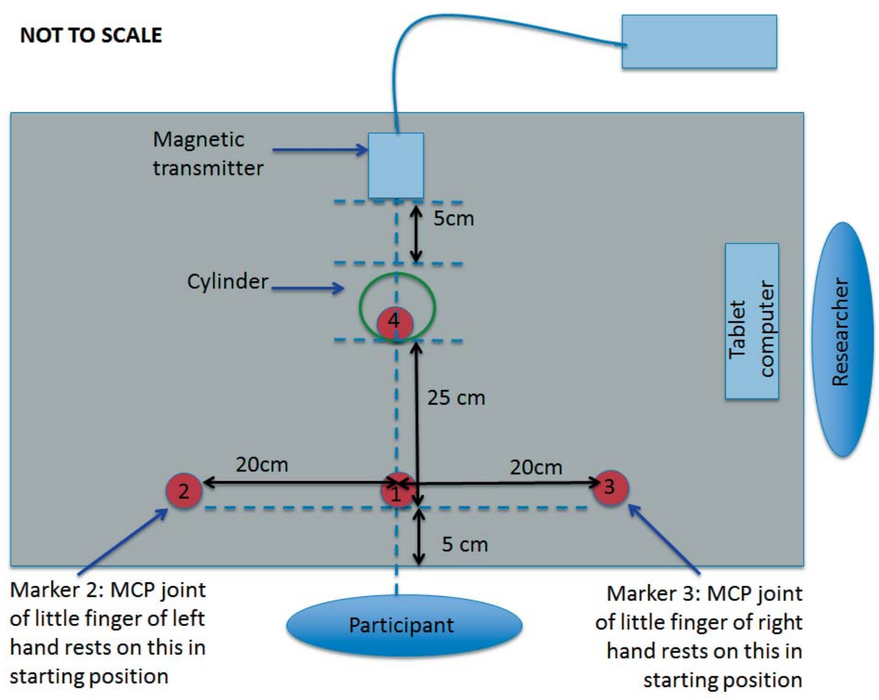
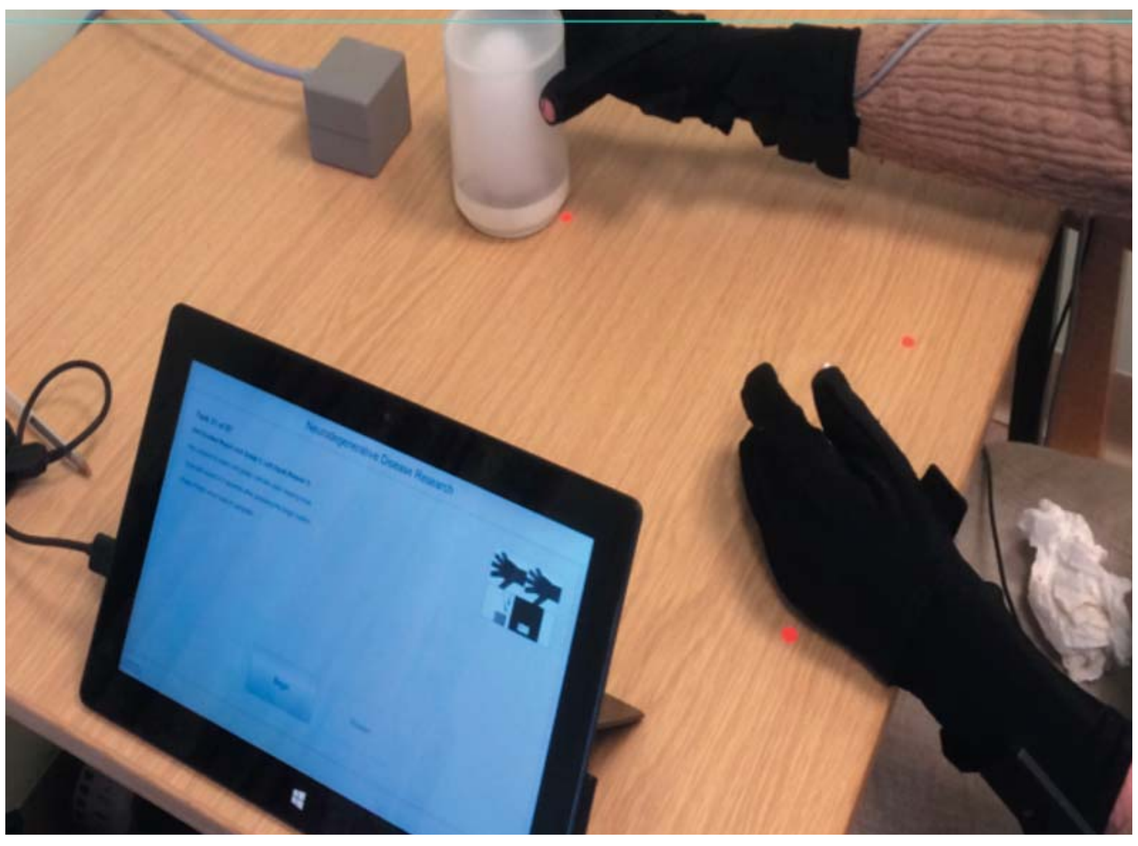


Figure 1: a) A schematic diagram of the experimental set-up. Not to scale.
Figure 1: b) A photgraph of the experiment in progress.



