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ISSUES IN EARLY PREDICTION AND IDENTIFICATION OF INTELLECTUAL GIFTEDNESS

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This chapter comprises three sections: (a) commentary on the Colombo, Shaddy, Blaga, Anderson, and Kannass chapter titled "High Cognitive Ability in Infancy and Early Childhood" (chap. 2, this volume); (b) consideration of issues concerning early prediction of gifted intelligence; and (c) discussion of implications regarding early identification of intellectual giftedness.

COMMENTARY ON "HIGH COGNITIVE ABILITY IN INFANCY AND EARLY CHILDHOOD"

Early prediction and detection of high intellectual ability has long been of interest to developmental psychologists and educators. As early as 1940, Thorndike (1940), in his *Psychological Bulletin* article titled " 'Constancy' of the IQ," reviewed the predictive value of infant and preschool tests and concluded that they are of limited value in predicting school-age intelligence test performance. Subsequent reviews throughout the century have continued to corroborate this general conclusion (e.g., Colombo, 1993; McCall, Hogarty, & Hurlburt, 1972) despite the strong psychometric characteristics of the standardized instruments used.

Regardless of the known difficulty of the task, in their research, the authors of chapter 2, Colombo et al., took on the challenge of identifying in a cohort followed from infancy a subsample of children deemed high in cognitive ability at age 4 years. They did so by incorporating standardized developmental testing as well as measures involving specific cognitive processes.

This research is important for several reasons. First, the researchers attempted to identify early roots and processes that might be involved in the origins and ontogeny of intellectual giftedness. This endeavor is worth further pursuit, particularly in light of new techniques used to assess cognitive development during infancy.

Second, the researchers used both forward and backward analyses (albeit not completely bidirectional across measures). Such analyses are interesting because they are based on different conditional probabilities, as the question addressed by each approach is different. The former is intended to advance predictive hypotheses and models so as to forecast probabilistic events or occurrences. The latter is postdictive, in that differences in the criterion are known or established and then a hypothesized developmental history is tested by determining factors that differentiate (and possibly account for) the designated outcome. These analyses do not necessarily furnish overlapping information about relationships over time. For example, with backward analyses, children designated as intellectually gifted during the school years were found to have performed higher on the Bayley Scales of Infant Development, Second Edition (BSID-II) at approximately 1.5 years of age than did their cohort peer comparison group (A. W. Gottfried, Gottfried, Bathurst, & Guerin, 1994). At the same time, however, high scores on the BSID-II have not been shown to be good predictors of intellectual gifted status. Shapiro et al. (1989) illustrated differences in findings using forward and backward types of analyses in attempting to predict and postdict giftedness using the BSID-II at 13 months and the Wechsler Scale of Intelligence—Revised (WISC–R) at 7.5 years. Children designated as gifted on the WISC–R showed prior differences on the BSID-II; however, advanced development on the BSID-II did not predict gifted performance on the WISC–R.

Third, Colombo et al. used standardized psychometric assessments, infant attention and psychophysiological measures, and appraisals of language and home environment. In this way they attempted to widen the methods used to identify high cognitive ability (HCA) during infancy as well as elucidate the processes that may be involved in the development of HCA.

Fourth, by applying multiple methods the assumption was made that no single measure during infancy may be sufficient in the prediction and understanding of the development of HCA. Bornstein et al. (2006) took a similar approach using sequential developmental measures from 4 months (visual habituation) to 4 years (Wechsler Full Scale IQ). Thus, the strategy Colombo et al. used represents a burgeoning area in terms of understanding not only cross-time relationships between infant and later cognitive functioning but also the multifaceted components involved in the ontogeny of cognitive and advanced intellectual development.

