Season of Birth of Students Receiving Special Education Services Under a Diagnosis of Emotional and Behavioral Disorder

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For several decades, evidence has been accumulating that pathologies of the central nervous system occur more frequency for persons born between January and June than during the remainder of the year. The strongest findings are for schizophrenia, but associations have been reported for a range of mental illnesses. The purpose of the current study was to extend this research to children receiving special education services for behavioral and emotional disorder. A sample in excess of 8,000 was studied from northern Georgia. The results strongly indicate that fewer than expected numbers of students are diagnosed as having a behavioral and emotional disorder if they are born during the fall months, and a greater than expected number are born during the late spring and summer. These findings could be the result of prenatal insults or could be related to relative age-in-grade. The implications of these interpretations for school psychology are discussed.

Keywords: emotional disturbance, special education, season-of-birth, age-in-grade

For decades, researchers have been reporting that persons with a range of medical pathologies have birth patterns that differ from those of the general population (Barry & Barry, 1931; Dalen, 1975). This line of inquiry has often been referred to as "season-of-birth research," although birth patterns have been studied on a weekly, monthly, or seasonal basis. The

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rationale for such research is that annual-occurring environmental events related to geophysical phenomena (e.g., temperature, available sunlight) or infectious disease (e.g., influenza) may increase the risk to the fetus that results in central nervous system damage.

There have been consistent findings of seasonal birth patterns and neurologically based pathologies. For example, over 200 studies have been published relating season-of-birth to schizophrenia, with many finding a disproportionately high number of births in the winter and early spring (Barr, Mednick, & Munk-Jorgensen, 1990; Castrogiovanni, Iapichino, Pacchierotti, & Pieraccini, 1998; McGrath & Welham, 1999; Takei, Sham, O'Callaghan, & Glover, 1995). Other pathologies for which disproportionate birth patterns have been reported include mental retardation (Takei, Murray, O'Callaghan, Sham, Glover, & Murray, 1995), autism (Mouridsen, Nielsen, Rich, & Isager, 1994), allergy (Nilsson et al., 1996), multiple sclerosis (James, 1995), and learning disabilities (Livingston, Adams, & Bracha, 1993; Martin, Foels, Clanton, & Moon, 2004; Wallingford & Prout, 2000).

There has been little published research on birth patterns of persons with affective disorders. Of the few studies that are available, most researchers find excess births sometime during the period January through June, although some have not found this pattern. For example, Torrey, Rawling, Ennis, Merrill, and Flores (1996) and Machon, Mednick, and Huttunen (1997) found that there was an excess of births of persons with major affective disorders born from January through mid-May. Moore et al. (2001) found that there were a disproportionate number of patients with bipolar disorders born in the winter months (January through March) that had deep subcortical white matter lesions. Two additional studies found that women diagnosed with anorexia nervosa were disproportionately born in the spring through early summer (Eagles, Andrew, Johnston, Easton, & Millar, 2001; Morgan & Lacey, 2000). However, Castrogiovanni, Iapichino,

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Pacchierotti, and Pieraccini (1999) found that persons diagnosed with panic disorder were born with greater than expected frequency from September through December. Morgan, Jablensky, and Castle (2001), studying births from 1916 through 1961 in Western Australia, found no association of season-of-birth with affective psychoses or with neurotic depression.

The literature relating seasonal birth patterns to internalizing disorders in children is very limited. Martin et al. (1995) found that children and adolescents in four separate samples who had high levels of anxiety or depression-related symptoms were disproportionately born in June, July, and August. Greer (2005) found that students in the top 25% of the distribution of ratings by teachers of anxiety and other internalizing problems were born with significantly greater frequency in the spring and summer months. In addition, research on suicide by several researchers found that adolescents and young adults born in the spring are more likely to commit suicide than those born at other times of the year (Kettle, Collins, Sredy, & Bixler, 1997; Salib, 2002).

