INFORMATION TO USERS

The most advanced technology has been used to photograph and reproduce this manuscript from the microfilm master. UMI films the text directly from the original or copy submitted. Thus, some thesis and dissertation copies are in typewriter face, while others may be from any type of computer printer.

The quality of this reproduction is dependent upon the quality of the copy submitted. Broken or indistinct print, colored or poor quality illustrations and photographs, print bleedthrough, substandard margins, and improper alignment can adversely affect reproduction.

In the unlikely event that the author did not send UMI a complete manuscript and there are missing pages, these will be noted. Also, if unauthorized copyright material had to be removed, a note will indicate the deletion.

Oversize materials (e.g., maps, drawings, charts) are reproduced by sectioning the original, beginning at the upper left-hand corner and continuing from left to right in equal sections with small overlaps. Each original is also photographed in one exposure and is included in reduced form at the back of the book.

Photographs included in the original manuscript have been reproduced xerographically in this copy. Higher quality 6" x 9" black and white photographic prints are available for any photographs or illustrations appearing in this copy for an additional charge. Contact UMI directly to order.
Order Number 9111807

Acoustical placement of voices in choral formations

Tochef, Robert Dale, Ph.D.
The Ohio State University, 1990
ACOUSTICAL PLACEMENT OF VOICES
IN CHORAL FORMATIONS

DISSERTATION

Presented in Partial Fulfillment of the Requirements for
the Degree Doctor of Philosophy in the Graduate
School of the Ohio State University

By
Robert Dale Tocheff

The Ohio State University
1990

Dissertation Committee: James Major
James Gallagher
J. David McCracken

Approved by
Adviser
School of Music
ACKNOWLEDGMENTS

I wish to express sincere appreciation to all who have assisted and given support throughout the duration of this investigation. Thanks is offered for the professional guidance of my adviser Dr. James Major, and the other members of my dissertation committee, Professor James Gallagher and Dr. J. David McCracken. Thank you to Mr. Stephen Naber for his expert assistance with the statistical analysis. Gratitude is expressed to the directors of the treatment choirs, Dr. Craig Johnson and Professor Robert Nims, who gave valuable rehearsal time and professional assistance to this project. Special thanks is extended to the panel of judges, Ms. Cindy Brewer, Professor Lloyd Kaufmann, Mr. Mark Hutsko, Ms. Joyce Stonebraker, and Mr. Joe Thrower for an extremely difficult task well done.

Grateful appreciation and love go to my wife and children for their patience and support throughout my entire doctoral program.
VITA

May 18, 1952 ......................................................... Born - Dayton, Ohio

1973 ............................................................... A. A., Associate of Arts
Mount Vernon Nazarene College
Mount Vernon, Ohio

1974 ............................................................... B. A., Music Education
Olivet Nazarene University
Kankakee, Illinois

1978 ............................................................... M. M., Music Education
Wright State University
Dayton, Ohio

1974-1981 ...................................................... Music Specialist
Kettering City Schools
Kettering, Ohio

1981-1983 .............................................................. Instructor of Music
Mount Vernon Nazarene College
Mount Vernon, Ohio

1983 - .............................................................. Assistant Professor of Music
Mount Vernon Nazarene College
Mount Vernon, Ohio

FIELDS OF STUDY

Major Field: Music

Studies in Music Education:
  Professors James Major, Timothy Gerber, Jere Forsythe, A. Peter Costanza

Studies in Choral Techniques and Conducting:
  Professors James Gallagher, James Major, Maurice Casey, Craig Kirchhoff

Studies in Vocal Pedagogy:
  Professor Helen Swank

iii
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ACKNOWLEDGEMENTS</strong></td>
<td>ii</td>
</tr>
<tr>
<td><strong>VITA</strong></td>
<td>iii</td>
</tr>
<tr>
<td><strong>LIST OF TABLES</strong></td>
<td>viii</td>
</tr>
<tr>
<td><strong>LIST OF FIGURES</strong></td>
<td>xii</td>
</tr>
<tr>
<td><strong>Chapter</strong></td>
<td></td>
</tr>
<tr>
<td><strong>I. INTRODUCTION</strong></td>
<td>1</td>
</tr>
<tr>
<td>Summary of Investigator's Questionnaire Results</td>
<td>4</td>
</tr>
<tr>
<td>Statement of the Problem</td>
<td>5</td>
</tr>
<tr>
<td>Need for the Study</td>
<td>6</td>
</tr>
<tr>
<td>Purpose of the Study</td>
<td>7</td>
</tr>
<tr>
<td>Hypotheses</td>
<td>8</td>
</tr>
<tr>
<td>Definitions</td>
<td>10</td>
</tr>
<tr>
<td>Limitations of the Study</td>
<td>12</td>
</tr>
<tr>
<td>Assumptions Pertinent to the Study</td>
<td>12</td>
</tr>
<tr>
<td><strong>II. REVIEW OF RELATED LITERATURE</strong></td>
<td>13</td>
</tr>
<tr>
<td>Acoustical Factors of Vocal Production and Performance</td>
<td>13</td>
</tr>
<tr>
<td>Affecting Choral Sound</td>
<td></td>
</tr>
<tr>
<td>Choral Sound</td>
<td>14</td>
</tr>
<tr>
<td>Choral Blend</td>
<td>14</td>
</tr>
<tr>
<td>Choral Balance</td>
<td>21</td>
</tr>
<tr>
<td>Intensity</td>
<td>23</td>
</tr>
<tr>
<td>Vibrato</td>
<td>24</td>
</tr>
<tr>
<td>Tone Color</td>
<td>26</td>
</tr>
<tr>
<td>Vowel Uniformity</td>
<td>28</td>
</tr>
<tr>
<td>Choral Intonation</td>
<td>31</td>
</tr>
<tr>
<td>Rhythm/Precision</td>
<td>33</td>
</tr>
<tr>
<td>Choral Formations</td>
<td>34</td>
</tr>
<tr>
<td>Placement of Individual Singers</td>
<td>34</td>
</tr>
<tr>
<td>An Interview with Weston Noble</td>
<td>39</td>
</tr>
<tr>
<td>An Interview with John Williams</td>
<td>43</td>
</tr>
<tr>
<td>An Interview with Rodney Eichenberger</td>
<td>46</td>
</tr>
</tbody>
</table>

iv
III. MATERIALS AND PROCEDURES

Design of the Study ................................................................. 76
Selection of Treatment Choirs and Directors ............................... 77
Selection of the Choral Pieces ...................................................... 78
Selection of the Panel of Judge .................................................... 78

Instruments of Evaluation .......................................................... 79
Choral Sound Inventory ............................................................... 79
Singer Evaluation Survey ............................................................. 79
Director Evaluation Survey ......................................................... 79

The Site for the Experiment .......................................................... 80

Pre-Experiment Preparation .......................................................... 80

Preparation for the Choir ............................................................. 80
  Establishment of the mixed formations ......................................... 81
  Establishment of the sectional formations ....................................... 82

Preparation for the Judges/Pilot Test ............................................. 83

The Experiment/Collection of Data ................................................. 83

IV. PRESENTATION AND ANALYSIS OF DATA ............................ 85

Data and Analysis for Dependent Variables ................................. 85
  Overall Blend .............................................................................. 85
  Instances of Noticeable Individual Voices ..................................... 92
  Overall Balance of Voice Parts/Intensity ...................................... 94
  Intonation ................................................................................. 97
  Rhythmic Precision/Ensemble/Diction .......................................... 104
  Interpretation/Expressiveness/Dynamic Control .......................... 108

Testing of Hypotheses ................................................................. 115
Testing Null Hypotheses 1 and 2 ......................................................... 117
Overall Blend ............................................................................. 117
Instances of Noticeable Individual Voices ...................................... 118
Overall Balance of Voice Parts/Intensity ........................................ 118
Intonation ....................................................................................... 118
Rhythmic Precision/Ensemble/Diction ............................................ 119
Interpretation/Expressiveness/Dynamic Control ............................ 120

Testing Null Hypotheses 3 and 4 As Interacting Hypotheses .......... 120
Testing Hypotheses 3 and 4 Separately ................................................. 121
Overall Blend ............................................................................. 122
Instances of Noticeable Individual Voices ...................................... 123
Overall Balance of Voice Parts/Intensity ......................................... 125
Intonation ....................................................................................... 125
Rhythmic Precision/Ensemble/Diction ............................................ 125
Interpretation/Expressiveness/Dynamic Control ............................ 125

Results of the Singer Evaluation Survey .................................................... 126
Question 1 Comments .......................................................................... 128
Question 2 Comments .......................................................................... 129
Question 3 Comments .......................................................................... 129

Results of the Director Evaluation Survey ................................................. 130
Results of the DES for Director 1 ......................................................... 130
Results of the DES for Director 2 ................................................ 131

V. SUMMARY AND CONCLUSIONS ......................................................... 133

Purpose of the Study ........................................................................... 133
Procedures .................................................................................. 133
The Treatment Choirs ........................................................................ 134
The Choral Pieces ........................................................................ 135
The Panel of Judges ........................................................................ 135
Instruments of Evaluation .......................................................................... 135
The Site for the Experiment ................................................................. 136
The Experiment/Collection of Data ...................................................... 136

Results ....................................................................................................... 137
Analysis and Discussion of the Effect of Independent Variables .... 137
on Each Dependent Variable

Overall Blend ............................................................................. 137
Instances of Noticeable Individual Voices ...................................... 139
Overall Balance of Voice Parts/Intensity ......................................... 139
Intonation ....................................................................................... 139
Rhythmic Precision/Ensemble/Diction ............................................ 141
Interpretation/Expressiveness/Dynamic Control ............................ 141
LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>ANOVA results for the dependent variable of overall blend with the</td>
<td>86</td>
</tr>
<tr>
<td></td>
<td>independent variable of acoustical/unorganized placement of voices</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>ANOVA results for the dependent variable of overall blend with the</td>
<td>87</td>
</tr>
<tr>
<td></td>
<td>independent variable of voice part placement</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>ANOVA results for the dependent variable of overall blend with the</td>
<td>88</td>
</tr>
<tr>
<td></td>
<td>independent variable of musical texture</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>ANOVA results for the dependent variable of overall blend with the</td>
<td>89</td>
</tr>
<tr>
<td></td>
<td>independent variable of choir</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>ANOVA results for the dependent variable of overall blend with the</td>
<td>89</td>
</tr>
<tr>
<td></td>
<td>independent variable of judge</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Interaction of the independent variables of musical texture (piece)</td>
<td>89</td>
</tr>
<tr>
<td></td>
<td>and acoustical/unorganized placement of voices for the</td>
<td></td>
</tr>
<tr>
<td></td>
<td>dependent variable of overall blend</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Interaction of the independent variables of voice part placement (mixed/</td>
<td>91</td>
</tr>
<tr>
<td></td>
<td>sections) and judge for the dependent variable of</td>
<td></td>
</tr>
<tr>
<td></td>
<td>overall blend</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>ANOVA results for the dependent variable of instances of noticeable</td>
<td>92</td>
</tr>
<tr>
<td></td>
<td>individual voices with the independent variable of acoustical/unorganized</td>
<td></td>
</tr>
<tr>
<td></td>
<td>placement of voices</td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>ANOVA results for the dependent variable of instances of noticeable</td>
<td>92</td>
</tr>
<tr>
<td></td>
<td>individual voices with the independent variable of voice part placement</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(mixed/sections)</td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>ANOVA results for the dependent variable of instances of noticeable</td>
<td>93</td>
</tr>
<tr>
<td></td>
<td>individual voices with the independent variable of musical texture (piece)</td>
<td></td>
</tr>
</tbody>
</table>
11. ANOVA results for the dependent variable of instances of noticeable individual voices with the independent variable of choir ............................... 94
12. ANOVA results for the dependent variable of instances of noticeable individual voices with the independent variable of judge ................................. 94
13. ANOVA results for the dependent variable of overall balance of voice parts/intensity with the independent variable of acoustical/unorganized placement of voices 95
14. ANOVA results for the dependent variable of overall balance of voice parts/intensity with the independent variable of voice part placement (mixed/sections) 95
15. ANOVA results for the dependent variable of overall balance of voice parts/intensity with the independent variable of musical texture (piece) 95
16. ANOVA results for the dependent variable of overall balance of voice parts/intensity with the independent variable of choir ................................. 96
17. ANOVA results for the dependent variable of overall balance of voice parts/intensity with the independent variable of judge ................................. 96
18. Interaction of the independent variables of judge and choir for the dependent variable of overall balance of voice parts/intensity ................................. 96
19. ANOVA results for the dependent variable of intonation with the independent variable of acoustical/unorganized placement of voices ................................. 98
20. ANOVA results for the dependent variable of intonation with the independent variable of voice part placement (mixed/sections) ................................. 99
21. ANOVA results for the dependent variable of intonation with the independent variable of musical texture (piece) ................................. 100
22. ANOVA results for the dependent variable of intonation with the independent variable of choir ................................. 101
23. ANOVA results for the dependent variable of intonation with the independent variable of judge ................................. 102
24. Three-way interaction of the independent variables of choir, musical texture (piece), and voice part placement (mixed/sections) for the dependent variable of intonation ................................. 102
25. ANOVA results for the dependent variable of rhythmic precision/ensemble/diction with the independent variable of acoustical/unorganized placement of voices

26. ANOVA results for the dependent variable of rhythmic precision/ensemble/diction with the independent variable of voice part placement (mixed/sections)

27. ANOVA results for the dependent variable of rhythmic precision/ensemble/diction with the independent variable of musical texture (piece)

28. ANOVA results for the dependent variable of rhythmic precision/ensemble/diction with the independent variable of choir

29. ANOVA results for the dependent variable of rhythmic precision/ensemble/diction with the independent variable of judge

30. ANOVA results for the dependent variable of interpretation/ expressiveness/dynamic control with the independent variable of acoustical/unorganized placement of voices

31. ANOVA results for the dependent variable of interpretation/ expressiveness/dynamic control with the independent variable of voice part placement (mixed/sections)

32. ANOVA results for the dependent variable of interpretation/ expressiveness/dynamic control with the independent variable of musical texture (piece)

33. ANOVA results for the dependent variable of interpretation/ expressiveness/dynamic control with the independent variable of choir

34. ANOVA results for the dependent variable of interpretation/ expressiveness/dynamic control with the independent variable of judge

35. Interaction of the independent variables of judge and musical texture (piece) for the dependent variable of interpretation/ expressiveness/dynamic control

36. Interaction of the independent variables of musical texture (piece) and acoustical/unorganized placement of voices for the dependent variable of interpretation/expressiveness/dynamic control
37. Paired observation t test of the independent variables of musical texture (piece) and voice part placement (mixed/sections) for the dependent variable of overall blend.

38. Paired observation t test of the independent variables of musical texture (piece) and voice part placement (mixed/sections) for the dependent variable of instances of noticeable individual voices.

39. SES question 1: What value do you see in acoustically placing voices to achieve compatibility with surrounding singers?

40. SES question 2: For the polyphonic selection (Bach), which formation did you prefer?

41. SES question 3: For the homophonic selection (Verdi), which formation did you prefer?
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>37</td>
</tr>
<tr>
<td>2.</td>
<td>41</td>
</tr>
<tr>
<td>3.</td>
<td>41</td>
</tr>
<tr>
<td>4.</td>
<td>42</td>
</tr>
<tr>
<td>5.</td>
<td>44</td>
</tr>
<tr>
<td>6.</td>
<td>45</td>
</tr>
<tr>
<td>7-9.</td>
<td>51</td>
</tr>
<tr>
<td>10-36.</td>
<td>55-64</td>
</tr>
<tr>
<td>37-46.</td>
<td>69-72</td>
</tr>
<tr>
<td>47.</td>
<td>87</td>
</tr>
<tr>
<td>48.</td>
<td>88</td>
</tr>
<tr>
<td>49.</td>
<td>90</td>
</tr>
<tr>
<td>50.</td>
<td>91</td>
</tr>
<tr>
<td>51.</td>
<td>93</td>
</tr>
</tbody>
</table>

1. "Zones" of influence; Johnson (1978)
2. Choral voice placement; stage 1; Weston Noble
3. Choral voice placement; stage 2; Weston Noble
4. Choral voice placement; stage 3; Weston Noble
5. Voice intensity assessment chart; John Williams
6. Example of tenor I placement chart; John Williams
7-9. Representations of sectional formation preferences in Wyatt's (1968) survey
10-36. Representations of sectional formations recommended by choral experts
37-46. Representations of mixed formations recommended by choral experts
47. Graph of main effect favoring acoustical placement over unorganized placement for the dependent variable of overall blend
48. Graph of main effect favoring a sectional over mixed formation for the dependent variable of overall blend
49. Graph of interaction of musical texture (piece) and acoustical/unorganized placement of voices for the dependent variable of overall blend
50. Graph of interaction of voice part placement (mixed/sections) and judge for the dependent variable of overall blend
51. Graph of main effect favoring a sectional formation over mixed formation for the dependent variable of instances of noticeable individual voices
52. Graph of interaction of judge and choir for the dependent variable of overall balance/intensity
53. Graph of main effect favoring acoustical placement over unorganized placement for the dependent variable of intonation
54. Graph of main effect favoring polyphonic over homophonic texture for the dependent variable of intonation
55. Graph of main effect favoring choir 2 over choir 1 for the dependent variable of intonation
56. Graph of three-way interaction of choir, musical texture (piece), and voice part placement (mixed/sections) for the dependent variable of intonation
57. Graph of main effect favoring acoustical placement over unorganized placement for the dependent variable of rhythmic precision/ensemble/diction
58. Graph of main effect favoring choir 2 over choir 1 for the dependent variable of rhythmic precision/ensemble/diction
59. Graph of main effect of judge for the dependent variable of rhythmic precision/ensemble/diction
60. Graph of main effect favoring choir 2 over choir 1 for the dependent variable of interpretation/expressiveness/dynamic control
61. Graph of main effect of judge for the dependent variable of interpretation/expressiveness/dynamic control
62. Graph of interaction of judge and musical texture (piece) for the dependent variable of interpretation/expressiveness/dynamic control
63. Graph of interaction of musical texture (piece), and acoustical/unorganized placement for the dependent variable of interpretation/expressiveness/dynamic control
64. Graph of t test for musical texture (piece) and voice part placement (mixed/sections) for the dependent variable of overall blend
65. Graph of t test for musical texture (piece) and voice part placement (mixed/sections) for the dependent variable of instances of noticeable individual voices
66. Choir 1: Acoustically placed sectional formation
67. Choir 1: Unorganized sectional formation ............... 180
68. Choir 1: Acoustically placed mixed formation ........... 181
69. Choir 1: Unorganized mixed formation .................. 181
70. Choir 2: Acoustically placed sectional formation ....... 181
71. Choir 2: Unorganized sectional formation ............... 182
72. Choir 2: Acoustically placed mixed formation .......... 182
73. Choir 2: Unorganized mixed formation .................. 182
CHAPTER I
INTRODUCTION

The sound produced by choral ensembles is the result of many factors of vocal production both individually and collectively. The subjective nature of choral sound due to personal preference and many acoustical variables causes definitive research to be scant and seemingly impractical. Although most choral directors would agree that the achievement of blend is necessary for a good choral sound, its definition and method of attainment are diverse.

