

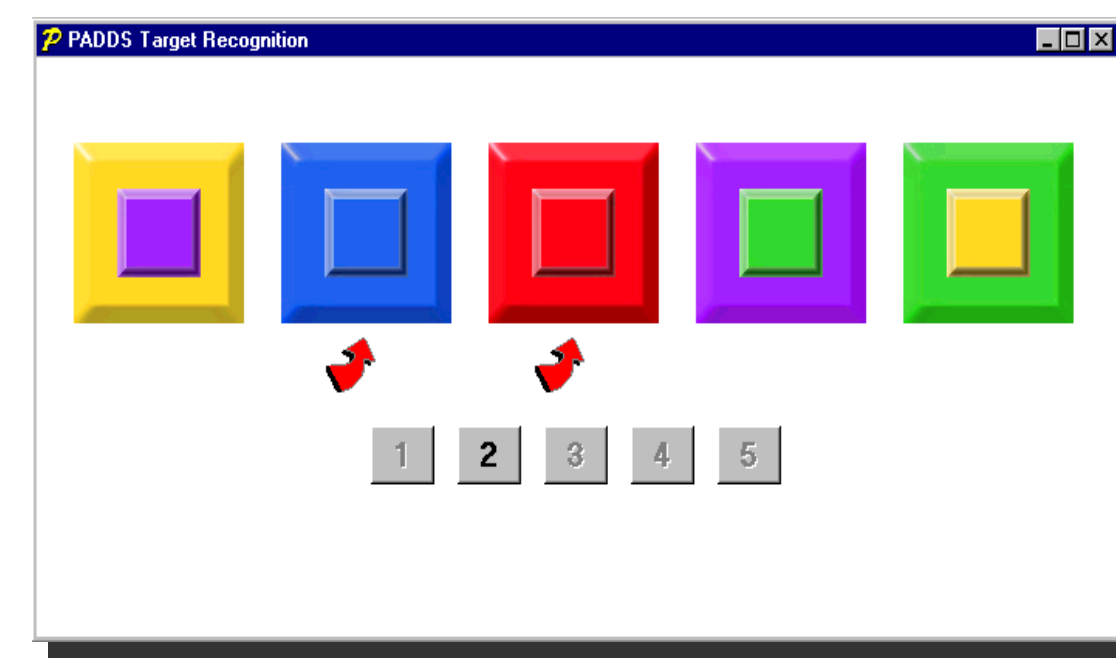
Evidenced Based AD/HD Assessment: Improving Diagnostic Accuracy and Treatment Effectiveness