Fifth, prediction necessitates longitudinal methodology. The research reported by Colombo et al. is based on the Kansas Early Cognitive Project. This longitudinal study is impressive because it comprises a considerable number of assessments during the early years using various standardized and contemporaneous developmental measures. Longitudinal designs are extremely difficult to conduct because of expense and time consumption, intense labor required for repeated assessment waves, and the uncertainty of maintaining the study population (for further discussion see A. W. Gottfried, Gottfried, & Guerin, 2006). The Kansas Project began with 227 infants recruited at 3 months of age; 140 children of the original study sample were tested again at 4 years. Furthermore, in longitudinal research, once the measures are in place and the children tested, modifications cannot be made. The investigator is set with the measures that had been selected for that age. If statistically significant and meaningful cross-time results are not obtained, nothing can be done for that sample. Recruiting another cohort and following them up is a daunting endeavor. However, even the finding of no significance is a contribution emerging from longitudinal research to determine important dimensions of prediction or failure to predict and formulate future hypotheses and efforts. Thus, every well-done longitudinal study has something to contribute to our knowledge of development.

We now highlight some of the most relevant findings from the Colombo et al. research regarding the issue of early prediction of HCA. First and foremost, the issue of instability of classification is raised by the cross-time pattern of test scores. Although 15 children ended up in the HCA group at 4 years, all but 1 child revealed instability of classifications across the previous years, clearly indicating that there is no consistent cross-time pattern of scoring above the designated cutoff from infancy through 4 years of age. This result is in accord with the findings of the Fullerton Longitudinal Study, although we did find that virtually all children (90%) who emerged as intellectually gifted at age 8 years evidenced at least one score equal to or greater than 130 during the infant years. This conclusion was based on a backward contingency analysis and not a predictive analysis. Not all infants who showed these elevations became gifted as measured by cognitive assessments, although such scores appear to be part of the developmental process and increases the probability of later giftedness. We interpreted our findings as evidence of early signs of reach, that is, potential for high intellectual performance (A. W. Gottfried et al., 1994). The spaghetti plots provided by Colombo et al. reveal that a number of the children also evidenced early signs of reach as we defined it.

Second, consistent with the findings from the Fullerton Longitudinal Study, emergence of differentiation between the HCA and cohort cognitive groups was evident in the 2nd year of life. Colombo et al. suggested that higher order thinking processes such as self-regulation, attention, and symbolic functions may be responsible for this. It is noteworthy that during this approximate time period socioeconomic status begins to correlate with cognitive functioning (A. W. Gottfried, 1985; A. W. Gottfried, Gottfried, Bathurst, Guerin, & Parramore, 2003), indicating that in the 2nd year of life, family environments and resources associated with social status may be showing up as factors that promote cognitive growth.

Third, the findings reported on home environment variables are also consistent with the Fullerton Longitudinal Study. Home environments of the HCA children were more stimulating as early as infancy. There is concordance regarding the specific role of variety of experience and provision of play materials. We likewise found that these two subscales of the Home Observation for Measurement of the Environment (HOME) Inventory significantly and specifically predicted cognitive outcomes from 1 year to 3.5 years. Furthermore, in the meta-analysis conducted at that time on the relation of early home environment as measured by the HOME and infant and preschool intellectual performance, variety of stimulation and provision of play materials proved to be two of the most pervasive and potent proximal variables related to early cognitive development (A. W. Gottfried, 1984; A. W. Gottfried & Gottfried, 1984). Moreover, only the variety of stimulation scale differentiated the gifted from the cohort comparison group at 1 year of age in the Fullerton Longitudinal Study (A. W. Gottfried et al., 1994). Hence, finding is noteworthy as a reliable and generalizable finding across time and studies.

