

CUT SCORES DEVELOPMENT  
FOR OSEP CHILD OUTCOMES REPORTING IN AEPSi  
A Technical Report  
February 7, 2011

ORIGINAL ISSUANCE OF GUIDELINE FROM THE EARLY CHILDHOOD OUTCOMES (ECO) CENTER

In July, 2006, ECO issued a paper, approved by the Office of Special Education Programs (OSEP) in the U.S. Department of Education, entitled "Recommendation of the Early Childhood Outcomes (ECO) Center for Determining Age Expected Functioning and the Points of the ECO Rating Scale." This paper, emailed to the publishers/developers of the online assessment systems, summarized the three child outcomes (positive social-emotional skills, acquisition and use of knowledge and skills, and use of appropriate behaviors to meet needs) and clarified the currently used five reporting categories—a) percentage of children who did not improve functioning, b) percentage of children who improved functioning but not sufficient to move nearer to functioning comparable to same-aged peers, c) percentage of children who improved functioning to a level nearer to same-aged peers but did not reach it (improved developmental trajectory, i.e., rate of growth), d) percentage of children who improved functioning to reach a level comparable to same-aged peers (i.e., gap closers), and e) percentage of children who maintained functioning at a level comparable to same-aged peers. ECO offered these guidelines in part because it was recognized that many states appreciate the value of and prefer to use a criterion- or curriculum-based measure rather than one that provides age equivalents or percentile scores (and even if a tool does have age equivalents or percentiles, cutoffs are still needed to help states determine age-expected functioning).

Publishers were asked to work with ECO to develop guidance that would allow states to use their instruments reliably to classify children's functioning as age-expected or not. They were advised they could approach the task either empirically or conceptually. The publishers were asked to age band the items of their tests for the identification of expected scoring patterns for children at different ages. ECO stated in this paper that "whether assessment publishers approach age banding empirically or conceptually and regardless of whether the instrument is normed or curriculum-based, the publishers (and the states) need guidance from the ECO Center on where to draw the line for what is within and outside the bounds of age expected behavior."

The ECO Center convened two groups of advisors, the Child Technical Work Group and the Implementation Work Group, and after conference calls and in-person meetings, the recommendation emerged to provide a single guideline for assessment publishers rather than having individually determined state guidelines. ECO recommended using the normal curve (i.e., functioning with regard to the three outcomes is normally distributed) and 10% as the estimate of the percentage of the general population ages birth to 5 years considered to have a disability or a delay. Using the normal curve to anchor typical functioning, the ECO Center recommended considering children functioning in the bottom 10% of an outcome area to be

considered functioning below age expectation and all others to be within the range of their same-age peers.

ECO also issued a table showing the recommended percentage of the population that would fall within each rating on their 7-point scale, the Child Outcomes Summary Form. This table also showed the corresponding upper and lower bounds on the standard deviations for each rating, developmental quotients for assessments with a mean score of 100, and t-scores around a mean of 50. The scale was developed to be sensitive to change among the lowest functioning children and not at all sensitive to change within age expectations (except a bit for ratings 6 and 7). The boundaries were deliberately set to have different percentages of children at each rating. This was done to reflect the fact that there are more atypical children with milder delays than severe delays. An extract from a portion of the table follows:

| ECO Rating | Cumulative proportion of population that is this rating or above |
|------------|--|
| 7          | 0.8413   |
| 6          | 0.9032   |
| 5          | 0.9332   |
| 4          | 0.9608   |
| 3          | 0.9803   |
| 2          | 0.9949   |
| 1          |  |

The recommendation and the detail in the table were shared with publishers as a guideline by which to identify functioning comparable to same-age peers, with the understanding that the precision in the table would exceed the level of precision available through many of the assessment tools and processes in place.

Brookes Publishing subsequently participated in the conference call held by ECO on September 12, 2006 with publishers and developers to help them further in this identification of age-expected functioning.

#### ANALYSIS BY EMRG (Early Intervention Management and Research Group, the AEPS authors)

Over the period from September 2006 through June 2007, the authors/developers of the AEPS undertook the process of identifying cut scores within the AEPS raw scores to identify age-expected functioning. EMRG elected to take on the additional work to do this empirically rather than conceptually. Using data gathered in previous studies conducted by EMRG members, and working with their statisticians familiar with IRT and Rasch modeling, EMRG undertook to:

1. Re-establish and cross-check OSEP cut scores by OSEP child outcome, by AEPS Test level (birth to 3 and 3 to 6), and in 3-month intervals
2. Establish additional cut scores for near-exit ratings by OSEP child outcome, by AEPS Test level, and in 3-month intervals
3. Develop a large set of tables of cut scores for OSEP reporting for both near-entry and near-exit by OSEP child outcome, by AEPS Test level, and in 3-month intervals