In Chapter II, two schools of thought on choral blend are explored. School A recognizes individual voice differences as assets to blend, and criticizes manipulation of technique as a means to achieving blend. The literature indicates that this is the preferred philosophy. Scholz, in Knutson (1988), refers to this preference as the mainstream in American choral singing—that is, moving away from a straight tone philosophy of blend to a soloistic (but non-operatic) vocal production. The School B Philosophy of blend supports the manipulation of individuals' vocal technique to achieve a similar color, thus creating blend. Swan, in Decker and Herford (1988), reports F. Melius Christiansen's contention that "...every singer in the chorus has a primary responsibility to subordinate his own ideas concerning tone production, rhythmic stress, and pronunciation to the blended and unified sound made by the total ensemble" (p. 12).

Other elements of choral vocal production similarly evade precise or predictable assessment. Balance is usually viewed as relative levels of loudness among voice parts. Again, personal preference dictates methods of arriving at proper balance. Generally the
factors include numbers of singers, placement of singers, range and voicing of music, texture of music, tone quality, intonation, diction, dynamics, and treatment of vocal lines (Triplett, 1971/1972; Roe, 1983).

The intensity of a vocal tone is not only a matter of adjusting individuals' volume, but is effected by acoustical principles. For instance, studies have shown that complex tones with many partials are perceived as louder than ones with a simpler spectrum (Goodwin, 1980; Skinner & Antinoro, 1970).

Vibrato is a factor of vocal production that is particularly controversial in regard to its effect on choral blend. Degrees of vibrato modification range from the straight tone philosophy of F. Melius Christiansen to the encouragement of the full vibrato of John Finley Williamson's mature soloistic approach. Dieicks (1960) recognizes that inhibiting vibrato may facilitate the blending process but at the cost of tone color and vocal health.

Vocal tone color—the unique quality of vocal sound determined by the length, mass, and shape of the vocal tract is also an element subject to various degrees of manipulation for the purpose of blend. Trevor (1977) suggests that even a freely produced tone may have difficulty blending because of a unique timbre. Others, however (Johnson, 1978; Waring, 1944; Shaw, 1945), suggest that singers use their full range of tonal color. The focus of this study, positioning of singers, is often used as a means of blending various tone colors while preserving individual timbres.

The controversy regarding manipulation in choral tone production is particularly evident in the concept of vowel uniformity. The term uniformity itself suggests that all choir members arrive at a preconceived standard or sameness. But manipulation takes on a slightly different connotation, in that vowel formants (the acoustical bands of energy responsible for making a vowel recognizable) necessitates manipulation of the pharyngeal cavity. Most choral directors agree that vowel unity is an important factor in choral blend,
but the degree of modification is debatable. Christy (1940) attributes poor ensemble as much to lack of vowel unity as to deviation from pitch or lack of dynamic balance. Knutson (1988) reports Olaf Christiansen's strong belief in vowel unification but without modification. Similarly, Dale Warland believes in agreeing on a basic vowel sound, but not in manipulating, shaping, or controlling each vowel.

Good intonation is certainly a criterion for good choral sound. Choral directors cite many factors causing poor choral intonation including bad vocal production, wrong vowel concept (Heffernan, 1982), aural laziness (Roe, 1965), and natural gravitation (Wyatt, 1967). Of particular relevance to this investigation, Heffernan (1982) lists incompatibility of voices as a factor causing intonation problems.

Rhythmic precision is viewed by some as a factor in achieving good choral blend (Shaw, Decker, Flummerfelt, and Olaf Christiansen, in Knutson, 1988), while others include rhythmic unity as a requirement for good ensemble performance (Trevor, 1977; Triplett, 1971/1972). Whether an element of blend or a matter of ensemble, rhythmic unity is an essential factor affecting expressive choral singing.

All the preceding factors regarding vocal production and choral sound become significant issues when determining how singers should be positioned in choral formation. Some choral directors believe that placing like-voices together achieves the best choral blend, and often assign certain voice types to specific rows (Roe, 1983; Johnson, 1978; Molnar, 1962; Contino, and F. Melius Christiansen in Knutson, 1988). Other writers suggest that pairing unlike or unequal qualities creates a more desired choral sound (Busch, 1984; Gordon, 1977; Lamb, 1988; Noble, 1989; Pfautsch, in Decker and Herford, 1988; Jennings, in Knutson, 1988).

Because singers control their sound by hearing themselves, as well as others, many directors suggest ample space between singers--as much as four feet (Goodwin,
1980; Pfautsch, in Decker and Herford, 1988; Gordon, 1977; Williams, 1989; Eichenberger, 1989). Factors other than vocal sound such as reading ability, height, and personality are also considered criteria for positioning singers by many choral directors.

While some choral directors believe in the results of one specific choral formation, many experts are of the opinion that a variety of formations is more productive (Lamb, 1988; Triplett, 1971/1972; Stanton, 1971). Pfautsch, in Decker and Herford (1988) and Stocker (1975) also favor a variety of positions but recommend settling on a formation well before a performance for security and adjustments to neighbors.

Summary of Investigator's Questionnaire Results

Several of the above factors, as well as others, were addressed in a questionnaire constructed by the investigator. The questionnaire was distributed to participants at two choral conventions in the summer of 1989. The complete results of this questionnaire are presented in Appendix A. A summary of the results, however, is presented below:

1. In placing voices in a formation, the size of the voice, vibrato, and compatibility were viewed as most important.

2. Regarding the singer's responsibility to choral blend, the natural technique philosophy was favored, but by a narrower margin than expected.

3. Regarding sectional versus mixed formations, the following responses are noted:

   A. There was equal opinion as to which formation was most effective in achieving the best overall sound.

   B. A sectional formation was favored the majority of time for rehearsal and performance.

   C. A sectional formation was strongly favored for contrapuntal music.
D. A mixed formation was preferred for homophonic music.

E. A mixed formation was strongly favored with singers of moderate or high vocal ability, and a sectional formation with singers of low ability.

F. A sectional formation was preferred for large ensembles, and a mixed formation for small ensembles.

G. A mixed formation was preferred for the improvement of intonation.

H. Surprisingly, respondents indicated that choir members preferred a sectional formation.

I. Results indicated that music is most quickly learned in a sectional formation.

J. Responses indicated that the musical growth of singers is best served in a mixed formation.

Statement of the Problem

The problem investigated in this study can be presented with these questions:

1. Does careful acoustical placement of voices in choral formation, with respect to surrounding singers, significantly affect the quality of choral sound?

2. Is a better choral sound yielded by homogeneously grouping voice parts in sections or by mixing the voice parts throughout the choir, with and without regard to acoustical placement, for homophonic and polyphonic music?
Need for the Study

Many choral experts agree that the positioning of singers greatly affects choral sound. However, the diversity of opinion, personal preference, and numerous extraneous factors has made the assessment of various seating plans and acoustical methods of positioning singers to remain primarily subjective. While the subjective nature of choral performance and its hearing is part of the beauty of this medium, it does not lessen the need for empirical data to further strengthen the art of choral singing.

Research is present assessing individual voice characteristics in relationship to choral blend. Trevor (1977) found vibrato extent to be more important to choral blend than vibrato rate. Through regression analysis, vibrato rate and extent together accounted for approximately 15% of the judges' perception of blend. Goodwin (1980) identified spectral differences between vocal sounds produced in solo singing and in unison ensemble singing aimed at achieving optimum blend. He found that sounds produced in the blend context tended to have slightly stronger fundamental frequencies in combination with fewer and weaker upperpartials; in addition, there were slightly stronger first formants with weaker second and third formants.

Experimental research involving whole ensembles is present but, in most cases, provides insufficient data regarding the purpose of this study. Killian (1985), in an experiment allowing high school students and conductors to manually adjust the balance of recorded four-voice chorales, found: (a) subjects could discriminate when a single voice was unbalanced; (b) subjects preferred significantly less bass; and (c) there were no significant differences between student and conductor preferences. Using intact high school choirs, Corbin (1982) assessed the influence of selected vocal pedagogy concepts on choral tone quality, choral diction/precision, student knowledge of the singing process, individual vocal performance, and student attitudes.
There is one experiment closely related to this writer's investigation. Lambson (1958) set out to determine if a particular seating plan provides significant acoustical or practical advantages over other formations. A section plan, quartet plan, scatter plan, and random plan were tested. It should be noted that this current investigation is not intended to be a replication of Lambson's study, but many features are similar making the results at least loosely comparable. A summary of Lambson's results is presented in chapter II.

**Purpose of the Study**

The purpose of the present study is to investigate the effect of various choral formations and methods of positioning singers on choral sound. Since the literature identifies texture as a possible criterion for choosing a particular formation, one homophonic and one polyphonic selection were chosen as trial pieces for the experiment. Since no two choirs are identical, readers may rightly question whether the results might be applicable to their own ensembles. For this reason replication was built into the design by having two choirs participate. Replication was employed again by having each choir sing each selection twice in each of four different choral formations (eight trials for each piece). The trial performances, randomly presented, were rated by a panel of experts, visually screened, using the Choral Sound Inventory developed by the investigator (Appendix B). Through statistical analysis, comparisons were made of the choral sound rendered in each of the four choral formations. The development of these formations is described in chapter III.
Hypotheses

The four hypotheses were tested in their null form with an alpha level of .05. The alternate hypotheses present the expected direction of difference.

Null Hypothesis 1

In a sectional formation, there is no significant difference in CSI ratings when voices are acoustically placed than with an unorganized placement—regardless of texture for the following dependent variables:

A. Overall blend
B. Instances of noticeable individual voices
C. Overall balance of voice parts/Intensity
D. Intonation
E. Rhythmic precision/Ensemble/Diction
F. Interpretation/Expressiveness/Dynamic control

Alternate Hypothesis 1

In a sectional formation, CSI ratings are significantly higher when voices are acoustically placed than with an unorganized placement—regardless of texture for the following dependent variables:

A. Overall blend
B. Instances of noticeable individual voices
C. Overall balance of voice parts/Intensity
D. Intonation
E. Rhythmic precision/Ensemble/Diction
F. Interpretation/Expressiveness/Dynamic control

Null Hypothesis 2

In a mixed formation, there is no significant difference in CSI ratings when voices are acoustically placed than with an unorganized placement—regardless of texture for the following dependent variables:

A. Overall blend
B. Instances of noticeable individual voices
C. Overall balance of voice parts/Intensity
D. Intonation
E. Rhythmic precision/Ensemble/Diction
F. Interpretation/Expressiveness/Dynamic control
Alternate Hypothesis 2

In a mixed formation, CSI ratings are significantly higher when voices are acoustically placed than with an unorganized placement—regardless of texture for the following dependent variables:

A. Overall blend
B. Instances of noticeable individual voices
C. Overall balance of voice parts/Intensity
D. Intonation
E. Rhythmic precision/Ensemble/Diction
F. Interpretation/Expressiveness/Dynamic control

Null Hypothesis 3

For polyphonic music, there is no significant difference in CSI ratings when voice parts are arranged in a sectional formation than when voice parts are arranged in a mixed formation—regardless of acoustical/unorganized placement of voices for the following dependent variables:

A. Overall blend
B. Instances of noticeable individual voices
C. Overall balance of voice parts/Intensity
D. Intonation
E. Rhythmic precision/Ensemble/Diction
F. Interpretation/Expressiveness/Dynamic control

Alternate Hypothesis 3

For polyphonic music, CSI ratings are significantly higher when voice parts are arranged in a sectional formation than when voice parts are arranged in a mixed formation—regardless of acoustical/unorganized placement of voices for the following dependent variables:

A. Overall blend
B. Instances of noticeable individual voices
C. Overall balance of voice parts/Intensity
D. Intonation
E. Rhythmic precision/Ensemble/Diction
F. Interpretation/Expressiveness/Dynamic control
Null Hypothesis 4

For homophonic music, there is no significant difference in CSI ratings when voice parts are arranged in a mixed formation than when voice parts are arranged in a sectional formation—regardless of acoustical/unorganized placement of voices for the following dependent variables:
A. Overall blend
B. Instances of noticeable individual voices
C. Overall balance of voice parts/Intensity
D. Intonation
E. Rhythmic precision/Ensemble/Diction
F. Interpretation/Expressiveness/Dynamic control

Alternate Hypothesis 4

For homophonic music, CSI ratings are significantly higher when voice parts are arranged in a mixed formation than when voice parts are arranged in a sectional formation—regardless of acoustical/unorganized placement of voices for the following dependent variables:
A. Overall blend
B. Instances of noticeable individual voices
C. Overall balance of voice parts/Intensity
D. Intonation
E. Rhythmic precision/Ensemble/Diction
F. Interpretation/Expressiveness/Dynamic control

Definitions

The concepts and items defined below represent areas of choral sound and choral formations pertinent to this investigation.

Acoustics -- In addition to the science of sound in the context of architectural design, this term will refer to the nature, quality, and production of the singing voice with special emphasis on unique phenomena occurring when voices are combined in the choral medium.

Acoustical Placement of Singers -- Positioning singers in their acoustically correct spot in relationship to surrounding voices where they and neighboring voices (as well as an entire section) sound best.

Choral Balance -- The relative levels of loudness among voice parts.
**Choral Blend** -- The resulting choral sound in relationship to the combination of various voice types.

**Choral Intonation** -- The degree to which all voices sing in tune with those of the same part (horizontally) and with other parts (vertically).

**CSI** -- Choral Sound Inventory; the judges' choir assessment instrument.

**DES** -- Director Evaluation Survey; the survey completed by the experimental choir directors.

**Intensity** -- The volume of individual voices and voice parts.

**Mixed Formation** -- Voice parts scattered throughout the formation either randomly or with a predetermined plan (e.g. quartets), either with or without regard to acoustical placement or practical considerations.

**Rhythmic Precision** -- "Exactness in the treatment of various aspects of choral music as it proceeds in time" (Triplett, 1971/1972, p. 8).

**Sectional Formation** -- All voice parts placed in homogeneous groupings either with or without regard to acoustical placement or practical considerations.

**SES** -- Singer Evaluation Survey; the survey completed by the singers in the experimental choirs.

**Tone Color** -- The unique quality of a vocal tone determined by the length, mass, and shape of the entire vocal tract.

**Vibrato** -- The natural variation in pitch of a sung tone above and below the fundamental frequency.

**Vibrato Extent** -- The degree of variation above and below the fundamental pitch.

**Vibrato Rate** -- The speed of the pitch fluctuation (oscillations per second).

**Vowel Uniformity** -- The same vowel shape and sound, whether modified or pure, being produced by all individuals singing that vowel.
Limitations of the Study

The choirs participating in the study were intact college choirs. The two week preparation period during which the choirs rehearsed in the experimental formations was the maximum amount of time that the directors could feasibly give to the project.

Practicality and time restraints dictated the implementation and testing of only two systems of acoustical placement of voices (one sectional plan and one mixed plan), along with the unorganized sectional and mixed formations. The investigator did his best to implement the philosophies of placement in the amount of time provided to him. If prepared by another director, different voice placements would have resulted with the same procedures. This limitation of subjectivity was impossible to avoid. It should be noted that acoustical placement of voices is a concept and technique for the changed voice-high school and beyond.

Assumptions Pertinent to the Study

The voice qualities of individual choir members did not change appreciably from the time they were placed to the time of the experiment. The directors did not show bias, for or against, any formation during the logged rehearsal times. During the actual experiment, the potential for fatigue or loss of concentration did not significantly affect the performance trials and the judges' ratings.
CHAPTER II
REVIEW OF RELATED LITERATURE

This review of literature will present research and professional opinion addressing numerous aspects of choral sound. The ultimate concern of this study is to determine the effects of various philosophies of positioning singers on the resultant choral sound. This task inherently requires investigation of several elements of choral sound and vocal production effected by these philosophies.

Acoustical Factors Of Vocal Production And Performance Affecting Choral Sound

The term "acoustics" in this investigation refers to the nature, quality, and production of the singing voice with special emphasis on unique phenomena occurring when voices are combined in the choral medium. Acoustical factors of vocal production and performance, both individually and corporately, will be reviewed. Goodwin (1978) addresses the complexity of the subject this way:

A tone's vocal blend is related to the combined effects of certain acoustical qualities rather than being a simple function of a single acoustical element....it appears that in a given choral blend situation the relative importance of a particular acoustical characteristic in affecting the blend of an individual vocal sound with an ensemble may vary with different individuals and different ensembles, depending on the total set of acoustical features presented by each sound source. (p. 198-199)
Choral Sound

Choral Blend

Blend is the term used by most to describe the overall sound of a choral ensemble. Regier, in Regier, Opheim, and Wise (1962), expresses the issue in this manner:

...too often the basic ingredient of true choral singing, a well-blended texture of choral sound, is lacking. A choral group cannot actually be referred to as such unless it projects an integrated effect. Until that occurs the group is merely a collection of individual voices unified only through physical and mechanical means. (p. 12)

Most will agree that it is the responsibility of the choir to create a fusion of sound most correctly portraying the concept of the composer. The controversy arises in the degree to which the director and/or individual choir members act upon the desired concepts. Opheim, in Regier et al. (1962), proposes that if individual choir members act upon the desired sound concept in their own way there would be many different approaches attempted. It is his contention that the director should present one studied approach to the interpretation of the music. Opheim points out that this is never argued in instrumental music. Wise, in Regier et al. (1962), agrees with this premise but cautions that it should not be carried to an extreme, resulting in expressionless singing.