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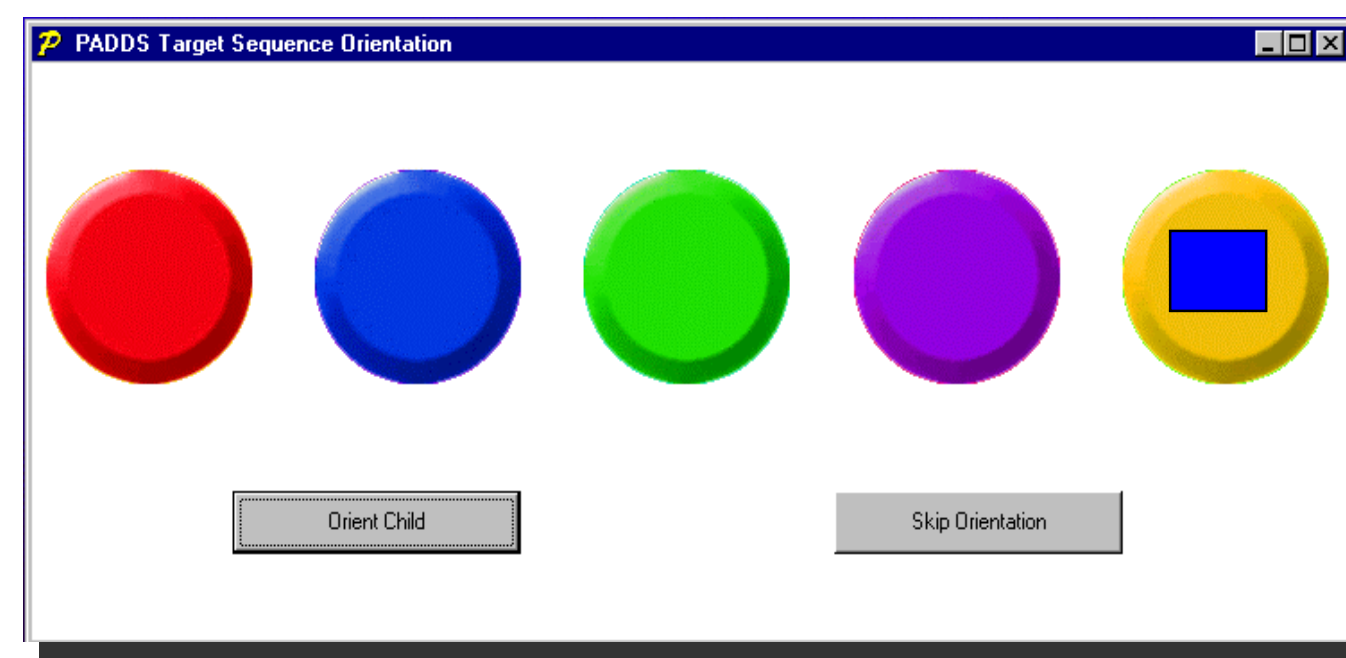
Abstract

Consensus statements regarding ADHD assessment and treatment rendered by The American Academy of Pediatrics and the National Institute of Health have indicated the need to develop and implement standardized evidence based assessment procedures that have solid clinical and psychometric properties and that can be applied within the primary care settings as well as within traditional settings. This paper will introduce a new clinical ADHD assessment suite referred to as the Pediatric Attention Disorders Diagnostic Screener or PADDs that was developed with the above needs in mind. This new system incorporates a semi-structured diagnostic interview along with three computer administered measure of Executive Functions which are referred to as the Target Tests of Executive Functioning. Results are evaluated and reported via a computer generated nomographic display clearly highlighting the incremental power of combining these highly effective procedures. The real clinical power of the suite is demonstrated by implementing evidence based analysis that utilizes an established base rate for initial assessment at 4 percent and then builds incremental validity for or against diagnosis as each element of the suite is evaluated and applied to the nomographic display. These procedures have clearly demonstrated clinical diagnostic superiority over classic standard score or reference group comparison.

