Effects of dopamine D2 receptor antagonist haloperidol on movement speed in a drawing task

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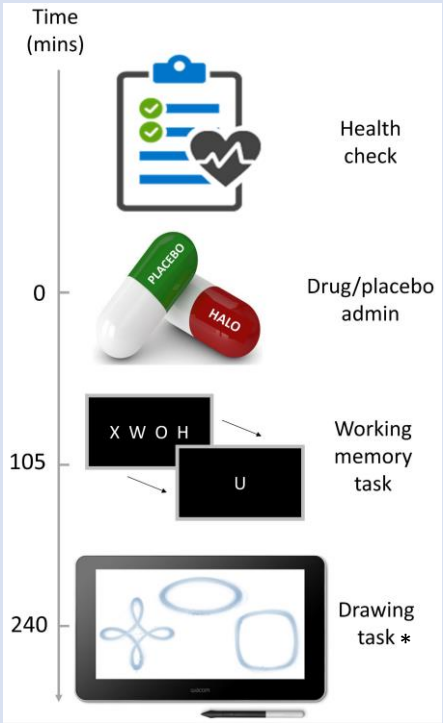
Background

- **Decreased brain dopamine** has been related to **slowed movement** response initiation[1] and **reduced movement vigour** when reaching to a target[2].
- **Withdrawal of dopaminergic medication** in patients with Parkinson's Disease (PD) leads to **abnormalities in handwriting kinematics**[3].
- To date, few studies have investigated dopaminergic modulation of movement speed in **tasks devoid of the reward-based motivation to move**, and many use only **ellipse shapes** (considering a single angular frequency)[4].
- Moreover, it is important to **control for baseline working memory (WM)**, as research has demonstrated its tight association with **baseline striatal dopamine,** with differential drug effects found in those with high vs. low WM[5,6].

Method

- **37 healthy adult participants** (16 female; M_{AGE} 26.3; M_{BMI} 23.3)
- **Double-blind**, **placebo-controlled** procedure to test the **effect of the D2 antagonist haloperidol on movement speed** during a simple drawing task.
- On two separate days, once after receiving **2.5mg haloperidol** and once after receiving **placebo**, participants completed the following procedure:



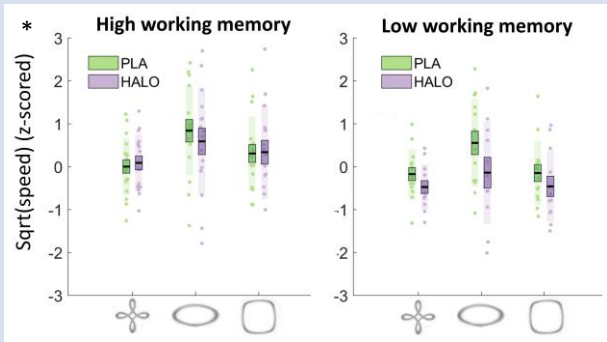
* Stylus used to draw 3 shapes (10 π rotations) on a Wacom touchscreen. X and y position was recorded at 133Hz. For each participant indices of overall speed were derived.

Results

- Linear mixed effect models examined the **impact of drug on drawing speed** as a function of shape and baseline dopamine levels (indexed by placebo WM):

  speed ~ shape + drug + shape*drug + shape*WM + drug*WM + shape*drug*WM + (1|subject)

- Drawing speed differed as a function of shape [$F(2,180) = 18.82$, $p < .001$]; with ellipse shapes of highest speed.
- Following administration of haloperidol, participants' drawing speed was significantly slowed compared to placebo [$F(1,180) = 4.28$, $p < .05$].
- Crucially, there was an **interaction between drug and baseline WM performance** [$F(1,180) = 6.75$, $p < .05$].
  - Those with high baseline WM showed no change in speed of drawing between placebo and haloperidol ($p = .82$)
  - Those with **low baseline WM** (i.e. low baseline dopamine) showed significantly **slower drawing speed following haloperidol** than placebo ($p < .05$)



* Median split by placebo working memory. Drawing speed by shapes for placebo and haloperidol conditions. Thick black horizontal line represents the sample mean, surrounding box represents 1 standard error of the mean and shaded region represents 1 standard deviation.

Discussion

- Our results support the role of dopamine in drawing speed and advocate the **use of the current task** to **assess movement atypicalities associated with PD**.
- Our findings are in line with those by previous studies highlighting **differential effects of haloperidol** between individuals with **low and high baseline WM**[5,6].

References

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