Although the approach to choral blend is usually a result of personal preference, two primary approaches can be identified. First is the philosophy that recognizes individual voice differences as assets to blend. According to this philosophy, good choral blend is the resulting sound of a properly combined group of individuals singing freely and naturally with good technique. This philosophy will be referred to as School A. The second philosophy purports that individual singers must manipulate their technique and
tone to achieve a similar color, thus creating blend. This philosophy will be referred to as School B.

Knutson (1987/1988) describes blend as "a product of sound where each element becomes unified or homogenized" (p. 4). Davison (1940), Finn (1939), Hoffer (1973), Rodby (1959), Sunderman (1970), and Wilson (1959) indicate that blend is often used synonymously with uniformity and homogeneity. This concept of homogeneity would appear to support the philosophy favoring manipulation of individual voices. However, proponents of School A may argue that a type of homogeneity is achieved by allowing singers to sing naturally without manipulation.

In a survey concerning factors related to achieving choral blend, Wyatt (1967) offered these definitions representing Schools A and B respectively:

1. The perfect fusion of the tone of a number of different voices, whose various characteristics mix so as to result in one beautiful sound.

2. Blend refers to the uniformity of the quality of tone within and between sections. (p. 15)

Of the 59 respondents, 67% preferred definition 1, while 22% preferred definition 2. Eleven percent thought both were correct.

In a survey conducted by this investigator (see appendix A, question 5), respondents were asked to indicate a preference for one of these statements concerning the individual and blend:

1. An individual singer must manipulate his/her technique to achieve choral blend.

2. An individual singer must sing freely and naturally, using his/her best technique; with proper placement of the voice in a formation, choral blend is achieved.
Of the 33 respondents, 34.4% preferred statement 1, while 56.3% preferred statement 2. One respondent (3.1%) felt that both statements were true. Two respondents (6.3%) had no opinion.

From these results and discussion to follow, strict adherents to school B appear to be in the minority. These are, perhaps, avid followers of the F. Melius Christiansen School. Swan, in Decker and Herford (1988) reports Christiansen's contention that "...every singer in the chorus has a primary responsibility to subordinate his own ideas concerning tone production, rhythmic stress, and pronunciation to the blended and unified sound made by the total ensemble" (p. 12). Christy (1940) supports School B by stating, "Good blend is the result of similar tone quality from all individual voices and all harmonic parts" (p. 47). Jones (1948) suggests that choristers try to match the tone quality of a member chosen for his/her desirable tone.

Some choral directors appear to embrace both School A and School B or, perhaps, neither. Finn (1939) states, "Differences of quality do not usually mar the blend of a choral line. On the contrary, they tend to enhance its musical values" (p. 166). So far this falls in line with School A. Finn goes on to say, however, that singers who assert themselves to the disadvantage of the choir must be subdued until their conspicuous quality can be brought into unity with the other singers. He also felt that vibrato was disastrous to choral unisons relative to pitch and pronunciation.

Triplett (1971/1972) defines blend as "the relationship of individual voices to those around them and to total sound in terms of volume, vowel color, and pitch" (p. 8). This leaves the term "relationship" open to interpretation. Jones (1977) attributes the achievement of choral blend to the acoustic principles of overtones and combination tones (favoring a predominance of the fundamental), perfect unisons, and vowel unification.
He believes that good choral blend brings the sensation of being immersed in the tone rather than it being directed from the choir to the audience.

Roe (1983) calls for much uniformity, but seemingly not to the point of manipulation and perfect homogeneity. He contends that blend is achieved by: (1) Fusing various voice qualities into a unified sound in a variety of vocal colors; (2) Uniformity of pitch; (3) Uniformity and precision of phonetic sounds; (4) Voice placement in the choir; (5) Singers listening to themselves, to the accompaniment, to their section, and to the choir as a whole; (6) Having all singers sing in their correct ranges and tessituras; (7) Uniform dynamics within a section and between sections, except when a part should be emphasized.

The majority of choral directors today, as well as some noted directors of the past, appear to favor the philosophy of School A--or at least lean in that direction. This is seen in the preferred definition of choral blend in Wyatt's survey and in the survey conducted by this investigator presented earlier in this chapter. Scholz, as reported by Knutson (1987/1988), refers to this preference as the mainstream in American choral singing—that is, moving away from a straight tone philosophy of blend to a soloistic (but non-operatic) vocal production.

Jordan (1984) contends that an individual should not be forced to blend. Placement of singers is a key factor. A voice should be placed in a section where that voice naturally sounds best. He criticizes the School B philosophy when he states, "... it appears that blend in choral music has made a strange transition from noun to verb" (p. 26). Goodwin (1980) prefers approaches for achieving blend and balance which do not involve asking singers to alter their usual solo vocal production. He stresses proper placement of singers as an important consideration.
Diercks (1960) prefers to avoid the technique of inhibiting the normal vibrato to facilitate the blending process. Inhibiting vibrato may aid blend but at the cost of tone color and vocal health. Sanders (1985) places the responsibility for good choral sonority on the individual singer and the director's recognition of each singer's uniqueness. He states that there should be a flexibility in the voice that matches the literature performed and a natural, free tone devoid of constriction or tonal distortion. Sanders maintains that if the director has, in his inner ear, the concept of sonority that the composer had in mind, not only will the intonation be consistent, and the tone be free, but blend and balance will occur automatically.

Draper (1972) feels that good solo singing and good choral singing go hand in hand. The choral director must treat the singer as an individual and not try to mold him into an abnormal concept of tone. According to Johnson (1978), singers must be free to use their full range of tonal color. It should not conflict or be swallowed by dominating voices. Proper positioning will allow for singers to feel as if they are contributing.

Knutson (1987/1988) presents Harold Decker's views of choral blend. It begins with basic vocal technique. He states that singers must be taught to sing musically as an ensemble in which four basic elements must be addressed: (1) Vowel unification; (2) Balance between individual voices of a section; (3) Unification of pitch among singers within a section; (4) Rhythm and text coordination. Decker points out that the emotional element of a singer is also important in achieving blend. Singers' imaginations must relate to the music in a common way. Glenn (1971) also quotes Decker on the subject of blend:

I don't believe in creating blend for blend's sake; I think it must be a result rather than a cause. I think there was a period of time in this country when people went for blend first. Then we heard a false sound and had a very
dull situation. I think that today there is more variety in a choral program, and that there is more blend in certain things than there is in others. If everybody sounds the same then you have nothing. We should encourage differences sometimes to get a wide palette of sounds. The answer to this question is not rigid; the kind of blend is dictated by the score. Blend should be a combination of clear thinking, physical response, and aesthetic response. (p. 42)

According to Knutson (1987/1988), Olaf Christiansen also believed that blend was a means to a higher end. He felt that the message of the text could not be conveyed unless all technical impurities were corrected and a good blend was achieved. Wyatt (1968) in his survey reports this comment:

Perhaps the question of blend has been thought to be much too important; it has become the 'end' rather than the means to a higher and more musical end. Blend is only a tool and ultimately these tools assume a secondary role during the moment music is being made. (p. 23)

Draper (1972) places a degree of responsibility for choral sound on the emotional state of the singer. Although some problems are physical and mechanistic (which need to be addressed), these problems must be dominated by the emotional state. He refers to this inner quality when he exclaims, "It is only when the fire of determination has been kindled, when a feeling of elation takes hold, and the heart fills up with joy that things begin to happen" (p. 13).

Through research and personal interviews, Knutson (1987/1988) sets forth the views of John Finley Williamson, Kenneth Jennings, Robert Shaw, Joseph Flummerfelt, Fiora Contino, Dale Warland, and Fred Waring that follow the philosophy of School A. John Finley Williamson's approach to blend was very individualistic. He gave a higher
priority to the individual's physical, emotional, and musical development than to matters of blend. He was after a big, dark, intensive sound. His mature soloistic approach is probably considered extreme even by many proponents of School A.

Kenneth Jennings' philosophy is that a blending choral sound centers around emotional and musical considerations. He prefers to allow for individual color rather than attempting to match voices to achieve one ideal voice. He declares, "A well produced voice will result in a healthy quality which will color the section rather than 'stick out'" (p. 73). Robert Shaw expresses that "...blend is a product, not a thing of itself" (p. 65). He addresses seven elements important to achieving blend. The two most important are intonation and voweling, that is, all singers producing the same vowel of a given text at the same time. The other five elements are tone quality, rhythmic integrity, dynamics, vibrato characteristics, and sectional balance.

Joseph Flummerfelt prefers using the term ensemble, as opposed to blend, because it takes into consideration a corporate pulse, unanimity of pitch and textual sounds, and careful attention to shape, texture, dynamic balance, and good vocalism. Attention to these elements will create a blended sound. Also understanding the human/spiritual impulses of the text allows the choir to achieve unanimity of expressive impulse. It is Fiora Contino's philosophy that a choral sound should be sought which best exemplifies the text and music of each composition. Singers should be flexible enough in their musicianship and interpretation to perform any style of music. Vowels must be unified. She warns that constant drilling of diction and rhythm out of the context of an actual piece of music causes a loss of natural word stress and natural living pulse. Similarly, imposing a common emotion for all music produces an unexpressive sameness.
Dale Warland defines choral blend as "...the overall sound or 'ensemble' that results from free and correct singing technique, unification of pronunciation, establishment of proper dynamic balances and consistent vibrato" (p. 101). Emotions of the singers must be allowed to flow with the emotion of the music. A singer's emotions must, however, be kept under control so that it doesn't affect the choir negatively. Warland refers to two extremes of choral sound: (1) No ear for ensemble--"everyone for themselves"; (2) Manipulation or control of every syllable and every sound. Robert Scholz attributes good choral blend to two main ingredients: (1) A healthy vocal production; (2) Singers must learn to listen to, and produce classical vowel sounds which can be blended.

Fred Waring, more than any other choral director, stressed diction as the primary tool for achieving good blend. Waring states that "...pronunciation of all vowels and consonants will result in greater unification of sound within the choir" (p. 39-40). According to Swan, in Decker and Herford (1988), the applications of Waring's diction principles should improve blend, quality of pronunciation, clarity of enunciation, and the ability to sense and maintain a beautiful legato phrase.

**Choral Balance**

Whereas the ultimate consideration of blend is the resulting choral sound in relationship to the combination of various voice types, balance is viewed more as relative levels of loudness among voice parts. Its achievement, as with blend, involves several elements of choral sound. Triplett (1971/1972) suggests several factors that affect choral balance:

1. Numbers of singers--For professional or well-trained singers, equal numbers are often preferred. Many directors, however, prefer fewer higher voices. Some high school directors may balance three girls with two boys.
2. Placement of singers--A variety of positions can contribute to improvement of techniques and sound.

3. Range and voicing of music--The natural tendency to sing high notes loudly and low notes softly should be avoided.

4. Texture of music--In both homophonic (vertical) and polyphonic (horizontal) music, this element greatly affects balance.

5. Tone quality--Singers must have consistent vocal production in order to execute delicate nuances required for balance.


7. Diction--Diction encompasses pronunciation, enunciation, and articulation. Good balance is impossible without good diction.

Roe (1983) adds the factors of dynamic levels, the relative importance of various vocal lines, and the reading ability of singers. Fred Waring embraced some of these factors, and more, as seen in Knutson (1987/1988): "Waring believed that establishing a proper balance of tone necessitates moving individual voices to different parts, moving individual voices to different positions in the choir, or even possibly asking individual voices to keep silent during a section of a piece" (p. 34).

Concerning numbers of voices, Olaf Christiansen, in Knutson (1987/1988), prefers a larger number of voices on the extreme high and low parts of male and female sections. He recommends lighter and brighter voices for higher parts (1st soprano and 1st tenor). Harold Decker (Knutson, 1987/1988) also prefers lighter voices for 1st soprano and 1st tenor, with a few more 1st sopranos because of the lighter quality. He recommends about an equal number of 1st altos and 2nd sopranos. A few more 2nd altos and 2nd basses are chosen for balancing the low notes. A few heavier 1st sopranos might be used for Romantic music.
Intensity

The variation of intensity (volume) of voice parts affecting choral balance is, of course, determined by the volume levels of individual singers. In an experiment allowing high school students and conductors to manually adjust the balance of recorded four-part chorales, Killian (1985) found: (a) subjects could discriminate when a single voice was unbalanced; however, the unbalanced voice was adjusted significantly louder relative to the balanced trials; (b) subjects preferred significantly less bass; and (c) there were no significant differences between student and conductor preferences.

Acoustical research has indicated that perceived loudness is influenced by different pitches (Wagner, 1977). Backus (1969) states that summation of simultaneous tones of differing frequencies and amplitudes yields differing perceptions of loudness. Timbre, also, influences loudness perception. Studies have indicated that complex tones with many partials are perceived as louder than tones with a simpler spectrum (Goodwin, 1980, Skinner & Antinoro, 1970).

It is important for directors and individual singers to understand the implications of intensity modifications in choral sound. Goodwin (1980) mentions that singers control their sound by what they hear (aural feedback). Placed in positions where singers cannot hear themselves (i.e., crowded on risers), they will intuitively sing louder. This, in turn, affects vowel quality, vocal timbre, and vibrato. Some voices will be louder because they have a naturally bigger instrument. Ehret (1959) admonishes:

'Solo' voices should be made aware of their artistic relationship to the rest of the chorus and should not be allowed to dominate. To keep 'strong' voices in line, surround them with light voices. The strong voices will tend to pull down their volume to match the dynamic level of the other voices. (p. 34)
When singers reduce their overall volume, according to Goodwin (1980), they increase their ability to perceive details in the choral sound which otherwise might be masked by their own loud sound. Also, a reduction of intensity reduces the number of upperpartials in soprano tones (Scott, 1960), and produces changes in vowel quality and vocal registration (Large, 1968).

Toms (1985) uses the term extensity to describe the mixture of acoustical elements that cause sound to seem big or small. Psychologically certain sounds seem higher or lower because of this principle of extensity. Toms contends that a bigger, fuller sound is achieved by resonating sound in the oral cavity with the velopharyngeal valve to the nasal cavity closed—except for m, n, and ng. Any other use of the nasal cavity for resonation produces, at least psychologically, a smaller sound.

**Vibrato**

Vibrato is the natural variation of pitch of a sung tone above and below the fundamental frequency. Vibrato rate is the speed of the pitch fluctuation, and may vary from 4 to 10 vibrato cycles per second (VCPS). Six to seven is most common for a well developed voice (Seashore, 1932). Vibrato extent is the degree of variation above and below the fundamental pitch. Seashore (1932) reports an average extent to be .6 of a tone, but could span a tone or more under certain circumstances. Even with this much fluctuation, the ear hears a mean tone. Trevor (1977) concludes, then, that it is easy to see how two tones sung simultaneously could sound a tone or more apart, and be heard as a distorted tone.

In his experiment to assess the effect of vibrato on blend, Trevor (1977) found vibrato extent to be more important in blend context than vibrato rate, but that a combined effect accounted for 15% of judges' perception of blend. When the difference of vibrato extents were minimized, a better judgement of blend was rendered. This could mean that
in some cases, vibrato extent of one singer might need to be increased or decreased to minimize the difference. Suggestions to routinely reduce or eliminate vibrato are, therefore, not implied by these results. Striving for straight tone, in fact, was found by Trevor to produce tension and disparity of pitch. (Trevor's experiment utilized only highly selected sopranos singing at one pitch level [f#1] on the vowel /a/).

Other researchers have determined that vibrato modification may be advantageous for one singer but not for another in the interest of blend (Goodwin, 1980). Goodwin attributes this, in part, to the hearing mechanism's sensitivity to partials near the 3,000 Hz level, which is often heard in the upward movement of the vibrato cycle. He continues to suggest that, theoretically, better blend may occur by reducing the vibrato, reducing overall intensity, or reducing the relative amplitude of upper partials.

This controversy of the possible distortion of tone or blend caused by vibrato of choral singers is long-standing. Knutson (1987/1988) recounts the following outstanding directors' views: F. Melius Christiansen was a firm believer that, for choral singing, a voice should be without vibrato or tremolo in order to blend. John Finley Williamson's concern for the individual's musical, physical, and emotional development gave rise to his encouragement of the use of vibrato. Olaf Christiansen felt that a healthy voice should have a vibrato, but that the extent should be limited in order to achieve a pure unison. Robert Shaw's preference for vibrato falls between that of F. Melius Christiansen (straight tone) and John Finley Williamson (bigger, operatic type voice).

Opheim, in Regier et al. (1962), is of the opinion that a straight tone is often confused with a good unison. A good unison, he says, is heard so infrequently that, when heard, is attributed to a straight tone. He explains, "Good unisons are the result of uniformity of pitch, color, and dynamics within and between sections" (p. 13). The so-
called straight tone choirs line up their chords well, but individuals are singing with vibrato of varying amplitude.

Many directors believe that a normal vibrato adds life to the choral sound as long as a voice is not overpowering. Wise, in Regier et al. (1962), states, "A natural vibrato adds dignity, quality and beauty to the tone, but an excess of vibrato cannot be tolerated" (p. 14). Others recognize that inhibiting vibrato may speed the blending process, but at the cost of tone color and vocal health (Diercks, 1960). Regier, in Regier et al. (1962), refers to what he considers the ideal situation when he states:

The acme of perfection in choral singing requires that every member of a particular choral group be so well trained that he can control both the rate and degree of his vibrato to conform to the other members of the group and to adjust to the style of music sung. (p. 15)

**Tone Color**

Tone color of a vocal sound is the unique quality of that sound determined by the length, mass, and shape of the entire vocal tract. Differences in these factors cause differences in the partial spectrums of the tone emitted from the vocal mechanism—thus the unique characteristics or color of individuals' tones. The degree of proper vocal technique allowing singers to produce their finest tone is also a factor. The combination of many such unique tones in a choral ensemble produces a corporate choral tone color or quality. Triplett (1971/1972) defines choral tone quality as an "overall composite sound that is the result of a group of people singing together" (p. 6). The elements of tone color and vibrato (vibrato actually being a factor of tone color) are two of the main elements of which the two philosophies of choral blend differ with respect to manipulation; the other main element being vowel production.
Different vocal techniques recommend various ways and degrees of manipulation of the vocal tract to produce a desired tone color. Coward (1914) asks singers to control the breath and direct the sounding air current to a region in the mouth where sound seems to float on the breath (This spot lies between the front of the mouth where the teeth join the palate--and the lips). Toms (1985) also contends that a bigger, fuller tone is achieved by resonating the sound in the oral cavity with the velopharyngeal valve to the nasal cavity closed--except for /m, n/ and /ŋ/. Any other use of the nasal cavity for resonance produces, at least psychologically, a smaller sound. Jones (1977), on the other hand, states:

...the voice is a two-homed instrument--the nose and the mouth. Over emphasis on vowels, diction, and vowel formants other than the necessary muscle action to produce them, will only lead to undue oralization or a mouthy tone which is often described as a 'white tone'. (p. 64)

Jones believes that choral tone should be a composite of the fundamental and its overtones, but favors a predominance of the fundamental.

