**Longitudinal comparison of in clinic and at home administration of the Cogstate Brief Battery and demonstrated practice effects in the Mayo Clinic Study of Aging**

*The Journal of Prevention of Alzheimer’s Disease*

Supplemental Online Resources

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Supplemental Table 1. Frequency of completion and integrity flags by location of administration.

|  |  |  |  |
| --- | --- | --- | --- |
|  | home | in-clinic | *p* |
| Completion, n (%) failed |  |  |  |
| Detection | 0 (0%) | 0 (0%) | - |
| Identification | 0 (0%) | 0 (0%) | - |
| One Card Learning | 0 (0%) | 17 (0%) | 0.02 |
| One Back | 0 (0%) | 15 (0%) | 0.03 |
| Overall1 | 0 (0%) | 22 (0%) | 0.005 |
| Integrity, n (%) failed |  |  |  |
| Detection | 50 (2%) | 203 (3%) | 0.26 |
| Identification | 0 (0%) | 0 (0%) | - |
| One Card Learning | 44 (2%) | 79 (1%) | 0.001 |
| One Back | 34 (2%) | 85 (1%) | 0.15 |
| Overall1 | 80 (4%) | 365 (5%) | 0.01 |

1 Overall failures were counted once even if more than one portion of the CBB was failed for that subject’s visit. Thus overall count may differ from the sum of the parts.

Supplemental Table 2. Linear mixed effects regression parameter estimates (standard errors) for predicting four cognition measures, using raw (untransformed) values.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Detection RT | | Identification RT | | One Card Learning Accuracy | | One Back Accuracy | |
| Fixed effects | β (SE) | *p* | β (SE) | *p* | β (SE) | *p* | β (SE) | *p* |
| Age at session | 3.281 (0.34) | <0.001 | 2.919 (0.31) | <0.001 | -0.0022 (0.00026) | <0.001 | -0.0012 (0.00018) | <0.001 |
| Sex (1=male, 0=female) | -20.413 (4.7) | <0.001 | -5.341 (4.3) | 0.22 | 0.0009 (0.0036) | 0.8 | -0.0053 (0.0024) | 0.03 |
| Education | -3.495 (1) | <0.001 | -2.652 (0.94) | 0.005 | 0.0038 (0.00077) | <0.001 | 0.0029 (0.00053) | <0.001 |
| First practice | 5.067 (3.6) | 0.16 | -23.591 (2.9) | <0.001 | 0.037 (0.0021) | <0.001 | 0.0061 (0.0026) | 0.02 |
| Subsequent practice (2+) | -5.285 (0.54) | <0.001 | -1.756 (0.45) | <0.001 | 0.0064 (0.00034) | <0.001 | 0.0028 (0.00035) | <0.001 |
| Location (Clinic vs. Home) | -11.972 (4.8) | 0.01 | -1.706 (4.3) | 0.69 | -0.054 (0.0032) | <0.001 | -0.02 (0.0036) | <0.001 |
| Subsequent Practice x  Location | 0.868 (0.76) | 0.25 | 0.476 (0.69) | 0.49 | 0.00021 (0.00051) | 0.67 | 0.0013 (0.00056) | 0.02 |
| SD of random effects |  |  |  |  |  |  |  |  |
| Intercept | 0.7758 |  | 0.0479 |  | 0.0627 |  | 0.0855 |  |
| Slope first practice | 0.0489 |  | 0.0144 |  | 0.0124 |  | 0.0599 |  |
| Slope subsequent practice | 0.0059 |  | 0.0019 |  | 0.0030 |  | 0.0043 |  |
| Residual | 0.0669 |  | 0.0523 |  | 0.0688 |  | 0.1393 |  |

*Note.* RT = reaction time. SE = standard error. SD = standard deviation. Age in years; sex is 1 for males and 0 for females; education is total years with all individuals less than 11 coded as 11; First practice is 0 = first session and 1 = second session; Subsequent practice (2+) is 0 = 2ndsession, 1 = 3rd, 2 = 4th, and so on; location is 0 = clinic and 1 = home. Taken together first practice and subsequent practice comprise a piecewise linear spline with a bend at session 2. For Detection and Identification, values represent raw score reaction time data (in milliseconds) and negative beta estimates signify faster/improved performance. For One Card Learning and One Back, values represent raw score accuracy data and positive beta estimates signify better/improved performance.

**Supplemental Results.**

Our presentation of Supplemental Table 2 assists with interpretation of the magnitude of the findings presented in this study. We re-ran the models using the raw untransformed data variables as these raw values are easier to interpret directly than the transformed values. However, the purpose of transforming the variables is to improve the normality of the distribution. Examination of the residuals from models using both the raw and the transformed variables confirmed that the residuals of the transformed variables do have better residual properties. Because of this, we retain use of the transformed variables for our primary analyses within the manuscript. However, because the results of models using the raw values help to illustrate the magnitude of the findings on an understandable scale, we now present full model results for the raw values in Supplemental Table 2.A simple back transformation of the transformed values as presented in Table 2 does not yield the same raw score estimates as re-running the models on the raw data.

