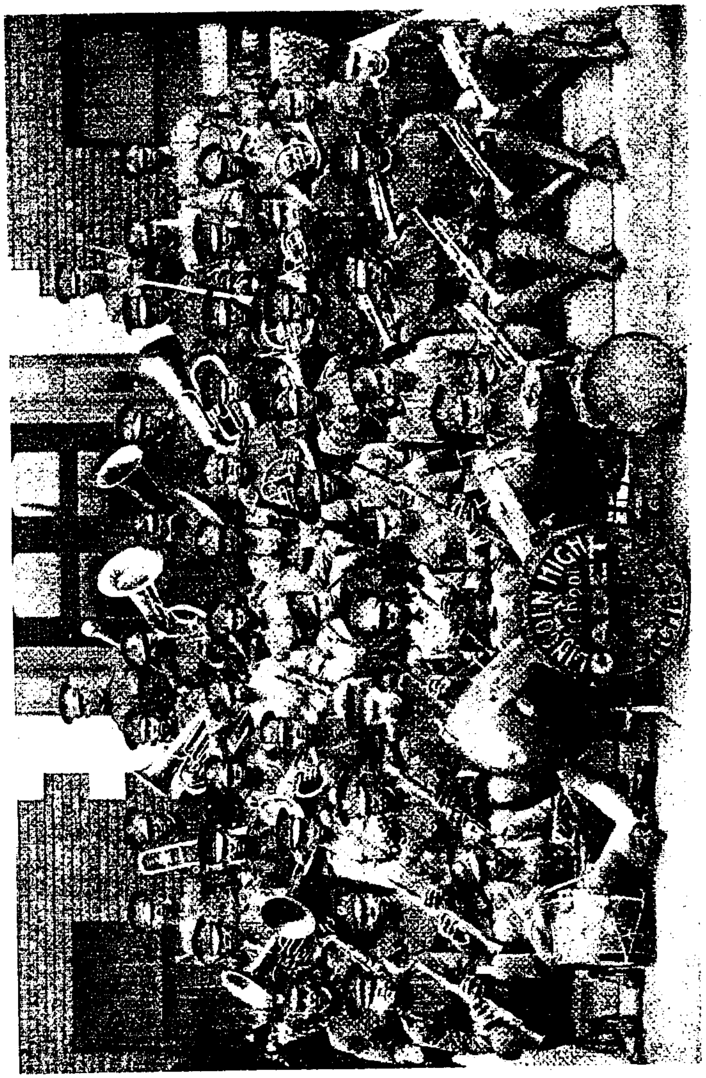

Lincoln High School Band—Ca. 1920
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INTERACTIVE COMPUTER FEEDBACK ON THE DEVELOPMENT OF FUNDAMENTAL CONDUCTING SKILLS

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Abstract

The purpose of this study was to examine the effects of two types of instruction, computer-generated musical feedback and verbal instruction, on undergraduate music majors' fundamental conducting skills. Subjects (N=52) conducted four musical etudes twice each in class (pre-post). In addition to classroom instruction on four conducting skills, represented in the respective etudes, one-third of the subjects worked outside of class with an interactive computer music system, the Digital Conducting System (DCS); one-third received verbal instruction and modeling examples by the instructor outside of class (Instructor); and one-third were unsupervised in their practice outside of class (Control).

Analysis of covariance results revealed that the DCS treatment was significantly more effective than unsupervised practice in improving skill 1 (preparatory/ictus/release) ($p<.05$). There were no significant differences between the two experimental treatments on any of the four skills, or between the treatments and control groups on skill 2 (legato), skill 3 (tenuto), and skill 4 (staccato). Results suggest that computer feedback was effective in improving selected fundamental skills. Replication of this study is recommended.

Research suggests that conducting enhances the attainment of aesthetic objectives among performers (Benge, 1996/1997; Geyer, 1982/1983; Grechesky, 1985/1986; House, 1998/1999; Sidoti, 1990/1991). Although directors of school music ensembles tend to utilize various teaching modes more than conducting (Sherrill, 1986), students in school ensembles seem to prefer rehearsal modes in which conductors use expressive gestures to highlight musical elements (Owens, 1992/1993).

