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Roots of Music Learning Theory and Audiation

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Foreword

Two bibliographies are included herein. The first, Gordon Bibliography, is integral to the subject of the paper. It contains only my own publications. The second, General Bibliography, includes publications of others cited in the text and relevant select references.

There is also a Glossary. It is intended primarily for readers who may be unfamiliar with some terminology in the text. It can also serve knowledgeable readers in recalling meanings and definitions.

Finally, though, with apology, errors of omission and commission may be uncovered, use of "the," "a," and "that" sparingly is not a mistake. When not necessary, they were avoided.

Introduction

For some time, I do not know exactly how long, critical music educators have been claiming there is no research to support music learning theory. They insist I have misrepresented facts. They are wrong on both counts! Probably they have not read many, if any, of my research reports or perhaps, they do not understand what they have read. Harassment reached a pinnacle in 2000. My colleagues urged me to write an article explaining the nature of research I had pursued, hoping that would take care of the matter. The paper, "Vectors in My Research" was published in 2005 in *The Development and Practical Application of Music Learning Theory*. It is a comprehensive article, however, that includes research more than about music learning theory. I did not hear or read any response from adversaries. It seems either they are unaware of the paper or are now conflicted in their thinking. Whichever the case, detractors nevertheless once again have raised the issue of absence of statistical research pertaining to music learning theory. Time would be better spent and all would benefit if naysayers actually engaged in research themselves in attempts to prove the theory amiss.

Because music learning theory indeed has formed the basis for development of rewarding music education curriculums in various countries, it seems incipient tests of statistical significance, when contrasted with successful practical and enduring application of the theory, would be supererogatory. That, however, not being the case, the purpose of this more specific article is to call attention again to research, hoping by publishing it in a more popular venue, it will be readily accessible to many readers of various persuasions. I am not unmindful of the possibility sincere music education researchers, current and future, experienced and inexperienced, might be stimulated by concepts espoused. Along with new explanations, it was necessary, of course, to paraphrase some prose from the previous article. Interested readers, nevertheless, will find it worthwhile to review the earlier one.

History

A short review of my background is apropos. In the 1950s, I was pursuing my PhD at University of Iowa. I arrived in Iowa City with a bachelors and two masters degrees, one of the latter in music and the other in education. Because most courses in music at University of Iowa were a duplication of what I had taken as an undergraduate and graduate student at Eastman School of Music, I was given an option of designing my own course of doctoral study with stipulations I pass foreign language requirements and pass comprehensive examinations in both music and education; education because I received an exceptional fellowship from College of Education. I was free and encouraged to enroll in and audit a variety of courses in addition to those in music and education. I became engaged in fine arts, educational psychology, linguistics, test development, measurement, and theoretical and applied statistics. I received my degree and became a professor in 1958.

Philosophy at the University was based on stimulus-response psychology. Gestalt psychology was virtually ignored. Thus, I was well indoctrinated with traditional experimental research techniques championing inferential statistics and tests of statistical significance. I did not question validity of what I was being taught. I accepted it without reservation and engaged in extensive application of experimental research. In fact, to the best of my knowledge, my doctoral dissertation was first in music education to use analysis of covariance.

Soon after I graduated, I began work on *Musical Aptitude Profile*. It was initially published by Houghton Mifflin in 1965. Although seven years intervened, time was devoted to various types of experimental and investigative validity studies of the battery in various public schools and institutions of higher learning. Design and results of all undertakings are copiously documented in the test manual. Several more experimental studies followed. Two more important ones are, *A Three-Year Longitudinal Predictive Validity Study of the Musical Aptitude Profile*, published in 1967, and *A Five-Year Longitudinal Study of the Musical Achievement of Culturally Disadvantaged Students*, initiated in 1970. While engaged in those studies, I served as general editor of six volumes of *Experimental Research in the Psychology of Music: Studies in the Psychology of Music*.

With your forbearance, a brief pause is necessary as backdrop to the forthcoming story. Because essence of music aptitude is intangible, the best option for validating a music aptitude test is to administer it to students before they receive substantial music education, and after a period of instructional time, the longer the better, administer music achievement criteria to those students. Of course, if the test and criteria were administered at the same time, it would not have been possible to determine whether results on one were cause of results on the other. Obviously, when an aptitude test is administered long before instruction and achievement criteria, it is reasonable to assume scores on the aptitude test precipitated results on the achievement criteria. If a majority of students who score high on an aptitude test also score high on achievement criteria and a majority of students who score low on an aptitude test also score low on achievement criteria, the aptitude test may be deemed valid for predicting degree of success in school music.

While conducting the three-year study, I began to question authenticity of highly wrought experimental statistical designs. The following story explains why. A boy in fourth grade earned a perfect score on all seven subtests of *Musical Aptitude Profile*. That is undeniably a rare occurrence. I was delighted because, if the boy also scored high on achievement criteria administered at completion of each year of study, that would contribute enormously to validity of the aptitude test. An unforeseen problem, however, had taken place. When I went to the boy’s elementary school a few weeks after the study had begun, I discovered he no longer was learning to play alto saxophone. I was told by the instrumental music teacher the student lacked talent and motivation, and he proved to be a nuisance. Both he and the teacher decided he should discontinue lessons. As is the custom to prevent potential bias in a predictive study, participating teachers were not informed of students’ music aptitude status.

School administrators permitted me to question the boy about the situation. After sufficient coaxing, he declared he had no music ability. Why? Because, he said, the teacher always gave a note the same name even though he thought the note was different. I ultimately understood what he meant. In one case he was audiating G as do in G keyality but as so in C keyality, but the teacher kept calling it G. The boy was frustrated because the instructor was mired in what in time I came to realize is an ineffective fixed system; specifically, pitch letter-names, time-value names, notwithstanding. The teacher confided in me there was reason to believe the boy was mentally deficient.

If the concept of audiation were understood by the teacher and taught as readiness for reading music notation, learning would have been in rational sequence and probably the problem avoided. I cannot conceive of an uncomplicated experimental research design that would have contributed so swiftly to such a simple but compelling, straightforward, and unpretentious conclusion. An epiphany! Serendipitous, amorphous birth of music learning theory had taken place. Thus, considering insight garnered, I was constrained to rethink veneration attributed to experimental statistical research. The subsequent realizations came to fore.

Traditional Analyses

Elaborate statistical research designs borrowed from agriculture, medicine, and natural science look good on paper and, thus, are deemed appropriate for educational research. That is a oversight. Without ample stratified random samples of a sufficient number of students from whom results are to be generalized, and unless all teachers are equally competent and well versed in one or more methods they are teaching, and that condition is rarely if ever met, pursuing statistically designed research in social sciences raises contentious issues. Though impractical and only rarely satisfied, need to engage more than one unbiased teacher to instruct students in each method is imperative.

To further exacerbate the situation, statistical experiments incorporating t-tests, F-tests, and Chi-square associated with analysis of variance and covariance or multivariate and canonical analyses are used to examine data to determine if derived differences are statistically significant or simply attributable to chance. Textbook technicians forewarn all have assumptions that must be affirmed. For example, individual students should be randomly selected and assigned to a specific method, all groups should begin at the same average level of academic accomplishment related to what is being studied and criteria used to determine if differences do in fact exist after instruction, and each group should have a normal distribution of students in terms of high, average, and low achievers in the subject being investigated. It is easy to understand why and how most or all of these requirements are unrealistic and, therefore, violated

Further, qualifying factors for applying tests of statistical significance and determining probability quotients are routinely violated. For example, statistical tests are dependent on power for positive results; that is, number of students (commonly referred to as N) who participate in an experiment. With more students (more power and, consequently, added degrees of freedom), it is easier to prove a statistically significant difference which may or may not actually exist. As implied, theoretical statisticians disagree with applied statisticians about whether students in an intact classroom constitute multiple degrees of freedom or an entire classroom of students who were not randomly assigned individually to a given method should be considered representative of only one degree of freedom.

It is axiomatic researchers opt for more power in attempting to elude negative effects of factitious findings and facilitate and substantiate favored results. Thus, conclusions are typically evasive, ambiguous, and unintelligible. On the other hand, when tests of probability support efficacious differences, naive researchers are encouraged to believe they have resolved an issue by virtue of only one study usually covering a semester or less. They are unaware a statistically significant finding simply informs colleagues of their research results and petitions them to replicate the study for verification or disputation.

A statistically significant result may have no practical significance regardless of how large or small the number of participating students. Given a substantial N, it is not uncommon for a minute impractical difference to be proved statistically significant. Techniques have gone so far beyond reflective thought, attempted reification typically renders reports of results beyond comprehension, particularly when an appealing statistical design determined choice of an imposed research problem. Not to worry, interpretation of results, in equivocation referred to as discussion, is substituted for conclusions. Most of this raised doubts in my mind concerning viability of conclusions of not only my own former and current statistical research, but also of others.

Statistical power is related to precision. Regardless of extent of power, unless a criterion measure has precision, that is, substantial reliability, mistaken non-significant results are almost assured. And, it is often the case, although a criterion is reliable, it lacks validity in relation to the research problem. Rather than spending time and energy designing a valid criterion measure, immature investigators ambitiously adopt an established one obliquely sensitive to the research problem. The situation becomes further aggravated when a researcher chooses a level of significance from computer output after data have been analyzed. That is akin to asking to view a gambling opponents' cards before betting. Rather than attempting to equivocate chance results by opting for a severe level of confidence to predict whether the same findings would occur if a study were replicated with a different but similar group of students under comparable conditions, actual replication of a study would be preferable.

Before so-called progress in designing research and analyzing data, humans for centuries relied on empirical evidence to guide quotidian activities. They learned what and what not to do based on experience, and they came to understand acquired information is not new. It is simply rediscovery of eternal truths. Of course, change is predictable and, thus, gleaned knowledge must periodically be reassessed, but that is so regardless of how knowledge is gained and assimilated. There is nothing that can be proved absolutely, truth of the moment, of course, not being forever.

Sagacious empirical researchers have theories that direct their inquiry and make biases obvious. They replicate inquiries with comity under a variety of conditions to determine if results are steadfast, and when not, they undertake new investigations to acquire more sophisticated information. Better yet, they encourage others to pursue similar experiences and empirical inquiry to cross validate their own conclusions. It is disagreement with one's previous research results or disagreement with colleagues' findings that advances human cognition.

Although being aware of problems associated with inferential statistics and tests of statistical significance, it was difficult for me not to continue in those paths, though I found them less and less attractive. However, as I weaned myself from habitual procedures, I relied on correlation studies as I made transition to researcher-teacher-observational studies. If one is familiar with range and scale of correlation coefficients and factors that affect magnitude of a correlation coefficient, practical knowledge renders tests of statistical significance unnecessary for interpreting correlational research results.

Given the foregoing background, I can properly explain my research that indirectly gave rise to results that support music learning theory and audiation. Particularly when studying music development of preschool children, because of their young age, it is not possible to administer a paper and pencil test to them and, thus, to depend on inferential statistics to investigate statistical significance. Nevertheless, I pursued both experimental and investigate research, distinguished in contemporary common parlance as qualitative and quantitative methodology, when apposite.

Revelations from Development and Use of Stabilized Music Aptitude Tests

My research in music aptitude was the catalyst that forced me to engage in alternative types of research. It was during the developmental period of *Musical Aptitude Profile* (MAP) and later in the national standardization program, which included a stratified random sample of more than 10,000 students, so much unexpected information was revealed. By unexpected, I mean although my primary concern was with subjective aspects of MAP--such as content, construct, and process validities--I was inundated with unanticipated fascinating facts, facts relating to issues that had not crossed my mind and, thus, I had no clue might be uncovered. MAP became an unanticipated astonishing validity criterion for unintended research problems. Findings, though indirect, were so disarming, they became foremost in my eventual interest in two vital subjects that continue to permeate my writings: music learning theory, of course, and audiation.