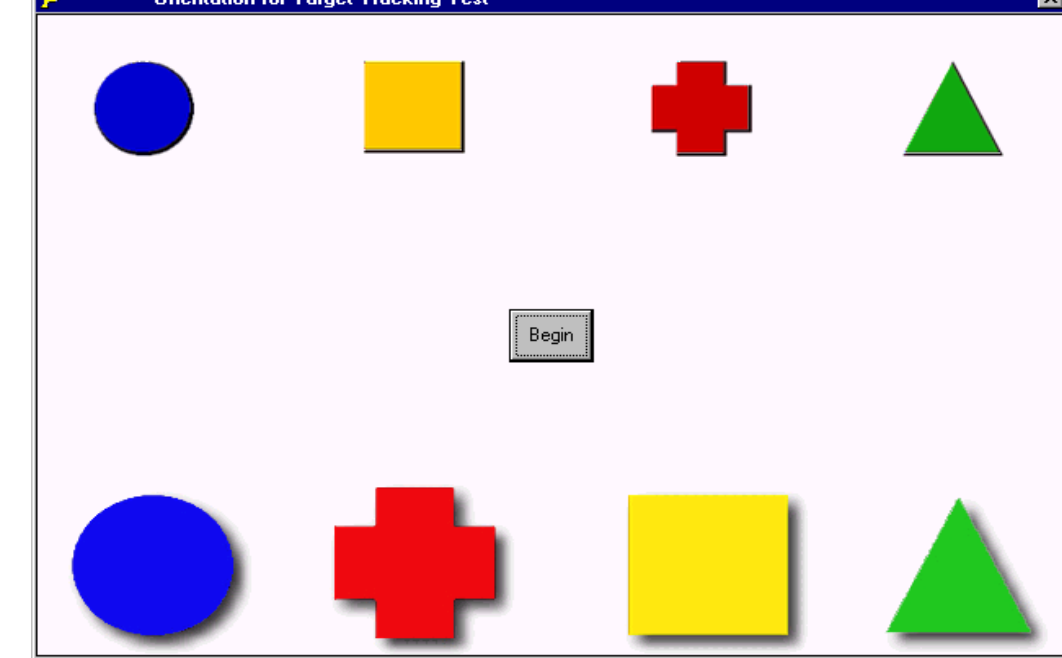
TARGET TESTS OF EXECUTIVE FUNCTIONING



Target Recognition - presents five large colored squares with smaller squares inside them. Below the squares are five buttons marked 1 thru 5. All five colored squares flash on and off at 1 1/2 second intervals over 153 presentations. The child is taught a strategy to count from left to right and count the number of squares with small squares of the same color and to click on the corresponding number below.



Target Sequencing - Across 39 trials, five colored circles have a small square appear and disappear in varying sequences. The child is taught to attend only to circles when the square matches it in color and to remember the sequence of color matches, first match first, second match second and last match last. Then to click on the circles that matched in the same order as they were presented.



Target Tracking - Across 20 trials this subtest presents four colored shapes at the top and bottom of the screen. The shapes will move, one at a time, to another shape at the bottom in differing sequences of two and three step moves, then reset. The child must then click and drag each shape to it's position on the lower shapes, in the same order. First move first, second move second and last move last.