Fourth, there is the issue of predicting those who did not emerge as HCA. Colombo et al. reported a high success rate in predicting non-HCA individuals. In predicting membership in the non-HCA group, or nongiftedness, a high negative prediction (known as specificity) is almost always likely to occur because of base-rate probabilities (Meehl & Rosen, 1955); that is, the occurrence of nongiftedness is quite high in the population by definition. In the general population, only 2% would be classified as gifted (i.e., at or beyond two standard deviations above the mean), with the remaining 98% being nongifted. Thus, there is a 98% chance of correct classification of nongiftedness without testing by simply labeling all members of the population as nongifted. This is because, by definition, individuals are more likely to be members of the non-HCA, or nongifted, group. To have an efficient test of nongiftedness, one would need to be successful above and beyond the 98% hit rate, which is highly unlikely and cost-ineffective. Thus, we take issue with the view of Colombo et al. that the identification of those who will not likely fall into the category is a tangible step toward the positive identification of individuals who will fall into this classification. Those who are identified as not HCA at one time could be so at a later time, especially given the aforementioned comments about unstable classification in the course of early development. Therefore, consistent contraindications are not necessarily valid in the future because of the instability of performance on various assessment instruments. There is always the chance that an individual not initially classified as gifted would be so at a future point in time. This issue is significant in the identification of giftedness for placement in educational programs.

ISSUES CONCERNING EARLY PREDICTION OF GIFTED INTELLIGENCE

A fundamental issue in prediction concerns the criterion that is being predicted, in this case IQ at a subsequent and designated point in time. Gifted children are typically identified and classified in the schools during the early to middle elementary school years. Taking this as a reference point, many researchers and educators who study gifted children have asked whether intellectual superiority is stable over time. Does once gifted imply always gifted?

The renowned Terman Study of Genius was based on teachers' nominations followed by intelligence testing. Although it was said that Terman recommended retesting from time to time (Hilgard, 1989, p. 16), repeated systematic IQ testing to determine the stability of IQ on the study population (or even a random sample of them) was not incorporated into the longitudinal design. Burks, Jensen, and Terman (1930) and McNemar (1947) attempted to address this issue by retesting some of the "Termites" (as the study participants came to be labeled) in the course of the investigation, albeit not with a systematic methodology. Other studies conducted in the first half of the 20th century, particularly around the 1930s, also grappled with the issue of stability of intellectual giftedness (e.g., Cattell, 1933; Hollingworth & Kaunitz, 1934; Lincoln, 1935; Nemzek, 1932). The studies by these pioneers are historical and dated and were limited or compromised in terms of methodological design and instrumentation. A tendency for scores to decline over time was most frequently observed, but increases in retest scores among children who were initially tested and classified as gifted were also noticed.

Developmental researchers subsequently conducted long-term longitudinal studies in which children were repeatedly tested on standardized intelligence tests (during the early years sometimes referred to as standardized developmental tests). Examples include the Berkeley Growth Study (Bayley, 1949), Berkeley Guidance Study (Honzik, Macfarlane, & Allen, 1948), Fels Longitudinal Study (Sontag, Baker, & Nelson, 1958), Louisville Twin Study (Wilson, 1983), and Fullerton Longitudinal Study (A. W. Gottfried et al., 1994, 2006).

Because the Fullerton Longitudinal Study is contemporary and conducted by us, we present some data to make a relevant point. Table 3.1 displays the standardized tests used during the course of our investigation. Table 3.2 pre-

TABLE 3.1
Intelligence Tests Administered in the Fullerton Longitudinal Study

Measure	Ages administered (years)
Bayley Scales of Infant Development	1, 1.5, 2
McCarthy Scales of Children's Abilities	2.5, 3, 3.5
Kaufman Assessment Battery for Children	5
Wechsler Intelligence Scale for Children—Revised	6, 7, 8, 12
Wechsler Intelligence Scale for Children—Third Edition	15
Wechsler Adult Intelligence Scale—Revised	17

sents the intercorrelations among the 13 standardized test waves from ages 1 through 17 years. Both the magnitude and, more important, the pattern of correlations are comparable to those obtained in the aforementioned longitudinal studies. Conclusions based on such longitudinal data include the following: (a) the adjacent testing periods typically reveal the highest correlations; (b) correlations decline as the interval between testing waves increase; and (c) with advancement in age, the magnitude of the correlations increases with regard to the final testing wave.

