Special FOCUS

MUSIC AND THE BRAIN

DOES MUSIC MAKE YOU SMARTER?

This discussion explores some of the research studies that have proposed connections between musical involvement and general intelligence.

BY STEVEN M. DEMOREST AND STEVEN J. MORRISON

Recently, there has been much positive press regarding music's impact on general intellectual development, which can be best summed up by the slogan "Music makes you smarter." Most of this attention has centered on two sets of studies done by a group of researchers at the University of California at Irvine. The first series of studies documents a short-term increase in performance on a spatial reasoning task after listening to Mozart, often referred to as the "Mozart effect."[1] The second series concluded that piano instruction caused preschoolers to improve on a single test of spatial reasoning ability.[2] While these studies were intended to focus on one extremely narrow aspect of human intelligence and its potential relationship to musical structure, they have been used to give the impression that any musical study benefits any academic endeavor. However tempting such a claim may be, a closer look at the findings suggests that it would be imprudent to make such a broad generalization.

In all the recent press about the potential benefits of music and music instruction, there is an implicit assumption that "smarter" means "smarter at something else."

Music teachers are often expected to be familiar with this research and to be able to answer questions about it. For this reason, this article will carefully review some of the better-known studies examining potential relationships between music or music instruction and other areas of knowledge. We will address the specific results of the studies, discuss where they are most often misinterpreted or overstated, and identify alternative points that music teachers may wish to emphasize. To use this information as a basis for music in the school curriculum without a thorough knowledge of the details surrounding it may ultimately weaken the future of our profession. As one author put it, we shouldn't "jump on a bandwagon before we know if it has wheels or where it's going."[3]

Smarter at What?

The title of this article raises an important question and, at the risk of losing readers beyond this point, we would like to end the suspense by providing the answer up front: yes. Music, or at least music education, does make you smarter. We are confident in this answer because there is a wealth of research that demonstrates without a doubt that music instruction makes students smarter in music. Unfortunately, that is not what most people mean when they say, "music makes you smarter." In all the recent press about the potential benefits of music and music instruction, there is an implicit assumption that "smarter" means "smarter at something else." When we encounter a person who

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demonstrates remarkable ability in mathematics, we say, "What a smart person!" However, if we encounter a person demonstrating outstanding ability in music, we say, "What a talented person!" Why should we react differently to two individuals who excel in divergent fields of human endeavor? "Smart" seems to describe a characteristic that is desirable for all students to develop; talented is considered an admirable trait that some people mysteriously seem to possess. Thus, while intelligence can be nurtured, it is assumed that talent is either present or absent from birth. This philosophy is antithetical to our role as music educators.

Contemporary theorists such as Howard Gardner purport that what we commonly call "intelligence" is really an amalgam of many separate intelligences.[4] Linguistic, logical-mathematical, spatial, and bodily-kinesthetic are some of the areas that have been proposed as separate intelligences, or unique ways of knowing. Among these, no higher or lower in importance than any other, is music. If music is truly an intelligence unto itself, then we can say without hesitation that the study of music will make a person smarter—it will develop his or her musical intelligence. More important, Gardner's theory suggests the possibility that each way of knowing the world has its own inherent value and is worthy of study for its own sake.

The "Mozart Effect"

In a January 14, 1998, Associated Press release, it was reported that "Gov. Zell Miller, an avid country-music buff, wants all Georgia newborns to have the chance to listen to soothing classical music. His hope is to boost baby brain power. Miller asked the legislature on Tuesday to spend $105,000 in tax dollars to pay for CDs or cassettes of hand-picked classical music."[5]

