# Automated eye tracking technology improves the sensitivity of an early childhood vigilance test (ECVT) of attention in Ugandan children perinatally exposed to HIV

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## BACKGROUND

▪ Over 1.2 million Ugandan children are uninfected but at risk from compromised caregiving due to HIV disease.[1]

▪HIV infection in mothers can disrupt neurocognitive and behavioral development in children.[2]

▪The Early Childhood Vigilance Test (ECVT) is a measurement of attention.[3] Attention and impulsivity are related to memory and learning measures in school-age Ugandan children perinatally exposed to HIV.[4]

**Figure 1:** Map of Uganda, Study Site: Tororo, Uganda

## STUDY AIMS

**Primary Study Aim**: To evaluate the use of automated eye tracking technology to enhance the sensitivity of the Early Childhood Vigilance Test (ECVT) of attention with younger children perinatally exposed to HIV in rural Uganda.

**Secondary Study Aim**: To evaluate whether this technology could enable the ECVT to correlate better with a color-object association test (COAT) of memory and learning, the Mullen Scales of Early Learning (MSEL), and the Behavior Rating Inventory of Executive Function (BRIEF).

**Child gazing at cartoon bunny on screen during the Early Childhood Vigilance Test (ECVT)**
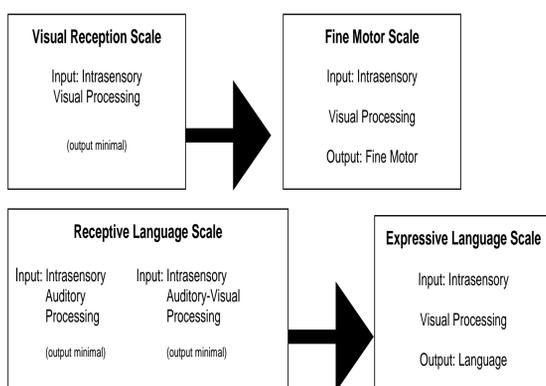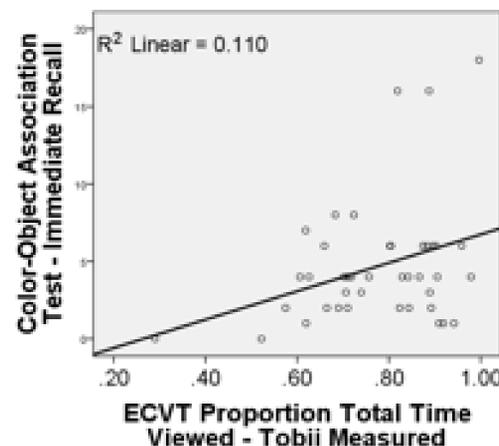
## METHODS

▪Study participants were children from Eastern Uganda perinatally exposed to HIV.

▪44 children 16 to 65 months of age were evaluated with the ECVT, COAT, MSEL, and BRIEF (24 boys M=52.3 SD=11.4 months of age; 20 girls M=52.4, SD=12.2).

▪The ECVT measures the proportion of time a child looks at the monitor during a 6 min 44 sec cartoon video displaying a bunny appearing at one-minute intervals to greet the child, followed by animals moving across the screen.

▪We programmed a Tobii X2-30 portable infrared camera to monitor the child's pupil direction during the cartoon to calculate % time watching.

▪Measures of working memory and early childhood learning were evaluated using the Color Object Association Test (COAT) and Mullen Scales of Early Learning (MSEL), respectively.

▪Caregiver-reported measures of executive function behaviors were evaluated using the Behavior Rating Inventory of Executive Function (BRIEF)

### Mullen Scales of Early Learning (MSEL)

| Visual Reception Scale | Fine Motor Scale |
|---|---|
| Input: Intrasensory Visual Processing (output minimal) | Input: Intrasensory Visual Processing Output: Fine Motor |

| Receptive Language Scale | Expressive Language Scale |
|---|---|
| Input: Intrasensory Auditory Processing (output minimal) | Input: Intrasensory Auditory-Visual Processing (output minimal) | Input: Intrasensory Visual Processing Output: Language |

### Color Object Association Test (COAT)

$R^2$ Linear = 0.110

Color-Object Association Test - Immediate Recall vs ECVT Proportion Total Time Viewed - Tobii Measured

**Scatterplots of ECVT Proportion of Time Viewing Animation -- Measured with Tobii Eye Tracking Camera**

R2 Linear = 0.106

Mullen Scales of Early Learning - Fine Motor Scale vs ECVT Proportion Total Time Viewed - Tobii Measured
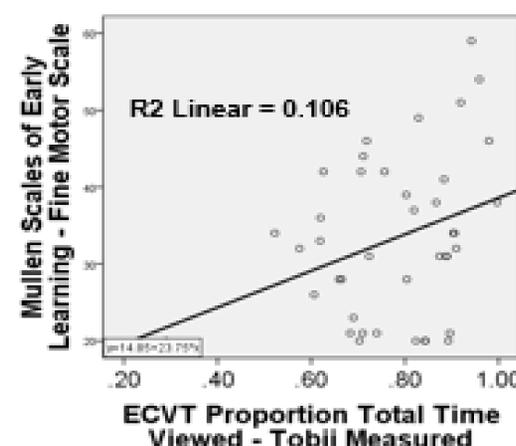
## RESULTS

▪Children watched 78% of the cartoon using Tobii automated eye tracking, while PROCODER webcam scoring resulted in an average of 67% ($r$=0.84, $P$<0.001).

▪ Older children performed better on the ECVT ($r$=0.41, $P$=0.008), although no gender differences were observed.

▪ECVT Tobii eye tracking significantly correlated with COAT immediate recall for color-object placement associations (tracking moving animals $r$=0.33, $P$=0.019; total percent time screen gaze $r$=0.31, $P$=0.035).

▪ECVT Tobii eye tracking (total proportion time looking at cartoon) significantly correlated with with MSEL Fine Motor performance (visual-spatial learning with motor response; $r$=0.33, $P$=0.037).

▪ECVT webcam PROCODER % was also significantly correlated with COAT memory ($r$=0.42, $P$=0.005) and learning ($r$=0.38, $P$=0.011), but not with MSEL Fine Motor.

## CONCLUSIONS

Enhancing the sensitivity of the ECVT with automated eye tracking improves its correlation with other visual-spatial measures of working memory and learning in Ugandan children at-risk from perinatal exposure to HIV infection.

## IMPLICATIONS

These findings imply that eye tracking technology has the potential of improving the sensitivity, validity and reliability of other neurocognitive measures in younger at-risk children in low-resource settings.