The sections below provide an illustration of the magnitude of the significant effects for each response variable from the raw score models presented in Supplemental Table 2. The pattern of findings is the same as those in Table 2 of the manuscript.

**Detection Reaction Time**. Based on the estimates from Supplemental Table 2, participants perform 12 ms faster at home on Detection at session 2. The session 1 to session 2 practice effect 5ms although it did not reach significance. For each additional session after session 2, performance is about 4 to 5 ms faster. Across sessions 2 to 7, this would be a 22 to 26 ms faster performance, which is a little larger than the average effect of sex (males are 20ms faster). The amount of offset for each additional practice at home (0.868) is small and the term in the model was non-significant. A 1 year increase in age leads to an estimated 3.28 ms slower performance. A 10 year age effect is therefore estimated as a 33 ms difference, and a 20 year age effect is a 66 ms slower performance.

**Identification Reaction Time.** There was no difference between performance at home and in the clinic after application of our linear correction for the PC effect as described in the manuscript. Participants are 24 ms faster at session 2 relative to session 1 on Identification. For each additional session after session 2, performance is about 1 to 2 ms faster. Across sessions 2 to 7, this would be a 6 to 9 ms faster performance, which is negligible. In comparison, a 1 year increase in age leads to an estimated 2.92 ms slower performance. A 10 year age effect is therefore a 29 ms difference, and a 20 year age effect is estimated as a 58 ms slower performance.

**One Card Learning accuracy.** Participants perform 5.3 to 5.4% lower on One Card Learning accuracy (out of 100% raw scale) at home relative to in clinic. There isa 3.7% increase in accuracy from session 1 to session 2.For each additional session after session 2, there is a 0.6 to 0.7% increase in accuracy. Across sessions 2 to 7, this would be a 3% increase in accuracy. Together, the increase in accuracy from baseline to session 7 would be 6.9%, with over half of that change explained by the first practice effect (session 1 to 2). For comparison, there is a 0.2% decline for each increased year of age. A 10 year age effect is therefore a 2% lower score on raw One Card Learning accuracy. A 20 year age effect is estimated as 4% lower accuracy.

**One Back accuracy.** Participants perform 1 to 2% lower on One Back accuracy (out of 100% raw scale) at home relative to in clinic. There is a 0.6% increase in accuracy from session 1 to session 2, which may seem small when compared to One Card Learning accuracy but the One Back effect is bounded (e.g., there is a ceiling effect). For each additional session after session 2, there is a 0.3 to 0.4% increase in accuracy. Across sessions 2 to 7, this would be a 1.4 to 2% increase in accuracy. Together, the increase in accuracy from baseline to session 7 would be 2%. For comparison, a 1 year increase in age leads to an estimated 0.1% decline for each increased year of age. A 10 year age effect is therefore a 1% lower score on raw ONB accuracy. A 20 year age effect is 2% lower accuracy.

Additional Sensitivity Analyses

**Impact of removing converters.** Data for participants who were cognitively unimpaired at the time of their first Cogstate session but later were assigned a diagnosis of mild cognitive impairment (MCI) or dementia at a follow-up visit were retained up until (but not including) the visit with the diagnosis to avoid biasing our sample toward individuals with less follow-up data available. While our primary study question was to understand how cognitively unimpaired subjects look over time, we also recognize that it is important to understand the potential impact of our approach of removing data following transition to MCI/dementia. To help address this issue, we performed a sensitivity analysis and fit new linear mixed effects models including all follow-up for the subjects in our study, without excluding visits having a diagnosis MCI or later.  Because we have a population based cohort, relatively few subjects progressed (n=38 to MCI, n=3 to dementia, n=4 to other) and contributed an additional 222 observations.  The models were very similar with and without these observations.

**Impact of time between sessions.** To consider if time between sessions was important in determining practice effects we defined new predictors involving the time from a clinic session to the next session, and time from an at-home session to the next session.  Comparing the new predictors to the previous predictors involving only the number of previous sessions showed the time variable for clinic sessions and number of clinic sessions, as well as the time variable and number of sessions for at-home to be highly dependent with correlations of 0.95 and 0.96.  With these high correlations, when fit simultaneously with number of sessions to describe the practice effect, model term estimates for time between sessions were unstable and did not present any clear evidence that time between sessions provided additional information beyond number of sessions.  We conclude that time between sessions did not play an important factor in determining practice effect magnitude within the current study.