It remains that a free, well supported tone is a prerequisite to a beautiful composite tone. Forced tone caused by improper production is a principle destroyer of choral tone (Morris, 1951). It is possible, however, that a freely produced tone may have difficulty blending because of a unique timbre (Trevor, 1977). But many, (Johnson, 1978; Waring, 1944; Shaw, 1945) suggest that choral singers use their full range of tonal color, but with certain conditions. Johnson (1978) warns that a singer's tone should not conflict or be swallowed by dominating voices. He recommends proper positioning to allow singers to feel as if they are contributing. Knutson (1987/1988) relates Fred Waring's belief that voices have distinctive colors, and that he preferred a variety of colors in his
choir. Waring also utilized choral tone to express the emotional quality of music. Waring (1944) states:

That is, besides singing in the dynamic range—from piano to forte, and the
frequency (or pitch) range from high to low, we also sing in the dynamic
or emotional range—using choral tone that is bright or dark, mellow or
harsh, strident of subdued, according to the demands of the song. (p. 57)

Shaw (1945) also thought it better to avoid any single choral color or sound, but rather to
strive for a variety of colors dictated by the expressiveness inherent in the music.

Choral directors have devised various ways of positioning singers (with varying
tone colors) to achieve a desired choral tone. (This will be addressed in more detail in a
later section.) Jones (1957) proposes dividing the kinds of tone qualities into classes of
light, medium, and dark. He suggests selecting a voice with desirable quality, then
adding others, one at a time, trying to match that quality. This is reminiscent of F. Melius
Christiansen placed voices with similar tone colors next to one another. To do this
singers were asked to match the placement of each vowel. He asked for a dark tone
because he thought they were more easily blended. William Finn, according to Knutson
(1987/1988) compared vocal tone with the color and timbre of instrumental tone; that is,
oo = flute, ee = string, ah = reed, aw = horn. He used this principle with extensive
vocalises to create his desired tone.

Vowel Uniformity

Many choral directors view vowel unification as a primary factor for achieving
choral blend. In his survey to assess factors affecting choral blend, Wyatt, (1967)
reported that 83% of the respondents rated vowel unification as very important; 17% as
important. Trevor (1977) questions this response because it presumes only homophonic
texture—the same vowel sung at the same time. He proposes that other factors are equally important, especially in polyphonic music. It appears that Trevor overlooks the theory that, when each part is unified, the total sonority is improved.

Bolster (1983) discusses the implication of vowel formants to the choral blend process. Every musical instrument, including the voice, has fixed pitches by which sympathetic resonance augments whatever partials of the fundamental are in tune with it. These bands of exaggerated partials are known as formants. Each vowel and consonant has its own characteristic pattern of overtones associated with a specific shape of the human resonating cavity. Each vowel is distinguished by the first two formants. These formants (bands of energy) occur at the same frequencies for any given vowel regardless of the fundamental, therefore, vowels, in this sense, have pitch. Bolster asserts that often in the female's upper range, the sung pitch is higher than the formant of certain vowels. She must, then, modify the vowel by raising the lowest formant frequency to match the fundamental. Concerning the singer's formant, Bolster states that the voice works more efficiently with its presence, and that fatigue is caused when it is intentionally removed (e.g. continually asking for softer dynamics). Rather than asking for its removal, Bolster contends that this formant should be developed in all singers.

Hunt (1970) analyzed acoustical aspects of certain vowels in choral tone production and concluded that the concept of unity of vowel sound is essential to the achievement of good vocal blend. He traces the problem of vocal unity to intonation. Each individual must attain correct intonation of the frequencies of the formants of the vowel and the frequencies of the voice pitch in order for good choral blend to occur. Regier, in Regier et al. (1962), agrees with this assessment by stating:

Correct vowels contribute to good tone quality. They affect freedom of tone and thus have a relationship to quantity. Poor intonation can often be
blamed on poor vowels as sounds that are not properly formed and placed will not ring true in pitch. (p. 30)

Goodwin (1978) found that vocal blend apparently may be achieved more readily on vowels having fewer upper partials and a slightly stronger fundamental; also a slightly stronger first formant. Therefore vowels with naturally fewer upper partials (oo, and oh) blend more easily than vowels having numerous upper partials such as oh. It is logical then for a singer seeking to blend to reduce the strength of upper partials. This will (1) provide a minimum of aural cues for the listener to identify the tone as a separate sound; (2) reduce the subjective loudness of the tone; (3) emphasize the portion of the spectrum that is most significant for the quality of the perceived vowel.

From research of past outstanding choral conductors and interviews with choral experts today, Knutson (1987/1988) cites several directors' opinions of the importance of vowel uniformity in achieving choral blend. Robert Shaw stresses the importance of voweling, that is, all singers producing the same vowels of a given text at the same time. Robert Scholz contends that singers must produce classical vowel sounds that can be easily blended. Fiora Contino states that vowels must be unified. Christy (1940) states, "Choral organizations must learn to sing vowels with a homogeneous quality, since poor ensemble is frequently caused by variations in the quality of vowel color and not by deviation from pitch or a lack of dynamic balance between sections" (p. 47).

Although most choral directors will agree that vowel unity is certainly a factor in achieving good choral sound, some would argue the degree of modification necessary. Knutson (1987/1988) presents Olaf Christiansen's strong belief in vowel unification, but without modification. Similarly, Dale Warland believes in agreeing on a basic vowel sound, but not in manipulating, shaping, or controlling each vowel.
The difference in range and the operation of vowel formants indicates that men and women must modify vowels differently (Bolster, 1983). Men must open vowels somewhat at the bottom of the range and close vowels progressively ascending toward f#1. Conversely, women must open vowels in their upper range and close progressively descending towards d1. Bolster, therefore, does not recommend strict vowel unification between sections. Within sections, however, vowels should be unified. He mentions a paradox in vowel unification in which a modified vowel sounds more like the intended vowel than does the pure vowel. Jordan (1984) is critical of prescribing vowel formations to a group because he feels it endangers the vocal health of the singers. He strongly suggests private vocal instruction for each choir member.

Opheim, in Regier et al. (1962) believes it is perfectly legitimate for directors to ask some voices to modify their production so as to become uniform with the rest of the section. This is done carefully so as not to place restrictions that would remove the freedom of production. Choral directors and private instructors, Opheim admonishes, need to show singers how to produce a wide gamut of color variations, but still do it with freedom. He points out that the human voice is the most flexible of all instruments.

**Choral Intonation**

Choral intonation is defined by Triplett (1971/1972) as the process of "singing in tune and maintaining tonality" (p. 8). Kink (1941) believes that achieving good choral intonation is a matter of merging the voices (putting them in time) with those of the same part (horizontally) as well as the other parts (vertically). Few would doubt the significance of proper intonation in the development of good choral sound (Wilson, 1959; Jones, 1957). This is also substantiated in Wyatt's (1967) survey in which respondents indicated intonation as an important factor in achieving blend. There appear to be many causes for inaccurate choral intonation. Heffernan (1982) offers the following factors:
(1) bad vocal production—poor posture, shallow breathing, lack of support, tension, and failure to resonate; (2) insecurity in the size of intervals to be sung; (3) tempo too fast or too slow; (4) dynamics too loud or too soft; (5) wrong concept of vowel to be sung; (6) incompatible voices singing together; (7) fuzziness in the bass section; (8) a lack of phrase sense; (9) inattention to downward moving passages; (10) inattention to repeated notes; (11) inability of the choir members to hear each other; (12) disinterest or boredom; (13) failure to listen and sing inwardly, in the imagination; (14) within a major key, singing flat mi and la; (15) failure to attain clean leaps of fourths and fifths; (16) wrong key for a particular acoustical situation. (pp. 69-70)

Roe (1983) charges that aural laziness and mental lassitude are the greatest contributors to poor intonation, along with faulty vocal technique. Wyatt (1967) relates that many writers attribute natural gravitation as a contributing factor to poor intonation. To combat this singers should think low on pitches that ascend, and high on pitches that descend. Concerning dynamic imbalance as an affect on intonation, Williamson (1950) suggests that basses should sing louder on low notes, and that sopranos should decrease volume when ascending.

Jordan (1987) presents a pedagogical base for understanding and improvement of choral tuning. He stresses that choirs need to be taught to audiate the resting tone (do) of any piece to achieve accurate intonation. He explains that too often directors audiate in this fashion, but expect their choirs to memorize correct intonation with no relationship to the tonic. Mayer (1964) proposes a technique that begins with striving for a perfect unison on the tonic, first with the basses, then adding the other sections at the appropriate octave. Next tune the third in unison, which is often flat. Then move back to the tonic.
At this point have all voices except second altos and second basses move again to the third. If the acoustical environment is good, difference tones at the fifth and octave will be discernible. Finally the first sopranos and first tenors move to the octave to complete the harmony.

It is suggested that acoustical properties of a room affect intonation. Triplett (1971/1972) recommends rehearsing in a room without a long reverberation time to minimize the effect on intonation when performing in a "dead" room. Fuhr (1944) contends that a low ceiling causes flating, and that echoing may produce sharping.

**Rhythm/Precision**

Some choral directors contend that rhythmic unity is not so much an aspect of the blending of choral tone as it is a requirement for good ensemble performance (Trevor, 1977). Precision, according to Triplett (1971/1972), refers to "exactness in the treatment of various aspects of choral music as it proceeds in time" (p. 8). He found no significant correlation between precision and balance. In Knutson (1987/1988), however, Shaw, Decker, Flummerfelt and Olaf Christiansen list rhythmic precision and coordination of text as important elements in achieving choral blend. Contino, though, warns that constant drilling of diction and rhythm out of the context of an actual piece of music causes a loss of natural word stress and natural living pulse. There is some disagreement among choral directors as to how the natural rhythmic flow of text (consonants and vowels) is best achieved. Some believe that consonants should be treated as grace notes, anticipating the beat, so that the vowel falls on the beat and the rhythm is executed clearly (Olaf Christiansen, 1965; Bolster, 1983).

Regardless of how it is addressed (as an element of blend or a matter of ensemble), rhythmic precision is one of the most essential factors affecting expressive choral singing. Draper (1972) says, "...the forward propulsion of musical and poetic
ideas must be so logical and naturally correct that the listener is never disturbed or jarred, and his interest is constantly sustained" (p. 13). Draper feels that singers should maintain a consistent feeling for the beat, regardless of tempo, retardation, accelerando, rubato, fermata, or tenuto.

**Choral Formations**

The placement of singers in the choral formation has been alluded to in the preceding sections of this chapter. Many choral experts agree that positioning singers in the most acoustically appropriate spot is crucial to the rendering of good choral sound. The approaches are many, and because of the subjectivity of the issue, it is not easily presented on paper. Noble (1989) confirmed this point in an interview with this investigator. He remarked that he usually refuses to write on the subject because it must be experienced to properly understand. Nevertheless, the following is an attempt to present as complete a picture possible of this complex and subjective factor of choral singing.

**Placement Of Individual Singers**

There are many criteria to consider when deciding where singers should be placed. There are principles, acoustical and otherwise, that cause singers to sound better or worse at different positions in the choir (Noble, 1989; Jordan, 1984). Triplett (1971/1972) mentions that singers should be positioned so they can see the conductor, hear the accompaniment, hear each other, and be seen full-faced by the conductor. Johnson (1978) emphasizes the importance of maximizing the carrying power of the choir. Careful placement is necessary so that the carrying power of individual voices is not "soaked up" by surrounding voices. On the other hand, this acoustical principle can
be used in such a way as to filter out undesirable qualities. Some voices are naturally good filtering voices.

Some choral directors are of the opinion that placing like-voices together achieves the best choral blend, and often assign certain voice types to specific rows. Roe (1983) suggests putting mellow voices, secure of pitch in the front row. Diercks (1960) adds that the front row should contain qualities most desirable. Johnson (1978) maintains that the front row sets a tonal front for the choir. His criteria for front row singers are carrying power and vocal maturity. He suggests that second row singers should be those who blend well, sing in tune, and are musically intelligent; third row singers usually have characteristics that adversely affect blend, (e.g. huge voices and unblending vibrato). Busch (1984) maintains that voices which stick out should never be placed on the outer edges of the section.

For a "quick blend" technique at the beginning of the year, Molnar (1962) uses a tone color matching system. Flute-like voices (light and clear) are placed in the front; reed-like voices (oboe quality) are placed in the back; string-like voices (between the above qualities) are placed in the middle row. Decker, in Knutson (1987/1988), reports that he classifies individual voices as light, medium, or heavy. Heavier voices are placed in the fourth row and lighter voices in the front row. Medium voices are in the second and third rows. Contino, in Knutson (1987/1988), believes that whether singing in a block or a mixed formation, lighter voices should be placed together and heavier voices placed together. She contends that when a lighter voice is placed next to a heavier voice, the lighter voice tends to oversing. Regier, in Regier et al. (1962), proposes seating bright or reedy voices in the rear of the choir; the dark or flute-like voices in the front; and those who have secured a fusion of focus (ping) and fullness in the middle rows. F.
Melius Christiansen (Knutson, 1987/1988) places voices with similar tone color next to one another. To do this singers were asked to match the placement of each vowel.

The opposite philosophy is expressed by Diercks (1960), "The more voices resemble each other in range, timbre, or texture, the more it is necessary to separate them" (p. 45). Other writers also suggest pairing unlike or unequal qualities such as weaker voices with stronger voices, inexperienced with experienced, modest musicianship with advanced, good voices but poor readers with less capable voices but good readers, reedy voices with flute voices (Mielenz, 1966; Busch, 1984; Gordon, 1977; Lamb, 1988; Noble, 1989; Pfautsch, in Decker and Herford, 1988; Jennings, in Knutson, 1987/1988). Kenneth Jennings (Knutson, 1987/1988) believes "...that the singers who have a good ear, are good sight readers, and have strong voices and experience should be seated next to singers needing assistance in those areas" (p. 75).

The placement of strong and weak singers is explored further. Diercks (1960), Miller (1988), Roe (1983), Shaw, in Robinson and Winold (1976), and Jennings, in Knutson (1987/1988), contend that stronger voices and better musicians contribute at their best deeper in the choir. In this position, less capable singers and those with less intensity will benefit from them. Waring, in Robinson and Winold (1976), similarly placed the heaviest voices which projected the most, furthest from the microphone in order to avoid dominance of any particular voice. Triplett (1971/1972) submits that, in a curved riser situation, voices weaker in intensity should be placed in the center so that they will directly face the audience. Opheim, in Regier et al. (1962), suggests placing the small reed voices on the ends of a section; progress with larger flute-like voices in the middle; then smaller again toward the other end of the section. He contends that this arrangement sometimes hides a voice which has difficulty blending.
Knutson (1987/1988) reports that F. Melius Christiansen would select a group of singers for the center of the choir which he called the "inner choir". Although he preferred the small reedy voice for its adaptability and purity, he included brilliant voices for the purpose of achieving climaxes. He would place these voices in the center of the section with smaller voices on either side. For advanced choirs, Lamb (1988) also suggests placing the strongest singers and those with the best intonation in the center of the choir. With an average choir, however, very weak singers would end up on the outside having difficulty singing in tune. Swan, in Decker and Herford (1988), relates William Finn's opinion that "... lyric voices are preferred in all sections. Dramatic voices can be 'lyricized', but the opposite process should not be attempted. Larger voices must be surrounded with smaller ones" (p. 23). Johnson (1978) criticizes this theory that a strong singer be centrally located within a cluster of weak singers. He thinks it dissatisfies or bores the strong singer and causes him to lose his vocal identity. It also causes the weak singer to become totally dependent. Johnson suggests placing "zones" of influence within the ensemble, more evenly distributing strong, average, and weak singers as indicated in Figure 1:

![Figure 1: "Zones" of influence; Johnson](image.png)

Goodwin (1980) describes a psychoacoustical principle which he calls the "precedence effect". He expounds as follows:
It occurs when two sounds which are very much alike in quality and intensity emanate from the sources which are different distances from a listener, e.g. two singers singing the same vowel. The sound is perceived as coming from the nearer source rather than from both sources or from some point between the two sources. (p. 6)

This phenomenon occurs until the delayed sound is increased about 8 Db. The practical implication of this theory is to place stronger voices behind less intense voices. Goodwin suggests that the same principle applies to sections as a whole. This phenomenon, referred to as "masking" by Diercks (1960), can be counteracted to some degree by allowing adequate space between singers--preferably two to three feet. He also suggests an eight inch elevation of riser steps. For Diercks these spacing adjustments did wonders for blend, warmth, and fullness (not loudness) of tone.

Goodwin (1980) mentions that singers control their sound by what they hear (aural feedback). Singers need to hear each other as well as themselves. Placed in positions where singers cannot hear themselves (e.g. crowded on risers), they will intuitively sing louder. This, in turn, affects vowel quality, vocal timbre, and vibrato. Goodwin suggests a distance of 4 feet between singers. He also submits the option of disconnecting the risers to deepen the curve. He proposes using the top and first rows of risers plus two floor-level rows. This spacious arrangement also allows for formation changes between numbers. Eichenberger (1989) favors ample space between singers because when their physical space is invaded, so is their tonal space. Adequate space between singers is recommended also to allow room for necessary body movement (Pfautsch, in Decker and Herford, 1988), and to prevent a small sound produced by a cramped ensemble (Gordon, 1977).
An Interview With Weston Noble

Weston Noble has been the choral conductor at Luther College in Decorah, Iowa for the past 40 years. He is recognized as an expert and innovator in the area of placement of singers within the choral formation. Noble's process begins in the spring when he auditions members of the freshman choir for entrance into the concert choir. He listens for general tone quality, smoothness of tone, and pitch. Subconsciously he listens for blend factors, but more to the solo voice. From this audition he determines call-back auditions which occur the next fall. He sends these singers notices and a common selection for all to prepare. These fall auditions also include current choir members from the previous year. He needs them to find the correct acoustical positions for the new singers.