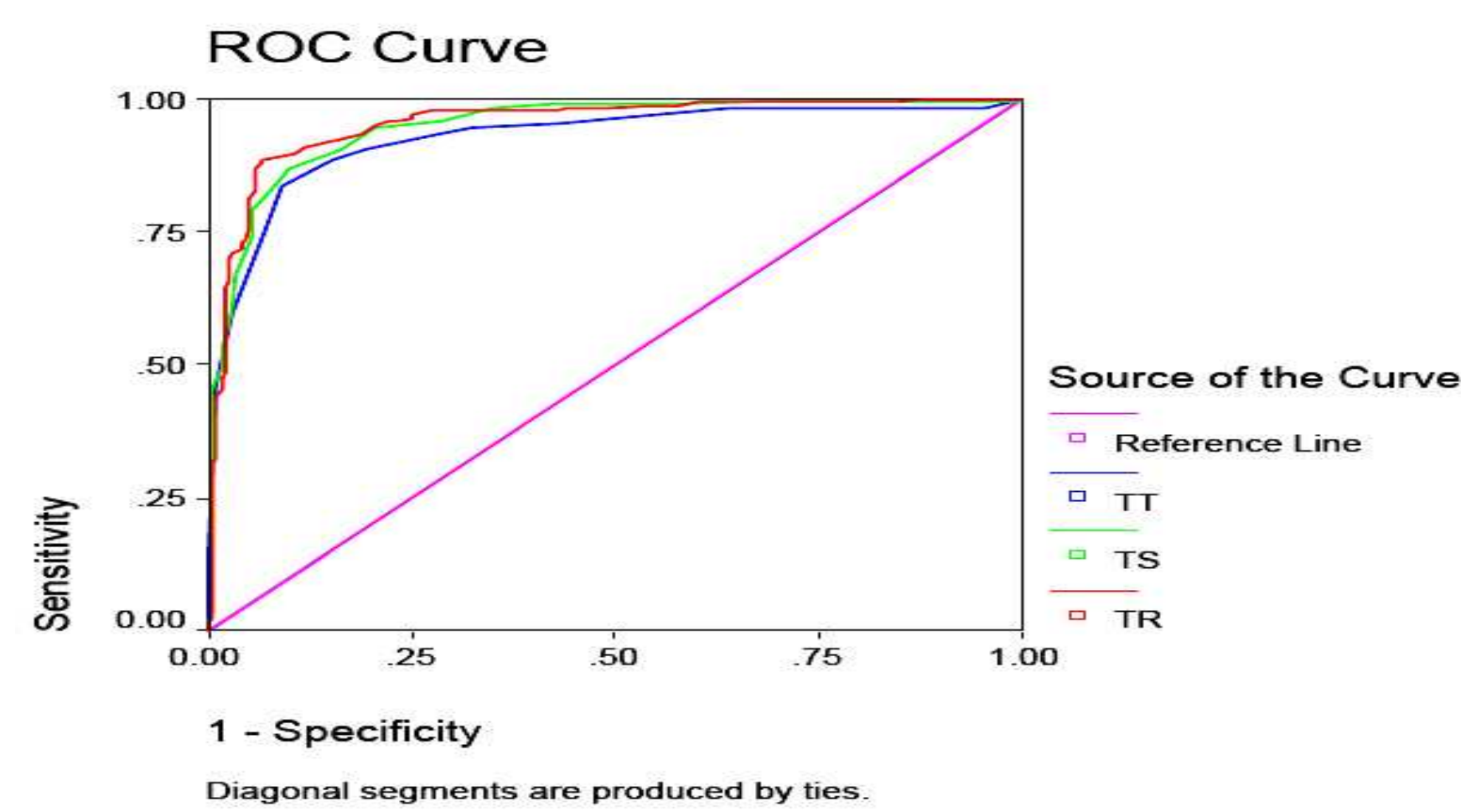
PSYCHOMETRIC SUMMARY FOR THE TARGET TESTS OF EXECUTIVE FUNCTIONING

Clinical testing of the PADDs Target Tests of Executive Functioning consisted of 629 children (266 females and 367 males) age 6 to 12 years ($M = 8.66$, $SD = 1.71$) split approximately evenly between those diagnosed with ADHD and age matched Non-ADHD/ Typical peers. Data was collected in seven states through a total of 10 data collection sites. Institutional Review Board (IRB) approval for the overall project was established through Armstrong Atlantic State University in Savannah, Georgia. Specific sites included specialty ADHD assessment centers in Illinois, Georgia, Idaho, New Jersey, Tennessee, California, and Florida. Each specialty site also obtained independent IRB review from their respective institution or agencies. Consent forms were sent home to parents explaining the study, and all children with parents consenting who were tested received a \$10.00 gift in return for their participation. All children signed assent forms detailing the gift and the right to discontinue at any time while still receiving the gift incentive. Participants recruited included both males and females from various ethnic and socioeconomic groupings.

Table 1 -- Descriptive Statistics for Target subtests

	Valid	TR	TS	TT
N	629	629	629	629
Mean	Missing	0	0	114
Std. Error of Mean		103.2846	25.7663	9.1534
Median		1.52037	.42684	.23128
Mode		115.0000	29.0000	8.0000
Std. Deviation		115.000 ^a	37.000 ^a	6.00
Variance		38.13064	10.70513	5.24847
Minimum		1453.946	114.59975	27.54646
Maximum		5.00	.00	.00

a. Multiple modes exist. The smallest value is shown



Test Result Variable(s)	Area	Std. Error ^a	Asymptotic Sig. ^b	Asymptotic 95% Confidence Interval	
				Lower Bound	Upper Bound
TR	.954	.010	.000	.935	.974
TS	.948	.010	.000	.928	.968
TT	.927	.013	.000	.901	.952

a. Under the nonparametric assumption

b. Null hypothesis: true area = 0.5

PADDs Psychometric Performance					
	629	ADHD	TYP	Totals	
					PPV 0.90
Test Positive		282	31	313	NPV 0.85
Test Negative		48	268	316	Sensitivity 0.85
Totals		330	299	629	Specificity 0.90

SUMMARY OF THE PADDs REPORT FEATURES

The PADDs System and Summary Report represent cutting edge advancement in Evidenced Based Assessment. This process presents the incremental input of multiple forms of information that research has shown to be most reliable and valid for ADHD assessment. The PADDs system relies on comparison of two well defined reference groups namely ADHD and Non-ADHD. Each component is calculated in additive or subtractive manner for and against a diagnosis in consideration of the ADHD base rate of 4%. The inputs are displayed in a real time format via a computer generated Nomogram presenting an individual and an overall predictive index of likelihood ratios establishing evidence for or against a diagnosis. Results are likewise presented in traditional Z-Score format for comparison to a non-clinical reference.

