Psychomotor Vigilance Task Evaluation for Touchscreen Devices

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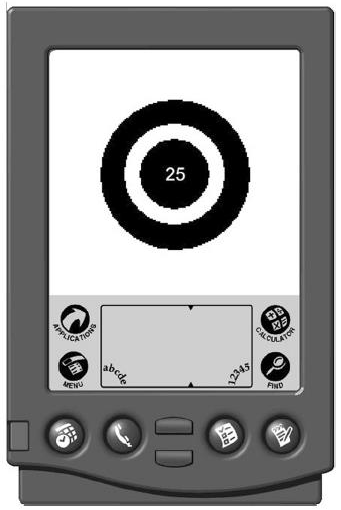
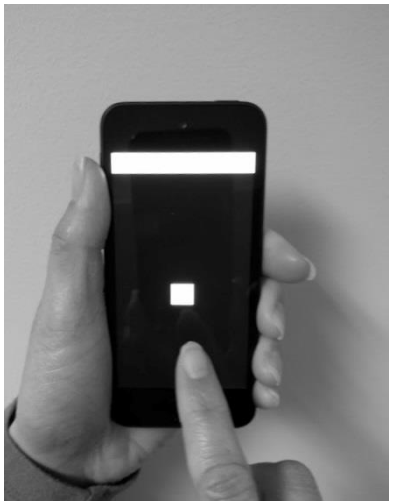
Background of PVT

- PVT-192 – widely used in laboratory studies
- Palm-PVT – 5-min widely used in filed studies.
- Various PVTs developed for laptop use and hand-held mobile devices.





Background of PVT

PVT-192

- Bulky, used on laboratory
- Cannot be used by multiple subjects
- Subjects have to declare their handedness in advance
- LED display
- Running-timer stimulus
- Immediate feedback
- ISI – 2-10s following a rectangular distribution

Palm-PVT

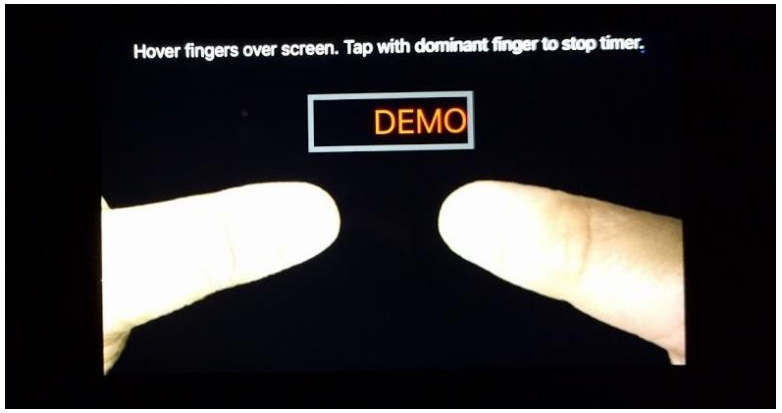
- Small, easy to carry around – used in the field
- Can be used easily by multiple subjects (distinguished by study code and name)
- Handedness can be entered just before first session
- LCD display
- Black-and-white circular target
- Feedback is provided at the end of each session
- Uses N discrete foreperiods determined by a user-specified step size and then randomizes without replacement in blocks of 2N.

Study goal

- To develop and validate a PVT for touchscreen devices that would have the same characteristics as PVT-192.

NASA - PVT

- It has the same features as PVT-192
  - ISI interval 2-10 sec, randomly (rectangular distribution)
  - Stimulus represented by a milliseconds-counter in a small rectangular box
  - Left and right areas predefined on the screen to serve as left or right buttons
  - Immediate feedback