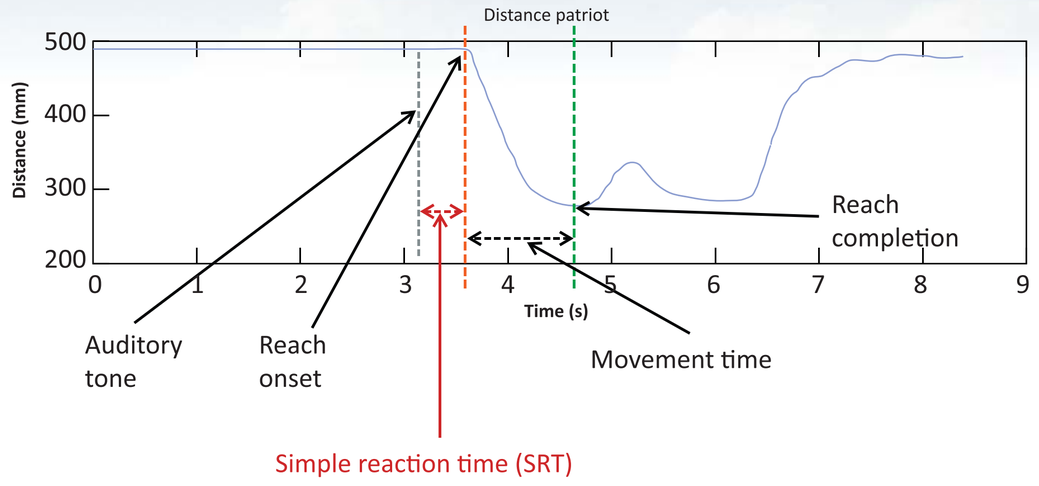


Figure 2: A two-dimensional representation of reach data from one participant. Simple reaction time (SRT) was defined as the difference between the auditory tone (the 'go signal') and reach onset (the first movement of the reaching hand towards the cylinder).

Results: The PD subjects had an average age of 69 years, disease duration of 6 years and MDS-UPDRS motor score of 29 tested whilst on. Using the MDS PD-MCI diagnostic criteria the 55 subjects were classified as 22 with PD-normal cognition (PD-NC), 23 with PD-MCI and 10 with PDD (Table 1).

	PD - all (n = 55)	PD-NC (n = 22)	PD-MCI (n = 23)	PDD (n = 10)	p
Age, years	69.1 (8.4, 44-85)	66.5 (9.4, 44-84)	70.0(8.0, 47-85)	72.6 (5.3, 64-83)	0.129
Disease duration, years	6.3 (4.8, 0.5-20)	5.1 (3.7, 0.5-15)	5.7 (4.0, 0.5-15)	10.5 (6.4, 1.0-20)	**0.007**
MDS-UPDRS PART 3 score	28.4 (11.7, 3-57)	25.9 (11.0, 3-49)	28.3 (11.5, 7 – 52)	34.4 (12.8, 12-57)	0.155
LEDD, mg/day	678.9 (567.8, 0-2836.3)	656.0 (621.7, 0-2836.3)	632.5 (492.8, 100.0 -2046.5)	835.8 (636.3, 0-2210.0)	0.630
MoCA score	23.2 (4.1, 12-29)	26.9 (1.1, 26-29)	22.1 (2.3, 17 – 25)	17.6 (4.0, 12-23)	**<0.001**
Simple reaction time (SRT), s	0.44 (0.11, 0.27-0.84)	0.41 (0.08, 0.28-0.64)	0.42 (0.08, 0.27-0.61)	0.55 (0.14, 0.29-0.84)	**<0.001**

Table 1: The demographic details, MoCA score and SRT for all particpants (PD-all) and then divided into cogntive groups. Statistical differences between the three cogntive groups are shown.

Multiple linear regression showed a significant association between SRT and disease duration and MoCA score (p = <0.001, adjusted R2 0.25) (Table 2).

Parameter	Significant associations	Beta	p (95% CI)	Adjusted R^2	ANOVA	p
Simple reaction time (SRT)	MoCA	-.484	<0.001 (-0.017 - 0.007)	0.251	F (4, 93) = 9.1	<0.001
	Disease duration	.210	0.021 (0.001 - 0.009)			

Table 2: Multiple linear regression controlling for age, disease duration and MDS-UPDRS Motor score shows that MoCA score and disease duration are significantly associated with SRT.

The unstandardised coefficient (B) shows that in PD subjects of identical age, disease duration and MDS-UPDRS Motor Score, each single point reduction in MoCA causes a 0.01s prolongation of SRT.

Conclusions: SRT is significantly associated with global cognition in PD subjects after controlling for motor function, age and disease duration.

SRT is a potential biomarker for cognitive impairment in PD and should be incorporated into longitudinal cohort studies.

References:

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3) Jordan N et al. Cognitive components of reaction time in Parkinson's disease. *Journal of Neurology Neurosurgery and Psychiatry 1992*: 55; 658-64.