The correlations from preschool (the criterion age used by Colombo et al.) to age 17 years hover in the low moderate range in magnitude. In con-

TABLE 3.2
Correlations Among Standardized Intelligence Test Scores in the Fullerton Longitudinal Study, Ages 1 Through 17 Years

Age (years)	Age (years) 1	1.5	2	2.5	3	3.5	5	6	7	8	12	15	17
1[a]	—												
1.5[a]	.41	—											
2[a]	.43	.62	—										
2.5[b]	.33	.63	.64	—									
3[b]	.37	.65	.67	.79	—								
3.5[b]	.37	.54	.68	.74	.76	—							
5[c]	.18	.34	.45	.54	.56	.51	—						
6[d]	.26	.45	.60	.57	.59	.67	.65	—					
7[d]	.22	.41	.55	.56	.59	.63	.62	.79	—				
8[d]	.20	.42	.54	.55	.59	.62	.70	.79	.83	—			
12[d]	.17	.39	.51	.42	.47	.47	.62	.72	.78	.80	—		
15[e]	.15	.35	.48	.40	.45	.45	.56	.64	.70	.77	.80	—	
17[f]	.16	.39	.43	.44	.49	.44	.60	.67	.70	.77	.82	.85	—

Note. All correlations are significant (one-tailed test), $p < .05$, with the exception of those between 1 and 15 years and 1 and 17 years.
[a]Bayley Mental Development Index. [b]McCarthy General Cognitive Index. [c]Kaufman Mental Processing Composite. [d]Wechsler Intelligence Scale for Children—Revised Full Scale IQ. [e]Wechsler Intelligence Scale for Children—Third Edition Full Scale IQ. [f]Wechsler Adult Intelligence Scale Full Scale IQ.

trast, by middle childhood (age 8), correlations with age 17 become moderately strong (.77). Age 8 years is significant for several reasons: (a) as noted earlier, it is the approximate age at which children are often considered for gifted programs; (b) it has been found to predict adult educational and occupational status (McCall, 1977); and (c) it was used in the Fullerton Longitudinal Study to discern intellectually gifted children from their contemporary nongifted cohort peer comparisons. Therefore, a fundamental question is whether there is stability in the gifted classification from middle childhood and thereafter.

The degree of stability or instability of correlations of intelligence test scores across time and the stability of classification of giftedness was addressed by Humphreys (1985, 1989; Humphreys & Davey, 1988). Basing his analysis on longitudinal data from the Louisville Twin Study (Wilson, 1983), Humphreys (1989) pointed out that instability is a monotonic function of the interval between testing periods (i.e., initial and subsequent tests). Assuming test reliability as high as .95, he stated that observed scores over 10 years would be characterized by a correlation between .63 and .70 (notice that the correlation between ages 7 and 17 years in the Fullerton Longitudinal Study is .70, as would be predicted from Humphreys's [1989] analysis). He asserted that a child with an IQ of 140 on the initial test would be expected to have an IQ of 125 a decade later as a result of regression toward the mean. In succinct terms, in the absence of any intervention, IQ scores of gifted children will inevitably regress toward the population mean. Thus, Humphreys (1989) argued that "an educational system should be forgiving of early performance that is less than illustrious and should not give undue weight to early illustrious performance" (p. 203). In addition, Lohman and Korb (2006) have shown that the majority of elementary-age children who score in the top percentiles in cognitive ability and educational achievement in one grade do not necessarily retain as high a level 1 or 2 years later. In other words, children classified as gifted on an initial testing are not likely to be so subsequently. The downward shift in performance is the result of regression effects.

Thus, we return to our original question: What is the stability of the criterion that early measures are intended to predict? At issue is whether researchers interested in early prediction of HCA are compounding the lack of predictability of the early tests with the imperfect stability of subsequent tests. Another issue is the inevitable regression toward the population mean of extreme scores in the absence of intervention and perfect reliability. Therefore, those children with initial scores in the gifted range would not necessarily maintain such scores at a later point in time because of regression toward the mean. By the same token, initial tests may fail to detect children who score below the requisite cutoff for designation of giftedness but who may emerge as gifted on subsequent tests because individuals' scores can fluctuate upward as a result of the lack of perfect reliability. These statistical properties in the context of multiple measures taken across time raise the following question: Is the criterion of intellectual giftedness a moving target? This has significant implications for early identification of intellectual giftedness and educational procedures and policies.