A final piece of evidence for greater vulnerability to anxiety and depression of spring- and summer-born children comes from the study of temperament in very young children. Extreme inhibition, often referred to as inhibition-to-the-unfamiliar, has been shown to predict later symptoms of anxiety and depression (Biederman et al., 1993; Rubin & Cohen, 1986). Gortmaker, Kagan, Caspi, and Silva (1997) showed that behavioral inhibition is related to season-of-birth in samples from New Zealand and the United States of children ages 2 through 7 years. For both samples, births during the spring were linked to high levels of behavioral inhibition, even though the spring in the northern and southern hemispheres were 6 months apart.

It was the purpose of the current study to extend this research to students who receive special education services through the emotional and behavioral disorder (EBD) classification. Children receiving services under this classification frequently manifest symptoms of anxiety and depression. Although there are no published studies on the seasonal birth patterns of children in this classification to our knowledge, based on the extant literature, we hypothesize that they will be born in disproportionately high numbers during the spring and summer months.

We believe this study will make a significant contribution to this literature for several reasons. First, there are few studies of birth patterns of children with anxiety and depressive symptoms. Second, the extant studies relating birth patterns to anxiety or depression, or related phenomena (e.g., suicide), suffer from a variety of methodological problems, including low sample size (Kettle et al., 1997; Salib, 2002). The study we report here overcomes many methodological problems. The sample consists of more than 8,000 students with birth years ranging from 1985 through 1994. This allows not only for a reliable test of the month-of-birth hypothesis by using data aggregated across years (the typical procedure in season-of-birth research) but also allows for the study of births patterns in a time series across 10 birth years. This procedure makes it possible to determine whether the same birth pattern occurs consistently across this 10-year period.

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METHOD

Participants in this investigation were 8,578 public school students receiving special education services in the state of Georgia through the program for students with EBD. The sample consisted of 3,314 African American students (77.1% male, 22.9% female) and 5,264 European American students (76% male, 24% female). The small numbers of students of other ethnic/racial groups receiving services under this classification were eliminated from the analyses (6.1% of the total). The analyzed sample was 38.6% African American, closely approximating the percentage of African American students in the Georgia public school system; in 2000–2001, 37.9% of all public schoolchildren in Georgia were African American.

The State of Georgia requires that children receiving EBD services must display one or more of the following characteristics: an inability to maintain satisfactory interpersonal relationships with peers and/or teachers; an inability to learn that cannot be adequately explained by intellectual, sensory, or health factors; consistent or chronic inappropriate type of behavior or feelings under normal circumstances; displayed pervasive mood of unhappiness or depression; displayed tendency to develop physical symptoms, or pains or unreasonable fears associated with personal or school problems. In order for a student to receive services through the program for students with EBD, the student must exhibit one or more of the preceding characteristics for sufficient duration, frequency or intensity that it/they interfere significantly with educational performance. The student's difficulty with learning must be emotionally based and cannot be better explained by intellectual, cultural, sensory, or general health factors. A classification of EBD is assigned only after a psychoeducational evaluation and review of results by the child's Individualized Educational Placement committee, usually consisting of the child's parents, teachers, school counselor, school psychologist, and a school administrator.

During the early and mid 1980s, some counties in Georgia classified students with behavioral and/or emotional problems as behavioral disordered (BD) or as seriously emotionally disturbed (SED). This practice was not uniform across the state. However, by the late 1980s (1989 in most school districts), those districts that utilized the two-category system began to use the single EBD category. In the current data set, the small number of students classified as BD and SED students were included in the EBD category. This was done because both the BD and SED category required that the student have significant emotional problems. Both categories were distinguished from children with simple problems of conduct.

The children in this study resided in 44 northeast Georgia counties and attended county public school districts. Data were originally sought from 56 counties in the northern third of Georgia, including the Atlanta metropolitan area. Because of lack of computerization of special education records and other reasons, 12 counties did not provide data. Counties were classified as rural, suburban, and urban. It was determined that the 44 counties from which data were obtained were representative of the region in terms this classification; that is, the counties that provided data had a rural, urban, and suburban distribution that was not significantly different from those that did not provide data. It was also determined that data obtained was representative of the region in terms of ethnicity/race of students in the public schools. For example, 61% of the students in counties that provided data were European American compared to 63% in counties that did not provide data; African Americans in counties that provided data were 29% of the student population, while for counties that did not provide data, African Americans were 31% of the student population.