Before I become more specific to the topic at hand, you might find it interesting to know, among many other compelling facts I discovered from analyses of data derived from the MAP standardization program, slightly under 50% of students in grades four through twelve across the country whose MAP composite scores were above the 80th percentile had not or were not receiving any special instruction in school music. And, the situation worsened with ongoing years of study. In fact, a more recent figure for elementary school students who participated in *Primary Measures of Music Audiation* (PMMA) and *Intermediate Measures of Music Audiation* (IMMA) standardization programs is currently above 50%. That information is alluded to in respective test manuals and more patently explained in separate research undertakings pertaining to validity of the tests.

Pertinent information is reported in *The Manifestation of Developmental Music Aptitude in the Audiation of "Same" and "Different" as Sound in Music*.

I was well acquainted with *Seashore Measures of Musical Talent*s, both 1919 and 1939 editions, and a majority of research of Seashore's advocates and adversaries in America and abroad. I also studied research of Herbert D. Wing that culminated in England in *Standardized Tests of Musical Intelligence*. In comparison to other tests of music aptitude, Seashore's and Wing's were most creative and best documented. Additional tests were largely configurations of the two. Disagreements among authorities, nonetheless, were enormous and I naturally had opinions of my own. Fundamental among scholars--such as James L. Mursell and a majority of his American and European adherents who did not publish tests but nonetheless were ardent critics of Carl E. Seashore's work--was discussion of what should be included in a music aptitude test (content validity), how it should be measured (construct validity), and how test results are best interpreted (process validity). Seashore was dubbed an atomist and Wing a Gestalist.

Among other uses, a well constructed music aptitude test battery provides teachers with necessary information for improving music instruction by assisting them in teaching to students' individual musical differences in terms of musical strengths and weaknesses. In initial developmental of MAP, decisions had to be made about content of the test battery, how many subtests might be included in the battery to cover the broad spectrum of music aptitude, what content of the subtests might be, and how content might best be measured. My approach was to examine and determine subjective and objective validity of better known existing tests, develop novel tests in accordance with new knowledge and techniques, and compare new tests to one another and new tests with existing ones.

I will begin with tonal tests initially designed for fourth grade (nine year old) students and older. Findings coupled with those of knowledgeable colleagues and my own intuition unraveled what extant tonal tests were actually measuring, regardless of their titles. Experimenting with various types of new tonal tests, it became apparent a fundamental attribute required for a tonal test to demonstrate substantial validity was content had to be embedded in context. There were other discoveries, too, and they are presented below and in the MAP manual under the extensive section dealing with eight years of development of the battery.

Tonal Considerations

* Establishing tonality before pitches were heard, or better, performing patterns in a music context, provided students with ability necessary to audiate and, thus, to more musically respond to test questions. It also substantially raised validity coefficients.

* Ability to discriminate pitches heard in isolation of established tonality (for example, major or minor) had, at best, borderline reliability and only minimal concurrent (or criterion related) validity when resultant scores were correlated with outside criteria associated with school music achievement.

* Students who scored high on tonal aptitude tests used or attempted to use a singing voice quality. When they did sing, most imitated without intrinsic understanding of music. However, some students who did not sing also scored high. That is, singing ability was not requisite for attaining lofty scores.

* The more tonalities included in a test, such as Dorian, Phrygian, Lydian, Mixolydian, Aeolian, and Locrian, in addition to major and minor and contemporary configurations, greater validity of a test. In analysis of data, however, no relationship was discovered between students' test scores and their music education and music experiences.

* Formal instruction in music, knowledge of music theory, and ability to read music notation were of no assistance for scoring high on music aptitude tests, although some students with supposedly high music aptitude were so indoctrinated with theoretical music achievement it appeared to prevent them from attaining superior results. They depended on knowledge and experience rather than trusting intuition when listening to test questions. That, of course, detracted from initial validity of the tests.

* Test validity increased when short melodies of original music were used as content for test questions.

* Tonal patterns, including a group of three or more pitches, rather than only one or two isolated pitches, enhanced students' audiation and increased test validity.

* Without specially composed music, tests functioned primarily as music achievement tests, not as music aptitude tests.

* Melodies performed on music instruments, particularly strings and excluding piano, were preferable for obtaining acceptable validity and maintaining interest of elementary school students. Over the years, however, that has not been found to be the case for very young children. With advent of synthesizers, construct validity, pertaining to media, has become a relatively complex matter.

* Need for at least two types of tonal tests--such as melody and harmony--was obvious. They demonstrated low intercorrelation with each other but relatively high correlation with outside validity criteria. In most cases, scores on tests of harmony predicted success in school music better than scores on tests of melody.

* Regardless of students' composite tonal scores being high or low, they were baffled when asked to respond to chord patterns (three successive chords), chord progressions (four or more successive chords), notwithstanding. Even if they could spell individual chords vertically or play a chording instrument, syntax of chords progressing to one another linearly was difficult for them to contemplate. They could not distinguish among sounds of tonic, dominant, and subdominant functions even when limited to major and harmonic minor tonalities.

* Students found it much easier to make sense of contrapuntal melodies than harmonic progressions.

* Tonal questions in rhythm context offered greatest validity with elementary school students. However, they had to be guided in concentrating on and answering questions about only tonal elements, disregarding rhythm implications.

* Music aptitude was found to be multidimensional. That is, approximately two dozen music aptitudes were identified, with seven (two tonal) being fundamental. Although all had from low to moderate intercorrelations with one another, each of the seven contributed substantially to validity of a composite test score.

* Option responses, such as "same" or "different," for responding to questions compromised validity. Asking whether a musical answer is like or different from a musical statement proved to be more resourceful when the musical answer of a test question was or was not intended to be a variation of the musical statement. The latter options coincided better with workings of the music mind in terms of what later came to be defined as audiation.

Tonal Implications

As explained, it was discovered results acquired from research designed to establish guidelines for developing tonal aptitude tests offered indirect findings for understanding how we learn when we learn music. In other words, findings pointed to conceptualizing tonal learning sequence activities and a sequential tonal music curriculum based on music learning theory. That eventually led to derivation of the concept of audiation. I shall explain what I generalized.

There is both content and context in music. Context, analogous to syntax in language, is represented by tonality (and meter), whereas content is represented by tonal patterns (and rhythm patterns). Thus, it is obvious in teaching and learning music, students best acquire a sense of tonality (and meter) as readiness for learning content, in this case, tonal patterns. How does this happen? Just as young children acquire a syntactic listening vocabulary as readiness for developing a speaking vocabulary in language, they acquire a syntactic listening vocabulary as readiness for developing a singing (and chanting) vocabulary in music. Performing vocabularies (speaking vocabularies in music), do not consist of isolated pitches or durations any more than a speaking vocabulary is dependent upon knowing the alphabet. We learn to speak words, not letters, and we learn to perform tonal patterns (and rhythm patterns), not individual pitches and durations.

Thought is the basis of a listening vocabulary in language. There was need for a word to explain the nature of a listening vocabulary in music. The word coined was "audiation," ability to hear and give meaning to music when sound is not physically present or may never have been physically present. Without audiation of context to serve as readiness for audiation of content, sound remains simply as sound and not translated into music by the musical mind. It was clear acquisition of a sense of tonality and recall of a vocabulary of patterns is fundamental to music learning processes. That is, context and then content, in that sequence, are learned before all else in terms of informal and formal instruction in music. Without the two being solidified in audiation, teachers can build only a faulty learning structure, because there is not a sequential foundation to support it.

Data offered additional specific insight into the nature of music context and content bearing indirectly on music learning theory and audiation. Context has been alluded to as if it is of a singular nature. It is not. Students who are most sensitive to music and demonstrate overall high tonal aptitude are those who are aware of an array of contexts, not only major tonality. They audiate in a practical, not theoretical, manner, minor and some remaining tonalities, especially Dorian and Mixolydian. Music learning is progressive when students are guided in listening to two, preferably more, contexts and comparing them to one another. Succinctly, beneficial learning takes place when students are exposed to differences in context, not when they hear only one context, such as major (or duple) over and over again. It is difference, not sameness, that sparks and motivates learning.

Rhythm Considerations

The Wing test does not include a specific rhythm part. The *Melody* part of the test does not ask listeners to consider rhythm at all. On the other hand, the Seashore battery includes both *Time* and *Rhythm* subtests. In the *Time* subtest, students are asked to indicate whether the second of a pair sounds, outside a music context, is longer or shorter than the first. In the *Rhythm* subtest, which was included in the 1939 revision of the battery, students listen to pairs of conjoined rhythm patterns, all in duple meter, and decide whether they sound same or different.

Two pertinent facts emerged from evaluating exploratory rhythm tests. Formal instruction and knowledge of notation and music theory were found to be irrelevant to distinguishing oneself in rhythm aptitude. Also, it became evident distinction between the words “note” and “duration” was mandatory. A note is seen in notation whereas a duration is heard in audition. Additional findings follow.

* Establishing meter before durations were heard, or better, performing patterns in a music context, provided students with ability necessary to audiate and, thus, to more musically respond to test questions. It also substantially raised validity coefficients.

* The more meters included in a test, such as usual combined, unusual paired, unusual unpaired, unusual paired intact, and unusual unpaired intact, in addition to usual duple, usual triple, and usual combine, the greater validity associated with the test.

* Rhythm patterns, not individual durations, best activated students’ audiation and raised test validity.
* Although analyses of data indicated no relationship between rhythm test scores and music background and experience, successive versions of rhythm tests had to be made increasingly easier in order to derive acceptable reliability estimates. Moreover, because

of impoverished music backgrounds, it was not possible to explain to students in test directions the nature of a rhythm variation in words comparable to those used in tonal tests. Thus, the option response “like” could not be used. Only “same” was operative.

* Unless performers on the recording accented each macrobeat (the words “macrobeat” and “microbeat” were actually coined later), reliabilities of rhythm tests were low. That is, a majority of students were unable functionally to place underlying macrobeats and, thus, were also unable to identify microbeats and meter in music they were hearing.

* Regardless of fast or slow tempos, accented microbeats (quarter notes in 3/4, for example) confused many students to the extent they would not even attempt to answer a question. Usual triple meter was clarified when only macrobeats were accented (dotted half notes in 3/4, for example.)

* Ability to discriminate durations heard separated from meter (for example, usual duple or usual triple) had at best marginal reliability and only minimal concurrent (or criterion related) validity when resultant scores were correlated with validity criteria associated with various types of music achievement.

* Students who scored highest on rhythm aptitude tests were able to chant and move comfortably in free, flowing continuous movement in space. They naturally took deep breaths as preparation for and while moving.

* Formal instruction in music, knowledge of music theory, and ability to read music notation may be so indoctrinated, any one or all of them may hobble or prevent a student with exceptional potential from scoring high on a rhythm aptitude test. Many depended on theoretical knowledge rather than trusting intuition when answering music aptitude test questions. That, of course, depreciated initial validity of rhythm tests.

* Rhythm tests in a tonal context offer greater validity with elementary school students than when rhythm decisions had to be made without tonal interaction. However, students had to be guided in concentrating on and answering questions about only rhythm issues, ignoring specific tonal implications.

* Two rhythm aptitude tests, meter and tempo, were identified as being fundamental. They had from low to moderate intercorrelations with each other but each contributed substantially to validity of composite test scores.

* Meter and tempo aptitude together are more potent than melody and harmony together for predicting success in school music, and of the two, aptitude for meter has higher predictive validity than tempo. It would seem to reinforce the idea rhythm aptitude is basic when compared to tonal aptitude.

Rhythm Implications

Foregoing results for rhythm aptitude tests, like those for tonal aptitude, established indirect evidence and offered implications for developing a music learning theory as well as better understanding the process of audiation. Generalizations follow.

There are at least two important parts of rhythm: meter and tempo. Both represent context. With regard to compelling content, again, it was patterns, specifically rhythm patterns, not individual written notes or durations. The rhythm alphabet (time-value names) demonstrated no relation to content or context. High scoring students were sensitive to meter and agilely audiated differences among meters.

It was evident without feeling for placement of macrobeats, ability to maintain a steady tempo, wherewithal to discriminate meter, and comprehension of precision in rhythm patterns, insights in rhythm were lacking. That corroborated realization rhythm has three dimensions; macrobeats, microbeats, and rhythm patterns. They are hierarchical and learned sequentially and, also, coordinated with movement and breathing. (Early on in my research, I referred to macrobeats as tempo beats, microbeats as meter beats, and rhythm patterns as melodic rhythm.)