Noble relates F. Melius Christiansen's method of having singers try to match one ideal voice. Although this has its advantages, Noble says, the tone can lack variety. It may have uniformity but it needs dashes of color along the way. Noble's concept, then, is that if he likes the voice, and can find its acoustically correct place, it need not match his ideal voice. Lutheran tradition began with blend and conformity. Noble's philosophy is blend without conformity.

Noble's system of placing voices will now be described in reference to a soprano section. He repeats this process with each section. Placing the sopranos, he says, takes a little longer, but they benefit the most. Noble starts by finding a model pair—two singers whose voices blend effortlessly. Usually these are smaller voices. Then (with an ear gained through experience) he chooses a third voice. Noble mentions that one never knows ahead of time, nor can predict matches. No two voices in the world are identical—as with fingerprints. He puts voice #3 between the model pair (voices #1 and #2) and has her sing with each. If she matches voice #2 best, that is fine; but if she matches voice #1
better, she then becomes the new voice #1; the other two becoming voices #2 and #3. Regardless, voice #2 must be comfortable with both voices #1 and #3. Noble interjects here that sometimes there is a pronounced difference in compatibility when simply singing on the other side of a person. He speculates that it might be because some of us hear better with one ear. He then finds voice #4 and has her sing with voices #1, #2, and #3, and places her accordingly. If she does not fit she just stays, for now, as voice #4. He continues this process until he has eight singers acoustically placed in one horizontal row.

Noble also has an overall model that he tries to achieve if possible. He attempts to place smaller voices with very good ears in the middle of the choir; then works outward with larger voices and/or weaker ears, but ending with another smaller voice with a good ear. A big voice should never be placed on the end because it will probably stick out.

At first Noble thought in terms of similarities of voices to achieve blend; similarities of color, vibrato, pitch, size of voice, and musical forwardness (the ability to move a musical line forward). Then he began to notice that he would hear pockets of bright and dark sounds. He then stumbled on to the idea of matching opposites rather than similarities. For instance, a bright and dark voice singing together tend to produce a compatible sound. The bright voice brings the dark one forward; the dark voice takes the edge off the bright one. Sometimes a big vibrato can be tamed by a couple of buffer voices. Noble speculates that through this system of auditioning and placement, probably 75% of potential problems can be solved before the first note is sung in the fall.

Noble's choir sings horizontally in sections (all first sopranos in a row, baritones in a row, etc.) for at least 2 1/2 months. Then he starts the placement system again, but this time with divisi parts together, that is, first and second sopranos together, basses and baritones, and so forth. So now he will end up with long lines of 16, or so, acoustically placed singers. He then makes four vertical rows from this line of 16 singers--singers 1-
4, 5-8, 9-12, 13-16. Now the concern for compatibility involves only one singer—the person behind—rather than two. This process is utilized for the other parts, resulting in sixteen vertical rows of acoustically placed singers. Visually, it looks as if an SATB quartet arrangement is the main goal, when actually the vertical placement is the crucial concern.

The procedure unfolds as follows:

1. Each divisi part is acoustically placed with a compatible partner in a horizontal row (Figure 2):

<table>
<thead>
<tr>
<th>BI</th>
<th>BI</th>
<th>BI</th>
<th>BI</th>
<th>BI</th>
<th>BI</th>
<th>TI</th>
<th>TI</th>
<th>TI</th>
<th>TI</th>
<th>TI</th>
<th>TI</th>
</tr>
</thead>
<tbody>
<tr>
<td>BII</td>
<td>BII</td>
<td>BII</td>
<td>BII</td>
<td>BII</td>
<td>BII</td>
<td>TII</td>
<td>TII</td>
<td>TII</td>
<td>TII</td>
<td>TII</td>
<td>TII</td>
</tr>
<tr>
<td>S I</td>
<td>S I</td>
<td>S I</td>
<td>S I</td>
<td>S I</td>
<td>S I</td>
<td>A I</td>
<td>A I</td>
<td>A I</td>
<td>A I</td>
<td>A I</td>
<td>A I</td>
</tr>
<tr>
<td>SII</td>
<td>SII</td>
<td>SII</td>
<td>SII</td>
<td>SII</td>
<td>SII</td>
<td>AII</td>
<td>AII</td>
<td>AII</td>
<td>AII</td>
<td>AII</td>
<td>AII</td>
</tr>
</tbody>
</table>

   Figure 2  
   Choral voice placement; stage 1; Weston Noble

2. All 16 singers of each part reaudition together as a section to arrive at one long row of that voice part. For instance, the sopranos (S I and SII) may end up in a row like this (Figure 3):

   S I I S I I S I I S I I S I I A I A I A I A I A I A I
   S I I S I I S I I S I I S I I A I A I A I A I A I A I

   Figure 3  
   Choral voice placement; stage 2; Weston Noble
3. The long horizontal row (for each section) is split evenly and rotated into four vertical rows (singers 1-4, 5-8, 9-12, 13-16). The four vertical rows from each section are then arranged in quartet fashion (Figure 4):

<table>
<thead>
<tr>
<th>SII 4</th>
<th>BII 4</th>
<th>All 4</th>
<th>TII 4</th>
<th>SII 8</th>
<th>BII 8</th>
<th>All 8</th>
<th>TII 8</th>
<th>SI 12</th>
<th>BI 12</th>
<th>All 12</th>
<th>TI 12</th>
<th>SII 16</th>
<th>BII 16</th>
<th>All 16</th>
<th>TI 16</th>
</tr>
</thead>
<tbody>
<tr>
<td>SI 3</td>
<td>BI 3</td>
<td>AI 3</td>
<td>TI 3</td>
<td>SI 7</td>
<td>BI 7</td>
<td>AI 7</td>
<td>TI 7</td>
<td>SII1</td>
<td>BII1</td>
<td>All1</td>
<td>TI1</td>
<td>SI 15</td>
<td>BI 15</td>
<td>AI 15</td>
<td>TI 15</td>
</tr>
<tr>
<td>SII 2</td>
<td>BII 2</td>
<td>All 2</td>
<td>TII 2</td>
<td>SI 6</td>
<td>BI 6</td>
<td>AI 6</td>
<td>TI 6</td>
<td>SII10</td>
<td>BII10</td>
<td>All10</td>
<td>TI10</td>
<td>SII14</td>
<td>BII14</td>
<td>All14</td>
<td>TII14</td>
</tr>
<tr>
<td>SI 1</td>
<td>BI 1</td>
<td>AI 1</td>
<td>TI 1</td>
<td>SII 5</td>
<td>BII 5</td>
<td>All 5</td>
<td>TII 5</td>
<td>SI 9</td>
<td>BI 9</td>
<td>All 9</td>
<td>TI 9</td>
<td>SI 13</td>
<td>BI 13</td>
<td>AI 13</td>
<td>TI 13</td>
</tr>
</tbody>
</table>

Figure 4
Choral voice placement; stage 3; Weston Noble

Noble keeps the height of singers in mind while auditioning, but not to the point of an inappropriate placement. He uses small boxes on the risers for shorter singers who, acoustically, should not be moved closer. If a singer is missing for a concert, he leaves a gap in that spot rather than ruining the acoustical placement of a row by filling it in. Concerning space between singers, with 75 singers on the risers, it is somewhat dictated. A big space is not an option.

Noble says that he did not use to pay much attention to the compatibility of different voice parts side by side in the final quartet arrangement. Now he asks for this compatibility. Not as many problems arise between different voice parts, but some, indeed, do need to be remedied.

Noble reports that his system of auditioning and placement is very agreeable to private vocal instructors. Although he contends that one does sing differently in a choral situation, this system allows for as natural a production as possible.

Noble does not consider the style of music being performed to have a significant bearing on the choral formation. He can see the possibility that some polyphonic styles
may be rendered with a cleaner line in a sectional formation, but it is not enough of a factor to cause him to change formations.

Noble relates the method he used in a high school situation. For learning new music he would have one formation with good readers spotted throughout the choir. Then, when appropriate, he would shift to the acoustically placed formation which might tend to group the good readers more than the other formation.

**An Interview With John Williams**

John Williams is the founder and president of International Concerts Inc. Previous to this post he was the director of the Indianapolis Symphonic Choir. He has also held choral faculty positions at Butler University, Indianapolis, Indiana; and Wittenberg University and Shawnee High School in Springfield, Ohio. Williams is highly respected for his superb choral ear and his work with acoustical placement of choral voices. Williams traces his interest of the acoustical properties of the voice back to his instrumental days. When he played the trumpet into the stroboscope, five or six overtones were apparent. When singing, the whole scope lit up. As Williams continued his music study, he gained insight from his various ensemble experiences. In one choir that was seated sectionally, he noticed different colors being produced from the various sections. Another choir moved to quartets occasionally, but he was disturbed because the director placed strong voices toward the front. He studied with Louis Diercks at Ohio State University and was impressed with his fine ear. He learned from Diercks not to place strong voices at the center but at angles on the back row. In this position they would mix as they cut through the choir to the opposite wall. From William Vennard he learned about vibrato characteristics. From these and other experiences, Williams established a system of making an instrument out of the choir.
It is William’s opinion that the solo voice and the choral voice are the same. Singer must use all the resonators—the head, mouth, and throat. When they do not use these resonators correctly, they must be positioned in the choir to complement their voice as well as those around them. According to Williams, two similar voices (even good ones) standing side by side may sound like one bad voice because of the interaction of overtones. For instance, when an alto sings a g and a tenor sings a d, the alto’s d overtone may clash with the tenor’s d fundamental.

Williams has devised a plan of voice placement to optimize various voice types and to reduce incompatibility. Through audition he assesses the intensity or weight of the voice and the vibrato. He evaluates the weight of the voice by a decibel-like measurement (Figure 5) as singers crescendo on a sustained tone.

![Voice intensity assessment chart](image)

**Figure 5**
Voice intensity assessment chart; John Williams

He then converts their forte decibel level to a comparative description as follows:

- 30 db -- 40 db = Light
- 40 db -- 50 db = Medium Light
- 50 db -- 60 db = Medium
- 60 db -- 70 db = Medium Heavy
- 75+ db = Heavy
Williams assesses vibrato through determining the oscillations per second. He then classifies the voice as follows:

- 0 -- 5 Oscillations = None to Little Vibrato
- 5 -- 9 Oscillations = Normal Vibrato
- 9+ Oscillations = Big Vibrato

Using the weight and vibrato assessments, he constructs a chart indicating probable placement of each voice. With chart in hand, the actual placement begins with the first tenors. They are placed about eight feet apart in certain rows according to their voice assessment. The front row contains the lightest voices (not more than 40--45 db) with the smallest vibrato. The middle row (or rows) contains medium weight voices with medium or normal vibrato. The back row contains the heaviest voices with a big vibrato. The placement is checked by listening to various triangles of singers' blend. The intent is to create a block of tenor sound coming straight through the choir, back to front, with voices in the front taking the edge off the voices behind (Figure 6).

![Figure 6](image)

Tenor I placement chart; John Williams

After the first tenors are placed, he uses the same procedure with the second altos, placing them next to the first tenors. This process is repeated for each section. One guiding rule for Williams is to never place a tenor on an end.
The height of the riser rows is important to Williams. There must be enough height for the sound waves to emanate through the choir. He feels that 12 to 14 inches is ideal. Typical risers measure about 8 inches between rows. Space between singers is also important. Williams prefers 2 feet between singers--side by side and front to back. When positioning singers Williams is not concerned with possible audience visual preferences such as uniform placement by height. The sound is more important. The first priority, says Williams, is the communication of the text. He cannot communicate with a bad sound.

Williams mentions that the conductor should stand as far from the choir as the choir is wide. This enables him/her to more accurately assess the mix of timbres and the total choral sound. Concerning cueing, Williams directs cues to an entire section, as opposed to choosing spots for each section. Williams reports three basic advantages to a scrambled formation: (1) The chorus becomes stronger; (2) Singers listen more because their neighbor is singing in a different range; (3) The singers prefer it. Williams warns that singers must first learn to blend their own voices with vowels before any placement technique will work. Understanding vowel placement and formants is crucial. Another factor is the natural acoustical properties of the room. A voice might sound different from night to night in different rooms.

**An Interview With Rodney Eichenberger**

Rodney Eichenberger is the Director of Choral Activities at Florida State University. Prior to this position he held similar posts at The University of Southern California and The University of Washington. Eichenberger is a highly regarded choral technician and is in demand to share his expertise.

Eichenberger comments that the philosophy of individual placement affecting choral sound is based on scientific fact. It has been proven, for instance, that some
people are right-eared or left-eared, and that the individual one stands beside affects his/her tonal production. Eichenberger's approach is to find the position in which each singer is as comfortable as possible. He does not seat any singer for any other reason than compatibility and freedom of production.

Eichenberger's eventual performance formation partly depends on the style of music being performed. He prefers a mixed formation in SATB quartets. He uses this plan for Romantic literature; also for much 20th century music that requires very clean tuning. He uses a sectional formation for polyphonic texture, especially Renaissance music. In some polyphonic pieces, he separates whole sections of divisi parts to gain the spatial separation of individual lines. For instance, if divisi soprano parts are singing contrapuntally, he will have the two parts placed on different sides of the choir. He relates one performance of the Pope Marcellus Mass in which each section was separated by 20 feet.

Eichenberger does not use the word blend because it evokes manipulation of technique in the minds of the singers. He, of course, seeks blend but does not use the term. Rather than asking for blend, he asks singers to do various hand and body motions that produces the necessary corrections (e.g., an ironing motion with the hands may subtly reduce a large vibrato).

The physical space between singers is crucial to Eichenberger. He feels that when one's physical space is invaded, so is his/her tonal space. He likes to leave enough room so that another singer could stand between. At any age level, ample space develops security.

The acoustical properties of the performance room are a factor no matter what formation is used. He does not feel that a particular formation is favorable for a certain
acoustical condition. It is nice, he says, to have several formation options to try in different rooms.

**Favoring A Variety Of Formations**

While some choral directors are avid believers in the results of one specific choral formation, many experts are of the opinion that the use of a variety of formations is more productive. Because all choirs are uniquely different, it is not wise to assume that a preconceived formation will work consistently (Lamb, 1988). Triplett (1971/1972) and Stanton (1971) maintain that the use of a variety of positions can contribute to improvement of techniques and sound, and better sensitize the choir to balance, blend, and overall tone quality. Stocker (1975) promotes the use of a variety of formations for rehearsal. But for performance he favors a sectional plan for the delivery of line and cultivation of tone. Pfautsch, in Decker and Herford (1988), suggests that formations should vary with each choral group, with change in personnel, and with demands of the repertoire. But as the performance date approaches, a consistent formation should be chosen for the sake of security and adjustments to the acoustical environment of the concert hall. Gordon (1977) adds that singers must be given time to adjust to their neighbors. Gordon expresses his preference for mixed formations with chamber groups where blend is a primary concern. In this type of arrangement, singers develop an empathy more readily. He prefers sectional arrangements for large groups because he is better able to mold balance and blend of many voices. Gordon suggests that using both approaches is often most productive. Sections could be used for learning music; move to a mixed arrangement for polishing, then back to sections for refining blend. Harold Decker, in Knutson (1987/1988), contends that better blend can be obtained in a mixed formation, but Baroque polyphonic music sounds best in sections. However, 16th century polyphony requires more equality between parts and is best performed in some
type of mixed formation. Eichenberger (1989) disagrees and calls for a sectional formation for 16 century music. Pfautsch, in Decker and Herford (1988), admonishes: "The eventual arrangement should help the group develop a sense of ensemble and balance, interdependence and independence, and personal as well as corporate responsibility" (p. 76).

**Visual/Style Criteria**

Ehmann (1968) proposes that the physical or visual aspects of the choral formation are tied closely to the structure of the music. Therefore, he feels that careful consideration of these elements greatly facilitates singing and listening. He states, "The placement of the various sections should be thought of as a redistribution and a rearrangement of a total body-soul organism" (p. 7). Ehmann sets forth many specific formations that relate to various styles and voicings. The significance he places on matching the formation to the musical architecture is seen in this statement: "Disorder in the seating arrangement brings about disorder in the music, and a stereotyped formation of the choir can result in stereotyped singing" (p. 13).

Separation of forces and understanding of sonic space is not new. Composers at Saint Mark's cathedral in the 16th century placed various forces within five alcoves. Schornick (1985) points out that composers of recent works are prescribing seating arrangements for several practical reasons or functions:

(a) as a theatrical extension of the music; (b) as an aid in separating various soloists or groups of instruments from each other; (c) for the benefit of increased accuracy of facility in performance; (d) for the separation of timbral effects; (e) for the facilitation of musical execution. (p. 5)

One example Schornick offers as a theatrical use of seating is Luigi Nono's *Ein Gespenst geht um in der Welt* in which, at one point, the choir surrounds the audience with
revolutionaries and the suffering masses. The chorus seems to tower above the audience, offering dominance to the text and a psychological advantage. Also evident are passages that uniquely surround the audience with sound by entrances of various sections in a designed sequence.

Pfautsch, in Decker and Herford (1988), also contends that the choral formation should relate to the style of the repertoire, particularly if there are unique circumstances such as polychoral works. Pfautsch does not necessarily concede to visual concerns, but rather the structure of the music and the aural effect required by it. In 16th century polyphony, Eichenberger (1989) sometimes separates whole sections or divisi parts to gain the spatial separation of individual lines. Boyd (1970) maintains that in a block formation, as opposed to a mixed arrangement, the listener can more easily sort out individual voices visually as well as aurally. He mentions, "We often forget that a choral concert is a staged work as well as a sounded work" (p. 69).