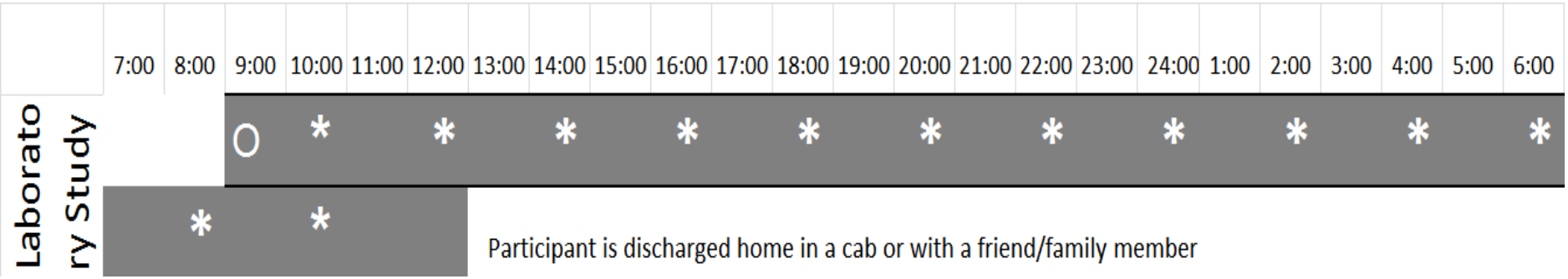


NASA-PVT

- Presence of FS or ERR on screen when participants react too fast to the stimulus or use the wrong finger to answer to the stimulus.
- The handedness can be entered at the beginning of the first session.
- It can be used by multiple subjects (change study code and id).

Study protocol/Participants

- 10 participants (5males, 5 females) between 19 and 38 years of age (M = 25.1, SD = 6.17)