The participants were also limited to children born from September 1, 1983, through August 31, 1994. Those born in 1980 through 1984 (August) and after August of 1994 were eliminated because the number born in each month was too few for analysis. The data obtained from county records consisted of date of birth, gender, ethnicity/race, special educational classification, school, and grade. This data collection was approved by the University of Georgia Institutional Review Board.

RESULTS

The first analysis was designed to determine whether the frequencies of births per month of students receiving services under the EBD classification was different from the monthly birth rate of children in the State. Birth rates for the State of Georgia were obtained from the natality data set prepared by the Centers for Disease Control and Prevention and the National Center for Health Statistics for the years of birth of the sample studied in this investigation.

In order to facilitate the analysis of these potential differences, an

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expected value was calculated for births per month for the 8,578 students studied, based on the proportion of births that occurred in the general population each month for a specific year. Thus, for each year of the study, the proportion of births in Georgia per month was multiplied times the number of births occurring for the children in EBD. These calculations were carried out separately for African American and European American students because the monthly birth patterns of these two groups were determined to be somewhat different. When the expected values were compared to observed values across the 120 months of the study, significant χ^2 values resulted for both the African American ($df = 119$; $\chi^2 = 130.44$; $p < .05$) and European American ($df = 119$; $\chi^2 = 148.83$; $p < .01$) students.

To help visualize these data, monthly expected and observed birth rates for both African American and European American students were aggregated across the 10 birth years of the study. Table 1 reveals that for both samples, fewer than expected numbers of births occurred September and October, and many more births than expected occurred in June, July (African Americans only), and August. Although the overall pattern was similar, there were some differences between the birth patterns for African American and European American students. African American students had a birth nadir in November whereas European American students nadir was in October; European American students' birth rates were as expected in July whereas that of African American students was greater than expected for the same month.

Figure 1 presents these same data in a somewhat different form; that is, as percentage discrepancies from expected values ([observed−expected]/expected). Figure 1 reveals that for both groups, EBD placement was 15%

Table 1. Birth Month of Children With a Diagnosis of Emotional and Behavioral Disorder Compared to Expected Frequency Based on Population Values

	African American			European American		
Birth month	Observed	Expected	Difference	Observed	Expected	Difference
September	251	294	−43	408	456	−48
October	216	275	−59	354	436	−82
November	236	275	−39	417	415	2
December	286	279	7	451	427	24
January	291	276	15	408	416	−8
February	278	270	8	400	413	−13
March	262	257	5	449	431	18
April	247	246	1	416	427	−11
May	273	249	24	450	426	24
June	286	265	21	475	429	46
July	322	285	37	449	449	0
August	319	297	22	512	455	57

Note. Observed and expected sums are marginally different from the sample size (1.4% less) due to adjusting the data for number of days per month.

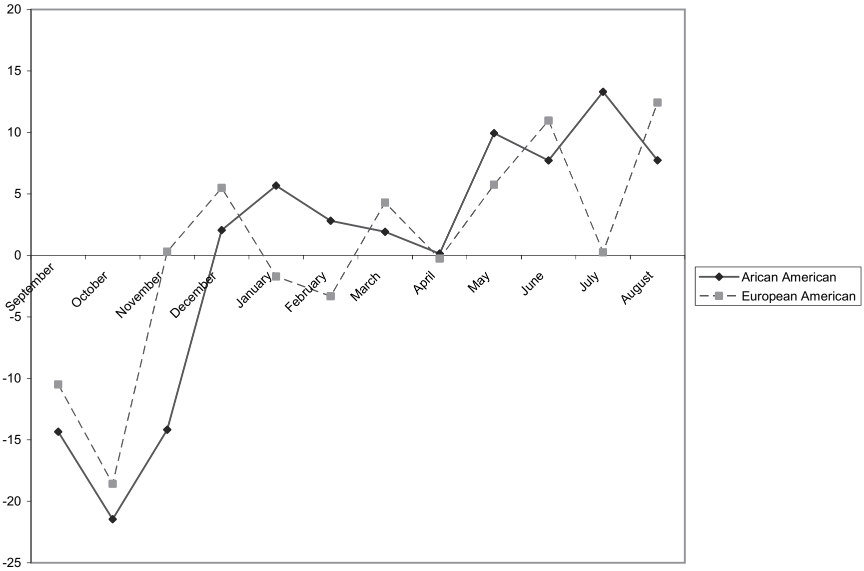

Figure 1. Percent discrepancy between observed and expected births per month of African and European American students receiving services for emotional and behavioral disorders.