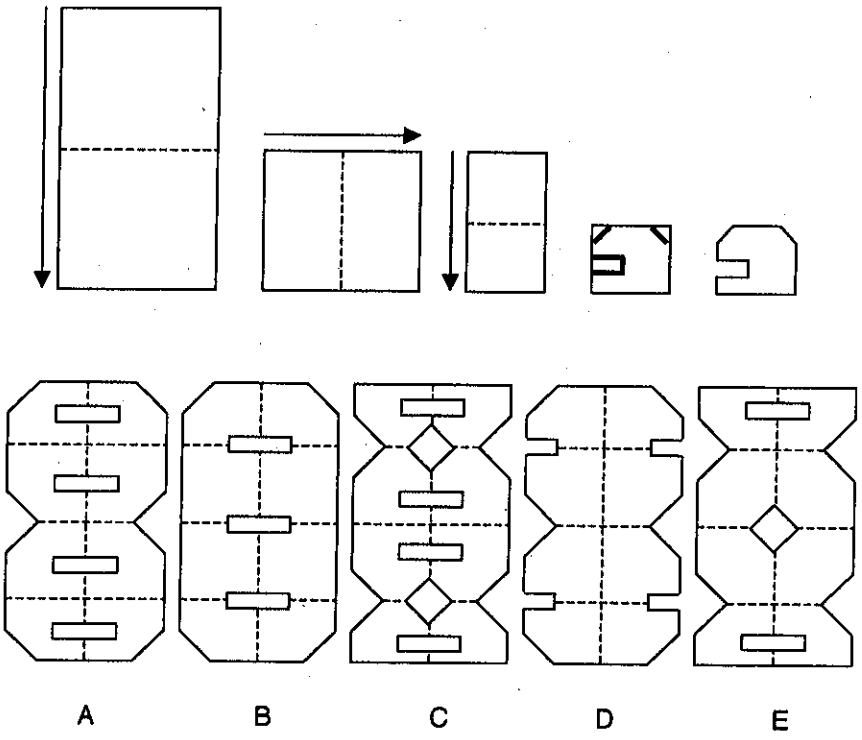
The much-discussed "Mozart effect" refers specifically to improvement on a single spatial reasoning task exhibited by college students after ten minutes of listening to Mozart's Sonata for Two Pianos, K. 448, as demonstrated in a 1993 study, the conclusions of which were retested in a 1995 study.[6] The 1995 study was the larger of the two; it involved seventy-nine college students taking a single spatial reasoning test derived from a subtest of the Stanford Binet Intelligence Scale, thought by the authors to best represent spatial-temporal reasoning. The task involved the completion of sixteen exercises in which the students had to work out in their minds the shape and design of a piece of paper that had been folded and cut (see Figure 1). After taking the test together the first day, the students were divided into three groups for days two through five. Prior to retaking the test, twenty-six students listened to ten minutes of silence, twenty-seven students to ten minutes of Mozart, and twenty-six to a mix of minimalist music, dance music, and spoken text. The group that listened to Mozart improved significantly from day one to day two and from day two to day three while the group that listened to silence also improved, but only from day two to day three. On a separate short-term memory test, the presence of music made no difference at all. The authors concluded that the Mozart group's improvement was due to listening, while the silence group's improvement was due to a learning curve. There was no explanation as to why similar results should be interpreted as having two distinct causes. It should also be noted that several attempts by other researchers to replicate the Mozart effect under similar conditions have failed.[7]

The belief in a link between the study of music and improved achievement in other areas of schooling goes back a long way.

It is intriguing to consider a possible connection between musical structure and certain types of cognitive activity, as Gordon Shaw and his colleagues have done.[8] It is important to note that the results of these studies apply only to a single spatial subtest from the Stanford Binet intelligence scale; so the effect is much narrower than general intelligence as measured by IQ.[9] Yet, a headline from a recent advocacy report used these same results to suggest that music "Raises IQ Scores."[10] Also, these studies were conducted with college students with no report of their musical training or background. It may be inappropriate to apply these findings to the musical education of children. Finally, though the reported improvement has been dubbed the "Mozart effect," the studies to date have employed only a single Mozart composition. No studies have tested whether or not the effect holds true for other works of Mozart, or those of his contemporaries.

Though the results are interesting, there is a long way to go before establishing any direct connection between musical organization and the inner workings of the mind. Since music is organized by humans for humans, such a connection is logical to consider, though the complexity of the relationship may be difficult to explain. Having parents rushing out to buy Mozart CDs will certainly not hurt children and may provide a certain type of cultural enrichment—at least involving one culture. The harm comes when these results are viewed either as a rationale for music education, or as a curriculum guide.[11] One of the most exciting and important changes in music education over the last twenty years has been the "globalization" of our curriculum. We should not promote the relatively untested contention that only the works of a single European composer possess some superior architecture that enhances general intelligence. If we do, then we are guilty not only of a poor application of science, but cultural imperialism.

Figure 1. Example of the paper folding and cutting task



Note. Students were instructed to visualize the folds and cuts and then choose the letter of the example that looks like the same piece of paper unfolded. The correct answer is "C."

