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# The Effects of Technology-Based Conducting Practice on Skill Achievement in Novice Conductors

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## Abstract

The purpose of this study was to compare technology-based practice (Radio Baton and Digital Conducting System) to self-practice (recorded music) on the skill achievement of beginning conductors. Participants ( $N = 33$ ) were undergraduate music majors—education and performance—from two beginning conducting classes randomly assigned to either the technology-based group or the self-practice group. Subjects worked for three, 15-minute sessions on the following skills: staccato conducting, legato conducting, and steadiness of tempo. The experimental design was a pretest-posttest using two conducting etudes to measure six dependent variables: staccato conducting, staccato presence, staccato steadiness of tempo, legato conducting, legato presence, and legato steadiness of tempo. Three expert judges scored videotaped pre and posttests with interjudge reliability ranging from .77 to .84. Six Analyses of Covariance tests (ANCOVA) were used to analyze the aforementioned dependent variables. A significant difference resulted between treatment and control groups for only the legato conducting variable ( $p = .05$ ). The researchers concluded that a longer treatment period was perhaps necessary to produce a significant difference between the groups on the other variables.

## Article

Research studies have examined the use of expression, gesture, movement, and skill in nonverbal communication as central to the effectiveness of conductors, as well as the impact of directors' conducting on ensemble performance and attitude of performers (Baker, 1992; Bengé, 1996; Cofer, 1998; House, 1998; Leppla, 1989; Marrin, 1996; Marrin-Nakra, 2000; Michelson, 1984; Sidoti, 1990; Sousa, 1988; Toney, 2000; VanWeelden, 2000; Yarbrough, Wapnick, & Kelly, 1979). It follows, if we value expression, gesture, movement, nonverbal communication, and skill in these areas, we ought to look for more efficient ways to foster these in developing conductors.

Conducting teachers understand that live sound sources are necessary to teach both instigation motions and leadership, as conducting to a recorded sound source does not foster these skills (Weller, 1987). If interaction could be attained another way, this would permit the student conductor to practice the instigation of motion and stylistic gestures, and gain the leadership that such practice would foster, as time in front of an ensemble is always limited. Therefore, it is logical that we, as teachers of conductors, begin to examine the resources that technology brings to us in pedagogical terms.

Several forays have been made into the area of technology and conducting pedagogy: Computer Assisted Instruction (CAI) and Information Feedback (IF). CAI has helped conductors develop proficiency in detecting basic musical errors, such as rhythm and pitch (Gruner, 1993) and aided in score study (Hudson, 1996). IF has helped conductors attain skill using computer-based training (Kraus, Gonzalez, Hill, and Humphreys, 2004; Schwaegler, 1984).

Gruner, in his 1993 study, developed and utilized a program (Computer Error Detection Skills Program) designed to train conductors in rhythm and pitch error detection. Subjects ( $N = 24$ ) were beginning conductors selected from undergraduate instrumental music education majors

and were randomly assigned to treatment and control groups. A pretest-posttest design was implemented and after the pretest, the treatment group used the program for eight hours over an eight-week period. Data were analyzed using several one-way analyses of variance with repeated measures (ANOVA), which revealed significant improvement in the treatment group ( $p = .007$ ) from pretest to posttest for both dependent variables, rhythm and pitch error detection.

Hudson (1996) developed and utilized a program designed to aid in score study. Subjects in his investigation were drawn from conducting classes at four universities and randomly divided into a treatment or control group, each with 22 students. All subjects took a researcher-developed pretest to measure their knowledge of the First Suite in E-Flat by Gustav Holst. The treatment group then used the computer-assisted program for six sessions over a three-week period, supplementing the classroom teaching. The control group experienced only the class instruction. Following the three-week treatment period, all students took the same dependent measure as a posttest. The treatment group showed significantly greater gains over the control group on the total measure. As in the Gruner study, the control group here was given no treatment to offset the drill and practice of the treatment group.

Two studies have examined the use of Information Feedback (IF). Schwaegler (1984) designed the Music Conducting Trainer (MCT) to investigate the effects of IF on the steadiness and shape of subjects' conducting patterns. Subjects ( $N = 60$ ) were volunteer undergraduate music majors, all previously untrained in conducting. Each was randomly assigned to one of four IF modes, and then took part individually in a three-part session: pre-treatment instruction, twelve test trials with the MCT providing one of the IF modes, and four test trials with the MCT providing music which followed in tempo the beat pattern of the subject. Results from a multivariate analysis of variance test (MANOVA) indicate students receiving training with supplementary IF—either concurrent with or following a performance—performed with a more ideal pattern than students who received training without IF. Those receiving supplementary IF concurrent with performance conducted with a less steady tempo than subjects receiving other IF modes.