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to 20% below expected levels in September through November and approximately 10% above expected levels in the period May through August, with some differences due to ethnicity.

Our analysis of births of students with EBD from 1983–1994 demonstrated a trend in the birth patterns in expected directions. However, we were interested to determine whether this overall trend was systematic across the 10 years of data analyzed. To find any significant cyclical trends in the data, time series analysis was utilized.

Time series data are relatively rare in psychological research. They consist of assessments of some behavior or condition that are carried out over time. Data are assumed to be continuous (on an interval or ratio scale), observations are at equally spaced time intervals, and at least 50 observations are required (Warner, 1998). The purpose of a time series analysis is to break down the variance that is obtained of the series into cycles. For example, data obtained for student behavior on a daily basis over an entire school year might result in a weekly cycle (conduct is worse early and late in the week), and an annual cycle (conduct is worse early and late in the year). This is determined through the use of a periodogram, which calculates the amount of variance accounted for by all possible cycles; in the example just given, the shortest possible cycle is a two day (up, down) cycle, and the longest is an annual cycle. In some applications, observations for cycles that are proximate to each other (6, 7, and 8 cycles) are aggregated based on specific weighting of each cycle to form a clearer picture of periods of time over which the cycle operates. This process of cycle aggregation is referred to as spectral analysis.

In the current application, a periodogram was created for both African and European American students (see Figure 2) indicating the proportion of variation in scores that was attributable to cycles of varying lengths (2 months through 12 months). Before this analysis, the data had been detrenched; that is, general increases or decreases in annual numbers of births were eliminated. Using the *g* statistic (Warner, 1998), which compares variance attributable to each cycle to overall variation in the time series, it was determined that for African American students there were significant cycles at 12 months and 6 months. There was a significant annual cycle showing a peak in July and a nadir in October ($g = 0.129$; $n = 120$; critical value = 0.114; $\alpha = 0.05$). There was also a significant 6-month cycle with one peak in January and one peak in July ($g = 0.123$; $n = 120$; critical value = 0.082; $\alpha < 0.05$). For European America students, all *g* statistics were nonsignificant. However, spectral frequency indicated for descriptive purposes that the largest frequencies occurred for 3- and 4-month cycles.

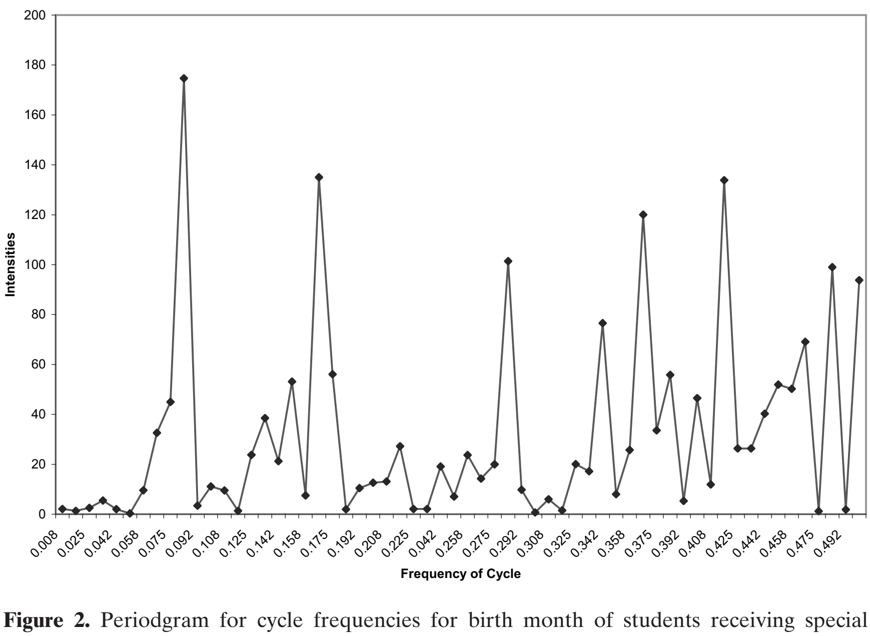

Figure 2. Periodgram for cycle frequencies for birth month of students receiving special education services in the emotionally and behaviorally disordered category.