Keyboard Training

In a 1997 news release, the American Music Conference announced the following:

> A research team exploring the link between music and intelligence reports that music training—specifically piano instruction—is far superior to computer instruction in dramatically enhancing children's abstract reasoning skills necessary for learning math and science.[12]

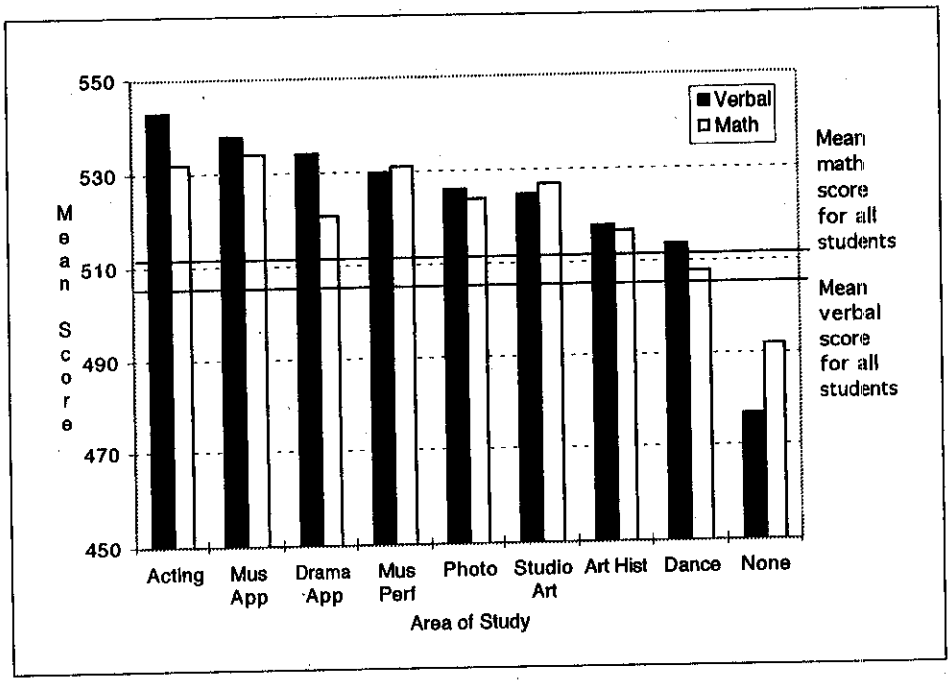
Similarly, in the then MENC president's testimony before Congress in 1999, the following was reported:

> One group of children received piano keyboard lessons. Another group received computer training, and a third group received no special instruction. The children who received piano keyboard lessons scored significantly higher on spatial reasoning tests than the other children who were matched in IQ and socio-economic status—34% higher to be exact. Spatial-temporal reasoning involves higher brain functions that are needed to solve complex math and science problems. Thus, the findings pointed to a direct link between music instruction and math and science aptitude.
>
> Dr. Rauscher expanded her work to determine if this remarkable improvement could be found with children in a public school setting. The answer was a resounding "yes." She replicated her earlier study but used kindergarten students rather than preschoolers and group piano instruction rather than private lessons. She found that students receiving keyboard instruction outscored those who received no formal music training by an astonishing 48% on spatial reasoning tests.[13]

These quotes illustrate the ways in which the results of some studies have been used to support the idea of a connection between music education and math and science. The details of the studies reveal a somewhat different picture. In one study, nineteen three- and four-year-olds received eight months of music training consisting of thirty minutes of singing daily and ten to fifteen minutes of keyboard a week, while fourteen children in the control group received no music instruction.[14] After four months and again after eight months, they were tested on five tasks dealing with spatial reasoning. The music group showed significant improvement on one of the five tasks—object assembly—and scored significantly higher than the nonmusic group. On the other four tasks, there was no difference in either base scores or improvement between the two groups.