Observing high scoring students, it was apparent music in 3/4 was audiated with one macrobeat in a measure (a dotted half note) and quarter notes as three microbeats. Further, two measures of 3/4 and one measure of 6/8 were audiated enrhythmically. That is, regardless of notation, 3/4 and 6/8 were audiated in the same manner.

Perhaps most important, perception of rhythm was crucial for understanding tonal dimensions of music. That finding suggested students should be given informal guidance in movement and breathing and formal instruction in rhythm achievement at least concurrently with, if not preceding, guidance and instruction in melody and harmony.

Expressive Considerations

The 1919 edition of *Seashore Measures of Musical Talent* included a test of *Consonance*. It was a preference subtest in which students indicated which of two dyads sounded better. Probably because of its low reliability and questionable subjective validity, it was replaced by a *Timbre* subtest in the 1939 edition of the battery. Seashore evidently changed his mind and decided preference does not impact on music aptitude. Wing, to the contrary, venerated preference as an important component of music aptitude. All four parts of his test, performed on piano, are preferential: *Rhythmic Accent, Harmony, Intensity,* and *Phrasing*. For *Rhythmic Accent*, two tunes are performed and students indicate whether they sound same or different. If different, they decide which is better according to dynamic accents. For *Harmony*, two tunes are performed and students indicate whether they sound same or different. If different, they decide which is better according to harmonic functions. For *Intensity*, two tunes are performed and students indicate whether they sound same or different. If different, they decide which is better according dynamic level. For *Phrasing*, two tunes are performed and students indicate whether they sound same or different. If different, they decide which is better according to staccato or legato interpretation.

Content of Wing's test includes familiar music composed by established composers. None of the music is original, and that simplified for Wing determination of "correct" answers. Preferred answers were decided in concurrence with whether music constituting questions is performed as composers intended. That puts validity into question, because it assumed a composer always knows best and a performer always plays the original version better than the "mutilated" version. Regardless, because of music being extracts from well known compositions, it is reasonable to assume students who are familiar with the compositions should score higher. That places the measures predominantly in the realm of music achievement rather than music aptitude.

After several years of experimentation, three of the seven subtests of what was to become *Musical Aptitude Profile* were designed as preference measures: *Phrasing, Balance,* and *Style*. For *Phrasing*, students decide which of two renditions of the same melody is played with better (not best) expression. Interaction of phrasing, tempo, volume, dynamics, tone quality, and intonation are variables. For *Balance*, students decide which of two endings better fits the same beginning of a melody. For *Style*, students decide which tempo is more suitable for the same melody. All music is specially composed and performed on string instruments by professional musicians. Use of piano proved unacceptable. Both parts of each test question has intended faults. If one performance is obviously more acceptable than the other, tests proved to lack sufficient variability and, thus, reliabilities approached zero.

Content and construct validity of the four subtests were established by asking ten professional musicians at a time (more than twenty agreed to participate on an intermittent basis) who were associated with classical and popular music to listen to recordings of ten pairs of melodies. Unless at least nine judges agreed with one another on a question, it was revised or eliminated from the test. More than 350 questions were composed and recorded before 30 for each subtest were found suitable. It is interesting that I, composer of the music, and some performers disagreed with keyed correct answers to a few questions. The following additional results associated with preference tests are unique.

Expressive Implications

* Most successful students in school music scored highest on preference measures.

* Students who scored high on preference measures comfortably used their body in continuous free, flowing movement in space and engaged in deep breathing. Their physical actions were not rigid.

* High scoring students on preference measures rendered most interpretive vocal and instrumental music performances in terms of expression and overall sensitivity.

* Scores on preference measures were highly correlated with students' potential to learn to create and improvise music.

* Preference measure scores intercorrelated exceptionally high with only one of the non-preference tests; *Meter*.

* Males and females demonstrated similarly high expressive music aptitudes.

* Performance medium had virtually no relation to scores on preference measures.

* Tone quality was the greatest determining factor in preference regardless of students' aptitude levels.

* When compared to all others, test questions in harmonic minor, Dorian, and Phrygian tonalities produced highest validity coefficients. Pentatonic melodies were least desirable. By no means did students consider minor melodies sad.

* Scores on preference measures correlated higher with students' recall and ability to make inferences, whereas scores on non-preference measures correlated higher with students' ability to memorize music and learn to perform music by imitation.

It was generalized audiation is essential for music preference (which comprises creativity and improvisation) and, thus, audiation is fundamental to both music aptitude and, necessarily, music achievement. It is the wellspring of a sequential music curriculum. To create and improvise is to be able to audiate in a unique manner. That is, students hear what they intend to notate or perform before they notate or perform it. Less constitutes, at best, mere exploration. It seems a student cannot be taught to function at high levels of music; the best a teacher can do is provide students with readiness to learn by themselves to create and improvise. Students need vocabularies of tonal patterns and rhythm patterns to create and improvise and for distinguishing among tonalities and meters. Those concepts ultimately gave rise to the dichotomy of discrimination learning and inference learning, the former serving as sequential readiness for the latter in music learning theory. Teachers teach and students learn.

Overall analyses of results derived from tonal, rhythm, and preference tests made evident several levels of discrimination learning and inference learning, some serving as sequential readiness for others and lower levels essentially becoming assimilated into all higher levels. Individual levels of content and context learning were observed in terms of discrete characteristics of music aptitude. Most compelling was the revelation, gathered from questionnaires and interviews with students, parents, and teachers, it is prudent to introduce students to improvisation as soon as possible, long before they are burdened with formal learning of music notation and music theory. It is precisely that which later made clear need for bridging (which I initially referred to as spiraling) within stepwise movement in the music learning theory to be developed a few years hence. Succinctly, it was patently obvious learning is not linear; it takes place in circular motion.

Classroom and Instrumental Music Instruction, Music Learning Theory, and Audiation

Concomitant with my working in music aptitude at University of Iowa, I used a portion of my graduate fellowship time to teach in University Laboratory Schools. I had had some public school teaching experience in Toledo, Ohio prior to my arrival at Iowa, but I knew there was much more to know than was apparent to me. Thus, I opted to teach various sections of classroom, vocal, and instrumental music, from kindergarten through grade twelve. That practice continued periodically throughout my graduate years and until I resigned as professor fifteen years later. It was then it became clear students were not ready to learn what most music teachers were trying to teach them, nor were many music teachers teaching substantial material,

I became distressed with necessity of so many classroom music specialists having to teach music appreciation, which ordinarily was an amalgamation of music history, music theory, and social studies, because their students did not have necessary informal and formal experiences and background to deal with music as a core subject. Moreover, instrumental and choral teachers were preoccupied with having students memorize music for purposes of performing at concerts, contests, and festivals, and a majority of students were not instructed in understanding what they were performing. I was aghast to discover when students stopped performing before a composition was completed, so few could sing or play the tonic or tell whether music was in major or minor tonality, let alone deduce whether a tonal modulation had taken place. They were not aware of where macrobeats were placed nor meter of the music. I considered all this to be alarming and realized there was need to research sources of problems and how they might be rectified. I continued to direct information I acquired from my work with MAP to design a practical music learning theory.

I was so convinced of importance of my discoveries, I wrote a levelheaded explanation of findings for undergraduate and graduate classroom teachers and music education majors. The book is titled, *How We Learn When We Learn Music*. Because I published the manuscript myself, I was able to revise it as often as I pleased in accordance with new research as it was uncovered. The second edition came to attention of Charles Leonhard of University of Illinois who invited me to write a book on music learning theory to be included in a series he was editing. That book, *The Psychology of Music Teaching*, was my first. It was published just a few years after *Musical Aptitude Profile*.

Type of research I engaged in is what some referred to then as action research and now, as I have already suggested, might be categorized as qualitative research. Actually, it was observational research based upon interviews and different types of instruction with the same and different groups of students. That is not to say quantitative analyses were totally disregarded. I think it safe to assume all nonpareil research is both qualitative and quantitative. Background and examples of the research follows.

Initially, I followed Gagné's eight steps of general learning theory, subsumed under general types of perception and conception, and attempted to apply them to music. I soon ascertained that was not possible, and I shall explain why soon with particular regard to verbal association. As I have already alluded to, it was not until later, when I was teaching at State University of New York at Buffalo, I posited the following two generic types of music learning: discrimination and inference, the former being readiness for the latter. Discrimination learning has five levels and inference learning three. It is important to emphasize all levels are sequential, each serving as readiness for and becoming combined with all higher levels.

There has been imposing debate, and continues to this day among philosophers of music education, about whether the main focus of music education should be on listening (aural) or performance (oral). I decided to investigate the question of whether one was actually more important than or readiness for the other, or whether both were necessary in a functional sequential music curriculum. I randomly divided third and fourth grade classes into three groups with equal numbers of students (approximately eight). I taught each group separately for one academic year. One group listened only to music, another only sang, and the third both listened and sang. The first two groups were exposed to recorded or published literature whereas the third group, in addition to listening to recordings and singing, heard me sing and chant tonal patterns and rhythm patterns in various tonalities and meters beyond major and minor and duple and triple.

After students acquired a sense of tonality (could identify a resting tone) and a sense of meter (could identify macrobeats and microbeats), they learned to perform patterns in imitation and improvisation. At completion of both semesters, students were asked individually to sing songs they had been exposed to during weeks beforehand. The performances were tape recorded and rated by independent judges. The group that participated in listening, singing, and pattern imitation and improvisation performed significantly better than either of the other two groups. In my mind, those results justified the aural/oral level of learning not only as an integral aspect of music understanding, but more important, as being fundamental. Both listening and performance appeared necessary for a well structured education in music. To argue about which is more important engenders misdirected energy, and the answer to the question may not become evident even when relevant neurological technology becomes available. Suffice it to say, it was clear performance without listening is a limiting factor in music development, and listening without performance produces acculturated sophisticates.

Reading about learning theory related to general education, particularly Gagne's, Piaget's, and Bruner's writings, I became intrigued specifically with whether and how Gagne's verbal association applied to music learning. When we learn words, we associate them with objects, but in music, patterns are not associated with objects. So I taught patterns using tonal verbal associations of do based major, la based minor, re based Dorian, so based Mixolydian, and so on, and with rhythm verbal association using syllables based on beat functions. It was obvious elementary school children in particular confused patterns with one another after they had learned to sing and chant about ten or twelve using only neutral syllables, but there was almost no confusion when tonal syllables and rhythm syllables were used. That is why, in contrast to Gagné's work, I included verbal association as the next higher level of learning above aural/oral.

I compared la based minor with do based minor, the latter being taught in university music theory courses, and also with use of the perennial number system. Also, I compared beat function syllables with systems associating rhythm syllables with note value names. The la based minor system and beat function system proved superior to all tonal and rhythm systems in contributing to acquisition of pattern vocabularies, superior intonation, good rhythm, proper meter, and skill in audiating and performing more than two tonalities and two meters. Without la based minor and beat function systems, my research and teaching in music learning theory might not have been brought to fruition.

Next, I became concerned with reading music notation. Instrumental music was compulsory for one year in the elementary division of University Laboratory Schools; string instruments in grade three, and brass, woodwind, and percussion instruments in grade four. I was receiving criticism from senior high school orchestra, band, and choral directors who claimed instruction based on my research did not include music theory or prepare students to learn to play instruments. That is, students were entering their classes without ability to name lines and spaces of the staff and names of note values. That students were well versed in tonal and rhythm syllables and could use them to read music notation fluently was ignored. As I look back on the situation, it should have been obvious teachers were threatened and felt intimidated because they were only partially familiar with tonal solfege and totally ignorant of rhythm solfege. The issue became so acute, even school administrators became involved in the impasse.

As discussions ensued, I was able to demonstrate students I taught were readily able to learn to read music notation by associating tonal syllables and rhythm syllables with tonal patterns and rhythm patterns, and they read more accurately and much quicker than students who were taught to use pitch letter-names and time-value names in tandem with common practice music theory. Merit of scales paled in comparison to tonal patterns, rhythm patters, and finger patterns. Scales facilitated instrumental technique whereas patterns complemented audiation and improvisation.

