

## Prospective Validation Studies of the Evolving Device and Algorithm

Evolving Device and Algorithm Description	Study Year/s	Methods	Participants	Key Findings	Peer Reviewed Publication
<p><i>One input</i></p> <p>1. Caregiver Questionnaire</p> <p>administered via an electronic platform with automatic scoring</p>	2012-2013	<p>Prospective clinical validation study</p> <p>Device administered to a clinical sample of children referred to a large pediatric medical center clinic for developmental/ behavioral concerns.</p> <p>Diagnostic determination of blinded clinicians compared to device output.</p>	<p>n=222</p> <p>Median age 5.8 years. Range 16 months to 17 years</p> <p>76.1% male, 31% received a clinical diagnosis of ASD</p> <p>Concern for developmental delay</p>	<p>Device showed a sensitivity to detect ASD of 89.9% [95% CI = 82.7-97]; specificity of 79.7% [95% CI = 73.4-86.1].</p>	<p>Duda, Daniels &amp; Wall. Clinical evaluation of a novel and mobile autism risk assessment. <i>J Autism Dev Disord</i> 2016; 466: 1953-1961.</p>
<p><i>Two inputs</i></p> <p>1. Digital Caregiver Questionnaire</p> <p>2. Digital Video Analyst Questionnaire</p>	2016	<p>Prospective, multi-center clinical feasibility trial</p> <p>Conducted across 3 large tertiary developmental medicine centers.</p> <p>Device completion followed by ASD diagnosis by clinicians who were blinded to the device output. Diagnostic recommendations compared.</p> <p>Objective: Sensitivity and specificity to detect ASD compared to other pre-existing screening tools.</p>	<p>n= 230</p> <p>162 of whom completed the device inputs in addition to reference tests and diagnosis</p> <p>Age: 18 - 72 months</p> <p>Referred to tertiary center for ASD related concern</p>	<p>Device found to perform similarly to other measures, accurately identifying children 71% of the time across the entire 18 to 72 month age range with an overall higher specificity in detecting ASD (62%) compared to the other measures ranging from 16% for the SRS-SA to 35% for the SCQ.</p>	<p>Kanne, S. M., Carpenter, L. A. and Warren, Z. (2018), Screening in toddlers and preschoolers at risk for autism spectrum disorder: Evaluating a novel mobile health screening tool. <i>Autism Research</i>. doi: 10.1002/aur.1959</p> <p>Abbas, H., Garberson, F., Glover, Eric., Wall, D. P. (2018), Machine learning approach for early detection of autism by combining questionnaire and home video screening. <i>Journal of the American Medical Informatics Association</i>, Volume 25, Issue 8, Pages 1000-1007, <a href="https://doi.org/10.1093/jamia/ocy039">https://doi.org/10.1093/jamia/ocy039</a></p>
<p><i>Three inputs:</i></p> <p>1. Caregiver Questionnaire</p> <p>2. Video Analyst Questionnaire*</p> <p>3. Healthcare Provider Questionnaire</p>	2017	<p>Prospective, blinded, multi-site clinical study</p> <p>Conducted across 3 large tertiary developmental medicine centers .</p> <p>Add-on to previous validation study.</p> <p>New participants received 3 device inputs. Roll-over participants received only 2 inputs (but an updated version of input 2 was used to re-analyze their videos).</p> <p>Device completion followed by ASD diagnosis by clinicians who were blinded to the device output.</p> <p>Objectives:</p> <ul style="list-style-type: none"> <li>• Device sensitivity and specificity compared to blinded best estimate clinical diagnosis</li> <li>• Device performance compared to 3 existing ASD screening instruments (CBCL, M-CHAT-R, and SRS)</li> <li>• Device concordance to ADOS</li> <li>• Impact of phenotypic characteristics such as age, IQ, and co-morbid disorders on device performance</li> </ul>	<p>n=375</p> <p>213 of whom are new subjects, data on all 3 device inputs available for this cohort,</p> <p>and</p> <p>162 roll-over subjects from previous validation study. Only input 1 and 2 data available for this cohort</p> <p>18 - 72 months</p> <p>Referred to tertiary center for ASD related concern</p>	<p>Device outperforms baseline screeners administered to children by 0.35 (90% CI: 0.26 to 0.43) in AUC and 0.69 (90% CI: 0.58 to 0.81) in specificity when operating at 90% sensitivity.</p> <p>Compared to the baseline screeners evaluated on children less than 48 months of age, the device outperforms the most accurate by 0.18 (90% CI: 0.08 to 0.29 at 90%) in AUC and 0.30 (90% CI: 0.11 to 0.50) in specificity when operating at 90% sensitivity.</p> <p>Addition of input 2 and input 3 are shown to significantly improve algorithm performance, compared to use of input 1 alone. Allowing for a 30% abstention rate, the following performance improvements with the addition of extra inputs were reported:</p> <ul style="list-style-type: none"> <li>• Caregiver questionnaire alone (N=375): AUC= 0.791</li> <li>• Caregiver and video analyst questionnaire (N=368): AUC 0.857</li> <li>• Caregiver, video analyst and health care provider questionnaire (N=204): AUC 0.916</li> </ul>	<p>Abbas, H., Garberson, F., Liu-Mayo, S., Glover, E., &amp; Wall, D. P. (2020). Multi-modal AI approach to streamline autism diagnosis in young children. <i>Scientific reports</i>, 10(1), 1-8.</p>

\*Independent research<sup>12</sup> has also demonstrated the feasibility of using home videos to support the diagnosis of ASD in young children