#### Explanation of Analysis Steps

AEPS Outcome Raw Scores for each of the three child outcomes for each level of the AEPS Test (birth to 3 and 3 to 6) were analyzed using Winsteps 3.6.1 to generate Rasch measures. A regression-informed line was used to re-establish age-expected functioning cut measures (i.e., a benchmark and a cut score) utilizing

the ECO criterion (from the table mentioned above) at 3-month intervals. The Rasch age-expected functioning cut measures were transformed back to the AEPS scale. The transformed AEPS scale scores were used to create an OSEP benchmark (0.9032) and an additional cut score (0.9608) necessary for OSEP near-exit reporting categories. Plotting raw scores and age, for each outcome, layers were identified in the data.

### OSEP Categories Decision Tree

In this manner the EMRG work group was able to generate empirically supported classification decision tables, valid and usable for OSEP reporting. When there was limited variability between the benchmark and the cut score, programming was developed in AEPSi so that the scoring notes of A (assistance provided) and B (behavior interfered) could be used to help with the classification of children at near exit. These decision tables, which show all the possible combinations of Near-Entry and Near-Exit scores, were then used by the AEPSi programmers to enable automatic generation in AEPSi of the a, b, c, d, and e ratings (the five categories) on the three OSEP child outcomes. For the Level I tables (birth to 3 years), test scores from 1,163 children across 17 states were analyzed. For the Level II tables (the 3 to 6 years AEPS Test), test scores from 2,115 children across 16 states were evaluated.

### REANALYSIS ENCOURAGED BY ECO AND UNDERTAKEN COLLABORATIVELY BY BROOKES, EMRG, AND ECO

Two years later, after having the opportunity to study the child outcomes data submitted to OSEP by the states, based on the use of a variety of different assessment tools, ECO recommended that all parties' original assumptions be re-analyzed and data and procedures re-evaluated to determine if the reporting was capturing trends and patterns in the data as well as possible. Overall, and across all online publishers' tools, far more children were being reported as falling in category e (% of children who maintained functioning at a level comparable to same-age peers) than had been expected for children receiving services through Part B, Section 619, and through Part C.

ECO further offered to work with the publishers to assist in these re-analyses. Brookes Publishing began this process in the summer of 2009, when ECO, EMRG (the author group), and Brookes entered into a mutual nondisclosure agreement to protect the confidentiality and privacy of the data and the online programming. For the next year, ECO, EMRG, and Brookes worked closely together, and the resulting analysis, while similar to the one conducted in 2007 to arrive at the original cut scores, used newer data and was able to be drawn from a larger population of typically developing children than the data available 2 years earlier. The steps of the study and the findings are described below.

### Analytic Process of the Study

The cut points were developed for total scores for each of the three OSEP child outcomes. Total scores for each of the three outcomes were computed using the crosswalks (between the three outcomes and AEPS Test items) developed by EMRG. The cut points delineate a range of functioning from no immediate foundational skills to all skills considered age appropriate. Empirical validation was completed by replicating analyses across multiple sets of data for children who were identified as typically developing, at risk, or developmentally delayed. Initial clinical validation was done using a review of the skills associated with each age band.

The analysis to create the cut points included several steps. The first step was to clean and compile the data sets used to estimate typical development and the data sets used to validate the cut points. Next, ECO scaled the instruments using Rasch modeling and checked for misfit items. Once misfit items were

removed, observed means were plotted and smoothed. Smoothed estimates of typical functioning, mean of observed standard deviations (SDs) across age bands, and Rasch item parameters were used to develop the cut scores. The cut scores were applied to several different samples of children with developmental delay and typically developing children as one way of checking the validity of the cut scores. Preliminary content validation of the cut point that demarcates typical development was completed using information from the Rasch scaling and expert review. Each of these steps is described in more detail below.

Step 1: Cleaning and Compiling Data Sets: To estimate the score that would be considered age appropriate functioning for each age band, the sample was restricted to children who were identified as typically developing. The data used for the birth to 3 years analysis included typically developing infants and toddlers combined across three data sets (n = 571). The data set used for the analysis of the 3 to 6 years data included typically developing children from one large set of de-identified AEPSi data (n = 1307). The following analyses included only children who were identified as typically developing.

Step 2: Computing Rasch Models: Once the final data sets were compiled, the three OSEP outcomes for birth to 3 years and 3 to 6 years were analyzed using Rasch methods to determine if all of the items fit within the scale and to calculate the item parameters. The items were mapped to the three outcomes using the crosswalk provided by EMRG. Items with fit statistics above 2 were removed from the calculation of the total score). All misfit items were on the birth to 3 years assessment. (The range of ability seen in infants and toddlers across the skills associated with each outcome makes calibration of items challenging.) There were no misfit items on the assessment for the 3 to 6 years assessment. For information in interpreting fit statistics see <http://www.winsteps.com/winman/index.htm?diagnosingmisfit.htm>.