Teachers were eventually and particularly pleased when it became evident intonation and rhythm precision of students taught according to tenets of even an inchoate music learning theory was superior to those who were taught traditionally. The idea of teaching context (a sense of tonality and sense of meter) before or along with content (tonal patterns and rhythm patterns) seemed to be the main reason students learned to read notation with confidence and effortlessly. That realization later formed the basis for including partial synthesis (ability to recognize and understand underlying context of patterns being performed) in the finalized music learning theory sequence, necessarily preceding introduction of symbolic association (associating tonal syllables and rhythm syllables with notation). There was little doubt students brought meaning to notation by associating what they were silently hearing with notation rather than by attempting to take meaning from notation by using theoretical knowledge. In time, that discovery gave rise to the word “audiation” and term “notational audiation.”

There were students enrolled in University Laboratory School who were taking private instrumental lessons from university professors and freelance music teachers in Iowa City and Cedar Rapids, Iowa. They were exempted from studying an instrument in the compulsory instrumental school music program, but nonetheless, many participated in school performances in middle and senior high school. It was noticeable students who learned to play an instrument in school group instruction, although somewhat deficient in technique when compared to that of private students, were more alert to adjusting intonation and tempo in ensemble, and their performances were far less mechanical. Because of musicality exhibited by those who learned in groups, common sense indicated group instruction, composed of heterogeneous instrumentation, was superior to initial private instruction, although private instruction for advanced students proved more advantageous for developing technique after students were able to audiate. Intonation was abused when all students in a group played the same instrument. In a word, in lieu of experimentally designed multiple group research, "the world" adequately served as a control group.

What followed was especially fascinating. Students who knew la based minor tonal syllables were able to recognize and identify tonality of music they were performing with very little guidance from teachers. Similar findings in terms of meter were revealed with students who were taught rhythm syllables based on beat functions, and, of course, they performed with consistent tempo, functional meter, and accurate rhythm. It was apparent what I later called composite synthesis had to follow symbolic association in music learning theory sequence. Differentiating partial synthesis and composite synthesis, the former involves awareness of tonality and meter when only listening, whereas the latter presupposes awareness of tonality and meter when both listening and reading music notation.

I observed students became overly dependent on a teacher when most of what they knew was taught by rote. I had no choice but to reaffirm the role of inference in music learning theory, which delighted me because it naturally incorporated improvisation. Before guiding students in learning how to apply in inference learning what they were taught in discrimination learning, it was determined most appropriate for them to sing and chant patterns and generalize before engaging in improvisation. I did not experiment with those suppositions, I took quantum leaps, extrapolated concepts, and if one was shown to be implausible, I explored other options. Most notions were viable but, of course, that does not mean there were not better ways of preparing students to engage in improvisation. Nonetheless, when structure of music learning theory was completed, the most elementary level of inference learning was called generalization and the next higher level, creativity and improvisation.

For my doctoral research, I worked with two groups of middle school students. The purpose of my dissertation was to determine if practice, training, or both in answering questions similar to those found on extant music aptitude tests affected scores. During extra time I had with students, I taught improvisation in one group but not in the other. Importance of improvisation and its fundamental role in readiness for other types of music learning was confirmed. The sooner students learned to improvise, the better they read notation and performed musically.

Necessity of bridging from discrimination to inference levels of learning, particularly creativity and improvisation, as an alternative to constant level to level stepwise movement in music learning theory, became evident. Clearly, creativity and improvisation are on a continuum. It seemed a matter of emphasis which was being undertaken at a given time. But, in another short study in which I worked with one group of students who learned to create before learning to improvise by singing and chanting patterns and another exposed directly to improvisation also by singing and chanting patterns, I concluded creativity was necessary readiness for the other. Finally, without further research, I placed theoretical understanding (common practice music theory) as the last level of learning. In fact, I was and still am not convinced music theory need be taught to learn how to audiate, although, of course, it is necessary for communicating with musicians who were taught conventionally.

Music Achievement, Pattern Research, and Developmental Music Aptitude

I left Iowa to become Director of Music Education at State University of New York in Buffalo in 1972. During my seven years there, with assistance and deft interrogation by a colleague, Maria Runfola, I was able to begin to bring precision to music learning theory in its present form. I dealt with tonal content and rhythm content learning sequences and how they were combined with skill learning sequence to establish a sequential music curriculum. I was becoming increasingly convinced for a sequential music curriculum to be feasible, simple statements of goals and standards, shrouded in techniques and literature, were inadequate. A viable sequential music curriculum had to emanate from analysis of what we audiate when we seriously listen to and perform music, and then designed around resultant implications.

There was an extant spate of research directed toward identification of tonal patterns and rhythm patterns, their difficulty and growth levels, and how they might impact on development of a sequential music curriculum based on music learning theory. That information led to studying developmental music aptitudes and intensive detailed research that took place during most of my stay in Buffalo. It offered direction for also investigating equally important issues, such as construction of practical and realistic bellwethers for formal music instruction in elementary and middle schools, manifest in *Jump Right In: The Music Curriculum,* and informal music guidance in preschool, outlined in *Music Play: Jump Right In*.

Research pertaining to *Iowa Tests of Music Literacy* (ITML) and tonal patterns and rhythm patterns was actually begun before I left Iowa. In fact, ITML, a multilevel music achievement battery, was recorded, standardized, and published in 1971, the year before I took up residence in New York state. Content of the six levels of ITML consists of tonal patterns and rhythm patterns identified over a seven-year period of inquiry. The three subtests of the tonal section require students to listen to tonal patterns and identify tonality of each, identify patterns in notation, and actually notate patterns. The three rhythm subtests parallel, in terms of meters and patterns, the tonal subtests. The test battery was initially developed to serve as validity criteria in *A Three-Year Longitudinal Predictive Validity Study of the Musical Aptitude Profile*. ITML, itself, was subjected to a five-year longitudinal predictive validity study in which hundreds of students participated. The results boded well for the test battery but, more important, the study also offered many indirect findings further corroborating what was to become specific levels and sublevels of music learning theory and their proper sequential relationships.

I previously investigated musical characteristics of patterns in ITML, but I was only superficially aware of their difficulty and discrimination levels. I wanted additional information, so I designed three continuous studies to investigate pattern difficulty levels and growth rates. (Growth rates relate to how difficulty of patterns do and do not change as students get older.) All studies are published, with the final two incorporating so much information they had to be reported in monograph form. The titles are *Toward the Development of a Taxonomy of Tonal Patterns and Rhythm Patterns: Evidence of Difficulty Level and Growth Rate; Tonal Patterns and Rhythm Patterns: An Objective Analysis;* and *A Factor Analytic Description of Tonal and Rhythm Patterns and Evidence of Pattern Difficulty and Growth Rate*.

In the first study, I extracted all tonal patterns and rhythm patterns from ITML, re-recorded them, and asked students to listen to them and indicate whether two tonal or rhythm patterns in a pair sound same or different. I reasoned by not presenting patterns in a musical context--for example, major, minor, Dorian, or Mixolydian tonality or duple or triple meter--as was done in ITML, all patterns could still be used but changed to serve as content in a quasi music aptitude test rather than as they functioned in the music achievement test. Listeners had to immediately intuit relative tonalities and meters.

Responses of various students in grade four and higher across the country were used to establish comparative pattern difficulty levels. Analysis was simple. If most students knew both patterns in a pair were same, the pattern was labeled easy. If the majority, no more than approximately 60%, of students knew both patterns in a pair were same, the pattern was labeled moderately difficult. If only a few, no more than approximately 20%, of students knew both patterns in a pair were same, the pattern was labeled difficult.

I was astonished to discover a normal distribution of difficulty levels for the entire hierarchies of tonal patterns and rhythm patterns for students in each grade (and, of course, all grades combined). However, results for only easy patterns, by themselves, yielded a wide range of difficulty levels for young elementary school students of the same age who had had no formal instruction in music. The process was obviously tapping into something other than music achievement. As a result of those findings, the concept of developmental music aptitude was expanded. No attempt was made to analyze patterns in a pair that were different because there was no way, without redesign of the study, to determine objectively how characteristics of one pattern in a pair uniquely affected characteristics of the other.

The second and third pattern studies were constructed to be cross validations of the first and each other. The second was like the first but included additional patterns, and the third included all patterns in the second but it incorporated unique statistical methods for measuring growth rates of patterns in association with difficulty levels. Ultimately, over an eight-year span, thousands of students listened to approximately 1,000 tonal patterns and 500 rhythm patterns in eight tonalities and seven meters. In all three studies, pattern difficulty levels were normally distributed, difficulty levels remained relatively stable from grade to grade and, thus, there was little evidence of pattern growth rates in terms of comparative means and standard deviations. That is, patterns easy at one school level tended to be easy also at other school levels. Likewise for moderately difficult and difficult patterns.

Before I delve into specifics of developmental music aptitude, some history is necessary. Seashore developed norms for his test battery for students in grade four and higher. To best of my knowledge, I do not know whether he tried or whether he simply decided not to establish norms for younger students. I can only assume even his more robust subtests demonstrated rather low reliabilities when administered to young children. On the other hand, Wing did offer norms for children eight years old but warned reliabilities were low. Arnold Bentley, another Englishman, who used content of Wing's test as a paradigm, attempted to simplify test questions and directions, and published norms similar to Wing's for younger children. Neither Wing nor Bentley, however, investigated validity of their measures for use with young children.

While in Iowa, I attempted to write a simpler version of MAP for use with children as young as five years of age. For example, using the same content, I limited subtests to three, provided less complicated directions, designed color coded answer sheets with larger spaces for children to mark answers, and extended time between questions on the recording for children to mark answers. It worked well with kindergarten and first and grade children selected by their district music supervisor in Ottumwa, Iowa as being especially "musical," but reliabilities were low for young children in general. A doctoral student, Charles Harrington, followed up my research for his dissertation using a shortened version of MAP with young children who were attending the laboratory school at University of Chicago. His results were not encouraging. It seemed at that time it might not be possible to measure music aptitudes of young children. At least that opinion accompanied me to Buffalo.

Given data from pattern studies, I concluded the reason it seemed impossible to achieve satisfactory reliability with earlier music aptitude tests for students younger than nine years of age was test content was inappropriate; that is, test questions were too difficult. Thus, I extracted all easy patterns from the tonal pattern and rhythm pattern taxonomies and complied them into a tonal subtest and a rhythm subtest. I received advice from reading specialists about how to design answer sheets and common words young children would easily understand in directions for taking the tests.

Moreover, I discovered through trial and error, coupled with continuous analyses of reliability and validity coefficients associated with each attempt, a developmental music aptitude test requires unique design in terms of construct and process validities as well as content validity. For example, unlike for a test of stabilized music aptitude, tonal content and rhythm content must be kept separate in a developmental music aptitude test. Young children were not able to attend to two or more dimensions of music at the same time. What I put together constituted *Primary Measures of Music Audiation* (PMMA). After engaging in typical test development, such as securing acceptable item analysis characteristics and test reliabilities for several revisions of the subtests, I undertook extensive lengthy validity studies. After I left Temple University, I published comprehensive results in a monograph titled, *Test Validity and Curriculum Development: Three Longitudinal Studies in Music*.

A most compelling finding was, with appropriate informal guidance (such as being exposed to short excerpts of various styles of music in various tonalities and meters and being sung and chanted to on a one to one basis by a musical adult) and formal instruction in music, average scores on PMMA increased as children moved from grade to grade. Without such guidance and instruction, however, scores could decline as well as remain constant. To the contrary, defined by MAP standard errors of measurement, stabilized music aptitude subtest scores do not increase with practice or training in music.

Young children progress through a developmental music aptitude stage, and when older, they enter a stabilized music aptitude stage. Although a specific point cannot be identified as changeover time due to individual differences among children, it seems, as stated, developmental music aptitude becomes stabilized at about age nine, coincidental with the approximate time some neurologists report physical changes take place in myelination of the great cerebral commissures located in frontal lobes of the brain. Consequently, MAP, a test of stabilized music aptitude, is appropriate for elementary school students who have entered the stabilized music aptitude stage whereas PMMA, a test of developmental music aptitude, is appropriate for elementary school children who have not emerged from the developmental music aptitude stage.