The PADDs first step inputs (measures/assessment techniques) consist of Parent and/or Teachers ratings of the behavioral criteria for ADHD from the Diagnostic and statistical Manual of Mental Disorders Fourth Edition-Revised. These behavioral criteria are extremely sensitive to the presence of ADHD and are considered a gold standard for preliminary review/assessment (Zolotor, A.J., & Mayer, J. 2004).

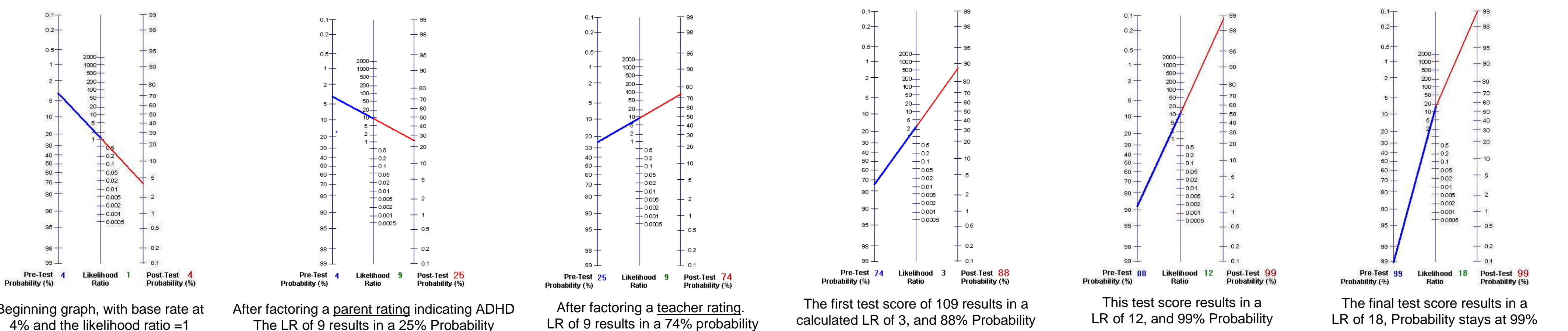
The second component of the PADDs Summary Report Consists of the review of the Computer Assisted Diagnostic Interview or CADI which enables the clinician to review multiple potential areas of concern as highlighted by the parent or informant that can be relevant to ruling out comorbid or exacerbating conditions for a given child. This cross validation represents a semi-structured interview and develops a preliminary treatment plan to help support decisions for further assessment and/or referral.

The third component of the PADDs system represents objective assessment of a Child's executive functions and working memory. The Target Tests of Executive Functioning have demonstrated superior ability as an adjunct to cross validate behavioral observation and background report. The process is quick and enjoyable and demonstrates superior Reliability, Validity, Sensitivity/Specificity, and Positive and Negative Predictive power over any other measure of its kind currently available (Please refer to the psychometric development and performance section of the PADDs Clinical Manual). These Executive measures were designed to be enjoyable, engaging and ecologically valid by requiring demands that are more consistent with those required in the typical classroom setting. Extensive research has shown that children routinely report them as fun but hard typically avoiding the strong negative emotions commonly evoked by CPT's tapping the ability to remain focused in highly redundant/boring conditions.