Sectional Versus Mixed Formations

Along side the issue of properly placing the individual voice with all the ramifications discussed previously, is the question of the type of formation in which the singers should be placed. Ultimately there are two basic options with many variations: (1) Some type of sectional/block formation; or, (2) A mixed/quartet/scrambled plan. Wyatt (1968) in his survey of choral directors regarding the achievement of blend, found the following preferences of formation types. For best blend, 23% preferred quartets; 20% preferred other mixed formations; 9% preferred octet or purely scrambled arrangements; totalling 52%. Of the 48% indicating a preference for sectional formations, 30% preferred Figure 7 formation.
Twelve percent preferred variations on Figure 7, that is, BSTA, ATBS, STBA. Three percent chose Figure 8 arrangement; 3% chose Figure 9 arrangement.

Another interesting result indicated that 89% of the respondents utilized the arrangement they thought was most conducive to blend, while 11% reported using a different arrangement than what they considered best for blend. It is implied that, for this 11%, blend was not the deciding factor in the decision of a formation.

In a questionnaire constructed and distributed by the investigator, several questions were asked regarding preference for sectional or mixed formations. A summary of the results of these questions are listed below. The results of the entire questionnaire are presented in Appendix A.

A. There was equal opinion as to which formation was most effective in achieving the best overall sound.
B. A sectional formation was favored the majority of time for rehearsal and performance.
C. A sectional formation was strongly favored for contrapuntal music.
D. A mixed formation was preferred for homophonic music.
E. A mixed formation was strongly favored with singers of moderate or high vocal ability, and a sectional formation with singers of low ability.

F. A sectional formation was preferred for large ensembles, and a mixed formation for small ensembles.

G. A mixed formation was preferred for the improvement of intonation.

H. Surprisingly, respondents indicated that choir members prefer a sectional formation.

I. Results indicated that music is most quickly learned in a sectional formation.

J. Responses indicated that the musical growth of singers is best served in a mixed formation.

Lambson (1958) conducted an experiment similar to this current investigation. The problem investigated was whether any particular seating plan provides significant acoustical or practical advantages over other formations. The seating plans tested were these four: (1) A sectional plan placing sopranos, altos, tenors, and basses in homogeneous groupings; (2) A quartet plan placing singers in heterogeneous, SATB groupings; (3) A scramble plan which organizes compatible pairings of groupings of well-blended voices, and in which no non-blending voices are in close proximity; and (4) A random distribution plan in which singers assume positions without regard for section, voice blend, or any other practical relationship.

Ten adjudicators rated the choir on two control songs, one polyphonic an one homophonic, in each of the formations. In addition to the textural contrasts presented, contrasts in style, dynamics, rhythm, tempo, and structure, and were evaluated with the revised 1958 edition of the standard MENC adjudication form. Not only were the live performances evaluated, but also recorded performances which the judges heard later in a
different sequence. In all evaluations judges were asked to aurally identify the formation used, and to indicate preferences. The ability of the judges to identify formations was erratic. The acoustical and practical results derived from the experiment and from a post-experimental questionnaire yielded the following results:

1. The sectional plan appeared to be acoustically superior for the live performance of polyphonic music in more than four parts. The block plan did, however, pose greater problems of microphone placement for recorded performances.

2. The sectional formation was practical both as a performing and a rehearsal technique, especially for non-select singers.

3. The sectional plan provided the most practical conducting control in terms of cueing entrances and dynamic variation.

4. The quartet arrangement seemed to be acoustically superior for the performance of four-part homophonic music.

5. The quartet formation had practical application as a rehearsal technique for the development of a feeling of ensemble and responsibility.

6. The quartet plan was practical as a performing technique when used with capable singers sensitive to expressive singing without over-dependence upon the conductor.

7. The scramble plan seemed to be acoustically inferior to the other plans.

8. The random distribution plan was seemingly impractical as a performing technique.

9. The scramble plan and the random distribution plan were practical as rehearsal techniques for the development of a spirit of initiative, self-reliance, and independent musicianship in his singers.
Lambson reports that although acoustical differences with the various formations are revealed in the experiment, they were not nearly as pronounced as generally believed. Therefore, says Lambson, "in weighing acoustical considerations against practical considerations, the choral director should give precedence to practical considerations" (p. 53).

**Sectional Formations**

Proponents of sectional formations cite several advantages of this type of an arrangement:

1. Sectional plans allow for more consistency of interpretation. Singers can measure their production with the rest of the section (Stocker, 1975).
2. Control of dynamics and articulation is more easily achieved (Boyd, 1970; Lambson, 1958).
4. Sectional plans are preferable for contrapuntal music because delineation of parts is more obvious. The listener, also, can sort out individual lines visually as well as chorally (Gordon, 1977; Boyd, 1970; Stocker, 1975; Garretson, 1986; Decker, in Knutson, 1987/1988; Lambson, 1958).
5. Individual voices are less likely to be noticed (Stocker, 1975).

Disadvantages to sectional forms are also cited:

1. Good balance is more difficult to achieve (Wilson, 1959; Triplett, 1971/1972; Roe, 1983).
2. Good blend and intonation are more difficult to achieve (Diercks, 1961; Busch, 1984; Roe, 1983; Garretson, 1986; Miller, 1988; Wise, in Regier et al. 1962).
3. An individual voice is more likely to pull an entire section off pitch (Gordon, 1977; Diercks, 1961; Stocker, 1975; Garretson, 1986).

4. The security gained by singing with those of the same voice part also causes weaker musicians to become over dependent on more capable singers (Diercks, 1961; Gordon, 1977; Roe, 1983; Boyd, 1970; Garretson, 1986; Miller, 1988).

Presented below are many variations of sectional formations found in the literature, with justifications when given:

1. Figure 10 polarizes the highest and lowest voices for good intonation stability (Busch, 1984). Ehmann (1968) suggests its use for large choirs. Pfautsch, in Decker and Herford (1988) present this plan as a usable option with no justification given.

```
T  B
S  A
```

Figure 10

2. Diercks (1960) states that Figure 11 formation is superior to Figure 10 because of either (a) the outside voices are together, or (b) the tone qualities are mixed more effectively. Pfautsch, in Decker and Herford (1988), and Decker and Kirk (1988) offer this arrangement as an option with no justification given.

```
B  T
S  A
```

Figure 11
3. Busch (1984) presents Figure 12 as a viable option when the men sections are weak.

![Figure 12](image)

4. Gordon (1977) offers Figure 13 formation in which the men's sections are reversed from Figure 12. No justification is given.

![Figure 13](image)

5. Busch (1984) and Gordon (1977) suggest Figure 14 formation for small male sections. Blocking the men in the center creates solidity.
6. Diercks (1960) and Decker and Kirk (1988) offer Figure 15 formation for eight-part voicing. The outside voices are together horizontally (within male and female parts) and vertically (between male and female parts).

![Figure 15](image)

7. Garretson (1986), Miller (1988), and Lamb (1988) present Figure 16 formation which reverses positions within sections from Figure 15. Separate male and female choirs are feasible. Soprano II and alto I, altos and tenors, and bass I and tenor II can double parts when needed. Outside voices are together vertically (between male and female parts) improving intonation. As with Figure 15, this formation is usable for four-part and eight-part voicings.

![Figure 16](image)

8. Roe (1983) provides Figure 17 formation which places extreme parts together for better intonation.

![Figure 17](image)
9. Pfautsch, in Decker and Herford (1988) suggests Figure 18 as a useable formation with no justification given.

![Diagram of Figure 18]

10. Pfautsch, in Decker and Herford (1988), and Decker and Kirk (1988) submit Figure 19 formation as an option with no justification given.

![Diagram of Figure 19]

11. Boyd (1970) states that with formation 20, an equal number of each voice can be placed in the front. A careful choice of front row singers will result in a cleaner sound. A problem singer can be more easily buried in this vertical formation. Altos and tenors can assist each other.

![Diagram of Figure 20]
12. Ehmann (1968) offers Figures 21 and 22 formations for smaller choirs; Figure 21 for an equal number on each voice part; Figure 22 for smaller male sections.

![Figure 21](image1)

![Figure 22](image2)

13. Pfautsch, in Decker and Herford (1988), presents Figure 23 formation with no justification given.

![Figure 23](image3)

14. Roe (1983) and Miller (1988) submit Figure 24 formation in which the extreme parts are together for better intonation. Female sections are joined in the back for unity.

![Figure 24](image4)
15. Gordon (1977) offers Figure 25 formation as an option when moving from SATB to SSATTB voicings within a work or program.

![Figure 25 Image]

16. Gordon (1977) offers Figure 26 formation for the use of an echo choir within the main ensemble.

![Figure 26 Image]

17. For antiphonal singing with two similar sized choirs, Gordon (1977) suggests Figure 27 formation.

![Figure 27 Image]
18. Gordon (1977) presents Figure 28 formation for the projection of a theme in cantus firmus types of compositions.

19. Roe (1983) presents Figure 29 formation in which extreme parts are together to aid intonation, female sections are joined for unity, and male sections are together for security.

20. The following formations are examples of Ehmann's (1968) philosophy of seating according to the structure of the music. Figure 30 is to be used for a two part composition in which the first voice has the lead. Figure 31 is a plan for a three voice composition in which two voices move in counter point to the lead. Figure 32 is an
option when two subordinate voices are in direct relationship to the leading voice, resulting in even texture.

Figure 30

Voice II
Voice I

Figure 31

Sub. Voice I  Sub. Voice II
Leading Voice

Figure 32

Sub. Voice I  Leading Voice  Sub. Voice II
21. Figure 33 is recommended by Garretson (1986), Miller (1988), and Lamb (1988) with the following justifications: (a) Aids development and blend of tenors; (b) Altos may double the tenor part; (c) Outside voices are together improving intonation; (d) Unstable male voices are given tonal support and confidence by being surrounded by treble voices; (e) Separate male and female choirs are feasible.

![Figure 33](image)

22. Figure 34 is recommended by Miller (1988) and Lamb (1988) with the following justifications: (a) It is usable for either four or eight part music; (b) Outside voices are together for improved intonation; (c) Altos and tenors can assist each other; (d) When divided, an entire part can be heard over that side of the choir; (e) Baritones and second tenors can assist each other.

![Figure 34](image)

23. Robinson and Winold (1976) describe the preferred arrangement of John Finley Williamson and the Westminster Choir (Figure 35). It is a classic block formation with basses behind sopranos and tenors behind altos. The bass section is the foundation of
sound. The first sopranos bring focus to the sound with a pure crystal-clear thread of tone. The voices between these provide a rich tonal texture.

![Diagram](image1)

**Figure 35**

24. Robinson and Winold (1976) describes the preferred arrangement of F. Melius Christiansen and his St. Olaf Choir. Figure 36 formation is said to be particularly effective for Renaissance and Baroque literature. The block arrangement allows the sections to maintain their identity in polyphonic music. The soprano-bass orientation is important for the works of J. S. Bach, Handel, and their contemporaries.

![Diagram](image2)

**Figure 36**

**Mixed Formations**

Many choral experts are of the opinion that a better choral sound is rendered when like voice parts are not positioned together in sections. These mixed arrangements take the form of either quartets of some type of scrambled plan--either random or planned. A randomly scrambled plan has two advantages according to Boyd (1970); (1) it is fast, and; (2) singers get a new perspective with each scramble. Other proponents of mixed formations utilize carefully planned systems of placing voices with regard to timbre,
vibrato, size of voice, and so forth (Noble, 1989; Williams, 1989; Eichenberger, 1989). According to many directors, a prerequisite for using a mixed arrangement is that the singers must be sure of themselves musically (Triplett, 1971/1972; Busch, 1984; Miller, 1988; Lambson, 1958).

Cuing is an issue of concern with mixed formations. Although it may appear to be problematic, some suggest cueing can be accomplished well by directing cues to familiar block positions. Singers learn to respond to cues to their part no matter where they are standing (Triplett, 1971/1972; Diercks, 1960; Jones, 1967). Williams (1989), on the other hand, cues all of a section at once even though scattered throughout the choir.

Following are advantages of mixed formations generally accepted by proponents of such plans:

1. An overall richer tone, better blend, and improved intonation is achieved (Diercks, 1961; Roe, 1983; Garretson, 1986; Miller, 1988; Wise, in Regier et al. 1962; Busch, 1984).


3. One singer having a bad day will not negatively affect an entire voice part as would happen if seated sectionally. This principle exists because more accurate singers often give in to the less accurate in the interest of blend (Diercks, 1961; Stocker, 1975; Garretson, 1986).
4. Educationally it is sound. Individuals perform better when they experience the whole rather than the part. Singers can hear themselves and other parts better (Stocker, 1975; Miller, 1988; Wise, in Regier et al. 1962).

5. A better tone front can be achieved by selecting the best quality voices for key positions. Voices which negatively affect each other can be separated (Diercks, 1961; Garretson, 1986). Diercks (1961) draws evidence supporting this principle from his colleague E. Milton Boone, Professor of Electrical Engineering. Boone states:

When singer A and singer B sing together the resultant is not A + B, but something more or less. This is true even though they sing the same pitch. Remember that this is experienced because of the nature of the ear—this sound is subjective or occult. Also keep in mind that each of these singers is a receiver as well as a sender and, so, tends to react to what he receives and this reaction causes a change in what is sent. (p. 45)

Boone continues to point out that the ear is a nonlinear hearing mechanism, thus receives sum and difference frequencies not emitted from the source. This is the principle behind the difference tone phenomenon when listeners hear chord tones that are actually not being produced by singers. Grim (1981) speaks of the importance of this difference tone phenomenon in the positioning of his ladies choir. He contends that improperly placed first and second sopranos can produce incompatible overtone series resulting in intonation problems. Whereas, by properly placing the first and second sopranos, the difference tone produced will actually enhance the alto section. Ironically he suggests that the pairing of unlike voices results in a better compatibility of overtones. The point is that singers have
different overtone complexities in their sound. This affects each singer’s vocal production and what the listener hears.

6. Although choral reading may be slower at first, the independence gained will enable singers to eventually read more accurately and quickly (Stocker, 1975; Roe, 1983).

7. Better balance is achieved because the problem of numbers of singers can be solved by appropriate placement. Also, average singers will sing with more volume when not surrounded by the same part, thus improving their tone quality (Triplett, 1971/1972; Roe, 1983; Wilson, 1959; Busch, 1984).

8. Good students respond favorably to the increased responsibility and challenge, thus improving morale (Miller, 1988).

9. Moving to a scrambled plan livens up the group. Psychologically, it may be just what is needed to gain fifteen more minutes of work from tired singers (Boyd, 1970).

Disadvantages to mixed formations are also cited:

1. There is a lack of line separation in contrapuntal music, especially in the late Renaissance when line took precedence to vertical sonority (Stocker, 1975; Boyd, 1970; Garretson, 1986; Lamb, 1988). A comment in Wyatt’s (1968) survey emphasizes this point: "The blend between sections is not good for contrapuntal music. Each line should have its own timbre. A total homogeneity of timbre is useful in very little choral literature" (p. 23).

2. Since the male voice has more carrying power than the female voice (due to the greater number of audible partials), it is more easily heard in quartets. This is especially true in high school choirs (Stocker, 1975).
3. There is a greater risk for the prominence of individual voices (Stocker, 1975). Stocker purports that if the total choir sound is reduced to solve the problem, a lid is placed on the sound. If strong voices are asked to reduce their intensity, these leaders may become discouraged. If the volume of the choir is brought up, expressiveness and interpretation are hindered.

4. Quartets that are consistent within themselves run the risk of being inconsistent with the other units (Stocker, 1975; Roe, 1983).

5. Control of dynamics and articulation is more difficult (Boyd, 1970; Lambson, 1958).

Stocker (1975) is not convinced that quartet or scrambled singing produces a better sound. Although the choir may tune better, and weaker singers may gain independence, the tone is not better. It is Stocker's opinion that "...by breaking up the sections the Gestalt principle has ceased to function whereby the whole of a section is greater than the sum of its parts" (p. 10). The group becomes more tonally diffuse. Stocker argues Diercks and Boone's (1961) acoustical theories of the detriment of placing two like voices together (described previously in this chapter). His argument takes three points: (1) The probability of ever having two identical voices together is very low because of the uniqueness of individuals' overtone productions (like fingerprints); (2) Even if two singers have a like color, the difference in size and rate of vibrato is causing pitch to be continually altered; (3) Boone's formulae which show a potential problem of the juxtaposition of two like voices can also represent a theoretical reason for placing them together. If, as Boone states, overtones can be doubled in intensity by their combination, certain individuals with similar overtone productions would benefit from singing together. This combining effect can work both positively and negatively. Most will agree that
when two strident voices are together, their harshness is compounded. Stocker suggests that the same principle should work in reverse for the encouragement of positive effects.

Following are examples of mixed formations with descriptions and justifications when given:

1. Jones (1967) describes his procedure for arriving at a quartet formation in his high school chorus. He begins with double quartets with each part in pairs (Figure 37).

![Figure 37](ss BB AA TT SS BB AA TT)

Next he reverses the second and fourth rows (Figure 38).

![Figure 38](TT AA BB SS TT AA BB SS)

The final move is into single quartets (Figure 39).

![Figure 39](TABS TABS TABS TABS SBAT SBAT SBAT SBAT TABS TABS TABS SBAT SBAT SBAT SBAT)
2. Busch (1984) offers Figure 40 formation. He contends this arrangement forces independence, and improves balance and blend when all parts are secure.

![Figure 40]

3. Roe (1983) used Figure 41 formation (75 voices) successfully for five years. He reports the main strength of the arrangement is its flexibility. There are four possible SATB choirs available for any antiphonal use or for rehearsal techniques.

![Figure 41]
4. Miller (1988) contends that mixed arrangements work best for smaller ensembles. He offers the examples of Figure 42 and Figure 43.

