Does the stylus matter whilst using Slurp the digital eye-hand coordination test?

Barbara M Junghans PhD **Sieu K Khuu** PhD

School of Optometry and Vision Science, University of New South Wales Sydney, Australia

Introduction

Currently the integrity of brain function driving behavior is predominantly measured in terms of pure motor function – yet most human behavior is visually driven. The easily accessible 'Slurp' test of eye-hand coordination (EHC), formerly known as the Lee-Ryan EHC test, was developed to provide an easily quantifiable means of assessing visuo-motor related brain activity. The test overcomes difficulties inherent in other EHC tests that include use of upper arm musculature, lack of objectivity and standardisation, and ease of use in clinical environments.[1,2,3] The Slurp test is formatted as an iPad game whereby participants trace along a straw as it draws a milkshake up out of its glass (Fig.1). At the end, total error score and total time are displayed for clinicians, but additional data for deeper shape-by-shape analysis (Fig.2) can be emailed from the iPad. Two subtests, each of just 6 trace items, appear equivalent with regards errors made and time taken. Each subtest is quick (taking on average just over 2 minutes each to conduct) and enjoyable for people of any age.

Purpose

This project investigates whether total error scores and total time taken on Slurp depends on the type of stylus employed (rubber-tipped stylus versus Bluetooth® stylus).

Figure 1: Example of Dragon trace in progress with the Slurp EHC Test using an Apple iPencil®

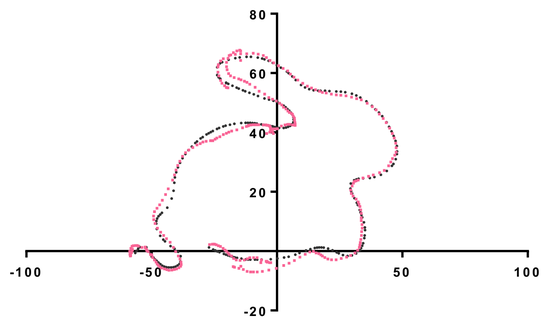

Figure 2: One participant's deviations (pink) against the original Rabbit shape (grey).

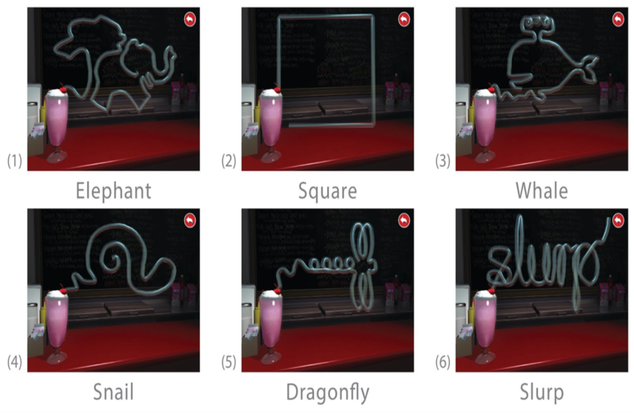

Figure 3A: Subset A of the Slurp EHC Test (elephant/square/whale/snail/dragonfly/slurp)

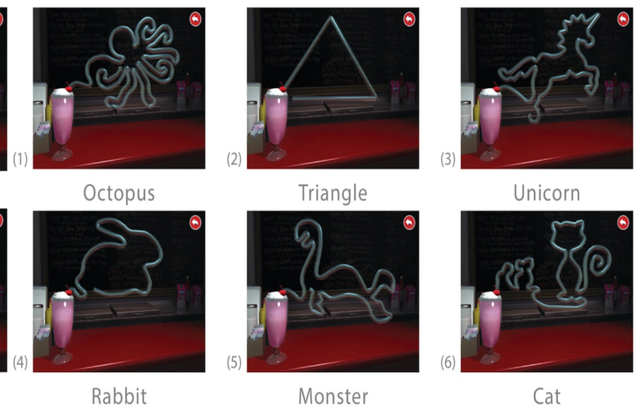

Figure 3B: Subset B of the Slurp EHC Test (octopus/triangle/unicorn/rabbit/monster/cat)