At last, hard evidence had been shed on the “nature/nurture debate,” which raged throughout the first half of the 20^{th} century, with regard to whether innate potential or environmental influences are responsible for music aptitude. The answer is both. Music aptitude is a product of innate potential and early environmental influences from birth (or prenatally) until about age nine, and after that time, when music aptitude becomes stabilized, practice and training does not alter a student’s relative standing in music aptitude. Realistically, the purpose of music instruction after age nine is to assist students in achieving in music to the extent their musical potential will allow, whereas the purpose of music instruction before that time is to provide environmental influences that stimulate innate music aptitude.

Sooner than expected, critics took me to task, and some are still unhappy with concepts of developmental and stabilized music aptitudes. Because a student’s position on a valid music aptitude test should be impervious to practice and training, the argument is if scores on a developmental music aptitude test fluctuate in accordance with exposure to music and informal guidance and formal instruction in music, the test must be one of music achievement. The same faultfinding was directed toward MAP, because what escaped reviewers was although raw scores (number of questions answered correctly) on MAP do increase with chronological age, albeit a phenomenon experienced with all types of tests, percentile ranks (relative standings) do not.

Of crucial importance and therefore needing emphasis is, scores on both developmental and stabilized music aptitude tests usually increase with chronological age. Nevertheless, students in the stabilized music aptitude stage maintain their same relative positions in score distributions, but children in the developmental music aptitude stage necessarily do not. Median correlation of scores on the same stabilized music aptitude subtest administered years apart approximates .80. Median correlation of scores on the same developmental music aptitude test administered years apart approximates .30. Unlike characteristics observed for raw scores on a stabilized music aptitude test, lower longitudinal coefficients for a developmental music aptitude test are more a product of magnitude rather than direction of score changes from year to year.

The following may assist skeptical professors in understanding why developmental music aptitude tests are not music achievement tests. In the pattern studies, tonality or meter was established on recordings before students responded to questions. On PMMA, that is not the case. Students infer in audiation a subjective or objective tonality and keyality or a subjective or objective meter and tempo for each pair of tonal patterns or rhythm patterns as they are being heard. Allotted time on the recording does not allow time to memorize the first pattern in a pair for the purpose of comparing it with the second, memorization being a fundamental mainstay of music achievement. Patterns are presented on recordings in a musically atypical manner; that is, not as one might hear music in familiar milieu.

Moreover, being adept at generalizing sound as music exemplifies audiation and, thus, is a primary characteristics of developmental music aptitude. What is asked of students and the nature of option responses for a developmental music aptitude test are not taught in formal music instruction, let alone in informal guidance in music. Finally, and perhaps most important, even kindergarten children can attain perfect scores on subtests without ever having any informal guidance or formal instruction in music. From follow up studies, it was discovered, with very few exceptions, high scoring kindergarten children were not exposed to music guidance or instruction in or outside the home. Suffice it to say, objective longitudinal validity of the tests has been established in a variety of situations over a period of years. Research in developmental music aptitude has been as comprehensive as that in stabilized music aptitude.

Within a year or two after publication of PMMA, it came to my attention it was not complex enough to sustain interest of students who were receiving superior guidance and instruction in music. Although scores on subtests approximated a normal distribution, they were skewed to the left and, thus, reliabilities decreased. In cases I was aware of, approximately 80% of these children, even in first grade, scored above the 50th percentile according to norms published in the test manual. On the one hand, I was happy test results indicated students who were receiving or had received sequential instruction in terms of music learning theory could and were effectively raising their music potential back toward their birth levels (their innate musical potential unaffected by early environmental influences). Conversely, I was displeased to discover scores of children who were receiving traditional five fold classroom music instruction on a limited basis, or who were not attending any music classes at all, remained stagnant or even declined. That was positive indirect evidence of merit and importance of sequential learning in music and exposure to various tonalities and meters through singing and chanting. It was evident a more advanced test was needed for more fortunate students whose music achievement was being overseen by thoughtful and informed teachers.

Once again I analyzed data derived from pattern studies and extracted only difficult tonal patterns and rhythm patterns. They became nucleus for *Intermediate Measures of Music Audiation* (IMMA), and after appropriate test development took place, it was published three years after PMMA. Content of the two tests is identical, the difference being increased difficulty of tonal patterns and rhythm patterns in IMMA. As might be expected, both PMMA and IMMA were labeled music achievement tests with more vigor by erstwhile critics simply because, in their minds, the need for complex content signified presence of music achievement. The concept of developmental music aptitude being a product of innate qualities and early environmental music experiences still escaped adversaries. Importance of informal and formal guidance and instruction cannot be overestimated.

Coming to terms with audiation has played an enormously important role in my personal as well as professional life. Thus, before I move on to the next section, though it is somewhat out of context, I feel it obligatory to report that before I left Buffalo in 1979, I, with the assistance of Claire Ives, my editor, had coined the word "audiation." It appeared as a footnote in an early edition of *Learning Sequences in Music:* S*kill, Content, and Patterns*. It was not until the next decade, when I was at Temple University, the concept of audiation came to full fruition, including eight types and six stages. Of course, there is no way to confirm directly types and stages of audiation through experimental research any more than it is possible to explain objectively how and what we think when we think. Nonetheless, audiation permeates music learning theory and provides substantially for its structure, it serves as a defining feature of music aptitude as well as music achievement, the word is seen more and more in scholarly journals and papers and professional magazines, and music teachers find philosophy surrounding audiation to be helpful in organizing their thinking in terms of sequential music curriculum development.

As I reflect on events, it is manifest audiation was the superstructure of music learning theory from its inception, but it took considerable time to find language to describe and explain the concept. At the time MAP was developed, the only option that seemed available to me, following Seashore's lead, was the word "imagery." I did not realize, until much later, confusion abounded as a result of persons placing imagery in a visual mode, ignoring the aural sense and, thus, associating music imagery with notation. Music educators as well as professional performers have told me they had been aware of audiation but never had a word or words to describe it or an understanding of how it develops.

Another brief digression is relevant. Currently there are approximately 6,000 spoken languages throughout the world, but about only 200 are written. Because unwritten languages have no prescribed grammar, they are more flexible and can easily change and be expressive. Similarly, in countries bereft of music theory and notation, performance is primarily audiated and improvised. Nevertheless, it may not be as complicated in harmony, rhythm notwithstanding, as written music. Is audiation or reading more important than the other? Both have a place in music education. It is sequence, however, in which they are taught that is of undeniable consequence. Audiation provides readiness for artfully reading and writing music notation.

During Renaissance activity, and probably before, artist musicians were adept at improvisation, which naturally incorporated audiation. Unfortunately, in the late 1800s, music reading and music theory for various dubious reasons became dominant over audiation, culminating in writings of a professor of musicology who taught at University of Leipzig in Germany. He, Karl Wihelm Julius Hugo Riemann, arbitrarily established artificial rules of music theory and rituals for music notation, still observed today in many if not most universities, colleges, and conservatories.

A parallel situation existed a century earlier in England with regard to the English language. Rules of grammar based on Latin and Greek were formalized by Robert Lowth in 1762 and Lindley Murray in 1794. As a result of all this, advantages and disadvantages for both music and language accrued. In language, vocabularies increased, writing became standardized, and great composers' works could be preserved. However, language became less spontaneous and writing developed forms of rigidity. The same is the case for music with regard to regrettable disenfranchisement of audiation and improvisation. Many formally unschooled performers of popular music, with benefit to all, primarily still persevere the two attributes.

Early Childhood Music

Some time before leaving Buffalo and arriving in Philadelphia, I realized if I wanted to know more about how we learn music, I would need to begin by subjectively observing music activities and analyzing music responses of very young children. I began my objective research many years before in Iowa with college and university students in association with test development research, but I soon learned much vital information was escaping me. I went on to work with high school students and then elementary school children, including those in kindergarten. Nonetheless, it was clear even elementary school children are too far into music achievement and, thus, too sophisticated to reveal intricacies of music learning.

Therefore, after a few years at Temple University, I became focused on early childhood music. I observed and analyzed children's behavior as others taught in an established early childhood music program, but I was not able to attain appropriate teaching conditions necessary to garner information I was seeking. To provide necessary ambient factors for observing differences in growth between individual children and groups of children, it was essential, among other things, for teachers to sing both familiar and unfamiliar songs in various tonalities and meters, to engage children in chanting and continuous spatial free, flowing movement, and not to use recordings and instruments excessively. Moreover, the youngest children being taught were three years of age, and that, I knew, was too old for my needs. Given the situation, to be successful in my endeavors, I, myself, had to teach children. I needed to begin with babies no more than a few weeks old. With that apparent, my renewed career in early childhood music development was launched.

I started as lone teacher but it was not long before graduate students asked to teach with me. I found having two teachers in the room offered many benefits, not only for teaching but also conducting research. Soon there were various sections other teachers and assistant teachers taught under my guidance, following the curriculum I was developing. Curriculum development was a living, continuous process, based on objective observations gathered day by day. Before reporting what I learned, some introductory remarks are necessary to explain the type of research I engaged in and why.

As described, classically designed experiments taught in theoretical research courses are just that: theoretical. It should not take long for an experienced researcher with common sense to grasp an understanding of unrealistic demands of such designs, especially when applied to preschool age children. Correlation studies, particularly those undertaken to investigate validity and related matters concerning tests, however, have much to recommend them. They are not dependent on levels of confidence and probability estimates. I have discussed much of this earlier under Traditional Analyses in this paper and in a journal article, *Contemplating Objective Research in Music Education*. I shall review a few important issues here.

It would take an assemblage of many hundreds of preschool students to select and equate randomly stratified samples of students to serve as parallel experimental groups, control groups notwithstanding. Even if that could be accomplished, negative factors of continuing participation of all children and attendance habits of parents over a period of at least one semester would interdict studies. And, even if by waving a magical wand those two problems could be ameliorated, consider difficulty in finding pairs of uniformly competent teachers who are capable of teaching similarly well and also who are able to teach comparatively well different methodological approaches. If that is not enough to dissuade a neophyte, consider statistical implications. Assumptions for applying tests of statistical significance to resultant data would not be met, nor would it be possible to determine degrees of freedom in an appropriate or trustworthy manner.

For those reasons, among others, I chose to observe reactions of children on a one to one basis, to maintain copious records in terms of rating scales constructed in such a way as to allow for estimating reliability and validity of teachers' markings, and to analyze data subjectively. Practical significance replaced statistical significance in interpretation of children's responses. I did not use control groups or resort to tests of probability to determine whether what I was discovering was or was not a matter of chance, but rather, I relied on idiographic analyses of replications and comparisons of different methodologies with different groups of children on different occasions who were taught by different teachers. When findings were consistent although many divergent personalities and idiosyncratic teaching techniques were involved, I felt secure in generalizing results.

On rare occasions, for specific research purposes, I randomly divided perhaps twelve children, birth to eighteen months old, in one class into two groups of six, and acculturated each group differently over a period of one semester or academic year. The personal needs and obligations of most parents prevented them from enrolling a child in a class on a coterminous basis. Thus, possibility of conducting longitudinal group studies virtually was precluded.

In one group, I would sing songs in only major tonality and the other songs in both major and harmonic minor tonalities. When children were able to sing tonal patterns in imitation as they matured, typically around two or three years old, the group of children who heard songs in both major and harmonic minor tonalities sang major patterns better in tune than the group who heard songs in only major tonality. I followed up with a similar study. One group heard songs in major tonality whereas the other group heard songs in major, harmonic minor, Dorian, and Mixolydian tonalities. Again, the more tonalities children were familiar with, the better in tune they sang tonal patterns in major tonality. Further, the group who heard four tonalities sang better than the group who heard only two. I interpreted those results to corroborate findings derived from doctoral dissertations I directed while still at University of Iowa as well as extant writings in other academic disciplines that emphasize students learn best by attending to difference rather than sameness. Repetition, other than early imitation, serving as readiness for learning how to audiate, has relatively little if any bearing on learning that goes beyond perfunctory training. From that point on, children in all groups were exposed to as many tonalities as time permitted in a regular half hour class period.