The five criteria removed from the birth to 3 crosswalk were: quiets to a familiar voice (Social Communication C1.5), uses sensory examination with objects (Cognitive F1.4), uses three-word agent-action-object utterances (Social Communication D3.4), says nursery rhymes (Cognitive G6.2) and swallows liquids (Adaptive A1.4). (This revised crosswalk for birth to 3 years has replaced the formerly posted crosswalk on the Brookes web sites and has been supplied to ECO for posting on their web site.)

Step 3: Smoothing Observed Means: Total scores were computed for each outcome. When items were missing, mean substitution was used to compute the total score. If more than 70% of items within an outcome were missing, a total score was not computed for that outcome. The SPSS syntax used to compute these total scores was supplied to Brookes by ECO. The distributions of total score on each of the outcomes were inspected to determine the quality of information they would provide for estimating expected performance within an age band. The distribution and progression of mean scores across age bands for the birth to 3 years assessment and the 3 to 6 years assessment were computed.

Step 4: Development of Cut Scores: The next step was to compute the upper and lower bounds of each of points on the 9-point scale. (ECO and Brookes agreed that this analysis would initially be done with 9 points and subsequently transformed to 7 points because of interest by some states in having a 9-point rating to enable a closer look at children at risk and typically developing.) The 9-point scale is an extension of the 7-point scale used on the Child Outcomes Summary Form (COSF). The 7-point scale is appropriate for children with delays and disabilities but needs more specificity within the age appropriate range to be useful for programs serving typically developing children. The 9-point scale expands the 7-point scale by including two new categories and new definitions for points 7, 8, and 9. All children scoring 6 or above in an outcome area are considered “typically developing” (i.e., not showing developmental delays). The extension of the 7-point scale acknowledges that there are meaningful distinctions in performance among children who are typically developing and that these differences are important because they are associated with the likelihood of success later in school. Children scoring a 9 on the scale are considered to be demonstrating

the level and quality of skills needed to succeed across all their current and future settings and situations including kindergarten. Children scoring an 8 are showing fewer skills and as such are at some risk for later school difficulties. Children scoring a 7 are showing even fewer skills and are at high risk for later school difficulties. Children scoring a 6 are typically developing but experiencing challenges in one or more of their current settings and situations and are at high risk for later school difficulties. For programs not using the 9-point scale, the 9-point scale is transformed into the 7-point scale (that is, the scale for ECO's Child Outcomes Summary Form [COSF] ratings), by collapsing ratings of 7, 8, and 9 together.

To compute the cut scores for the 9-point scale, several pieces of information about the observed distribution of scores for typically developing children were used: the mean, the standard deviation in raw score units, and the standard error in Rasch measure units. The development of the cut scores had two main steps:

- Step 1: Set the upper bound for a rating of 5 (i.e., the distinction between typically developing and not typically developing) based on Rasch standard error units below the mean.
- Step 2: Set the additional cut points based on standard deviation units from the mean.

This two step process was employed because step 1 allowed a line to be drawn between what is considered age-appropriate/typically developing functioning and below. This line was set using the Rasch parameters that theoretically should be less sample specific. Standard deviation units were used to set intervals around the initial cut point because these gave more information about the distribution of raw scores.

Step 5: Validation of Cut Points: The next step was to program these new cut scores into the SPSS syntax used to compute a 9-point rating for each child.

The validation for the birth to 3 years analysis was done using four separate data sets.

1. One data set collected on children participating in one selection of Part C programs (n = 223). The data points in the file were all collected at exit.
2. Another data set collected on children participating in another selection of Part C programs (n = 4,653).
3. Another data set (de-identified) from AEPSi supplied by Brookes (n = 546).
4. The sample of typically developing children used to develop the cut scores (n = 571).

The distribution followed expectations about the status of children with disabilities for the first and second data sets mentioned above. These expectations are that very few children will score at the bottom of the scale and that most children with disabilities will score between 4 and 7. The third data set above had a large number of children scoring at 1; this could be related to the quality of the data in that data set or to the nature of the population with whom the AEPSi is being used. The fourth data set showed a high number of children scoring at 9, which would be expected.

The validation for the 3 to 6 years analysis was done using three separate data sets.