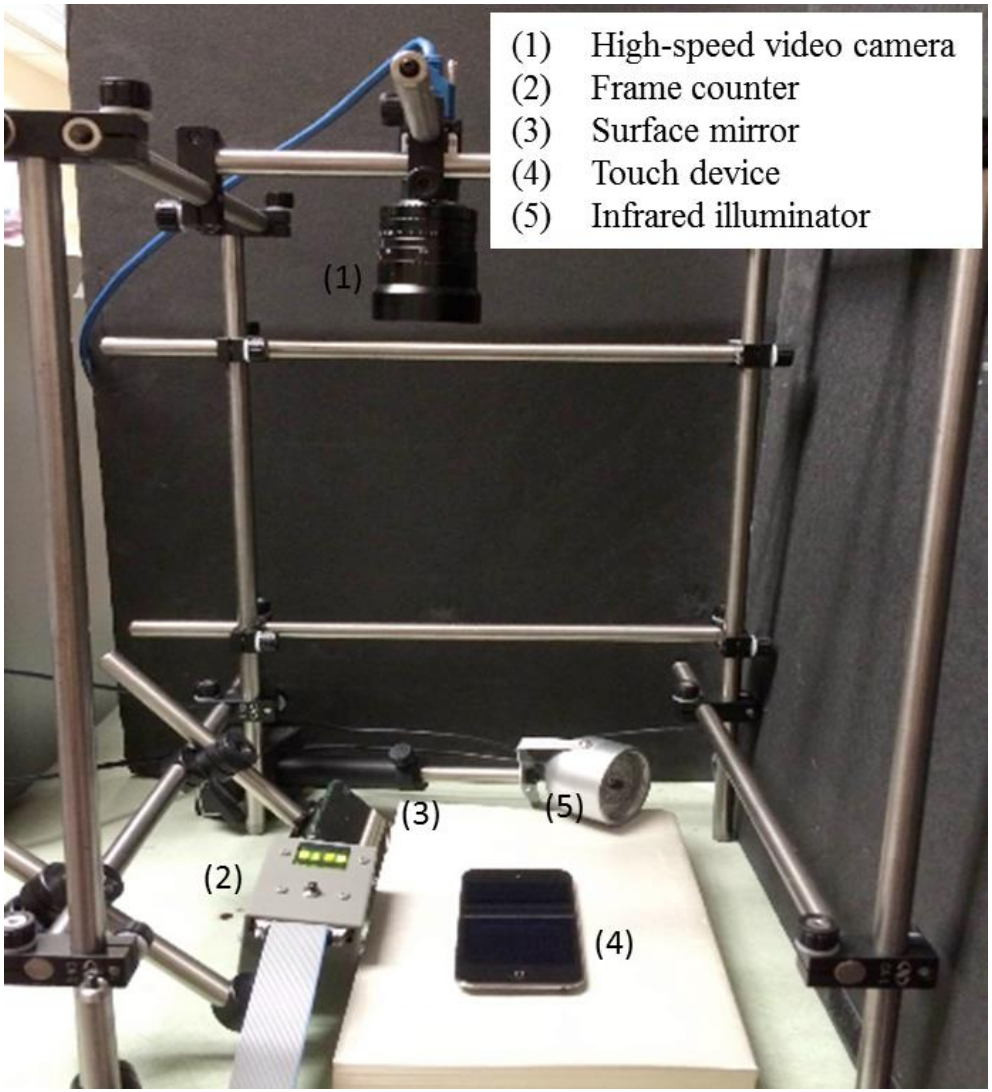


O = Orientation

* = 5-min PVT-192, 5-min Nasa-PVT

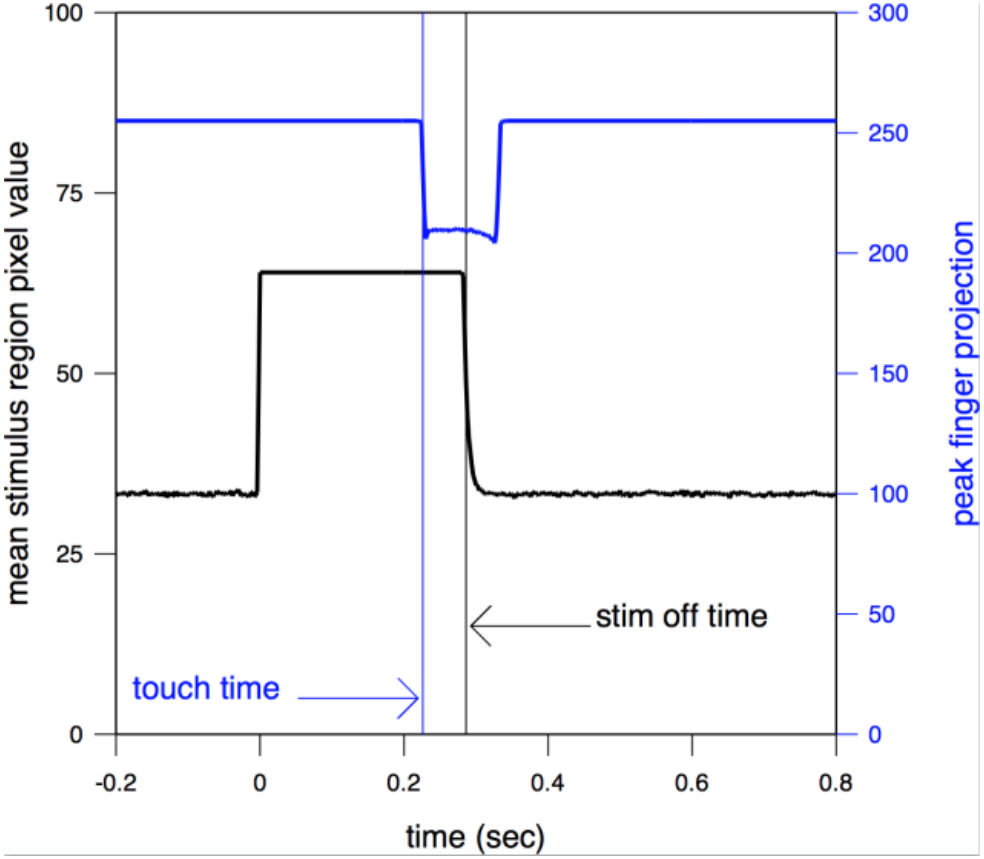
Touchscreen device latency

- Latency - the time between user action (touches the screen) and the system's response.



Touchscreen device latency

- Device latency = 77.42 (16.77).
- The mean device latency was subtracted from each PVT trial before analyzing the PVT data.