Similarly, classroom activities associated with conducting have been linked to significant improvements in students' musical performances, and conducting gestures have been shown to positively affect musical expression in ensembles of various ability levels (Grechesky, 1985/1986; Kelly, 1997; Sidoti, 1990/1991). Therefore, it stands to reason that objectives for conducting classes should be constructed in ways that facilitate skill development and creativity in young conductors (Baker, 1992/1993).

Unfortunately, in many undergraduate conducting classes, students do not conduct live ensembles. Instead, students typically receive limited amounts of aural musical feedback on the effectiveness of their conducting, with most feedback limited to verbal comments from course instructors and perhaps fellow students.

In a previous study (Zirkman, 1984/1985), college conducting teachers indicated that more time should be devoted to conducting in the undergraduate curriculum, and that the curriculum should include a variety of conducting-related experiences. Similarly, 18 respondents representing 20 exemplary American conducting programs indicated that they favored live ensembles over recordings in the training of conductors (Weller, 1987). Seventeen of those respondents agreed that live feedback produces positive effects on students' conducting skills. The author of this study recommended the availability of live ensembles to students outside of class time.

The literature suggests that readily available sources of feedback would enhance the development of conducting skills in the undergraduate music curriculum (Zirkman, 1984/1985; Weller, 1987). Computer technology could provide some new means for training conductors, such as giving real-time feedback to students. Therefore, there is a need for research aimed toward developing and refining new technologies and teaching methods for the teaching of conducting.

Several researchers have studied computer technology as a means of simulating the conducting environment (Bertini & Carosi, 1992; Dannenberg & Bookstein, 1991; Nakra, 2000); and several others have focused on the use of such technology in the teaching of conducting (Fry, 1992/1993; Schwaegler, 1984/1985). Among these, Fry (1992/1993) studied the effects of an interactive video disc system with conducting students. There were no significant results reported between the groups; however, he reported that an experimental group using an interactive videodisc appeared to achieve class objectives better than did a control group.

Schwaegler (1984/1985) employed a computer-based Music Conducting Trainer to provide information feedback to 60 beginning

undergraduate conductors on the size and steadiness of their beat patterns. Results revealed that students who received feedback from the MCT during or after their performances demonstrated more consistent patterns and steadier tempos than did a control group.

Although research supports the use of technology to train conductors, there is little research on the use of interactive computer systems in the training of beginning conductors. The purpose of this study was to test the effectiveness of bio-feedback given through a computer system designed to assist beginning conductors in the development of fundamental conducting skills. In addition to testing operating procedures, we compared the effects of the computer-assisted training, instructor tutoring, and a control setting on the acquisition of selected conducting skills.

Method

Equipment

The authors employed the Digital Conducting System (DCS), an interactive real-time computer music system that plays musical etudes in response to fundamental conducting gestures. The DCS was designed and tested in the Media Laboratory at the Massachusetts Institute of Technology (MIT). A MIT graduate with experience in conducting and music performance designed the equipment for use in college-level conducting classes.

The DCS uses two electromyography signal-conditioning electrodes, attached to the right bicep and forearm, to monitor muscular movements in a conductor's right arm. The electrodes send a signal into a computer that displays the magnitude of the muscle movements.

A second computer plays four pre-programmed etudes. Etudes one through four focus respectively on the following gestures/styles: (a) preparatory, ictus, and release (skill 1); (b) legato (skill 2); (c) tenuto (three); and staccato (skill 4). The computer alters the performance of each etude in response to the respective conducting skills reflected in the arm movements. All etudes require the use of a conducting baton to most efficiently simulate the physiology of each skill.

A set of etudes was designed to accompany the four skills. The first etude (skill 1) consists of a simple progression of chords that requires subjects to execute a preparatory gesture, a sustained ictus, and a gesture of release, all with the right hand. Etude 2 (skill 2), an excerpt from a *Menuet* by Telemann, requires legato style conducted with the right hand. Etude 3 (skill 3) consists of the opening passage from Johannes Brahms' *Ein Duetches Requiem*. Subjects were asked to conduct in a connected tenuto style, with the tip of the baton below the horizontal plane. Etude 4 (skill 4), a portion of a *Menuetto* by W. A. Mozart, was designed to teach light staccato style.