1. The first AEPSi data set (DD n = 12,788; TD n = 3,661)
2. The data used for the original calibration (DD n = 1,048; TD n = 1,140)
3. The second AEPSi data set (DD n = 5,778; TD n = 1,333)

The results for cut points with the calibration data set and the AEPSi second data set are consistent with expectations for children with disabilities and typically developing children. (The patterning of data for in the first data set was unusual for the children labeled typically developing children and may be the result of mislabeling children with developmental delays as typically developing.) Typically developing children were

seen to score higher than children with developmental delays, and a reasonable proportion of children with developmental delays scored at or above typical development.

Step 6: Content Validation of the Cut Point that Demarcates Typical Development: Next, a descriptive look at what the cut points define as typical development was undertaken. The purpose of this activity was to determine if the cut points set match what is known about typical development. There were three possible results. The first is that the cut points are too low, meaning that children who are not functioning at a level similar to same-age peers are being scored as if they are. The second is that the cut points could be too high. This would mean that children who were functioning at a level similar to same-age peers would be scored as if they are functioning at a level below same-age peers. The third (and most problematic) option is that the behaviors themselves do not align in an order that is consistent with what is known about child development. This would lead to high error rates in identifying children functioning at a level similar to same-age peers.

Item parameters from the Rasch analysis were used to complete this content validation. The items within each outcome within each level of the instrument were scaled using a partial credit model. This model estimates the ability of children likely to pass at each response level; these item parameters are often called thresholds. For the AEPS, two thresholds were computed for each item. The first threshold is the ability at which a child is more likely to score a 1 than a 0. The second threshold is the ability at which a child is more likely to score a 2 than a 1. In AEPS, these scoring options are defined in the following way:

- 0 = Child does not meet the criterion
- 1 = Child inconsistently meets criterion
- 2 = Child consistently meets the criterion

The age content validation was done by ordering the items within each outcome from easiest to hardest based on the threshold that defined the ability at which a child is more likely to score a 2 than a 1 (that is, the ability at which a child is likely to consistently meet the criterion). To determine the age at which a child would be likely to perform the behavior consistently, the ability score of the upper bound of a 9-point rating scale score of 5 was used for each age band. Conceptually the age bands on the items represent the skills that children in that age band would be expected to consistently perform (90% of children in the age band would be expected to have mastered the skill). The age bands in this analysis were created using the information in the cut score tables above. The sample used to create the age bands is the same as the sample used to create the cut scores.

## FINDINGS: NEW CUT SCORES FOR OSEP CATEGORY REPORTING AND COSF RATINGS

The results are a new set of cut points that can be applied to the two levels of the AEPS Test, birth to 3 years and the 3 to 6 years, to transform scores into the five child OSEP reporting categories of a through e for each of the three OSEP child outcomes. Through the fall of 2010 Brookes Publishing helped AEPSi users who needed to apply these new cut scores to their data. The results of this study have now been incorporated into the programming calculations in AEPSi to automatically generate the child outcomes category ratings in the OSEP reports as well as COSF ratings reports in the online system. Brookes Publishing as always highly recommends following best practice and the ECO Center's instruction to use multiple sources of evidence to inform the determination of a child's ratings.

## ONGOING WORK

EMRG and Brookes continue to cooperate with the ECO Center to examine refinements in the ongoing development of the OSEP child outcomes reporting process and measurement system. Parties using AEPSi



who would be interested in participating in this process are welcome to inquire with Brookes Publishing. Please see the contact information at the end of this report.

## PSYCHOMETRIC STUDIES OF THE AEPS TEST

Reports of the psychometric properties of the AEPS Test are unchanged by the OSEP child outcomes reporting process and the above-reported analyses to assist in the generation of the five categories in OSEP reporting.

Psychometric studies of the AEPS have been ongoing since the mid 1980s, and numerous reports have been published. A list of nearly 20 studies, including a number supported by the U.S. Department of Education, is provided for download at [www.aepsinteractive.com](http://www.aepsinteractive.com). AEPS has very high ratings across all the usual measures of a test's psychometric strengths. These are reported in Appendix A from AEPS Volume 1 (Bricker et al., AEPS® Administration Guide), which is also reproduced for download at [www.aepsinteractive.com](http://www.aepsinteractive.com). Studies have looked at interobserver agreement, test-retest reliability, concurrent validity, sensitivity, specificity, and treatment validity. Follow-up and replication studies have also reported on these findings.

The author group formed a not-for-profit research corporation in 2006, the Early Intervention and Management Research Group (EMRG), to further their studies and ongoing development of the AEPS. In accord with their mission set forth in their By-laws, EMRG will "Manage future developments associated with linked measurement and curriculum systems designed to enhance early childhood intervention offered to young children and their families, thus providing a public service and benefit. The corporation will enable members to communicate, to meet to address issues, and to conduct/support development, research and training."

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