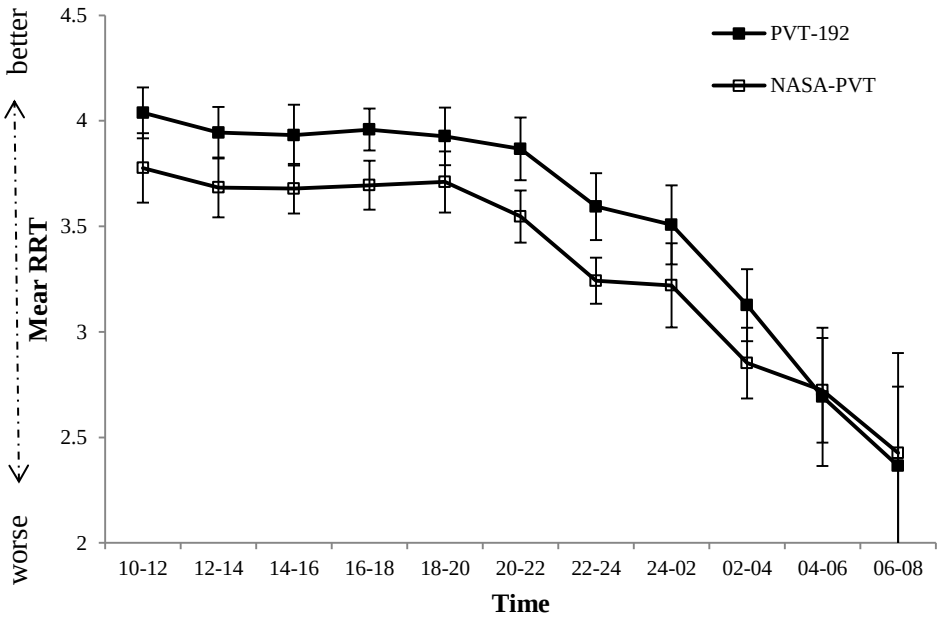
PVT outcome

- Mean 1/RT - reciprocal response time or response speed, measured in seconds.
- Lapses - the cumulative number of RTs exceeding 500 ms.
- Fastest 10%RT - the fastest 10% of response times for all trials. It indicates the best performance a participant is capable of producing.
- Slowest 10% 1/RT (cognitive slowing) - the slowest 10% of reciprocal response times for all trials. It indicates the vigilance response slowing.

- Mixed effects ANOVA with 2 two within subjects factors: Time and PVT type.

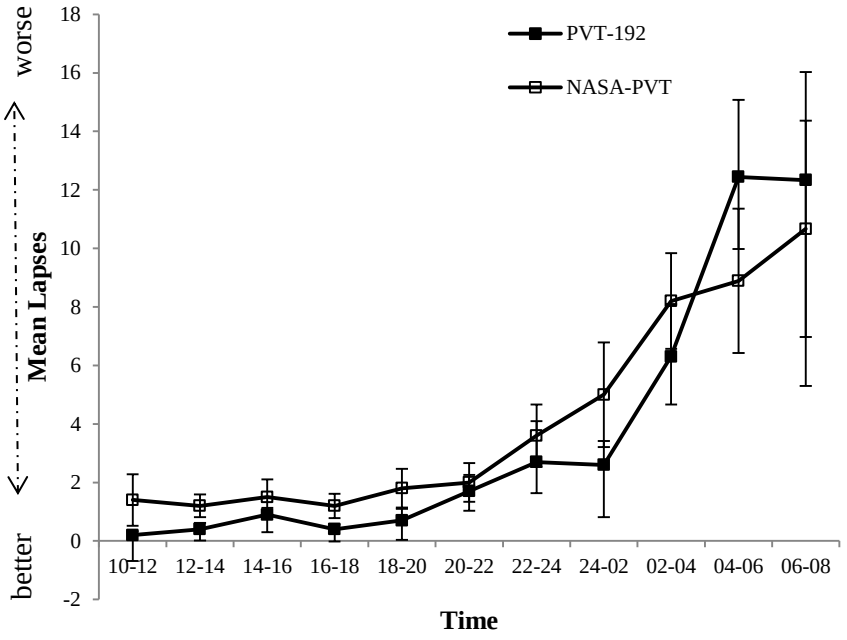
Mean 1/RT

- Main effect of time ($p < .001$) The mean 1/RT of both PVTs became worse over time.
- Significant linear decrease in performance over time for both PVTs.
- Main effect of PVT ($p = .001$. The mean 1/RT for the two PVTs were significantly different overall.