Results

- **The equivalence of Sets A and B across all ages with respect to total errors was confirmed (21.4±21.6 versus 20.9±23.2 errors respectively). Similarly, no difference in the total time taken was found (139.4±77.3 versus 142.9±76.4 seconds). See Fig.4.**
- **Errors were approximately halved when an iPencil was used ($p<0.001$; blue bars in Fig.4) compared with when a rubber-tipped stylus was used (pink bars)**
- **Times were approximately 25% faster when an iPencil was used ($p<0.001$; blue bars in Fig.4) than when a rubber-tipped stylus was used (pink bars)**
- **The effect of age upon errors and time taken was similar regardless the type of stylus used. Those younger than, or older than, 13-50 years made significantly more errors and were significantly slower.**

Discussion

- **The type of stylus used during tracing when using the Slurp test is important**
- **Population norms must be established for both rubber-tipped and Bluetooth types of stylus.**

Conclusion

Two subtests of the the game-like Slurp Eye-Hand Coordination Test app have been created and validated to quickly provide equivalent testing pre-/post-intervention.

However, importantly, the type of stylus employed demands reference to relevant population norms. Such norms can be readily established in a format suited to those interested in quantifying EHC performance[4] either in a clinical or research setting in order to further evaluate ophthalmic conditions such as amblyopia[5], or other medical/ developmental conditions that may affect EHC performance.

Slurp provides optometrists, ophthalmologists, orthoptists and other healthcare professionals such as psychologists, paediatricians, neurologists, rehabilitation specialists and educationalists with a speedy objective standardised test of eye-hand coordination, and hence, the integrity of visually-driven brain function.

Methods

HARDWARE AND SOFTWARE

- iPad® Pro [Apple Inc., Cupertino, CA, USA, Model A1674; 9.7 inch]; Apple iPencil® [Model A1603]; rubber-tipped stylus [Slim Stylus for Smartphone, Targus USA]
- The original software (Lee et al.[3]) was re-developed by Chaos Theory Games to provide more appealing rendered figures, additional geometric traces, improved sound effects, and improved data download functionality. The current version was downloaded from iTunes® for a token fee
- As no order effect had been found previously [ARVO 2017/#5427], 4 easy, 4 medium and 4 difficult tracing plates were assigned across two subsets (A:Slurp and B:Octopus) such that previous data for those items (within a 19-plate testing protocol) yielded comparable total errors and total time taken scores which were then verified on 65 participants to be equivalent.

SUBJECTS

- 217 participants, age range 5 - 88 years, mean 34.4±22.5 years.
- No history of motor, visual or psychological or cognitive impairment; nor fitted with an electronic medical device.

METHODS

- Participants were seated at a desk at 33-40cm, wearing habitual near correction viewing binocularly and using their preferred hand while they traced on the iPad flat on the desk with either an iPencil or rubber-tipped stylus
- A common first plate (the 'castle') was used for practice, and the warning sound option was activated to alert when a mistake had been made. Participants were encouraged to start tracing within 5 seconds of each new shape appearing
- Most participants completed both Subsets A and B (Fig.3). They were randomly started on either Set A or Set B. Within a set, the plates were traced in the same order
- Instructions were: *"Sitting still, and starting from the cherry on top of the milkshake, do your best to trace within the straw as fast as you can without lifting the stylus off the iPad and taking care on tight corners. The number of mistakes you make and your time will be saved by the program. You will be able to take a rest in between each shape if you want."*
- Spatio-temporal output data were emailed from the iPad to the researcher and analysed using non-parametric methods seeking main effects for stylus and age group relating to errors and time taken.

STUDY MEASUREMENTS

- Output data included (i) time taken to complete each trace, (ii) total errors made for each trace, and (iii) stylus used.

STATISTICAL ANALYSIS

- Participants were split into 3 age groups (5-12, 13-50, over 50 years). ANOVAs were undertaken using Prism® to compare data from subsets A and B, and assess the influence of age and stylus.

