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; \(M_\text{AGE} \, 26.3; M_\text{BMI} \, 23.3\))
• 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:
  - Time (mins)
  - Health check
  - Drug/placebo admin
  - Working memory task
  - Drawing task *

* Stylus used to draw 3 shapes (10\(\pi\) 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):
  
  \[
  \text{speed} = \text{shape} + \text{drug} + \text{shape*drug} + \text{shape*WM} + \text{drug*WM} + \text{shape*drug*WM} + (1|\text{subject})
  \]
• 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 (\( p < .05 \)).

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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