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DISCUSSION

The purpose of this study was twofold. First, we wanted to determine the birth patterns of children and adolescents who received special education services through the program for children with EBD. Second, if such effects were found, we wanted to investigate whether these seasonal effects followed cyclical patterns over the 10-year period we studied. We found that seasonal effects did exist for both African American and European American students with EBD; both groups had fewer than expected births in the months of September and October, and greater than expected births in May, June, July (African Americans only), and August. For African American students, we found statistically significant annual and 6-month cycles. We did not find a statistically significant cycle for European Americans, although spectral frequencies indicated the largest frequency was for a 3- to 4-month cycle.

The importance of these results is that they open up to investigation etiological questions that are not suggested by current theories of behavioral and emotional difficulties of schoolchildren. Most current theories posit that such problems are the results of genetic, caretaker (parent, teacher) interaction, peer, macroenvironmental (socioeconomic status) factors, or the interactions of all of these. Although not denying these well-researched factors, none of these theories predict that there would be seasonal differences in birth dates of children manifesting these problems. Thus, season-of-birth research helps focus the attention of the practitioner and research communities of other factors that may play in behaviorally and emotionally based school problems.

Our results are comparable to other season-of-birth research, especially as it pertains to learning-based and affective disorders. For example, Martin et al. (2004) found that children born in the months of June, July, and August were diagnosed with specific learning disabilities at a greater than expected rate. In a related finding, research by Livingston et al. (1993) indicated that children with dyslexia are born more commonly during May, June, and July. The research is also consistent with that of Greer (2005), who found that children with anxiety and other internalizing problems are born with significantly greater frequency in the spring and summer months.

Two primary explanations exist as to why children with affective and learning-based pathologies are disproportionately born in the summer months. The first is that children born in the summer months are cognitively and socially less mature than their peers. Most schools in the United States have a September 1 cutoff for school entry. Therefore, those born in the summer months (up to August 31) are the youngest in their grades. As a result, these children's central nervous system is less mature, specifically

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in the realms of self-regulation of attention, emotion, and other functions (e.g., memory; Siegler, 1991). These and other functions located in the frontal lobe are responsible for selective attention (Miller, 1991), metacognition (Garner, 1991), and inhibitory control (Barkley, 1998). Martin noted that all of these functions are known to become more efficient with age and are associated with neurological maturation. In other words, summer-born children are cognitively less equipped to deal with the academic and behavioral demands (such as remaining seated for extended periods) placed on them in a school setting. In addition, Martin explains that young-in-grade children maybe at a social disadvantage in terms of peer relationships relative to their older, same-grade peers. The younger children tend to be physically smaller, weaker, and less physically and socially skilled overall. Taken cumulatively, these disadvantages can result in lowered self-esteem, which leads to lower on-task behavior, lower achievement when compared to older children (Pellegrini, 1992), and may result in more behavioral and emotional problems.

Another explanation as to why children born in the summer months seem to be at greater risk for affective and learning-based pathologies reflects the possibility that these children are in midgestation during the winter months, considered a risk period for later social-emotional outcomes (Dombrowski, Martin, & Huttunen, 2003). Prenatal insults such as pneumonia and influenza occur with greater frequency during the winter months, peaking between December and the beginning of March (Glezen & Couch, 1997). These infections can impair fetal central nervous system development (Mednick, Machon, Huttenen, & Bonett, 1988; Takei, Murray, et al., 1995). In addition, less ultraviolet light, the type of sunlight that produces vitamin D, is available in the winter months. There is credible evidence that women of childbearing age, especially at higher latitudes during the winter when receiving less ultraviolet light, are more likely to be vitamin D deficient (Nesby-O'Dell et al., 2002), potentially impairing central nervous system development. Greater birth weight is considered a protective factor against pathology for newborn infants, and several studies have found that maternal exposure to increased sunlight during the first trimester of gestation is correlated with increased birth weight, length, and height when the child reaches 18 years old (Tustin, 2004; Waldie, Poulton, Kirk, & Silva, 2000).