A second study was performed to test these results, adding a group that received keyboard training—not on the piano, but on the computer keyboard—and a group that received only singing instruction.[15] In this study, thirty-four three-year-olds received eight months of music training con-

Figure 2. Mean SAT scores for fine arts students, 1999



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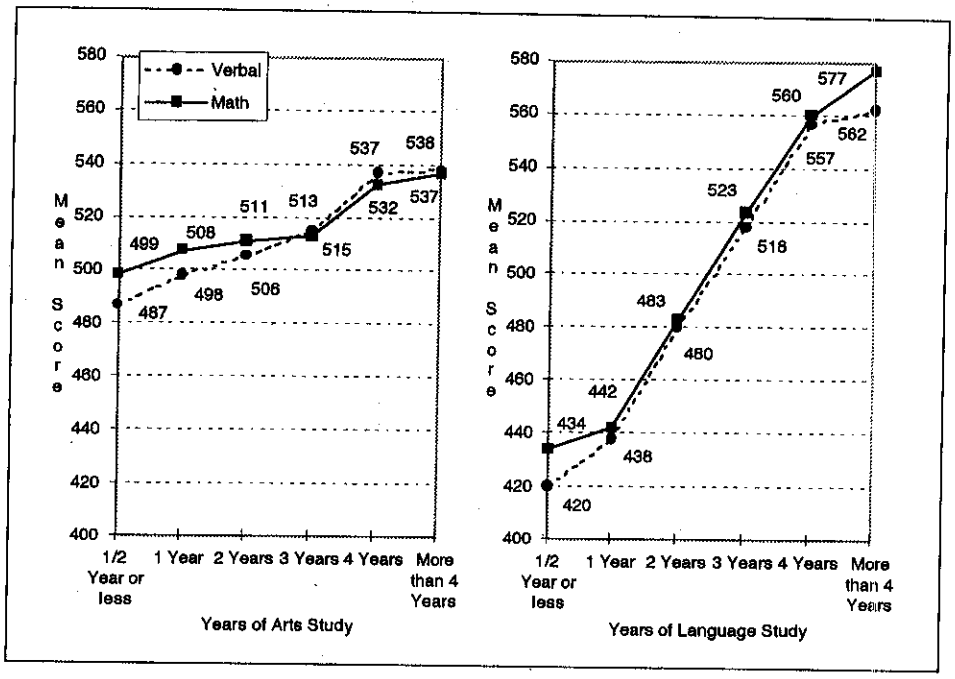
sisting of thirty minutes of singing daily and ten to fifteen minutes of piano keyboard instruction a week. One of the piano keyboard groups received lessons twice a week for six months. The keyboard subjects also had an hour a day set aside to practice, though practice time was not recorded. Three other groups were divided as follows: (1) twenty children received computer keyboard lessons of the same length and number as the piano lessons; (2) ten children received only the half hour of daily singing with no other music instruction; and (3) fourteen children received no music instruction and no computer training. Four separate tests were given before and after training. One test assessed spatial-temporal reasoning while three assessed spatial recognition. The music keyboard group showed significant improvement only on the spatial-temporal reasoning test; no other groups showed significant improvement on any of the tests. The improvement was classified as "long-term" because it lasted at least one day.

These studies suggest an exciting link between piano training and spatial reasoning.[16] But, while it would appear that some aspect of piano instruction could have caused the improvement, music educators should interpret these results cautiously. As with the Mozart studies, the nonmusical benefit was realized only for a very specific type of reasoning measured by a single standardized subtest. The results could just as easily be stated, "Keyboard training has no impact on three out of four tests of spatial intelligence" or "Keyboard training helps children assemble puzzles rapidly," not quite the same as increasing their aptitude for math or science. Music educators might also be concerned over the lack of improvement for the singing group. Summaries of this study often report only three groups: keyboard, computer, and "other controls"; they do not differentiate between the control group that received no instruction and the control group that sang for half an hour a day.

If we were to reform music education based on these results, we could simply provide all children with fifteen minutes per week of private keyboard instruction. General music, with its emphasis on group music making, would either be eliminated or substantially changed since children who sang together for half an hour a day (far more than the public school norm) showed no significant improvement on the tests! (The authors are well aware that a comprehensive elementary music program consists of much more than group singing, but there is a clear and appropriate emphasis on vocal music in the elementary music classroom.) Despite the obvious enthusiasm for this research, there seems to be considerable disparity between what the study defined as music training and what we do in public school music education. Researchers are beginning to explore whether or not similar improvements might be realized from more comprehensive approaches to music education, but results thus far are mixed.[17]

Figure 3. Mean SAT scores of fine arts and foreign/classical language students by years of study, 1999



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Music and Academic Achievement