The Kraus et al. study employed the use of Marrin-Nakra's Digital Conducting System (DCS) that she developed in the Media Laboratory at the Massachusetts Institute of Technology. Kraus described the DCS as follows: "An interactive real-time computer music system that uses two electromyography signal-conditioning electrodes attached to the right bicep and forearm which monitor muscular movement in the conductor's right arm and sends a signal to a computer that displays the magnitude of the movements." To further this description, a second computer plays pre-programmed etudes that respond to the conducting skills reflected in the conductor's arm movement. The Kraus et al. study used a pretest-posttest design in which subjects ( $N = 52$ ) conducted four musical etudes used to measure different conducting skills: a) preparatory, ictus, release; b) legato; c) tenuto; d) staccato. Subjects were randomly assigned into three groups: one group worked outside of class with the DCS; a second group worked with an instructor outside of class; a third group (control) practiced unsupervised outside of class. The treatment period lasted four weeks, each subject working either with the technology or an instructor once a week for 5-20 minutes and on one skill each week. The DCS group received more instruction time; however, no significant differences were found between the two experimental groups. Additionally, ANCOVA results revealed a significant difference between the DCS group and the

control group on etude one which measured preparatory, ictus, release ( $p < .05$ ), indicating that computer feedback was effective on improving selected fundamental skills. The authors suggested that short treatment periods and a small number of subjects may have impacted the results of this study.

The purpose of the present study was to compare technology-based practice—Nakra’s previously mentioned Digital Conducting System (DCS) and Max Mathew’s Radio Baton (RB)—with self-practice in the skill achievement of beginning conductors. The RB is an electronic instrument adapted for conducting pedagogy that consists of an antenna base that is struck with a percussion-like mallet to initiate and control tempo of a pre-recorded etude using the right hand, much as a conductor would with a baton. The left hand mallet is able to control volume through sagittal (forward and backward) movement, and timbre through up and down movement, much as a conductor would do with the left hand. Our investigation used only the right hand to initiate and control tempo.

The current study used the DCS to develop two conducting skills, staccato and legato. In addition, we were curious if skills practiced separately would transfer. Thus, the “steadiness of tempo” variable, practiced on the Radio Baton (RB), was measured not by a separate etude during the pre and posttests, but was measured twice: once each during the staccato etude and once during the legato etude. Likewise, we investigated if presence was measurably improved in those students working with the DCS and RB, as this equipment simulated a live sound source; therefore, building upon Weller’s (1987) suggestion that only time with an ensemble could build leadership referred to as presence in this study. The following dependent variables were measured: staccato conducting, steadiness of tempo in staccato, and presence as a conductor in staccato, legato conducting, steadiness of tempo in legato, and presence as a conductor in legato.

## Method

Subjects ( $N = 33$ ) were undergraduate music majors in their first semester of conducting from a large university music school in the southwest region of the United States. Two intact classes, both taught by the same instructor and receiving the same instruction, provided 33 participants who were randomly assigned into two groups: technology-based or treatment ( $n = 17$ ) and self-taught or control ( $n = 16$ ).

Prior to the three-week treatment period, each subject conducted two etudes, one staccato and one legato, using an in-class ensemble while being videotaped. Following this pretest, participants individually took part in three, 15-minute timed practice episodes outside of class that focused on a different skill each session. The treatment group, those working with the DCS and RB, needed approximately five minutes before the timed practice for set up and instruction on the equipment. Staccato and legato practice etudes were administered with the DCS, and steadiness of tempo with the RB. While the treatment subjects worked with the technology, the control group subjects individually practiced the same musical etudes and skills with pre-recorded music. Each subject’s session was monitored to be sure that s/he practiced for the

specified amount of time so that we could rule out improvement simply from extra time put into practice.

One researcher supervised the conducting students' practice, but neither group received conducting instruction. The technology used and skills practiced were as follows: first session, RB, a Bach etude that was neither staccato or legato, steadiness of tempo; second session, DCS, a Mozart etude, staccato conducting; third session, DCS, a Brahms etude, legato conducting. Following the treatment period, all subjects were videotaped conducting the same etudes used in the pretest while conducting the same in-class ensemble.