I did the same with meters, and this I find particularly important considering most popular music children are exposed to is in duple meter. Hearing songs and chants in only duple meter was inferior to hearing songs and chants in both duple and triple meters. Better yet, the sooner children heard me sing and chant in unusual paired and unusual unpaired meters along with usual meters, the better they could eventually chant rhythm patterns in all meters. Not only could they sustain a steady tempo, they maintained meter and performed rhythm patterns confidently and with improved precision.

Singing and chanting without words to individual children and using words with others, and then comparing musical progress, using neutral syllables was superior to using a lyric. Children in the former group performed better and were continually aware of resting tones and placement of microbeats (and for some, even macrobeats) when singing and chanting. Most startling was the discovery children who learned quickly and were advanced musically were constantly aware of the resting tone of a song they were performing. Whenever and wherever I or they stopped singing a song and I asked them individually or as a group to sing the resting tone, they did without hesitation.

In conversations with exceptional children, in an incomparable manner they explained they knew “the top note was right or wrong by knowing the bottom one.” What I deduced was they were continually audiating the resting tone of the song being performed, always distinguishing melody notes in relation to the resting tone. They determined pitches accurately by identifying them vertically rather than by responding to horizontal intervals. In terms of intonation, they seemed to be unconcerned with how ongoing pitches related to one another. Without direction from me, they apperceived rather than perceived. Common practice music theory of teaching melodic intervals contradicts children's natural proclivity.

Thinking about words distracted children from audiating. It seems because they normally listen to conversation more than music and are typically spoken to on a one to one basis, they naturally are attracted to words instead of tonality and meter of a song they are hearing, let alone tonal patterns and rhythm patterns constituting the song. Children, in their instinctive need to learn, gravitate to what is familiar. Thus, presenting songs and chants to children using neutral syllables until they are able at least to audiate resting tones and macrobeats in music they are hearing or performing is preferable.

I also reasoned that when children learn to sing songs with words, they are inadvertently granted permission to continue to use a speaking voice quality when singing rather than learning to acquire a singing voice quality to balance their speaking voice. I believe that is one of the reasons there are so many poor singers in our society. Watch and listen to young persons "sing." Most simply mouth all words on the same pitch. Without hearing words, they might not even recognize a song they have heard many times.

Children need to be sung and chanted to on a one to one basis as much as time allows. Substantial learning does not occur simply by listening to recordings. Adults who believe to the contrary should stop speaking to newborns and just play recordings of persons speaking English. If that sounds like a ridiculous way to learn a native language, why then apply such inanity to learning music.

Value of singing and chanting tonal patterns and rhythm patterns to young children cannot be overestimated. Consider language. Linguists estimate at one time or another there were around 30,000 languages spoken throughout the world of which only 6,000 still exist. In fact, 300 were spoken by native Americans. Why does a language disappear? The reason is parents do not speak the language to their children. When one generation of adults does not acculturate babies of the next generation to a language, that language is forgotten. Only one skipped generation is all it takes for a language to vanish. Languages are learned with ease and unconsciously by babies, but by age thirteen or so, it is poorly learned mechanically through force. Much of the same may be said for music. Unless babies are acculturated to tonal patterns and rhythm patterns by capable adults, quality of music declines. Unfortunately, that is becoming more and more the case. Consider what currently is accepted as music by a majority of the population.

I dabbled a bit using piano, rhythm instruments, and recordings. With regard to piano, autoharp, guitar, and ukulele, used either for melody or accompaniment, even when well tuned, detracted from learning. When played, children tended to stop audiating, unconsciously expecting an instrument to do their audiation for them. Rhythm instruments signaled fun time and music learning ceased, except possibly for opportunity to "explore." It was more productive to guide children in creating and improvising rather than allowing them to dally and simply make noise. I construed playing recorded music during class was a "filler" and wasted valuable guidance and instructional time.

There was ample opportunity in cross sectional analyses to observe sequel actions of children of different ages. Too, tonal patterns they performed were documented. In general, first they preferred diatonic patterns. However, before singing an arpeggiated pattern, the typical child sang a resting tone or dominant of the tonality. Given a tonal aptitude test when older, those who sang the resting tone earlier generally scored higher than those who began with the dominant, but children who initially sang a perfect fifth or fourth that included both tonic and dominant of the tonality, scored highest. Most children sang two-tone before three-tone arpeggiated tonic and dominant patterns in major and harmonic minor tonalities.

With regard to rhythm, most children were uncoordinated, and therefore could not move with continuous free, flowing movement in place or in space. It was soon obvious free, flowing movement was a requisite for learning to chant microbeats in consistent tempo and rhythm patterns with some degree of precision. Children knew intuitively there can be space without music time but there cannot be music time without space. Rather than being concerned in the same way adults are with time, space, weight, and flow, in that order, it was exact opposite for children. Their primary considerations were flow and weight, with space and time being almost an imposition. I found audiation of physical flow and weight to be readiness for appropriately engaging in space and music time, and audiation of physical space to be readiness for performing music time accurately. One can count correctly, but unless the number is verbalized at the correct time, tempo becomes inconsistent, which in turn adversely affects meter and rhythm. It would seem impossible to perform an extremely slow consistent tempo musically without imagining a feeling of free, flowing movement of the body, indicating amount of space intervening between beats.

Children responded to microbeats but practically never to macrobeats before chanting rhythm patterns the length of two underlying macrobeats in duple meter and usual triple meter. Practically all children were capable of chanting rhythm patterns in which a division pattern was superimposed on the first underlying macrobeat but not the second. Chanting of rhythm patterns four macrobeats in length came much, much later, but what came very early was children’s ability and preference to move in unusual paired meter (for example, 5/8) and unpaired meter (for example, 7/8). As a matter of fact, children seemed more adept in comprehending unusual paired meter than usual combined (for example, duplets and triplets in 2/4). Those who displayed a slower personal tempo at an early age tended to score higher on a rhythm aptitude test when older.

What I learned about relationships among singing tonal patterns or chanting rhythm patterns, body movement, and breathing was overwhelming. Though it was something only young children could teach me, it likely applies to musicians of all ages. I specifically attended to children who sang and chanted naturally well with little effort and confidence. When they sang and chanted, each, singing and chanting, was assimilated uniquely with movement and breathing. The opposite of what might be expected was, when singing tonal patterns, body movement in the form of tension preceded inhaling by a fraction of a second and then the voice became involved. When chanting rhythm patterns, inhalation preceded muscular tension by a fraction of a second and then the voice became involved. Body movement occurred before breathing with tonal patterns but breathing occurred before body movement with rhythm patterns.

After several years of intensive teaching and research in early childhood music, I felt confident in describing music learning processes of young children, children not yet old enough to attend regular school. There is an obvious difference between necessity for informal and formal guidance on the one hand that leads to formal instruction on the other. In addition to creating a practical sequential curriculum, I developed a music learning theory for newborn and young children, which culminated in my book bearing that title. The theory includes three hierarchical types of learning--acculturation, imitation, and assimilation--assimilation of singing and chanting with breathing and movement being a goal for children to attain before they enter public school. It is no secret a majority of children enter kindergarten or first grade without readiness to learn what music teachers are attempting to teach.

With regard to acculturation, imitation, and assimilation, which follow the same natural path of learning as acquisition of language, seven hierarchical stages within the three hierarchical types of learning were observed. The process is called preparatory audiation, which is necessarily requisite for engaging in audiation. The theory posits, as in communication where children hear language spoken a substantial amount of time before they speak, they should hear various tonalities and meters before they perform. Short songs and chants, highly repetitious and sequential, rather than extended compositions, are paramount. Without ability to imitate, a child will not have experience to draw upon when learning how to audiate. After a child can imitate tonal patterns and rhythm patterns, not complete songs with or without text, assimilation of singing or chanting with breathing and movement becomes a possibility. Ideally, with that accomplished, children are ready for school music, embracing a sequential curriculum of education that takes precedence over entertainment.

No doubt I was handicapped in my research with young children because I could not obtain objective evidence of their music aptitudes until they were older. I needed that crucial information as early as possible to teach adequately to their individual musical differences. My best approach for educing such information was to begin documenting their physical movements as babies when being sung and chanted to in a variety of ways. PMMA was administered to the few who remained in the program on and off until they were four years old. I correlated behaviors I subjectively observed with their objective test scores. The median correlation was approximately .50, and that relatively low coefficient could be due to a number of reasons. Primary among them was perhaps the children were too young to take PMMA, the battery had to be administered to them individually over a period of weeks (10 to 20 questions at a time for both the *Tonal* and *Rhythm* subtests). Also, different persons administered the subtests and data were gathered over a span of years and then combined for purposes of overall analysis.

Nonetheless, when all information was collated and alternative interpretations of data were studied and compared, the inevitable conclusion was level of music aptitude a child is born with cannot be raised by music achievement. Regardless of quality and quantity of guidance and instruction in music, a child will probably not achieve in music at a level higher than his or her birth level of music aptitude (potential) will allow. About all teachers of early childhood music can do is assist children in raising their music achievement back to their birth level of music aptitude, but to expect music achievement to go beyond their potential appears unreasonable.

During the same time I was teaching and engaging in research on a regular basis, I began conducting research at Immaculata College (located in a suburb of Philadelphia) with three and four year old children who were enrolled in the regular preschool program the college administered. My purpose was singular. I was determined to design a valid music aptitude test for three and four year old children to be used for enhancement of sequential music curricular research and teaching of young children. I taught a bit, but my main activity was to gain trust of the children. I asked many questions, administered sample test questions incorporating a two option response scheme of "same" or "different," and then asked more questions.

After periodic visits for two years, one child in particular explained to me why I was having problems. The reason was children would answer "same" to most questions because they heard the same voice singing what they called "the two songs" in a pair. It was the voice, not music, that attracted their foci. The child also told me in an inimitable way, which to this day I still cannot specifically recall, she did not understand the word "different." She suggested the alternative option response of "not same," because, in paraphrase, she explained an unfamiliar woman was not different. Simply, she was not her mom. Unfortunately, it would not be until years later I realized value of her analysis and then began using her idea in future research even with older students.

I discovered a developmental music aptitude test for preschool children required different constructs than those for a developmental music aptitude test designed for school age children. For whatever reason or reasons, preschool children need to hear both pitch and rhythm together in a test question but they are able to answer a question about only tonal or rhythm facets. They cannot attend to both tonal and rhythm elements simultaneously. In 1989, the developmental music aptitude test, *Audie,* was completed and published. It is curious design of MAP (a test of stabilized music aptitude for school age students) and *Audie* (a test of developmental music aptitude for preschool children) are similar in terms of construct validity but, of course, not content validity. I still cannot grasp why designs of tests of developmental music aptitude for school age children, such as PMMA and IMMA, need to be different from *Audie*.

Stabilized Music Aptitude Revisited

In the late 1980s, I was invited to speak at a convention of National Association of Schools of Music. During my presentation, persons asked why I or no one else had developed a music aptitude test for adults. MAP is normed for only fourth through twelfth grade students. They did not want to use a test as a selection device for admitting prospective students to their schools, but rather, as an objective aid to supplement many subjective criteria they were employing to assign students to different classes and teachers according each student's musical promise. The improvement of remedial instruction was of principal importance. Their interest in music aptitude was encouraging, so I set out to develop a music aptitude test for adults. Because they said there was only limited time for examining prospective students, I was asked to make the test no longer than 20 minutes and have it yield separate tonal and rhythm scores. I derived unique ways of designing the test and, in particular, how it should be scored.

Research pertaining to comparing various ways of scoring the test to offer greatest validity is reported in the test manual and two monographs (*Predictive Validity Studies of AMMA* and *Taking Another Look at the Established Procedure for Scoring the Advanced Measures of Music Audiation*. The test, published in 1989, is *Advanced Measures of Music Audiation* (AMMA). Other objective studies were undertaken to investigate predictive validity of the battery for high school students and undergraduate and graduate university and conservatory music students, and to examine effects of practice and training on test scores. In addition, because some school teachers objected to length of MAP, they used AMMA with seventh and eighth grade students. They passed on positive results and, thus, I included norms for twelve and thirteen year old music and non-music students in the test manual along with corresponding musically select and unselected norms for adults. Interestingly, design of AMMA was eclectic in terms of dual characteristics of developmental and stabilized music aptitude tests. It was uncovered mature students and adults must hear both tonal and rhythmic elements in every question as they listen simultaneously for possible changes in either tonal or rhythm components.