In her testimony before the U.S. House of Representatives, Joan Schmidt, member of the board of directors for the National School Boards Association (NSBA), said, "I'm here to tell you that NSBA supports raising student achievement, and we know music can do that. Students who participate in music earn higher grades and score better on standardized tests."[18]

The belief in a link between the study of music and improved achievement in other areas of schooling goes back a long way. Will Earhart, speaking in 1919 as president of the Music Supervisors National Conference (now MENC), claimed that knowledge in such disparate areas as mathematics, geography, and vocational training was enhanced by a strong musical education.[19] Anecdotally, music teachers often relish sharing stories of their students' multiple successes throughout the school community. Empirically, it has been reported that music students receive higher grades in math, English, history, and science; higher test scores in reading and citizenship; and more general academic recognition than students who do not participate in school music activities.[20] In light of such positive data, it is tempting to conclude that music must be a consequential variable in elevating student achievement. However, these findings potentially tell us more about our students than about the effects of music.

SAT scores. Let us consider students' performance on the Scholastic Assessment Test (SAT). Statistics show that students who study music (and other arts) during their precollege years scored significantly higher on both the verbal and the mathematics portions of the SAT (see figure 2). Unfortunately, this information is often mistakenly interpreted to be a result of music study instead of a characteristic of music students. Recent advocacy materials in support of school music boast that music education "increases SAT scores."[21] Materials compiled by MENC refer to the "effectiveness of music study in helping children become better students."[22] The Web site of one school music program emphasizes the "impact that the arts have on SAT scores."[23] Interpretations such as these suggest that music study plays an active role in raising levels of academic achievement. At present, we cannot say this with any confidence other than that which comes from our hoping it is so.

Looking again at the data, average SAT scores for music students are, indeed, above the average for all students and well above the average scores of students not participating in school fine arts study. However, they are not the highest. Math and verbal scores of students enrolled in acting and verbal scores of students studying drama appreciation were even higher. Additionally, scores of students enrolled in music appreciation were higher than those of students participating in music performance. If we wish to argue that part of music's value lies in its correlation with higher test scores, we must also acknowledge that the study of acting and drama may be more valuable

and that membership in a music appreciation class may be more valuable than ensemble participation.

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Research in neurology has demonstrated that all human beings are born with musical brains.

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A second finding is that SAT scores were higher among students who studied arts for a greater length of time (see figure 3). Again, we are tempted to conclude that the longer one participates in music, the greater the improvement in academic performance will be. It is just as likely that this result is more a reflection of attrition than advancement. In other words, students who are the highest academic achievers are the ones who tend to remain music participants throughout their school years, while students who struggle academically may be more likely to end their musical involvement early. Furthermore, this trend is not exclusive to fine arts study. As shown in figure 3, test scores of students enrolled in foreign and classical language courses—another elective offering—also increase with years of study, even more dramatically than those of fine arts students.

Scholastic progress over time. To gain further insight into the relationship between music and academic achievement, we need to compare the scholastic progress of students over time. We might also consider the academic profile of students prior to their selection of a music elective. A recent doctoral dissertation compared two groups of elementary students, one group that elected to begin fifth grade instrumental music study and one group that did not.[24] Using the results of the Comprehensive Test of Basic Skills (CTBS) as a measure, the researcher found that the music participants did, indeed, score significantly higher as sixth graders, after one year of pull-out instrumental study. However, these same students also scored higher as fourth graders, before entering the school band program. These results indicate that students who scored better on the CTBS elected to join the band, not that joining the band promoted improvement on the CTBS. A further result of this study showed that students who elected instrumental music but dropped out before completing an entire year of study scored lower than students who completed a year of study, but higher than the students who did not elect band at all. Assuming this trend were to continue throughout the school years, it would lead to the SAT profile described above, that students who stayed in music longest received the highest test scores.

While these realizations may seem to undermine popular rationales in support of school music, they may allow us to consider alternative, and possibly more compelling, arguments. Suppose, instead of claiming that "music makes you smarter" (academic achievement as a result of music study), we accept the equally likely conclusion that students who participate in music and the other arts tend to be the most academically successful (music study as a characteristic of academic success). Rather than teachers arguing the value of a musical education by citing its effect on grades and test scores, teachers could argue that academically successful students value music education and choose to spend their time making music. And the most successful among them are choosing to make music for the greatest length of time.

