Mouse motion measures improve SSRT in impulsivity assessment

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Introduction

ADHD and other disorders are characterized by impulsivity. It is studied through both questionnaires and performance-based tasks. However, these measures rarely correlate with each other (Toplak et al., 2013). **Why?**

- Decision-making is dynamic (Stillman et al., 2017)
- Performance-based tasks rely only on accuracy and RT
- Motor-based measures are indicative of ADHD (Leontyev et al., 2018)

Hypothesis: Augmenting traditional performance-based task with motor measure will improve associations with questionnaire-based measures.

Participants & Design

Design: Contrasting keypress and mouse movement conditions.

- Keypress: N = 56 (25 male/31 female)
- Mouse movement: N = 35 (16 male/17 female)

Materials & Methods

Stop-signal task (Ma & Yu, 2016):

- 576 trials (432 "go"/144 "stop")
- Random Dot Kinematogram (10, 50 or 80 % coherence)

Questionnaires:

- Connors' Adult ADHD Questionnaire (CAARS)
  - Subscale C (Impulsivity/Emotional lability)
  - Subscale F (DSM-IV: Hyperacitve/Impulsive symptoms)
- Barkley Deficits in Executive Functioning Scale (BDEFS)
  - BDEFS section 5 (Self-regulation of Emotion)

Materials & Methods

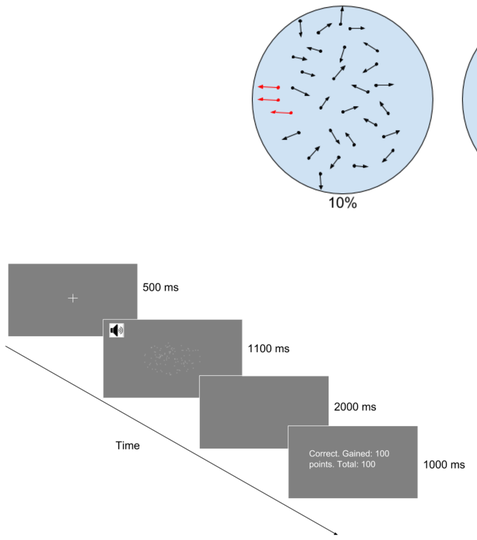

Figure 1: Keypress trial

Independent variables:

- Mean RT, SD RT, Accuracy
- SSRT

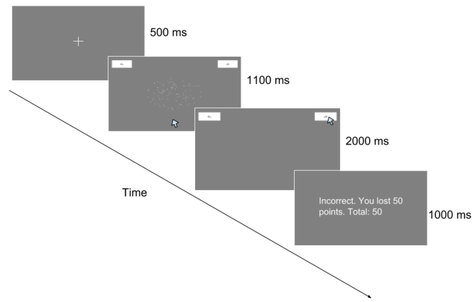

Figure 2: Mouse movement trial

Independent variables:

- Mean RT, SD RT, Accuracy, SSRT
- Mean total distance, mean maximum acceleration, mean maximum velocity
- Stopping distance

$$d_{stop} = d_{total} - d_{before\ stop-signal}$$

Results

Spearman's rank correlations

Keypress: Accuracy in "stop" trials and Impulsivity/Emotional lability (ρ = -0.288, p = .03).

Mouse movement:

	Impulsivity/Emotional lability	DSM-IV: Hyperactive/Impulsive
Velocity in "go" trials	0.019	-0.455**
Acceleration in "go" trials	0.29	-0.079
Total distance in "go" trials	0.343*	-0.19
Velocity in "stop" trials	0.034	-0.436**
Acceleration in "stop" trials	0.36*	0.029
Total distance in "stop" trials	0.38*	0.031
Mean stopping distance	0.43**	0.18

*p<.05, **p<.01

Results

Adjusted R^2 for final stepwise regression models

	Impulsivity/Emotional lability	DSM-IV: Hyperactive/Impulsive
Keypress	.11	–
Mouse motion	.17	.13

Conclusion

- Stop-signal task's ability to assess impulsive symptoms can be strongly improved by introducing mouse movement features.
- Stopping distance is a good analogue of SSRT for motor control.
- Horse-race model's assumptions can be challenged.
- This measure is useful for non-clinical populations.

References

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2. Ma, N., & Yu, A. J. (2016). Inseparability of go and stop in inhibitory control: Go stimulus discriminability affects stopping behavior. *Frontiers in Neuroscience, 10(MAR)*, 1–10.
3. Stillman, P. E., Medvedev, D., & Ferguson, M. J. (2017). Resisting Temptation: Tracking How Self-Control Conflicts Are Successfully Resolved in Real Time. *Psychological Science, 28(9)*, 1240–1258.
4. Toplak, M. E., West, R. F., & Stanovich, K. E. (2013). Practitioner Review: Do performance-based measures and ratings of executive function assess the same construct? *Journal of Child Psychology and Psychiatry and Allied Disciplines, 54(2)*, 131–143.