IMPLICATIONS CONCERNING THE EARLY IDENTIFICATION OF INTELLECTUAL GIFTEDNESS

According to Olszewski-Kubilius (2003), there has been little change in educational practice regarding identification of gifted children. Schools typically assess for gifted IQ once, and if the requisite score or gifted classification is not achieved, no future assessment is undertaken (Matthews & Foster, 2005). This perspective roughly corresponds to what Matthews and Foster (2005) termed the "mystery" model, in which IQ is seen as fixed and stable across the life span. Such a conception does not fit with what is now known about the change in IQ performance over the school years as detailed earlier.

The challenges associated with identification of giftedness during the school years raise serious concerns about the potential application of giftedness identification during infancy and early childhood. Matthews and Foster (2005) described early identification as one of the most contentious in the field of giftedness. The problems pertaining to early identification arise because of questions about whether giftedness can be reliably identified during infancy and early childhood. Furthermore, if such identification is undertaken, what is the predictability of the index used with regard to giftedness during childhood and beyond?

In light of the points raised earlier regarding the well-established findings about cross-time instability of intelligence tests scores from infancy through late adolescence, we concur with Perleth, Schatz, and Mönks (2000, p. 303) that "practitioners and researchers should be skeptical of too much optimism about the possibility of predicting high ability and high achievement from early age." Identification of early giftedness could be misleading for children and their families because of the following two types of errors in predictions: (a) false positives, that is, identification of the infant or young child as gifted when that is not the case later or (b) false negatives, that is, designation of infants or young children as not gifted when they would emerge as gifted at a subsequent point in time.

Finally, what is the criterion we are attempting to predict? Is it a changing criterion because of issues of reliability and regression toward the mean? Or perhaps it is not a single index at all (as is IQ) but instead a multifaceted construct. Thus, identification during infancy or early childhood becomes more of a guess as to what it predicts rather than being a known precursor to a specific status. Taking into consideration the converging research evidence regarding change and stability of the IQ, as well as critical issues raised regarding gifted identification in infancy and early childhood, it is of paramount importance to determine the appropriate identification criteria. This involves conceptions of what giftedness is during infancy, early childhood, and beyond. Another question is whether identifying HCA, or giftedness, in infancy reinforces a stability view because it appears to assume that processes regulating giftedness or HCA are present before subsequent environment, parental stimulation, education, motivation, training, and encouragement have come to bear on its unfolding. Contemporary conceptions of giftedness incorporate these latter factors in advancing critical issues facing researchers and educators alike (Borland, 2003). More differentiated views of competence, high ability, giftedness, talent, and expertise are becoming increasingly prominent (see Feldhusen, 2003; Heller, Mönks, Sternberg, & Subotnik, 2000).

When Should Children Be Tested for Intellectual Giftedness?

Because of the questionable predictability of infant and early childhood intellectual measures, as well as the possibility of plasticity in giftedness or nongiftedness across the school years, the issue of classifying young children for selection into programs is of concern. It was previously recommended that "attempts to identify gifted children should be a continuous process to allow for inclusion of children who are not identified as gifted at one point, but who may become identified at a later point" (A. W. Gottfried et al., 1994, p. 178). We further recommended that programs remain open to children who evidence giftedness at a later point, and to use multiple criteria, such as achievement and motivation, to help "provide clues" as to who may emerge as superior and gifted at a subsequent point (A. W. Gottfried et al., 1994, p. 178). Matthews and Foster (2005) are consistent with these recommendations in advancing their "Mastery" approach in which they propose that identification timing should be ongoing as needed and that measures other than IQ are used. The view of ongoing assessment has implications for parent advocacy because parents may need to take the lead on pursuing ongoing assessment for their children.