Learning Sequence Activities

Learning sequence activities represent practical applications of music learning theory. I originally had no interest or desire to become involved in systematic aspects of sequential music curriculum development for students attending elementary through high school. Reactions to my books, however, were such that readers did not fully understand music learning theory until they were given pragmatic applications. Rather than simply writing more books to guide them, I decided, with ample encouragement from my publisher, to create a model sequential music curriculum based on music learning theory. To do that, it was my responsibility to be sure teaching techniques functioned well in the classroom.

With that need in mind, I again undertook teaching classroom music in elementary school. I taught periodically over a span of two years in grades three and four in a parochial school, Gwynedd Mercy Academy in Springhouse, Pennsylvania. I was allowed to teach as need presented itself, and the principal and classroom teachers were extremely helpful in documenting what did and did not contribute to achieving my goals. That is not all. They also offered well thought out remedial teaching techniques. To be sure, I was indeed fortunate to be teaching students who were highly intelligent and analytical. They were not shy about accommodating my requests for assistance in clarifying what was lacking in my explanations of what I expected of them.
In 1985, I completed and published the first edition of *Reference Handbook for Teaching Learning Sequence Activities* along with two *Tonal Register Books* and two *Rhythm Register Books,* 42 tonal units and 42 rhythm units in all. Practical research embarked on in the classroom with regard to efficacy of teaching techniques, combining learning sequence activities with classroom activities, and devising methods of measuring and

evaluating students' progress resulted in many new insights. There was time for only one paper to be written and published pertaining to a few research outcomes: *The Effects of Instruction Based Upon Music Learning Theory on Developmental Music Aptitude*. Remainder of findings are included in terms of practical teaching suggestions in the handbook and register books.

Over the years, content of the material has not changed much. Explanations of teaching techniques has commanded major attention in revisions. Negative reactions to the curriculum generally comes primarily from those who, unfortunately, are bereft of sufficient musicianship to use techniques offered. They seem to be intimidated by what they do not know and recoil at possibility of having to come to terms with gaps in their music backgrounds. They are under misapprehension to understand music learning theory and learning sequence activities, they must deny their own education.

Instrument Timbre Preference Test

The longitudinal predictive validity coefficient derived from the three-year study of MAP is .75. Interpreted, that means approximately 55% of the reason or reasons students are successful in school music is associated with MAP scores. I was curious about the nature of the remaining 45% of the variance. That gave me cause to investigate extent to which students' preference for instrumental timbre and range affected success in instrumental music instruction. To study the matter, I authored *Instrument Timbre Preference Test* (ITPT), which, after years of preliminary research, was published in 1984. The extensive prepublication research on development of the test and concomitant matters are reported in the test manual. Several post publication studies on predictive validity of the test are published in monograph form (for example, *Predictive Validity Studies of IMMA and ITPT*). Results of studies suggest when students are administered ITPT in conjunction with a valid test of music aptitude, longitudinal predictive validity can be raised to approximately .82, accounting for 10% of the theretofore unknown variance.

Indirect findings in the development of ITPT bearing on music learning processes were abundant, and they complemented much of what I had already learned from research associated with previous test development. There was little doubt music aptitude is far more potent for learning music than preference for instrumental timbre and range. Preference for musical style, balance, and tempo, as measured in MAP, remained as important as ever. From a practical viewpoint, however, it is unconscionable so few students learn to play an instrument for which they have an objective preference. And, there are professional musicians who wish they had learned to play another instrument. They report they are not especially enamored of the sound of the instrument on which they perform.

Harmonic and Rhythmic Improvisation Readiness

Coming from a professional background as jazz bassist, it should not be surprising I am fascinated with how musical improvisation is learned and by specific mental processes, barring individual differences, that one engages in when improvising. It appears just as thought is required to participate in conversation, audiation is required to engage proficiently in improvisation. Performance of scales and continually quoting oneself from moment to moment solo leaves much to be desired.

Preliminary philosophical thought about improvisation had been a mainstay with me early in my research activities. In fact, I had difficulty in choosing between music aptitude and improvisation as the subject of my doctoral dissertation. It was not until late in my teaching career, in mid 1980s, I was able to turn considerable attention toward improvisation and its ramifications. As I emphasize in the manual for *Harmonic Improvisation Readiness Record* (HIRR) *and Rhythm Improvisation Readiness Record* (RIRR), the most commanding type of music improvisation is based on harmonic patterns combined into harmonic progressions.

Objective research in development and use of HIRR is sketchy compared to undertakings associated with previous tests, but what I ascertained in a few short years was invaluable. In particular and perhaps most important, students who improvise well audiate chord changes, but more importantly, they anticipate, in terms of musical time, when new chords in a piece of music are to be sounded. Thus, they act rather than react in improvisation. That is not the case with students whose improvisation is impoverished. Even if they know there are chord changes in a familiar song, they are unsure when they occur. They respond to chord changes after they are heard, and that impairs quality of improvisation. It seems obvious readiness for harmonic improvisation is a product of ability to identify chord changes and accurately anticipate them. Thus, to further study readiness for improvisation and how to adapt instruction to students' individual musical differences, I authored RIRR. It was published in 1998.

Validity studies incorporating, of course, objective test scores coupled with documented subjective performance observations were rich in outcomes. Straightforward results and conclusions can be found in the test manual and monograph, *Studies in Harmonic and Rhythmic Improvisation Readiness*. I believe, however, the following indirect findings and suppositions, some of which I have already made passing reference to, are captivating.

* Harmonic improvisation cannot be taught. A teacher provides students with readiness to learn (teach themselves) how to improvise. Readiness is audiation of a vocabulary of tonal patterns and rhythm patterns linked into melodic patterns (combined tonal and rhythm patterns).

* Further readiness consists of ability to audiate harmonic patterns and time patterns that form underlying structures of harmonic progressions.

* It is not necessary for beginning students to become familiar with sounds of a myriad of harmonic patterns, such I II V I and I VI II V I. What students need to audiate to begin participating in harmonic improvisation are sounds of relationships of different chords to a tonic chord, in progression and retrogression. That was the basis for developing tests of harmonic improvisation readiness.

* Audiation of chord patterns and progressions best begins by students singing tonic, dominant, and subdominant triads in ensemble. In major, do mi so, ti fa so, and do fa la. In harmonic minor, la do mi, si re mi, and la ra fa. Triads need not be sung in root position. Linear voice leadings produce most beneficial results.

* Audiation develops rapidly when all types of dominant triads are major-minor sevenths.

* Teaching vertical structure of chords along with part writing skills is unnecessary for learning to improvise harmonically. Students need to audiate sonance of horizontal sequential relationships of one chord to another, irrespective of inversions.

* Initially, teaching of complex chords, such as augmented elevenths with added thirteenths, is best not undertaken. They prove to be intimidating and confusing to neophytes. In fact, patterns in major, harmonic minor, and Dorian tonalities that include a IV chord are as basic as those that include a V7 chord. Both are best taught as structures in harmonic progressions upon which elaborate superstructures are based and serve as substitutes.

* By physically engaging in time and space with appropriate free, flowing body movement, students are most able to transfer "audiation of feeling" to anticipation of and preparation for chord changes. When told music is in 3/4, students count. When told, however, music is triple meter, they move their bodies.

There is an objective result that, for me, defies interpretation. Time may reveal it to be one of the most important contributions I have made to psychometrics as well as psychology of music. It is this. Regardless of chronological age, the average score (the mean) on HIRR remains about 28 and the average score for RIRR remains about 29. That is true for students in grade two through twelve as well as adults, both musicians and non-musicians. Is that finding simply an artifact or has generic music aptitude unwittingly been uncovered? I expect ongoing research to shed light on the enigma. After longitudinal effects of instruction in harmonic improvisation on HIRR and RIRR scores and comparative predictive validities of the two measures become evident, there should be sufficient evidence to come to closure on the matter. Albeit, for the moment, the concept and compelling possibility music aptitude as measured by HIRR and RIRR reflects outward flowing intuition whereas music aptitude as measured by MAP, PMMA, IMMA, and AMMA reflects inward directed tuition. If speculations prove to be grounded in fact, indirect implications for audiation and music learning theory will be enormous.

As I approach 84 years of age, my research activities have come to closure. It would be gratifying to know others are planning or engaging in research pertaining to music learning theory and audiation. So much still needs to be accomplished. For a listing of relevant research problems, read my keynote address given at the 3rd International Conference on Music Learning Theory in August, 2011. Gordon Institute for Music Learning (GIML) will publish the paper.

Afterthoughts

I have directed approximately 60 doctoral dissertations and 10 masters honor theses during my teaching career. Because students came to study with me largely because of my scholarly interests and wanted to learn how to conduct research in those academic disciplines, subject matter of most dissertations and theses dealt with music aptitude, music learning theory, audiation, improvisation, and rhythm. I could not but learn much from students and their work.

Finally, I must acknowledge Sid Wiess, Philip Sklar, Gene Krupa, and Albert N. Hieronymus. Sid, who gave me jazz bass lessons during my high school years, was the bass player in, among many notable groups, Benny Goodman's ensemble. Contrapuntal harmonic improvisation was his forte. Phil became my bass teacher when I was working as a freelance musician in New York City after I graduated Eastman. He held principal chair in NBC Symphony Orchestra under Arturo Toscanini. What I learned from him was so vast it would take a lifetime to relive the relationship. I am certain most of what he inculcated in me resides somewhere in my unconsciousness, but I feel certain it has and still contributes to conclusions I draw from data as well as interpretations of unexpected ancillary findings. Gene was not a formally educated musician, but his understanding of rhythm was enormous. Much of my thinking about rhythm is derived from our conversations as well as experiences accorded me as a result of nightly performances, during which I was ever next to him on the bandstand. He had different names for what I call macrobeats and microbeats, but concepts coincide. He helped me become aware of various components of rhythm, how they interact, and how one component simultaneously becomes foundation for another. All it took was one viewing of him in performance to comprehend value of continuous free, flowing spatial movement in achieving rhythm fluency. Although he and Phil were on different sides of the same extraordinary music mountain, they agreed on much when it came to musicianship. Al, coauthor of *Iowa Tests of Basic Skills*, was my psychology professor at University of Iowa. Without his guidance and knowledge of test development, *Musical Aptitude Profile* would not have come to fruition. I suspect he never knew how much he indirectly contributed to conceptualization of music learning theory.

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Glossary

<u>Aeolian Tonality</u>	Tonality of la to la with la as resting tone. When compared to harmonic minor tonality, it has a lowered seventh step.
<u>Arrhythmic</u>	Inappropriate word used to describe multimetric, multitemporal, polymetric, and polytemporal music.
<u>Atonal</u>	Inappropriate word used to describe multitonal, multikeyal, polytonal, and/or polykeyal music.
<u>Audiation</u>	Hearing and comprehending in one's mind sound of music not, or may never have been, physically present. It is not imitation or memorization. There are six stages of audiation and eight types of audiation.
<u>Aural Perception</u>	Hearing music when sound is physically present.
<u>Chord</u>	Four or more pitches sounded simultaneously.
<u>Classroom Activities</u>	Traditional activities in classroom music coordinated with learning sequence activities.
<u>Content</u>	Tonal patterns and rhythm patterns constituting music.
<u>Context</u>	Tonality and meter of music comprising component patterns of that music.
<u>Correlation</u>	Relation between factors. The cause of relation must be determined experimentally.
<u>Creativity</u>	Spontaneous audiation and use of tonal patterns and rhythm patterns without restrictions.
<u>Developmental Music Aptitude</u>	Music potential affected by quality of environmental factors. A child is in the developmental music aptitude stage from birth to approximately nine years old.
<u>Discrimination Learning</u>	Lower of two generic types of skill learning. In discrimination learning, students are taught skills and patterns through imitation. Discrimination learning includes aural/oral, verbal association, partial synthesis, symbolic association-reading, symbolic association-writing, composite synthesis-reading, and composite synthesis-writing. Discrimination learning is readiness for inference learning.