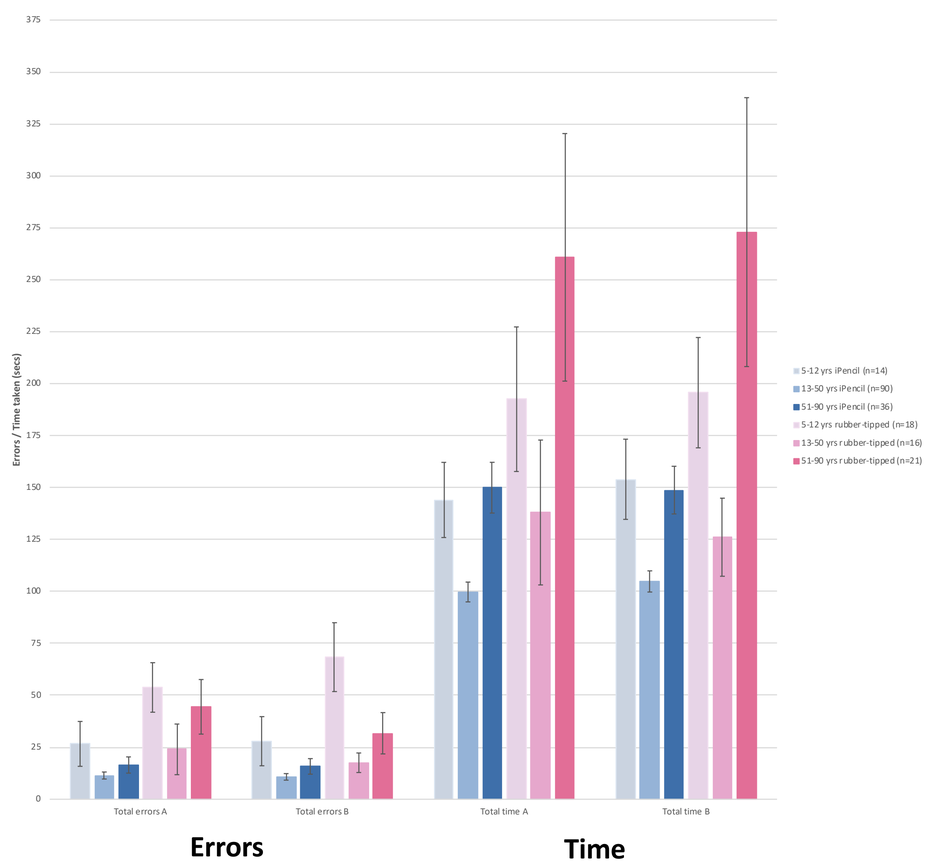

Figure 4: Mean total errors/total time taken on subtests A and B according to age and type of stylus used to trace each set of six items. Error bars 95% CI.

References

1. Ruff R PS. Gender and Age-specific changes in Motor speed and Eye-hand coordination in adults: Normative values for the Finger tapping and Grooved Pegboard tests *Perceptual and motor skills* 1993; 76: 1219-1230.
2. Vesia M EJ, Prime S, Klavora P. Correlations of selected psychomotor and visuomotor tests with initial Dynavision performance. *Perceptual and motor skills* 2008; 107: 14-20
3. Lee K, Junghans BM, Ryan M, Khuu S, Suttle CM. Development of a novel approach to the assessment of eye-hand coordination. *Journal of neuroscience methods* 2014; 228: 50-56.
4. Van Halewyck F, Lavrysen A, Levin O, Boisgontier MP, Elliott D, Helsen WF. Both age and physical activity level impact on eye-hand coordination. *Human movement science* 2014; 36: 80-96.
5. Suttle CM, Melmoth DR, Finlay AL, Sloper JJ, Grant S. Eye-hand coordination skills in children with and without amblyopia. *Invest Ophthalmol Vis Sci* 2011; 52: 1851-1864.

Acknowledgements

The Slurp EHC Test app is available from iTunes® for a small fee (US$1.99). The authors were involved in the development of the software, but have no financial interest. Test A/B graphics courtesy of SooJin Nam.