Although we propose ongoing assessments for those who are not identified as gifted at first testing, we do not advocate retesting children who have already qualified for and been placed in such programs, nor do we advocate removing children from programs on the basis of a later assessment. Because it is known that scores of gifted children are likely to decline just on the basis of regression to the population mean, if they are doing well educationally in their programs, they should remain there. Ongoing assessment for children already identified as gifted and who continue to succeed is unnecessary and valueless.

Prediction Gaps

Aside from statistical regression effects, potential developmental factors may be associated with prediction failures leading to what we term *prediction gaps*. First, individual differences exist in developmental timing of the emergence of giftedness. Second, giftedness exists in aspects of HCA other than IQ. This differentiation encompasses multifactor theories of intelligence (see Borland, 2003; Heller et al., 2000) and special areas such as spatial abilities (see chap. 4, this volume). The third factor pertains to the development of children's academic intrinsic motivation, a topic of research in giftedness included in the potentiality–enrichment theory (A. W. Gottfried et al., 1994) and in the construct of gifted motivation (A. E. Gottfried & Gottfried, 1996, 2004; A. W. Gottfried, Gottfried, Cook, & Morris, 2005). Potentiality–enrichment theory proposed that intrinsic motivation is inherently tied to the emergence of intellectual giftedness as it concerns pleasure inherent in cognitive processing. Hence, those children who enjoy cognitive processing to a greater extent are likely to be more engaged in activities that promote their cognitive excellence. In the conception of gifted motivation, those with superior strivings in academic intrinsic motivation showed superior cognitive and academic performance and are motivationally gifted in their own right independent of intelligence (see A. E. Gottfried, 1985, 1986, 1990, for further elaboration of academic intrinsic motivation). Therefore, motivation itself needs to be included in developmental conceptions of giftedness as well as in identification methods. The last factor proposed herein concerns environment itself and changes in the environment that support and regulate the emergence, continuity, and discontinuity of intellectual giftedness (A. W. Gottfried et al., 1994; Subotnik, Olszewski-Kubilius, & Arnold, 2003).

Implications for Family and Educational Factors

Parents and teachers are on the front line of recognizing gifted potential and signs of reach (A. W. Gottfried et al., 1994). Indeed, Subotnik and Olszewski-Kubilius (1997) pointed out that parents are the first to identify childhood talent and often the first teachers for those who evidence exceptional talent and eminence. Robinson (2000) asserted that parents are better than just test scores in identifying giftedness in young children, and test scores often confirmed parental observation. Parents and educators of infants and young children should be responsive to children's bids for activities and stimulation and provide the requisite exposure, such as variety of stimulation, as well as opportunity to stimulate mastery (A. W. Gottfried et al., 1994; Robinson, 2000). It was found that gifted children were more likely to ask parents for lessons and activities, their parents were more responsive, and the home environments of gifted children were significantly more intellectually and culturally stimulating (A. W. Gottfried et al., 1994). Therefore, it is recommended that one take a developmental approach toward the assessment of superior competence or giftedness. Horowitz and O'Brien (1985, 1986) emphasized the importance of a developmental approach to assessing as well as understanding the processes underlying the emergence of giftedness. Olszewski-Kubilius (2003) asserted that "the fruition of childhood ability and promise is very tenuous, and social, environmental, and psychological variables play a huge role and interact in very complex ways" (p. 499). Feldman (2003) asserted that if the field of gifted education continues to maintain its assumptions that IQ is natural, unchanging, and unchangeable (p. 23), there will be little emphasis on a developmental approach that requires the incorporation of a wider field of talents and abilities.

The study of high ability during infancy and early childhood with an emphasis on early processes and the developmental pathways to giftedness is an important research endeavor. However, extreme caution must be taken in adopting a gifted–nongifted classification for infancy and early childhood because of the aforementioned problems and concerns. Nevertheless, if high ability and potential are to be recognized early, they should not be used to classify children as gifted, but rather their recognition should enable these competencies to be nurtured appropriately. It would be expected that if children are exposed to optimal environments that facilitate the continued development of their potential, their gifts will emerge, albeit possibly at different times across childhood.

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II

CHILDHOOD