Conclusion

While our profession may continue to benefit from the recent public perception that music makes people smarter, we should be honest with ourselves about the true benefits of musical involvement. Future research may indeed strengthen the connection between music and other forms of intelligence, but musical intelligence and achievement is its own reward, as seen countless times in our students. Like other researchers in this area, we are optimistic about what science can do for music education, as long as the science in question takes into consideration music education theory or practice. As Bennett Reimer points out, music educators should be more concerned with what science like this might do to music education by putting us in the vulnerable position of presenting our field as a means to an end rather than an end in itself.[25] Already articles, such as "Mozart for Baby? Some Say, Maybe Not" and "Prelude or Requiem for the Mozart Effect," question the popular interpretations of this research, and warn parents to view these results cautiously, if not skeptically.[26] While we are sounding a cautionary note in this article, the attention generated by this research does offer our profession an unprecedented opportunity to educate people about the many positive benefits of music participation.

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For example, one piece of evidence that can be gleaned from the available data is that music participation does not interfere with academic progress. Students in music pull-out programs and those with greater years spent in arts education maintain a higher than average level of academic achievement. This is a direct contradiction to the

"back to basics" mentality that views music and other arts as frills that distract students from more important subjects. Whether or not music increases children's brain power, it clearly doesn't hurt it. Thus, the path to academic excellence would seem to involve multiple avenues rather than the single road of reading, writing, and arithmetic.

Research also strongly supports the contention that all humans are musical and can develop their musicianship. MENC's 1922 credo of "Music for every child, every child for music" might simply be shortened to "Every child is musical." Research in neurology has demonstrated that all human beings are born with musical brains.[27] As ethnomusicologist John Blacking observed, "There is so much music in the world that it is reasonable to suppose that music, like language, and possibly religion, is a species-specific trait of man."[28] What this means is that musical achievement is directly tied to the availability of a quality education in music and to hard work rather than to a predetermined amount of talent.

Another positive outcome of all the recent attention has been an increased awareness and enthusiasm on the part of music teachers regarding the potential relevance of music research for music education practice. Researchers actively engaged in exploring human musical cognition are always interested in studies that suggest connections between musical thinking and other forms of knowledge. As other articles in this issue illustrate, there is a wealth of research activity focused on a better understanding of the musical mind. We are optimistic that the years ahead will yield many exciting findings about the important cognitive, social, and emotional roles of music in human life.

Notes

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6. Frances Rauscher, Gordon Shaw, and Katherine Ky, "Music and Spatial Task Performance," *Nature* 365 (1993): 611; Frances Rauscher, Gordon Shaw, and Katherine Ky, "Listening to Mozart," *Neuroscience Letters* 15 (1995): 44–47.

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13. June M. Hinckley, statement before the Subcommittee on Early Childhood, Youth, and Families of the House Committee on Education and the Workforce, U.S. Congress, 15 July 1999 (available on www.menc.org/music_classes/advocacy/hinck2.htm).

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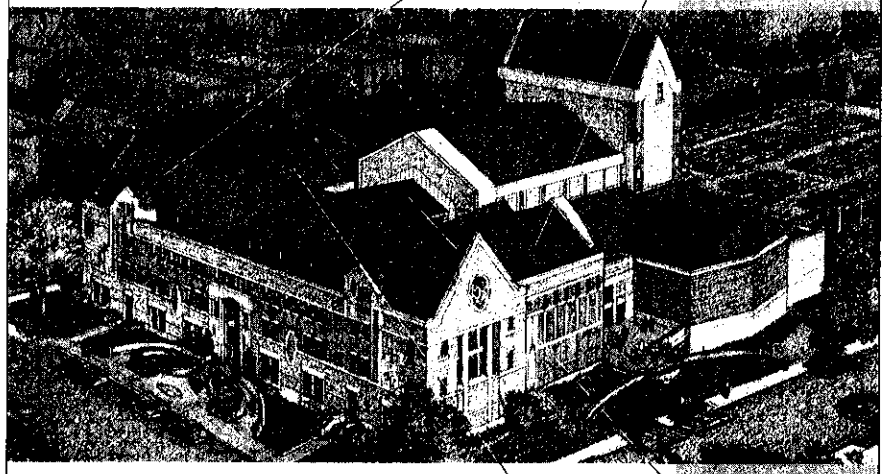

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