Study Design

The combined populations of two beginning conducting classes (N=52) in a large university music school located in the southwestern United States were randomly divided into one control and two experimental groups. The subjects were majoring in performance, music education, music therapy, and composition. The classes met twice weekly (Tuesdays and Thursdays) for one hour.

Subjects in the DCS group (N=16) participated in one individual session per week outside of class with the DCS equipment. The principal author monitored each session and provided verbal comments intended only to assist the subject in operating the equipment. Feedback in the form of verbal instruction and modeling were avoided. Each session lasted from 10-20 minutes, depending upon the subject's level of success with the equipment and etude.

Subjects in the instructor group (N=18) also received weekly individual sessions with the principal author. Only verbal corrective feedback was given, with no use of the DCS. Sessions lasted from 5-10 minutes, depending upon the instructor's assessment of the subject's progress. (DCS sessions were longer due to subjects' unfamiliarity with the equipment.)

The control group (N=18) received no instruction outside of class. Instead, subjects were asked to practice the classroom conducting assignments on their own.

The study period lasted four weeks, with each skill and corresponding etude presented during a seven-day period. The instructor introduced skills and etudes on Tuesday. On the following Thursday, students conducted the etude in class (Pre-test). On the following Tuesday,

students conducted the etude a second time (posttest), and the next skill and etude were introduced. Class members performed for the student conductors on their major instruments on both pre and posttests.

Subjects participated in the experimental treatments (and control group practice) between each pretest (Thursday) and posttest (Tuesday). Missed treatment sessions were rescheduled prior to each respective posttest. Subjects conducted in a different random order on each test. All pre and posttest conducting performances were videotaped (52 pre and 52 posttests per week for four weeks, for a total of 416 tests). We inserted group mean pre and posttest scores, as appropriate, where there were missing test data due to subject absences from classes. This made up 18% of total pre and posttest data.

Three expert judges viewed the pre and posttest videotapes, each tape with a different pre-determined order, without knowledge of group assignment or function of the test (pre-post). The judges were instructed to rate the respective conducting gestures from 1-5 (low to high).

Inter-judge correlation results revealed substantial lack of agreement between one judge and the other two (p<.05), but an acceptable level of agreement between two judges (r=.831). Therefore, we used only two-judge mean ratings in the analysis.

Results

Four analysis of covariance (ANCOVA) tests were used to analyze results from the pre and posttest conducting performances, with the respective pretest scores serving as the covariate in each case. For skill 1 (preparatory/ictus/release gestures), there was a significant difference by group (Table 1). Post-hoc analysis revealed that the DCL group adjusted posttest means were significantly higher than those of the control group for skill 1 (Table 2). For skill 2 (legato), skill 3, (tenuto), and skill 4 (staccato), there were no significant differences by group (Table 1).

Table 1

One-Way Analysis of Covariance by Group

Source	SS	df	MS	F	p
Skill 1: Preparatory Beat, Ictus, and Release Gestures					
Group	7.25	2	3.62	5.42*	.007*
Covariate	5.99	1	5.99	8.97	
Treatment-Covariate	5.58	2	2.79	4.14	
Error	30.57	46	.66		
Skill 2: Legato Style					
Group	.32	2	.16	.23	.79
Covariate	5.92	1	5.92	8.77	
Treatment-Covariate	.13	2	.06	.09	
Error	31.07	46	.67		
Skill 3: Tenuto Style					
Group	3.37	2	1.68	2.90	.064
Covariate	4.80	1	4.80	8.27	
Treatment-Covariate	3.33	2	1.66	2.87	
Error	26.71	46	.58		
Skill 4: Staccato Style					
Group	.70	2	.35	.58	.56
Covariate	1.98	1	1.98	3.28	
Treatment-Covariate	.66	2	.33	.55	
Error	27.77	46	.60		

Note: asterisk (*) indicates significant difference by treatment type ($p<.05$).

Table 2
Fischer PLSD Post-hoc Test Results Based on ANCOVA Adjusted Means

Skill 1: Preparatory Beat, Ictus, and Release Gestures

DCL	Instructor	Control
[3.07]	[2.70]	[2.47]

Note: Underlines indicate no significant differences ($p<.05$).

Discussion

The results of this study suggest that interactive computer music feedback may be as effective as individualized verbal instruction in the teaching of fundamental conducting skills. The DCS and instructor treatments were statistically similar to each other on all four conducting skills, which suggests that computerized instruction could be an effective addition to classroom instruction, and that the use of this approach could save instructor time in college and university settings.