In most season-of-birth research, birth rates are aggregated across many birth years because of low sample sizes. This makes time series analyses impossible. In the current study, time series analysis revealed a systematic 6- and 12-month cycle of increased number of births for African American children receiving EBD services, with peaks in January and July. This finding of a systematic increase in births in January provides some evidence of a season-related perturbation of development, because January births are unrelated to age-in-grade. However, there was less evidence

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for a systematic birth pattern for European American students receiving EBD services, although clearly they were born at higher rates in the spring and summer. This simply means that during some births years, spring- and summer-born students were disproportionately diagnosed as EBD, whereas for other years this pattern did not occur. This result could occur if there were specific environmental factors related to seasons (extremely cold winters, lowered vitamin D levels because of increased cloudiness during the winter, higher rates of maternal viral infection) that affected the development of the fetus but that did not occur every year. At this time, the factors producing these differential birth cycles for African American and European American students remains unclear.

IMPLICATIONS FOR SCHOOL PSYCHOLOGY

There are several practical implications of the findings of this study, and the implications are directly related to the interpretation that is made of the data. If the immaturity hypothesis is accepted, the possibility must be considered that summer-born children are overdiagnosed for pathology, receiving costly special education and psychological services that they do not necessarily need. This practice may place an undue financial and human resource burden upon the public schools. Just because a child is socially and cognitively immature compared to her peers does not necessarily mean she has, or will develop, pathology. However, if the prenatal perturbation hypothesis is accepted, and summer-born children receive higher rates of special education services because of increased rates of prenatal insults, one could argue that the disproportionate services provided for spring- and summer-born children are wholly justified. Such an interpretation would argue for early identification of these at-risk children and would lead to early intervention of their developmental problems, giving the child a greater chance of academic and social success throughout their academic careers.

If there is any merit to the prenatal perturbation hypothesis, then educational policy setting early fall cutoff dates for school entry have inadvertently disadvantaged children that are already at risk of school failure. That is, the fall cutoff date has guaranteed that the youngest, most immature students are also most at risk because of prenatal perturbation. A better cutoff date from this point of view would be January 1. An alternative would be biannual cutoff dates for school entry, although such a policy would require adjustment of a number of school activities, such as annual achievement assessment. School psychologists can help with this problem by helping teachers and parents understand that the youngest

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children in grade may have difficulty with reading and other academic activities, in part because of their maturation. These maturation effects are thought to be minimized by grade 5 for most children, thus parents may wish to keep their children with their age cohort to see whether the problems ameliorate with time. Also, school psychologists are encouraged to increase their awareness of prenatal conditions that adversely affect development and to gather information on the prenatal history of their clients from parents.

Continued research is necessary to determine whether the results of this study regarding higher rates of services for spring- and summer-born children generalize across different regions of the country. In particular, study of birth patterns of EBD students from school systems with different cutoff dates would be particularly helpful. Additional intensive study of samples of birth patterns of premature and/or low birth weight infants might be helpful, because these perinatal factors are known to have social/emotional consequences for child development.

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National Standards for High School Psychology Curricula

The American Psychological Association (APA) welcomes feedback on the *National Standards for High School Psychology Curricula*, a document created for policy makers, educational administrators, and teachers. These standards outline what high school psychology students should be taught in the introductory psychology course. The standards emphasize the importance of the scientific foundations and applications of psychology and demonstrate the breadth of the field of psychology in the high school curriculum. The document is available online at http://www.apa.org/ed/natlstandards.html.

The second revision of the standards will begin in 2007, and recommendations for revision are currently being solicited. Comments and recommendations will be accepted via an online submission form, available online at http://www.apa.org/ed/natlstandards.html. Recommendations must be submitted by May 1, 2007.

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