Do-Signature — Traditionally called key signature. However, it does not indicate any one tonality or keyality. It does indicate where do is found on the staff.

Dorian Tonality — Tonality of re to re with re as resting tone. When compared to harmonic minor tonality, it has a raised sixth step and lowered seventh step.

Duple Meter — See usual duple meter.

Duration — Part of a rhythm pattern. For example, each eighth note in a rhythm pattern of two eighth notes is a duration.

Enharmonic — Tonal patterns that sound the same but notated differently. Also, different key signatures used to notate the same sounding keyality.

Enrhythmic — Rhythm patterns that sound the same but notated differently. Also, different measure signatures used to notate the same sounding meter. Enrhythmic is to rhythm notation and audiation what enharmonic is to tonal notation and audiation.

Harmonic Pattern — Two or three triads or chords audiated linearly as a sonority.

Harmonic Progression — Contiguous harmonic patterns audiated linearly as a sonority.

Imitation — Repeating music heard but not audiated; that is, without giving it music meaning. Imitation may be immediate or delayed.

Immovable-do — C is always do regardless of keyality or tonality.

Improvisation — Spontaneous audiation and use of tonal patterns, rhythm patterns, and harmonic patterns and progressions with restrictions.

Inference Learning — Higher of two generic types of skill learning. In inference learning, students are guided by a teacher to learn skills and tonal and rhythm patterns by teaching themselves. Students are not taught by imitation in inference learning. Inference learning includes generalization-aural/oral, generalization-verbal, generalization-symbolic,creativity/improvisation-aural/orcreativity/improvisation-symbolic, theoretical understanding-

Intact Macrobeat — Macrobeat in unusual meter not long enough to be divided into microbeats. It can be divided into only one or more divisions of a microbeat. An intact macrobeat is the durational equivalent of a microbeat.

Key Signature	Actually a do-signature. A key signature is seen in notation whereas keyality is audiated. A key signature does not indicate any one keyality. For example, the key signature of three flats may indicate Eb keyality in major tonality, C keyality in harmonic minor or Aeolian tonality, F keyality in Dorian tonality, G keyality in Phrygian tonality, Ab keyality in Lydian tonality, Bb keyality in Mixolydian tonality, and D keyality in Locrian tonality. Nevertheless, although do is not resting tone in all of those tonalities, Eb is do in all of them.
Keyality	Pitch name of the tonic. Keyality is audiated whereas a key signature is seen in notation. C is keyality in C major, in harmonic minor, in C Aeolian, in C Dorian, in C Phrygian, and so on. Tonic is associated with keyality whereas a resting tone is associated with tonality.
Learning Sequence Activities	Activities that include skill learning sequence, tonal and rhythm learning sequences, and pattern learning sequences They usually take place during the first ten minutes of a class or rehearsal. Tonal and rhythm register books are used by a teacher in learning sequence activities.
Locrian Tonality	Tonality of ti to ti with ti as resting tone. When compared to harmonic minor tonality, it has a lowered second step, raised third step, lowered fifth step, raised sixth step, and lowered seventh step.
Lydian Tonality	Tonality of fa to fa with fa as resting tone. When compared to major tonality, it has a raised fourth step.
Macro/Microbeat Pattern	One function of rhythm patterns. A macro/microbeat pattern includes combinations of macrobeats and microbeats, only macrobeats, or only microbeats.
Macrobeats	Fundamental beats in a rhythm pattern. In usual duple meter in 2/4, quarter notes are performed or are underlying macrobeats. In usual triple meter in 6/8, dotted quarter notes are performed or are underlying macrobeats. In usual triple meter in 3/4, dotted half notes are performed or are underlying macrobeats. In unusual meters in 5/8 and 7/8, performed or underlying macrobeats are combinations of quarter notes and dotted quarter notes.
Major Tonality	Tonality of do to do with do as resting tone. When compared to harmonic minor tonality, it has a raised third step and raised sixth step.
Mean	Average score.

Measure Signature	Traditionally called time signature or meter signature. However, measure signatures indicate neither meter nor time, only fractional values of a whole note found in a measure. Because measure signatures are enrhythmic, a measure signature cannot indicate any one meter. Tempo markings and metronome markings indicate tempo, measure signatures do not.
Measurement	Objective analysis of students' music aptitude and music achievement. Measurement provides objective bases for subjective evaluation.
Melodic Pattern	A combined tonal pattern and rhythm pattern.
Meter	Usual meter is determined by how macrobeats of equal length divided. There are three types of usual meter. When macrobeats are divided into two microbeats of equal duration, the result is usual duple meter. When macrobeats are divided into three microbeats of equal duration, the result is usual triple meter. When some macrobeats are divided into two and others are divided into three microbeats, and not all microbeats are of equal duration, the result is usual combined meter. Unusual meter is determined by how macrobeats of unequal temporal lengths, some of which may be intact, are grouped. There are four types of unusual meter: unusual paired, unusual unpaired, unusual paired intact, and unusual unpaired intact.
Microbeats	Divisions of a macrobeat. The following are examples. In usual duple meter in 2/4, groups of two eighth notes are performed or are underlying microbeats. In usual triple meter in 6/8, groups of three eighth notes are performed or are underlying microbeats, or in usual triple meter in 3/4, groups of three quarter notes are performed or are underlying microbeats. In unusual meters in 5/8 and 7/8, groups of two eighth notes and groups of three eighth notes are performed or are underlying microbeats.
Minor Tonality	See harmonic minor tonality.
Mixolydian Tonality	Tonality of so to so with so as resting tone. When compared to major tonality, it has a lowered seventh step.
Movable-do Syllables	Tonal system in which placement and position of do are dependent on keyality. For example, in major tonality, C is do in C keyality, D is do in D keyality, and so on. Ascending chromatic syllables are do, di, re, ri, mi, fa, fi, so, si, la, li, ti, do. Descending chromatic syllables are do, ti, te, la, le, so, se, fa, mi, me, re, ra, do. In the immovable or fixed-do system, regardless of keyality, C is always

	do. The tonal syllable system used in learning sequence activities is movable-do with a la based minor.
<u>Music Achievement</u>	Accomplishment in music.
<u>Music Aptitude</u>	Potential to achieve in music.
<u>Music Learning Theory</u>	Analysis and synthesis of the sequential manner in which we learn music.
<u>Notational Audiation</u>	Audiation of what is seen in music notation without aid of physical sound.
<u>Note</u>	A symbol read or written in music notation representing what should be audiated.
<u>Objective Keyality</u>	Keyality for which there is consensus.
<u>Objective Meter</u>	Meter for which there is consensus.
<u>Objective Tempo</u>	Tempo for which there is consensus.
<u>Objective Tonality</u>	Tonality for which there is consensus.
<u>Percentile Ranks</u>	Rankings derived from raw scores. Because they have standard meaning, they provide for immediate and clear interpretation.
<u>Phrygian Tonality</u>	Tonality of mi to mi with mi as resting tone. When compared to harmonic minor tonality, it has a lowered second step and lowered seventh step.
<u>Pitch Letter-Names</u>	Names of lines and spaces of the staff.
<u>Pitch Names</u>	Letter names associated with sounds, not notation, of pitches.
<u>Preparatory Audiation</u>	Hearing and comprehending music while in music babble as readiness for engaging in audiation. There are three types and seven stages of preparatory audiation.
<u>Raw Score</u>	Number of correct answers on a test.
<u>Readiness</u>	Background necessary to achieve sequential objectives.
<u>Reliability</u>	Degree to which students' scores on a test remain the same when

that test is administered to them again after a short period of time.

Resting Tone	Sometimes referred to as a scale tone or home tone. Tonal center or centers to which a piece of music gravitates. Resting tone is specified by a movable-do syllable in the movable-do system with a la based minor. Tonality has a resting tone whereas keyality has a tonic.
Rhythm	Consists of three fundamental parts: macrobeats, microbeats, and rhythm patterns. In audiation, microbeats are superimposed on macrobeats and rhythm patterns are superimposed on microbeats and macrobeats.
Rhythm Learning Sequence	Rhythm learning sequence includes all rhythm classifications and functions. Classifications and functions are taught sequentially in combination with skill learning sequence.
Rhythm Pattern	Two or more durations in a given meter audiated sequentially and forming a whole.
Rhythm Solfege	See rhythm syllables.
Rhythm Syllables	Names chanted for different durations in a rhythm pattern. Rhythm syllables used in learning sequence activities are based on beat functions(macrobeats and microbeats) and divisions of beats rather than on time-value names of notes.
Rote Learning	Information acquired through thoughtless imitation.
Score Distribution	How test results are dispersed from highest to lowest score.
Semantic Meaning	Programmatic suggestions of music extrinsic to music itself.
Skill Learning Sequence	Curriculum including discrimination and inference skills taught sequentially to students in conjunction with tonal or rhythm learning sequences.
Stabilized Music Aptitude	Music potential no longer affected by environmental factors. One enters the stabilized music aptitude stage at approximately nine years old and remains there throughout life.
Standard Deviation	A statistic describing how scores vary around a mean.
Standardized Test	A test with standard administrative and scoring procedures. A

standardized test may or may not have standard scores.

Syllable Names	Also called vocabulary names in learning sequence activities. For example, syllable names in a tonal pattern are do so, and syllable names in a rhythm pattern are du ta de ta.
Syntax	Orderly arrangement of pitches and durations in music. Music has syntax (context) but not grammar.
Tempo	1) Speed at which rhythm patterns are performed and 2) relative lengths of macrobeats within rhythm patterns.
Time-Value Names	Arithmetic fraction names given to durations relative to a whole note seen in music notation.
Tonal Learning Sequence	Tonal learning sequence includes all tonal classifications and functions. Classifications and functions are taught sequentially in combination with skill learning sequence.
Tonal Pattern	Two, three, four, or five pitches in a given tonality audiated sequentially and forming a whole. Eight pitches in a diatonic scale comprise at least two tonal patterns.
Tonal Solfege	See tonal syllables
Tonal Syllables	Names sung for different pitches in a tonal pattern. Tonal syllables used in learning sequence activities are based on movable-do with a la based minor, not do based minor.
Tonality	Determined by a resting tone. If do is resting tone, tonality is major; if la, harmonic minor or Aeolian; if re, Dorian; if mi, Phrygian; if fa, Lydian; if so, Mixolydian; and if ti, Locrian. A tonality is always in a keyality but a keyality may not be in a tonality.
Tonic	Pitch name of keyality. For example, C, D, or Eb. Keyality has a tonic whereas tonality has a resting tone.
Triple Meter	See usual triple meter.
Unusual Meter	Four types of meter in which macrobeats are of unequal length, regardless of whether they are audiated in pairs or more than a pair, whether some are intact, or whether they are divided into two or three microbeats of equal length.

Unusual Paired Intact Meter	Meter that results when macrobeats of unequal length are audiated in pairs, and at least one macrobeat is intact.
Unusual Paired Meter	Meter that results when macrobeats of unequal length are audiated in pairs. Some macrobeats are divided into two and others into three microbeats of equal length.
Unusual Unpaired Intact Meter	Meter that results when macrobeats of unequal length are audiated in more than a pair and at least one macrobeat is intact.
Unusual Unpaired Meter	Meter that results when macrobeats of unequal length are audiated in more than a pair. Some macrobeats are divided into two and others into three microbeats of equal length.
Usual Combined Meter	Meter that results when macrobeats of equal length are audiated in pairs. Some macrobeats are divided into two and others into three microbeats of unequal length.
Usual Duple Meter	Meter that results when macrobeats of equal length are audiated in pairs. Each macrobeat is divided into two microbeats of equal length.
Usual Meter	Three types of meter in which macrobeats of equal length are audiated in pairs. Macrobeats are divided into two or three microbeats of equal length or into two and three microbeats of unequal length, depending on meter.
Usual Triple Meter	Meter that results when macrobeats of equal length are audiated in pairs. Each macrobeat is divided into three microbeats of equal length.
Validity	Verification of one or more purposes of a test.

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