The DCS treatment was significantly more effective than unsupervised, out-of-class practice (control group) in improving subjects' preparatory/ictus/release gestures (skill 1). The results suggest that, for skill 1, out-of-class instruction led to a higher level of proficiency than did regular practice.

The Hawthorne effect could have played a larger role during the first week (skill 1) than during subsequent weeks due to the novelty of the equipment and subjects' awareness of their participation in a research study. On the other hand, the DCS requires highly precise, controlled movements of the arms. Proper manipulation of the equipment, and thus desirable musical rendering of the etude, requires subjects to conduct preparatory beats, ictús, and releases with the great care.

It is also possible that the DCS was more effective in facilitating an awareness of relationships between appropriate gestures and resulting sounds in a pedagogically oriented etude (etude 1) than in "real" musical passages (etudes 2, 3, and 4). Of the four skills, skill 1 is the most complex. The gestures used to initiate and release sound are perhaps the most important gestures in the conductor's vocabulary, and they are perhaps better served through live feedback.

Other factors that may have affected the results were the short treatment periods and the relatively small sizes of the three groups. In addition, the two judges whose scores were used reported having experienced some fatigue while viewing the tapes, and there was some evidence that the judges may have evaluated the tapes based on overall conducting skills rather than on the specific criteria provided for each etude.

The results of this study suggest that computerized instruction could be as effective as out-of-class verbal instruction and modeling for teaching beginning conducting gestures (Fry, 1992; Schwaegler, 1984) and their relationship to musical performance (Weller, 1987). Once students become familiar with the equipment, they could probably operate and use it for practice with little or no direct instructor support, thereby rendering such an approach more efficient in terms of teacher time. Regardless, the use of computer technology (and outside verbal instruction and modeling) could save class time normally used for remedial instruction, as well as for the introduction and reinforcement of new material.

The results of this study suggest that computer-assisted conducting training may be a benefit to beginning conducting students. However, further research is needed to determine whether computer-generated feedback is more effective in improving skills among beginning conductors than other modes of instruction. The authors recommend longer treatment periods, perhaps one month for each skill set. Finally, we recommend the use of more specific judging criteria and simultaneous tape viewing by all judges.

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HARMONIC CONTENT IN THE MARCHES OF JOHN PHILIP SOUSA

Jim Chesebrough

Although many studies have been written on the marches of American composer John Philip Sousa, very few have examined the harmonic language of the "March King." Perhaps this is because the harmonic structure of the American march seems to be a simple case of diatonic harmonies with occasional secondary functions. For much of the march repertoire this is true. Sousa was a contemporary of Wagner, Strauss, and other late Romantic composers, and he had solid musical training in the European tradition. While it seems likely that Sousa might have chosen to employ the harmonic vocabulary of the late Romantics, in fact the nature of the march did not allow for such an expanded harmonic vocabulary. The conservative character of the march, due to its heritage as functional music for the military, and the conservative personality of John Philip Sousa himself precluded the radical exploration of the harmonic language of the time. Chromatic harmonies in Sousa's marches were used judiciously to provide color and variety, to create strong cadential points emphasizing the specific form of the march, and to contribute to the thematic variety, texture, and momentum of the music.

John Philip Sousa was born in Washington, D.C. During his lifetime (1854-1932), the United States emerged as a world power, and Sousa had considerable influence on his country's cultural development. Today he is considered by some to be a composer of secondary significance, but during his lifetime he was held in high esteem. A performance by the Sousa band was viewed as a cultural and social event of the highest order.

Sousa's musical training began at the age of six with the violin and continued when he apprenticed in the band of the United States Marine Corps at thirteen . He sold his first composition at age seventeen. Two years later, he began a career as a violinist in the opera houses of Washington. In 1876 he moved to Philadelphia, where he performed with a number of ensembles, including Jacques Offenbach's orchestra for the Philadelphia Centennial Celebration. Various publishers asked him to make arrangements of music for violin and piano, and numerous conducting opportunities arose, including directing a successful tour of Gilbert and Sullivan's *H. M. S. Pinafore*.

In 1880 Sousa became the leader of the United States Marine Band,