

Title: Standardized and novel executive function task performance in children with Down Syndrome in relation to parent perception of executive function

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Introduction: Executive function (EF) is broadly defined as the set of processes that deal with managing oneself and the environment in order to achieve a goal (Cooper-Kahn & Dietzel, 2008). Recent research utilizing the NIH Toolbox Cognition Battery, specifically the Flanker task that evaluates inhibition, task-shifting, and processing speed, suggests a broad impairment in EF among children and adolescents with Down Syndrome (DS) (Traverso et al., 2018). Similar results have been found through the use of the Behavior Rating Inventory of Executive Function (BRIEF) (Gioia et al., 2000), a standardized measure completed by parents regarding their child's daily functioning (Daunhauer, 2017; Lanfranchi et al., 2014; Lee et al., 2015). We have recently designed a new battery of cognitive outcome measures to be more child friendly and amenable to testing children with intellectual and developmental disabilities The Arizona Memory Assessment for Preschoolers and Special Populations (AMAP), assesses various memory and cognitive skills. This tablet-based, game-themed app contains several phases, one of which measures the switch and inhibit subtypes of EF. The AMAP and Flanker tasks, together, may serve as accurate predictors of EF. This study focuses on performance across the three tasks in both the DS and typically developing (TD) populations. We then will determine the accuracy of the caregiver report of EF by investigating the associations with the BRIEF.

Method: As part of a multisite measurement validation study, we administered the AMAP, Flanker, and BRIEF in school-age children with DS (N = 36) and mental-age matched TD children (N = 32). The AMAP itself is novel to measuring cognitive function; however, we included Phase 12 data for the current analyses. The AMAP and Flanker tests were conducted on a large touch screen tablet (iPad). Approximately 58% and 56% of the sample was male, in the DS and TD groups, respectively. We asked parents of children with DS to complete the BRIEF-2 while parents of TD children completed the BRIEF-Preschool (BRIEF-P) version. We included the total score on Phase 12 of the AMAP, raw scores and reaction times on the Flanker, and the Global Executive Composite score on the BRIEF in our analyses.

Results: Altogether, 36 and 32 participants completed the Flanker assessment. Similarly, 33 participants with DS and 32 participants without DS completed the AMAP. Across the three measures, we found a significant difference on the total score of the incongruent phase of the Flanker test with the DS group displaying lower scores than the TD group (4.92 vs. 6.71, respectively; $p = 0.002$). Although participants with DS scored lower on the AMAP in comparison to the TD group, it was not statistically significant (19.39 vs. 20.81; $p = 0.197$). There was a significantly positive association between the total scores on the AMAP and Flanker assessments in the DS group ($p = 0.034$). In the TD group, total score on the AMAP was positively associated with the Flanker congruent score ($p = 0.019$) and Flanker total score ($p = 0.047$) and negatively associated with Flanker congruent reaction time ($p = 0.026$). There was no significant correlation between parent report of EF, as measured by the GEC, and the Flanker and AMAP assessments in either diagnosis groups.

Discussion: As concluded by previous studies, our study further confirmed a decreased overall ability of EF in the DS group. Incongruent Total Score from the Flanker shows that, on average, TD participants had a higher performance than DS participants. This suggests that the DS group has more difficulty adapting to a rule change, which is a measure of the inhibit and switch subtypes of EF. The positive correlation seen between the total scores on the AMAP and Flanker assessments in the DS group suggests that the AMAP is accurately measuring EF as compared to the standardized Flanker assessment. However, the A-MAP measure may be less able to detect group differences in EF between TD and DS. No significant correlation was observed between the parent report of EF, as measured by the GEC, and the Flanker and AMAP assessments in either group. These results confirm the presence of EF deficits in DS and help highlight new methods of assessing these domains in individuals with DS.

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