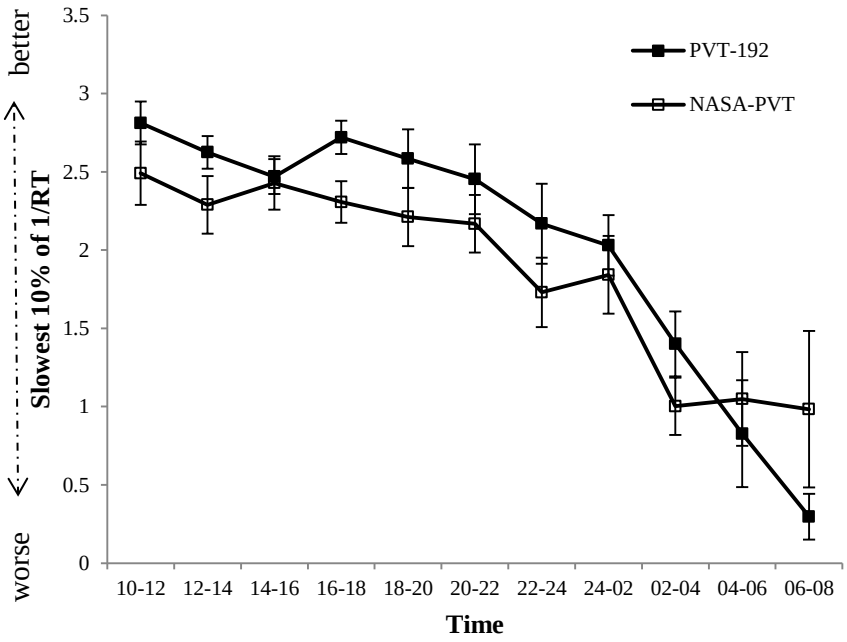
Lapses

- Main effect of time ($p < .001$). The mean lapses of both PVTs. increased significantly across time
- Significant linear increase in lapses over time for both PVTs.
- No main effects of PVT.



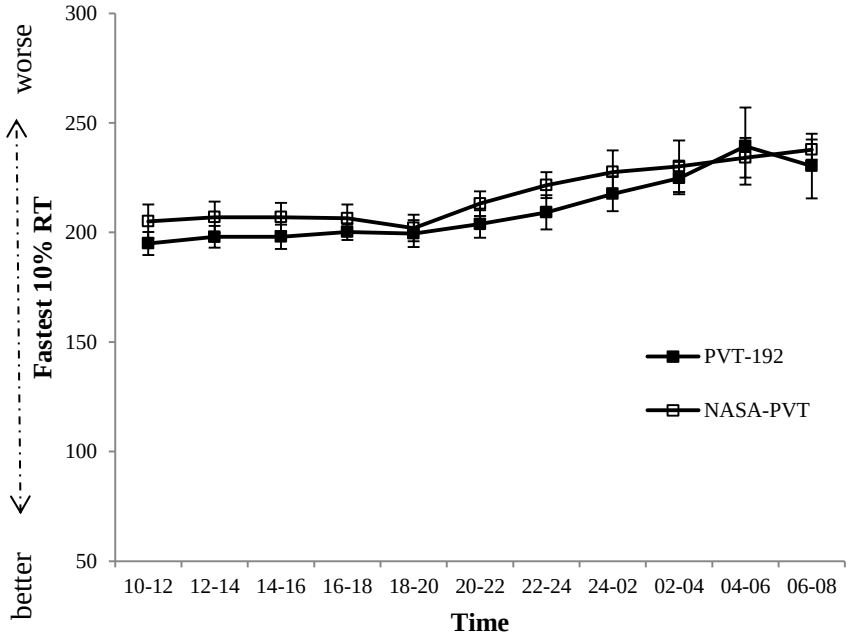
Slowest 10% of 1/RT

- Main effect of time ($p < .001$) The mean slowest 10% 1/RT of became significantly worse across time.
- Significant linear decrease in perfomance over time for both PVTs.
- Main effect of PVT ($p < .01$).



Fastest 10% RT

- Main effect of time ($p < .001$) The mean fastest 10% RT of both PVTs changed significantly across time.
- Significant linear increase over time for both PVTs.
- Main effect of PVT ($p < .05$).



Conclusions

- NASA-PVT follows the same shape and is similar on mean RTs and lapses after the latency cutoff was applied.
- Our results are limited to acute sleep deprivation.
- Future studies -
- Problems with touchscreen devices: latency, double touch, variability within and between subjects.

Problems with touchscreen devices

- Latency
- Double touch
- Variability of latency between trials in the same test for the same subject
- Variability of latency between subjects

Contributors

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