Analysis of Finger Tapping Parameters in People with ADHD

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Attention Deficit Hyperactivity Disorder (ADHD)

- Most common childhood psychiatric disorder
- Affecting 4%-12% of 6-12 year-old children
- Up to 65% of cases persist into adolescence
- One of the most common undiagnosed psychiatric disorders in adults

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Attention Deficit Hyperactivity Disorder (ADHD)

• Reflected in:
  – Difficulties in timing motor paced tasks
  – Difficulties in attention and impulsiveness

• Recently suggested:
  – Deficit in temporal information processing
  – The attentional-gate model
Spontaneous Motor Tempo (SMT)

- SMT - individual's rate of spontaneous motor functions, such as gait, speech and tapping
- SMT is thought to reflect the pace of an internal attentional timing mechanism, capable of adapting to external temporal events
Detection of the SMT

• Each subject was asked to tap using his/her index finger of a dominant hand on a surface, at a regular rate, most comfortable to him/her.
• The tapping duration was 15 sec.
SMT Analysis System

- System:
  - Pressure transducer
  - Data acquisition
  - Signal Processing

- Analysis
  - Preprocessing
  - Touch/off detection
  - Statistical Analysis

Data Acquisition and Sampling

$fs = 1150\text{Hz}$

5-points Median Filtering

Thresholds Setting

Onset and Offset Time Detection

Outliers Removal

Statistical Analysis

$C_v_{off}, \sigma_{off}, \mu_{off}, P_{cycle}, C_v_{touch}, \sigma_{touch}, \mu_{touch}$

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Finger Tapping Phases

Touch-phase   Off-phase   Touch-phase
Closer Look on Tapping Signal
Experiment and subjects

- Participants: 132 young adults (26.4±5.1 years), 22 were excluded (improper diagnosis or taking methylphenidate (Ritalin)
- 68 ADHD subjects (26.8±5.8 years)
- 41 control subjects (27.8±5.1 years)
## Results

| Finger tapping parameters                          | ADHD       | Control    | t
|----------------------------------------------------|------------|------------|---
| $\mu_{\text{touch}}$ (t-touch, msec.)             | 122.3±81.6 | 120.7±71.5 | 0.01
| $\sigma_{\text{touch}}$ (t-touch std, msec.)      | 13.0±8.6   | 10.1±7.3   | 1.83
| $\mu_{\text{off}}$ (t-off average, msec.)         | 445.0±195.1| 439.7±211.4| 0.13
| $\sigma_{\text{off}}$ (t-off std, msec.)          | 26.8±14.6  | 32.6±59.6  | 0.77
| $\mu_{\text{cycle}}$ (whole finger tapp cycle, msec.) | 567.3±212.4| 560.4±230.5| 0.16
| $\sigma_{p}$ (std t-cycle, msec.)                 | 167.5±187.0| 172.2±148.4| 0.870
| $C\nu_{\text{touch}}$ (t-touch coeff. of variation) | 31.3±14.2  | 25.4±9.5   | *U=942
| $r_{\text{touch}}$ t-touch to t-cycle ratio        | 0.227±0.109| 0.234±0.096| 0.359

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Results (cont.)

- t-touch average
- t-off average
- t-cycle (mean rate)
- t-touch coV
- t-off coV
- t-touch to t-cycle ratio
Results (cont.)

- The coefficient of variation of the touch-phase was significantly higher in ADHD subjects compared to control subjects.
- No significant difference was found in: mean rate, rate variability, mean touch phase, mean off-phase or off-phase variability.
Conclusions

• The coefficient of variation of the touch phase was found to be the only parameter that differed between ADHD subjects and controls.
• This parameter was significantly higher in the ADHD group.
• The increased variability in adult ADHD subjects can be interpreted as fluctuations or instability in attention performance, timing performance or both.
Questions for Further Research

- Does the finding also apply to children with ADHD?
- Do other touch phase characteristics such as length of the touch phase differ in children?
- What happens after training?