<table>
<thead>
<tr>
<th>SATB</th>
<th>SII AII TII BII SII</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>AII TII BII SII</td>
</tr>
<tr>
<td>T</td>
<td>BII TII AII SII</td>
</tr>
<tr>
<td>S</td>
<td>BII TII SII AI</td>
</tr>
<tr>
<td>A</td>
<td>BII TII AI SII</td>
</tr>
</tbody>
</table>

Figure 42

<table>
<thead>
<tr>
<th>SI</th>
<th>SII AII TII BII SII</th>
</tr>
</thead>
<tbody>
<tr>
<td>AI</td>
<td>AII TII BII SII</td>
</tr>
<tr>
<td>TI</td>
<td>BII TII AII SII</td>
</tr>
<tr>
<td>II</td>
<td>TII BII SII AI</td>
</tr>
<tr>
<td>BI</td>
<td>TII AII SII AI</td>
</tr>
</tbody>
</table>

Figure 43

5. Decker and Kirk (1988) suggest Figure 44 formation with no justification given.

<table>
<thead>
<tr>
<th>SATBSATB</th>
<th>SATBSATB</th>
</tr>
</thead>
<tbody>
<tr>
<td>BTASBTAS</td>
<td>BTASBTAS</td>
</tr>
</tbody>
</table>

Figure 44

6. Boyd (1970) and Lamb (1988) present a modified scrambled plan (Figure 45) that mixes soprano and bass, and alto and tenor. This allows the singer to directly hear only one other part rather than three. Cueing and expressive directions are also made more efficient. Boyd cautions that this method does not work with mixing any other sections.

<table>
<thead>
<tr>
<th>SSBB</th>
<th>SSBB</th>
<th>AA TT</th>
<th>AA TT</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSBB</td>
<td>SSBB</td>
<td>AA TT</td>
<td>AA TT</td>
</tr>
<tr>
<td>SSBB</td>
<td>SSBB</td>
<td>AA TT</td>
<td>AA TT</td>
</tr>
<tr>
<td>SSBB</td>
<td>SSBB</td>
<td>AA TT</td>
<td>AA TT</td>
</tr>
</tbody>
</table>

Figure 45
Diercks (1961) presents the scrambled plan in Figure 46 for a possible set-up with nine SI, seven SII, eight A I, seven AII, five T I, seven TII, eight B I, and seven BII.

Room Acoustics

Certainly, an important external factor affecting choral sound is the acoustical features of the rehearsal or performance room. It is not within the scope of this study to exhaustively investigate the science of architectural acoustics, but the ramifications of this element are, indeed, important to choral directors. The effect of this external factor is controlled for in this investigation because all performances occur in the same room. Readers must be reminded, however, that different acoustical properties could influence the judges' evaluations. An acoustical description of the room in which the experiment was conducted is provided in Chapter III.

Kramme (1978) provides an excellent discussion of the association of acoustical principles to the choral situation. Following is a summary of his discussion and research.

In choral room acoustics, the medium of sound transmission is air. The original vibrating bodies are the vocal folds. The secondary vibrating material of greatest importance is the eardrum. Two critical properties of sound are: (1) Frequency—emitted from the original sound source and registered in cycles per second; and (2) Intensity—
relating to the total power output of the sound wave and expressed in watts per square centimeter.

Sound is propagated outward to the listener at approximately 1130 feet per second. Corresponding to the physical quantities of frequency and intensity, the human hearing system recognizes the two subjective assessments of pitch and loudness. Subjective evaluations of pitch are dependent upon both frequency and intensity (Lundin, 1967). Lundin also reports of research findings that the ear is most sensitive in the octave around 3000 cps, and that the sensitivity decreases considerably at higher and lower frequencies.

Directionality is the attribute by which the brain discriminates and evaluates the minute differences in intensity and time delay between the signals received from both ears. This attribute is effected by the physical environment in which the sound is produced and heard. Muncey and Nickson (1964) state that sound perceived by a listener in an enclosed room is of two types:

1) the direct sound which is heard only once, in amounts depending on the relative positions of the source and the listener, and 2) the reflected or indirect sound which reaches the listener by various paths from different directions at different times with successive echoes becoming weaker until inaudible. (p. 143)

As reflected sound waves accumulate, the brain begins to add the separate sound energy values and the listener experiences a real increase in intensity over the same sound source heard outdoors.

Reflected sound in a room is called reverberation. In a speaking voice, there is an average of ten speech sounds per second. In a room with reverberation time of more than one second, a speaker's words soon begin to accumulate to the point at which the brain
cannot decipher the multitude of signals being received (Muncey and Nickson, 1964). An additional complication is the low acoustical power of consonants compared with that of vowels. This causes the consonants to decay quickly while the vowels linger.

With the exception of very fast, syllabic styles, most choral music contains fewer than ten sound events per second. This is why optimum reverberation time for choral music is among the highest in the performing media--about 1.1 seconds. The human voice has no appreciable, natural sound decay and depends upon reverberation to improve sustaining quality. There is also subjective evidence that reverberation lends a sense of continuity to choral sound creating confidence in singers (Beranek, 1962).

Choral conductors are interested in proper reverberation to assist blend and intensity for the listeners. But conductors need to hear a maximum amount of direct sound for clarity and analysis, in addition to the first reverberant sounds. Reverberation is effected greatly by the frequency absorption patterns of the boundary surfaces and the resonating frequencies or normal modes of the room. Kramme (1978) lists several ideal acoustical characteristics for achieving optimal reverberation for choral singing. They are summarized as follows:

1. Hard, reflective back wall and ceiling incorporating little or no absorptive materials;
2. The ceiling, employing large array panels when possible, should be canted to allow reflections to focus near the conductor's stand;
3. The side walls should have reflective diffuse surfaces with regularly spaced absorptive patches placed as needed;
4. The front wall should have the most reflective surface and might incorporate an adjustable absorbent such as curtains;
5. Risers should be used to lessen the absorption and diffraction resulting from singing into heads.

Kramme is quick to point out that any room acoustical adjustments cannot improve the musical quality of an ensemble. He continues, "The finest chorus, however, will be perceived only to the extent to which the physical characteristics of a room allow the sound to develop, exist, and decay" (p. 12).
CHAPTER III
MATERIALS AND PROCEDURES

Design of the Study

Two intact college choirs were the experimental units used to assess the effect of various choral formations and musical textures (independent variables) on the dependent variables of choral sound. The independent variables were as follows:

(A) Choral Formations Regarding Acoustical Placement of Voices

(level 1)
Formation in which voices are placed in their best acoustical position in relationship to surrounding voices

(level 2)
Formation in which voices are unorganized without regard for acoustical placement

(B) Choral Formations Regarding Voice Part Placement

(level 1)
Homogeneous grouping of voice parts in sections

(level 2)
mixing the voice parts throughout the choir

(C) Musical Texture (represented by the two choral pieces)

(level 1)
Polyphonic; Lobet den Herrn, J. S. Bach

(level 2)
Homophonic; excerpt from Requiem, Verdi

(D) Choir

(level 1)
Choir 1

(level 2)
Choir 2
(E) Judge

(level 1-5)
Judges 1-5

The dependent variables measured with the Choral Sound Inventory developed by the investigator were:

(A) Overall blend

(B) Instances of noticeable individual voices

(C) Balance of voice parts/Intensity

(D) Intonation

(E) Rhythmic precision/Ensemble/Diction

(F) Interpretation/Expressiveness/Dynamic control

Selection of Treatment Choirs and Directors

The criteria for selection of the treatment choirs were: (1) Similar size and ability level; (2) Reputable choral program; (3) Reasonable proximity to the investigator; (4) Time for the project and coordination of schedules.

When the decision to use college choirs was made, several potential directors were contacted. All the directors contacted were very interested in the study. The two chosen were able to agree upon the time commitment in the spring of 1990. The choirs and directors chosen were The Ohio Wesleyan University Choral Art Society, Robert Nims, Director, Delaware, Ohio; and The Otterbein College Concert Choir, Craig Johnson, Director, Westerville, Ohio. The investigator attended concerts by both choirs to confirm the suitability of these ensembles. An honorarium was given to the directors for their time and expertise.
Selection of the Choral Pieces

The only stipulation set forth for the selection of the two choral pieces was that they meet the requirements for the independent variable of texture. To assess the effect of texture, one piece was to be predominantly homophonic and the other polyphonic. With this requirement the selection of the literature was done by the participating directors, coordinated and approved by the investigator. The intent was to allow the directors to choose selections that would be usable in their own Spring concerts.

The polyphonic piece chosen was the concluding "Alleluia" section of Lobet den Herrn, alle Heiden by J. S. Bach, Edition Peters, No. 6106. The homophonic piece chosen is from the final section, "Libera me", of Requiem by Verdi (pp. 182-185), G. Schirmer edition.

Selection of the Panel of Judges

A minimum of five sets of ratings was recommended for proper statistical analysis. Upon recommendations by the choral experts on the investigator's committee, five judges were chosen for their reputation as outstanding choral directors, their fine choral ear, and their experience with judging choral ensembles. The judges selected were Lloyd Kaufmann, Rosedale Bible Institute, Irwin, Ohio; Joyce Stonebraker, Westerville North High School, Westerville, Ohio; Joe Thrower, Reynoldsburg High School, Reynoldsburg, Ohio; Mark Hutsko, Worthington High School, Worthington, Ohio; and Cindy Brewer, Dublin High School, Dublin, Ohio. These judges were given an honorarium for their expert services.
Instruments of Evaluation

Choral Sound Inventory

The judges rated the choirs on the Choral Sound Inventory (CSI) developed by the investigator. The criteria for its construction were that it thoroughly measure the dependent variables and be concise and efficient for the many performance trials being rated. A Likert-type scale of 1 to 5, with 5 indicating strong agreement, was the method of response. (The Choral Sound Inventory is presented in Appendix B)

Singer Evaluation Survey

The literature suggests that the attitudes and morale of choir members, as well as their satisfaction with their placement in a formation, affects the choral sound produced. Purely as a descriptive assessment, the Singer Evaluation Survey (SES) was administered to the participating choir members. The singers were asked to assess the value of the experimenter's method of acoustical placement, and to give their preference of the four choral formations for the polyphonic and the homophonic experimental pieces. (The Singer Evaluation Survey is presented in Appendix B).

Director Evaluation Survey

Other than the investigator, the directors of the participating choirs spent the most time directly with the formations prepared by the investigator. In fact, the directors heard the total choral sound in the formations more than anyone. Because of this involvement and their familiarity with their respective choir, their evaluation of the study was insightful. A more subjective, expository instrument, the Director Evaluation Survey (DES), was completed by Professor Johnson and Professor Nims. (The Director Evaluation Survey is presented in Appendix B).
The Site for the Experiment

The site for the actual experiment was mutually agreed upon by the investigator and the participating directors to be the concert hall in the Battelle Fine Arts Center at Otterbein College, Westerville, Ohio. This concert facility is a moderately small, pie-shaped hall that measures approximately 30 feet wide at the front of the stage to about 50 feet at the back of the hall. The length from the front of the stage to the back of the hall measures approximately 30 feet, and contains nine rows of chairs. With a small balcony of two rows, the total seating capacity is 272. The height from the floor to the ceiling is 25-30 feet. All wall surfaces are hard plaster. The floor is cement, with flat, hard carpet in the two length isles. Reverberation time is judged by most directors to be very good for choral performance. This is aided by acoustically absorptive tiles along the entire, 5 by 30 foot, front face of the balcony.

Pre-Experiment Preparation

Preparation for the Choir

Since it takes a period of time for singers to adjust to any formation, the four experimental formations were established two weeks prior to the experiment. The directors allowed the investigator to create these formations at normal rehearsal periods. The investigator has gained previous experience in acoustically placing voices with his own choirs and in various clinics and classes. For this experiment, the investigator did not test the significance of varied space between singers. A reasonably close spacing, without crowding, was used. During the two week period prior to the experiment the directors logged the rehearsal time in each formation ensuring a reasonable equality. This procedure also controls for the novelty threat to external validity.
Establishment of the mixed formations

Since it was not feasible to test the many systems of creating mixed formations, only two methods were chosen as independent variables. The acoustically placed mixed formation was based on John William's method discussed in Chapter II. (A strict quartet plan could not be considered because of substantial inequities of voice part numbers in one of the experimental choirs.) The investigator auditioned each member of both choirs, assessing each voice's intensity or weight (light, medium light, medium heavy, heavy) and vibrato (little or none, normal, big). Also assessed were other vocal tone characteristics and labeled as pleasant, strident, nasal, and so forth. Using this information, a chart was constructed indicating the probable placement of each voice.

With this chart in hand, each voice part was placed separately beginning with the tenors. Singers of a particular part were positioned about eight feet apart in certain rows according to their voice assessment. The front rows contained the lightest voices with smallest vibratos. The back rows contained the heaviest voices with bigger vibratos and voices with unique or non-blending qualities. The placement of each section was checked by listening to various triangles of singers' blend. The intent was to create a block of sound from each voice part coming straight through the choir, with voices in the front taking the edge off the voices behind. William's rule to never place a tenor on the end was followed. Singers' heights were given little consideration. The final formation was documented and used in rehearsals and in the experiment. (see Appendix D)

The second mixed formation really involved no method at all, but is reported in the literature as a usable option— that is, the unorganized or scatter plan. The only stipulation is that singers stand next to another voice part, and that voice parts be reasonably evenly distributed throughout the choir. From the acoustically placed formation, the singers were asked to reassemble themselves, moving to any other spot
designated for their voice part. When this was accomplished (one section at a time), the arrangement was documented and used in rehearsals and in the experiment. (see Appendix D)

**Establishment of the sectional formations**

The basic SATB block plan as shown in Figure 11 was used for both experimental formations. The literature identifies it as a favorable arrangement because of the aid to intonation due to the proximity of outer voices—soprano with bass, and alto with tenor.

The acoustically placed sectional arrangement was formed for each choir using Weston Noble's method of acoustical placement described in Chapter II. Each section was placed separately. For each section, the investigator chose a model pair—two singers whose voices blended effortlessly. Then, through a tedious system of acoustical matching (see Chapter II, An Interview with Weston Noble), two acoustically placed rows for each section were formed. The premise underlying many of the placements was the matching of unlike voice qualities. When the rows were brought together again for a final check, the experimenter and director determined the best placement of the rows. When the whole formation was complete, it was documented and used in rehearsals and in the experiment. (see Appendix D)

For the unorganized sectional formation, the singers were asked to reassemble themselves within each section with no consideration of voice compatibility or individual voice qualities. When this was accomplished, the formation was documented and used in rehearsals and in the experiment. (see Appendix D)
**Preparation for the judges/pilot test**

To familiarize the judges with the study, and to ensure uniform calibration of scores, they were provided with a practice tape as a pilot procedure. This tape included SATB choral excerpts of homophonic and polyphonic music. The taped choir had been asked to assume various sectional and mixed formations and to purposefully produce problem sounds in the areas of the dependent variables being tested.

Before the experiment began, the investigator conferred with the judges to establish agreement in the calibration of scores. It was important that the judges use the full 1-5 Likert scale in their assessment rather than confining their scores to two or three ratings.

**The Experiment/Collection of Data**

The experiment took place on April 30, 1990 from 4:00-6:00 p.m. at the Battelle Fine Arts Center, Otterbein College, Westerville, Ohio. The parties involved were the investigator, the two choirs and directors, the five judges, and a tape recording technician. (The performance trials were tape recorded only for reference, and not for analysis.) Schedule constraints required that the experiment be concluded in a two hour period. The 32 performance trials took approximately 75 minutes. With one minute between trials the time limit was met.

A computer-generated random ordering of 32 integers was applied to the choirs, musical pieces, and choral formations. The resulting random order used for the experiment is presented in Appendix C.

The judges were seated in the balcony with a small visual shield positioned directly in front of them. This method of visual screening posed no threat of distorting the choral sound. The judges rated each performance trial on the Choral Sound
Inventory. During the one-minute period between trials, the change of choirs and/or formations took place. There were a few instances when the same choir performed in the same formation, back-to-back (only the piece was different). When this happened the choir came off the risers then immediately returned to the same formation so that the judges would not be aware of the consecutive order.

The judges carefully numbered each CSI rating sheet so that they could be easily matched to the established random order. These ratings were then subjected to statistical analysis which is presented in Chapter IV.
CHAPTER IV
PRESENTATION AND ANALYSIS OF DATA

The data obtained from the judges' ratings of the 32 trial performances were subjected to statistical analysis. A five factor, full factorial analysis of variance and, for some data, a paired observation t test, were implemented using the SAS statistical package at The Ohio State University. The first section of this chapter will present data and analysis to explain main effects and interactions for each dependent variable with each independent variable. The alpha level is .05. The next section will use the same statistical information to support the rejection or failure to reject each null hypothesis at the .05 alpha level. Following sections will report the results of the singer evaluation survey and the director evaluation survey.

Data And Analysis For Dependent Variables

Overall Blend

Tables 1 through 7 present data regarding the dependent variable of overall blend. Table 1 and Figure 47 indicate a significant main effect favoring the acoustical placement of voices over an unorganized placement. Table 2 and Figure 48 indicate a significant main effect for voice part placement favoring a sectional formation over a mixed formation. Table 6 and Figure 49 indicate a significant interaction of the independent variables of musical texture (piece) and acoustical/unorganized placement of voices. The data reveal that the homophonic piece (Verdi) benefited significantly from acoustical
placement of voices, whereas the polyphonic piece (Bach) was nearly unaffected. Therefore, for the dependent variable of overall blend, the main effect favoring acoustical placement of voices is due almost entirely to its effect on the homophonic piece.

Table 7 and Figure 50 indicate a significant interaction of the independent variables of voice part placement (mixed/sections) and judge. The data reveal that the strong preference for the sectional formation by judge 1 and judge 2 was inconsistent with the other three judges' fairly static ratings. Therefore, for the dependent variable of overall blend, the main effect favoring the sectional formation is due primarily to the ratings of judges 1 and 2.