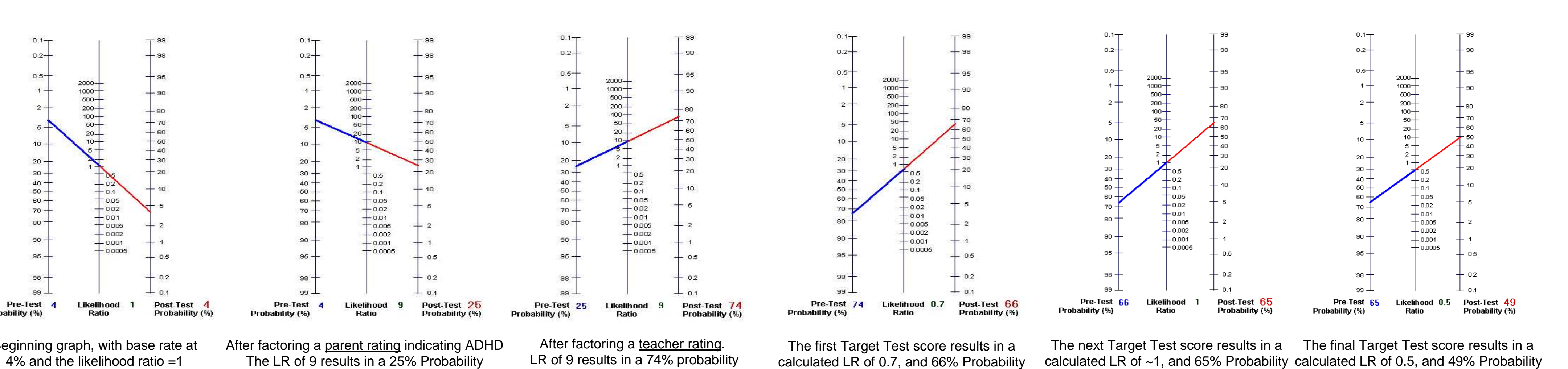
The fourth and final component is the nomographic display of the individual and cumulative inputs. This evidence is evaluated stepwise via the calculation of likelihood Ratios applied incrementally with a Fagan's Nomogram, the results produce an overall predictive index that is compared to a **conservative base rate of 4%** (ADHD prevalence at 4%). When these components are used in conjunction with clinical judgment they have proven highly effective in consideration of diagnosis, in highlighting/documenting the need for further evaluation or actions and may allow the clinician to evaluate their own diagnostic practices and effectiveness over time.

Likelihood Ratios and the Nomogram

COMMON ADHD PROFILE



COMMON NON-ADHD PROFILE



DISCUSSION

In the common ADHD study the parent and teacher ratings of DSM-IV criteria for ADHD produced a post test probability of only 74%. Thus, it is clear that multiple inputs are required to push the predictive index within acceptable range to warranting a diagnosis of ADHD. In the second or non ADHD study we see that the addition of the TTEF subtests modify the probability away from supporting a clinical diagnosis of ADHD. In this case this subject was found to have a moderate reading disability that was addressed without medication.

Despite the outstanding classification potential demonstrated by the Target Tests of Executive Functioning with known groups, these metrics, when applied individually against a base rate of 4% (as with ADHD) will result in significantly lower predictive power than is implied from their ability to separate groups with 100% known assignment. Thus, each potential raw score from the Target Tests of Executive Functioning was analyzed to determine the exact percentile rank for both the ADHD and Typical groups that corresponded to that given raw score. This was done so as to determine the sensitivity and specificity of every possible score for each of the three Target Tests. These sensitivities and specificities were used to develop likelihood ratios from every potential score for all three subtests. These ratios can then be applied incrementally with other data, as judged clinically appropriate, to a Fagan nomogram. These incremental inputs develop a predictive index for or against diagnosis in a given case. This transparent process forces the clinician to evaluate the relative weight of all procedures and to consider the combined evidence accumulated for or against a diagnosis in conjunction with clinical judgment. This is the heart of an evidence based approach and will constitute a highly standardized approach to ADHD assessment that could help clinicians reduce both over and under identification of ADHD by fine tuning their diagnostic approach over time. The overarching emphasis in this proposed approach is to use several measures with solid psychometric properties and proven clinical utility in the most conservative manner possible.



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