The pre and posttest conducting episodes were randomly dubbed onto one videotape so that judges' would score subjects in a random order. Three experts, consisting of two university conducting professors and one doctoral conducting student, used a training period to familiarize themselves with the scoring rubric—a five-point, Likert-type scale—and the operational definitions for each dependent variable. Using videotaped examples from students not participating in the study, judges practiced scoring conducting episodes and were encouraged to discuss their practice ratings. Once the researchers were confident that the judges were clear on the evaluation process, the scoring of the pretest and posttests began. Interjudge reliability was calculated among the three experts using a Pearson product-moment correlation matrix; reliabilities ranged from .77 to .84.

## Results

Six, one-way analysis of covariance tests (ANCOVA) were used to investigate the differences between the treatment and control groups on six dependent variables. Because of the small sample sizes, the ANCOVA was employed only after the researchers carefully determined assumptions for use were met. Analyses revealed that for the variable of legato conducting, there was a significant difference favoring the treatment group  $F(1, 23) = 4.39, p = .05$ . For the variable of legato tempo, there was a significant interaction between the treatment and the covariate ( $p = .02$ ); therefore, this result negated the additional significant difference found between the treatment and control groups ( $p = .04$ ) on this variable, legato tempo. There was no significant difference between the treatment and control for the dependent variable of legato presence. Results for staccato conducting, staccato tempo, and staccato presence revealed there were no significant differences between the treatment and control groups.

## Discussion

The results of this study indicate that technology-based conducting practice may be effective for teaching legato skill to novice conductors. This result was different from the previous study conducted by Kraus et al. (2004) who found no significant difference among groups on the legato conducting variable while using the same equipment (DPS) and legato etude. We observed that when students used the DCS for legato conducting, the computer program demanded that they over-exaggerate the gesture before it would play the etude in a legato

manner; therefore, when the students conducted the posttest etude with an ensemble, the gesture became an effective and obvious motion an improvement from the previous test. Regardless of the current study's significant result, it is the opinion of the researchers that a stronger design is needed to fully assess the usefulness of technology as a pedagogical tool. While most students greatly enjoyed the novelty of the technology, two students became flustered by it, and needed more time to get used to the equipment. We highly recommend replication of the study with a longer treatment period and the use of more subjects.

One benefit of this type of research is to become familiar with the types of technology available for pedagogical purposes and to build relationships with those who are involved in the development of such instruments. Unfortunately, much of this technology is developed separate from conductors and teachers with other purposes in mind. Often it is up to music educators to forge relationships with the creators of these technologies and find appropriate applications for their use concurrently with traditional music instruction. As a result of insight gained through this study, Mr. Mathews is further adapting his Radio Baton to make it more pedagogically useful to student conductors. Interaction with Ms. Nakra has allowed her to make adjustments in her equipment as well.

Although there are only a handful of studies on technology-based conducting instruction, the results of this study and others (Gruner, 1993; Hudson, 1996; Kraus, Gonzalez, Hill, and Humphreys, 2002; Schwaegler, 1984) suggest that a certain synergy is created by the use of technology with pedagogy. The implications to instruction could be astounding if this technology is fully developed and studied. Just as students can now individually go to a computer laboratory and practice ear training, students could do the same with CAI and IF developed for conducting pedagogy, giving them interaction and feedback with a simulated ensemble source where currently they generally must practice without this advantage. Other such collaborations between researchers, students, and developers of technology could result in truly remarkable advances for conducting pedagogy and music education.

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[About the Authors](#) - Dr. Diana Hollinger is Coordinator of Music Education and conductor of the Symphonic Band at San José State University. Born and educated in California, Ms. Hollinger received her Bachelor of Arts degree in music education and Bachelor of Music degree in music composition from California State University, Fullerton. She received her Master of Music degree in conducting from the University of North Texas where she studied conducting with Eugene Corporon and composition with Cindy McTee. While there she guest conducted the North Texas Wind Symphony, Chamber Winds, Symphonic Band, and the two Concert Bands, and produced for a number of recording projects involving the Wind Symphony and Symphonic Bands. Ms. Hollinger received her D.M.A. in Music Education with a cognate in conducting at Arizona State University, where she studied with Gary Hill and was the Research Assistant for the “Digital Conducting Laboratory.”

In addition to her University duties, Hollinger is active as an adjudicator and clinician, serves on the CMEA Bay Section board in the capacity of Higher Education Representative, and recently completed a term on the California Music Educator's Association state board as Secretary. She also serves on the California Music Project board, and is chair of their education committee. Ms. Hollinger pursues an active research and writing schedule, most recently finishing her dissertation on the Venezuelan youth orchestra system.

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