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Mean Difference</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acoustically Placed</td>
<td>3.150</td>
<td>.915</td>
<td>.325</td>
<td>5.01</td>
<td>.0267</td>
</tr>
<tr>
<td>Unorganized</td>
<td>2.825</td>
<td>1.016</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 2. ANOVA results for the dependent variable of overall blend with the independent variable of voice part placement (mixed/sections); see Figure 48

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Mean Difference</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mixed</td>
<td>2.788</td>
<td>1.052</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Section</td>
<td>3.188</td>
<td>.858</td>
<td>.400</td>
<td>7.60</td>
<td>.0066</td>
</tr>
</tbody>
</table>

Figure 47
Main effect favoring acoustical placement over unorganized placement for the dependent variable of overall blend.
Figure 48
Main effect favoring a sectional over mixed formation for the dependent variable of overall blend

Table 3. ANOVA results for the dependent variable of overall blend with the independent variable of musical texture (piece)

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Mean Difference</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyphonic (Bach)</td>
<td>2.938</td>
<td>1.023</td>
<td></td>
<td>.47</td>
<td>.4919</td>
</tr>
<tr>
<td>Homophonic (Verdi)</td>
<td>3.038</td>
<td>.934</td>
<td>.100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 4. ANOVA results for the dependent variable of overall blend with the independent variable of choir

<table>
<thead>
<tr>
<th>Choir</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Difference</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Choir 1</td>
<td>2.950</td>
<td>1.028</td>
<td></td>
<td>.74</td>
<td>.3905</td>
</tr>
<tr>
<td>Choir 2</td>
<td>3.050</td>
<td>.926</td>
<td>.125</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5. ANOVA results for the dependent variable of overall blend with the independent variable of judge

<table>
<thead>
<tr>
<th>Judge</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Judge 1</td>
<td>2.969</td>
<td>1.204</td>
<td>.42</td>
<td>.7947</td>
</tr>
<tr>
<td>Judge 2</td>
<td>3.125</td>
<td>1.008</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Judge 3</td>
<td>3.063</td>
<td>.982</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Judge 4</td>
<td>2.875</td>
<td>.871</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Judge 5</td>
<td>2.906</td>
<td>.818</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 6. Interaction of the independent variables of musical texture (piece) and acoustical/unorganized placement of voices for the dependent variable of overall blend (see Figure 49)

<table>
<thead>
<tr>
<th>Piece</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Difference</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyphonic (Bach)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acoustically Placed</td>
<td>2.950</td>
<td>.986</td>
<td>.025</td>
<td>4.27</td>
<td>.0405</td>
</tr>
<tr>
<td>Polyphonic (Bach)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unorganized</td>
<td>2.925</td>
<td>1.071</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Homophonic (Verdi)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acoustically Placed</td>
<td>3.350</td>
<td>.802</td>
<td>.625</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Homophonic (Verdi)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unorganized</td>
<td>2.725</td>
<td>.960</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 49
Interaction of musical texture (piece) and acoustical/unorganized placement of voices for the dependent variable of overall blend
Table 7. Interaction of the independent variables of voice part placement (mixed/sections) and judge for the dependent variable of overall blend (see Figure 50)

<table>
<thead>
<tr>
<th>Judge</th>
<th>Mixed</th>
<th>Sections</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Mean Difference</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Judge 1</td>
<td>Mixed</td>
<td></td>
<td>2.313</td>
<td>1.195</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sections</td>
<td></td>
<td>3.625</td>
<td>.806</td>
<td>1.312</td>
<td>3.65</td>
<td>.0073</td>
</tr>
<tr>
<td>Judge 2</td>
<td>Mixed</td>
<td></td>
<td>2.750</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sections</td>
<td></td>
<td>3.500</td>
<td>.894</td>
<td>.750</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Judge 3</td>
<td>Mixed</td>
<td></td>
<td>3.063</td>
<td>1.181</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sections</td>
<td></td>
<td>3.063</td>
<td>.772</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Judge 4</td>
<td>Mixed</td>
<td></td>
<td>2.813</td>
<td>.911</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sections</td>
<td></td>
<td>2.938</td>
<td>.854</td>
<td>.125</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Judge 5</td>
<td>Mixed</td>
<td></td>
<td>3.000</td>
<td>.894</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sections</td>
<td></td>
<td>2.813</td>
<td>.750</td>
<td>.187</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 50
Interaction of voice part placement (mixed/sections) and judge for the dependent variable of overall blend
Instances Of Noticeable Individual Voices

Tables 8 through 12 present data regarding the dependent variable of instances of noticeable individual voices. Table 9 and Figure 51 indicate a significant main effect for voice part placement favoring a sectional formation over a mixed formation. No other main effects or interactions are present for this dependent variable.

Table 8. ANOVA results for the dependent variable of instances of noticeable individual voices with the independent variable of acoustical/unorganized placement of voices

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Mean Difference</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acoustically Placed</td>
<td>2.900</td>
<td>1.063</td>
<td>.312</td>
<td>3.24</td>
<td>.0741</td>
</tr>
<tr>
<td>Unorganized</td>
<td>2.588</td>
<td>1.198</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 9. ANOVA results for the dependent variable of instances of noticeable individual voices with the independent variable of voice part placement (mixed/sections); see Figure 51

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Mean Difference</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mixed</td>
<td>2.513</td>
<td>1.158</td>
<td></td>
<td>7.09</td>
<td>.0086</td>
</tr>
<tr>
<td>Sections</td>
<td>2.975</td>
<td>1.079</td>
<td>.462</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 51
Main effect favoring a sectional over mixed formation for the dependent variable of instances of noticeable voices

Table 10. ANOVA results for the dependent variable of instances of noticeable individual voices with the independent variable of musical texture (piece)

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Mean Difference</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyphonic (Bach)</td>
<td>2.713</td>
<td>1.127</td>
<td></td>
<td>.13</td>
<td>.7195</td>
</tr>
<tr>
<td>Homophonic (Verdi)</td>
<td>2.775</td>
<td>1.158</td>
<td>.062</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 11. ANOVA results for the dependent variable of instances of noticeable individual voices with the independent variable of choir

<table>
<thead>
<tr>
<th>Choir</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Mean Difference</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Choir 1</td>
<td>2.900</td>
<td>1.063</td>
<td>.312</td>
<td>3.24</td>
<td>.0741</td>
</tr>
<tr>
<td>Choir 2</td>
<td>2.588</td>
<td>1.198</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 12. ANOVA results for the dependent variable of instances of noticeable individual voices with the independent variable of judge

<table>
<thead>
<tr>
<th>Judge</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Judge 1</td>
<td>2.813</td>
<td>1.230</td>
<td>1.58</td>
<td>.1814</td>
</tr>
<tr>
<td>Judge 2</td>
<td>2.625</td>
<td>1.362</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Judge 3</td>
<td>3.063</td>
<td>1.294</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Judge 4</td>
<td>2.813</td>
<td>.780</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Judge 5</td>
<td>2.406</td>
<td>.875</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Overall Balance of Voice Parts/Intensity

Tables 13 through 18 present data regarding the dependent variable of overall balance of voice parts/intensity. No significant main effects were found. Table 18 and Figure 52 indicate a significant interaction of the independent variables of judge and choir. The data reveal that the strong preference for Choir 2 by judge 3 and judge 4 are inconsistent with the other three judges' fairly static ratings and even reversed preference for Choir 1.
Table 13. ANOVA results for the dependent variable of overall balance of voice parts/intensity with the independent variable of acoustical/unorganized placement of voices

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Mean Difference</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acoustically Placed</td>
<td>3.000</td>
<td>1.019</td>
<td>.175</td>
<td>1.12</td>
<td>.2927</td>
</tr>
<tr>
<td>Unorganized</td>
<td>2.825</td>
<td>1.167</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 14. ANOVA results for the dependent variable of overall balance of voice parts/intensity with the independent variable of voice part placement (mixed/sections)

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Mean Difference</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mixed</td>
<td>2.888</td>
<td>1.114</td>
<td>.09</td>
<td></td>
<td>.7633</td>
</tr>
<tr>
<td>Sections</td>
<td>2.938</td>
<td>1.083</td>
<td>.050</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 15. ANOVA results for the dependent variable of overall balance of voice parts/intensity with the independent variable of musical texture (piece)

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Mean Difference</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyphonic (Bach)</td>
<td>2.813</td>
<td>1.213</td>
<td></td>
<td>1.46</td>
<td>.2294</td>
</tr>
<tr>
<td>Homophonic (Verdi)</td>
<td>3.013</td>
<td>.961</td>
<td>.200</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 16. ANOVA results for the dependent variable of overall balance of voice parts/intensity with the independent variable of choir

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Mean Difference</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Choir 1</td>
<td>2.813</td>
<td>1.159</td>
<td></td>
<td>1.46</td>
<td>.2294</td>
</tr>
<tr>
<td>Choir 2</td>
<td>3.013</td>
<td>1.025</td>
<td>.200</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 17. ANOVA results for the dependent variable of overall balance of voice parts/intensity with the independent variable of judge

<table>
<thead>
<tr>
<th>Judge</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Judge 1</td>
<td>2.938</td>
<td>1.458</td>
<td>1.51</td>
<td>.2011</td>
</tr>
<tr>
<td>Judge 2</td>
<td>2.875</td>
<td>1.008</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Judge 3</td>
<td>2.563</td>
<td>1.268</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Judge 4</td>
<td>3.188</td>
<td>.644</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Judge 5</td>
<td>3.000</td>
<td>.880</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 18. Interaction of the independent variables of judge and choir for the dependent variable of overall balance of voice parts/intensity (see Figure 52)

<table>
<thead>
<tr>
<th>Judge</th>
<th>Choir</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Mean Difference</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Judge 1</td>
<td>Choir 1</td>
<td>3.063</td>
<td>1.611</td>
<td>.250</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Choir 2</td>
<td>2.813</td>
<td>1.328</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Judge 2</td>
<td>Choir 1</td>
<td>2.938</td>
<td>1.063</td>
<td>.125</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Choir 2</td>
<td>2.813</td>
<td>.981</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Judge 3</td>
<td>Choir 1</td>
<td>1.875</td>
<td>.957</td>
<td>1.375</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Choir 2</td>
<td>3.250</td>
<td>1.183</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Judge 4</td>
<td>Choir 1</td>
<td>2.938</td>
<td>.680</td>
<td>.500</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Choir 2</td>
<td>3.438</td>
<td>.512</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Judge 5</td>
<td>Choir 1</td>
<td>3.250</td>
<td>.856</td>
<td>.500</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Choir 2</td>
<td>2.750</td>
<td>.856</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Intonation

Tables 19 through 24 present data regarding the dependent variable of intonation. Table 19 and Figure 53 indicate a significant main effect favoring acoustical placement of voices over an unorganized placement. Table 21 and Figure 54 indicate a significant main effect for musical texture favoring the polyphonic piece (Bach) over the homophonic piece (Verdi). Table 22 and Figure 55 indicate a significant main effect for the choir variable favoring Choir 2 over Choir 1.

Table 24 and Figure 56 indicate a significant three-way interaction of the independent variables of choir, musical texture (piece), and voice part placement (mixed/sections). The data reveal that for Choir 1, the polyphonic piece (Bach) scored a higher intonation rating in a sectional formation than in a mixed formation; the
homophonic piece (Verdi) scored a higher intonation rating in a mixed formation than in a sectional formation. For Choir 2, the direction was reversed. The polyphonic piece (Bach) scored a higher rating in a mixed formation than in a sectional formation; the homophonic piece (Verdi) scored a higher rating in a sectional formation than in a mixed formation. Not only was the direction reversed, but the mean differences were greater. It is apparent that for the dependent variable of intonation, the relatedness of voice part placement (mixed/sections) and musical texture (piece) is inconclusive. One can speculate that the differences in the choirs (voice types, numbers on each part, etc.) affected the disparity in ratings.

Table 19. ANOVA results for the dependent variable of intonation with the independent variable of acoustical/unorganized placement of voices (see Figure 53)

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Mean Difference</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acoustically Placed</td>
<td>3.025</td>
<td>1.043</td>
<td>.337</td>
<td>4.82</td>
<td>.0302</td>
</tr>
<tr>
<td>Unorganized</td>
<td>2.688</td>
<td>1.098</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 53
Main effect favoring acoustical placement over unorganized placement for the dependent variable of intonation

Table 20. ANOVA results for the dependent variable of intonation with the independent variable of voice part placement (mixed/sections)

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Mean Difference</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mixed</td>
<td>2.838</td>
<td>1.152</td>
<td></td>
<td>.06</td>
<td>.8078</td>
</tr>
<tr>
<td>Sections</td>
<td>2.875</td>
<td>1.011</td>
<td>.037</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 21. ANOVA results for the dependent variable of intonation with the independent variable of musical texture (piece) see Figure 54

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Mean Difference</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyphonic (Bach)</td>
<td>3.150</td>
<td>1.020</td>
<td>.587</td>
<td>14.60</td>
<td>.0002</td>
</tr>
<tr>
<td>Homophonic (Verdi)</td>
<td>2.563</td>
<td>1.006</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 54
Main effect favoring polyphonic over homophonic texture for the dependent variable of intonation
Table 22. ANOVA results for the dependent variable of intonation with the independent variable of choir (see Figure 55)

<table>
<thead>
<tr>
<th>Choir</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Mean Difference</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Choir 1</td>
<td>2.650</td>
<td>1.115</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Choir 2</td>
<td>3.063</td>
<td>1.011</td>
<td>.413</td>
<td>7.20</td>
<td>.0084</td>
</tr>
</tbody>
</table>

Figure 55
Main effect favoring choir 2 over choir 1 for the dependent variable of intonation.
Table 23. ANOVA results for the dependent variable of intonation with the independent variable of judge

<table>
<thead>
<tr>
<th>Judge</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Judge 1</td>
<td>2.563</td>
<td>1.134</td>
<td>1.33</td>
<td>.2625</td>
</tr>
<tr>
<td>Judge 2</td>
<td>3.094</td>
<td>1.174</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Judge 3</td>
<td>2.781</td>
<td>.975</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Judge 4</td>
<td>2.906</td>
<td>.995</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Judge 5</td>
<td>2.938</td>
<td>1.105</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 24. Three-way interaction of the independent variables of choir, musical texture (piece), and voice part placement (mixed/sections) for the dependent variable of intonation; (see Figure 56)

<table>
<thead>
<tr>
<th>CHOIR 1</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Mean Difference</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyphonic (Bach) Mixed</td>
<td>2.800</td>
<td>1.240</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polyphonic (Bach) Sections</td>
<td>3.100</td>
<td>1.021</td>
<td>.300</td>
<td>3.87</td>
<td>.0112</td>
</tr>
<tr>
<td>Homophonic (Verdi) Mixed</td>
<td>2.500</td>
<td>1.051</td>
<td>.300</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Homophonic (Verdi) Sections</td>
<td>2.200</td>
<td>1.005</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CHOIR 2</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyphonic (Bach) Mixed</td>
<td>3.650</td>
<td>.745</td>
<td>.600</td>
<td></td>
</tr>
<tr>
<td>Polyphonic (Bach) Sections</td>
<td>3.050</td>
<td>.887</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Homophonic (Verdi) Mixed</td>
<td>2.400</td>
<td>1.142</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Homophonic (Verdi) Sections</td>
<td>3.150</td>
<td>.875</td>
<td>.750</td>
<td></td>
</tr>
</tbody>
</table>
Three-way interaction of choir, musical texture (piece), and voice part placement (mixed/sections) for the dependent variable of intonation.

Figure 56
Rhythmic Precision/Ensemble/Diction

Tables 25 through 29 present data regarding the dependent variable of rhythmic precision/ensemble/diction. Table 25 and Figure 57 indicate a significant main effect for the independent variable of acoustical/unorganized placement of voices favoring acoustical placement over unorganized placement. Table 28 and Figure 58 indicate a significant main effect for the independent variable of choir favoring Choir 2 over Choir 1. Table 29 and Figure 59 indicate a significant main effect for the independent variable of judge. This shows that the overall mean scores of the judges were significantly different for this particular variable. The data reveal that the low rating of judge 1 and the high rating of judge 2 are inconsistent with the static ratings of the other three judges.

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Mean Difference</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acoustically placed</td>
<td>3.238</td>
<td>.931</td>
<td>.500</td>
<td>10.75</td>
<td>.0013</td>
</tr>
<tr>
<td>Unorganized</td>
<td>2.738</td>
<td>1.099</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 26. ANOVA results for the dependent variable of rhythmic precision/ensemble/diction with the independent variable of voice part placement (mixed/sections)

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Mean Difference</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mixed</td>
<td>2.975</td>
<td>1.102</td>
<td></td>
<td>.03</td>
<td>.8700</td>
</tr>
<tr>
<td>Sections</td>
<td>3.000</td>
<td>.994</td>
<td>.025</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 27. ANOVA results for the dependent variable of rhythmic precision/ensemble/diction with the independent variable of musical texture (piece)

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Mean Difference</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyphonic (Bach)</td>
<td>3.125</td>
<td>1.060</td>
<td>.275</td>
<td>3.25</td>
<td>.0735</td>
</tr>
<tr>
<td>Homophonic (Verdi)</td>
<td>2.850</td>
<td>1.020</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 28. ANOVA results for the dependent variable of rhythmic precision/ensemble/diction with the independent variable of choir (see Figure 58)

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Mean Difference</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Choir 1</td>
<td>2.813</td>
<td>1.068</td>
<td></td>
<td>5.27</td>
<td>.0232</td>
</tr>
<tr>
<td>Choir 2</td>
<td>3.163</td>
<td>.999</td>
<td>.350</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 58
Main effect favoring choir 2 over choir 1 for the dependent variable of rhythmic precision/ensemble/diction

Table 29. ANOVA results for the dependent variable of rhythmic precision/ensemble/diction with the independent variable of judge (see Figure 59)

<table>
<thead>
<tr>
<th>Judge</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Judge 1</td>
<td>2.625</td>
<td>1.040</td>
<td>2.46</td>
<td>.0480</td>
</tr>
<tr>
<td>Judge 2</td>
<td>3.375</td>
<td>.976</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Judge 3</td>
<td>3.031</td>
<td>1.062</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Judge 4</td>
<td>2.969</td>
<td>.933</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Judge 5</td>
<td>2.938</td>
<td>1.134</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Tables 30 through 36 present data regarding the dependent variable of interpretation/expressiveness/dynamic control. Table 33 and Figure 60 indicate a significant main effect for the choir variable favoring Choir 2 over Choir 1. Table 34 and Figure 61 indicate a significant main effect for the independent variable of judge. This shows that the overall mean scores of the judges were significantly different for this variable, particularly due to the low rating of judge 1.

Table 35 and Figure 62 indicate a significant interaction of the independent variables of judge and musical texture (piece). Judges 1 and 5 strongly preferred the polyphonic piece (Bach), whereas judges 3, 4, and especially judge 2 favored the homophonic piece (Verdi) for this particular variable. Table 36 and Figure 63 indicate a
significant interaction of the independent variables of acoustical/unorganized placement of voices and musical texture (piece). The data reveal that the homophonic piece (Verdi) benefited more from the acoustical placement of voices as compared to the nearly static rating for the polyphonic piece (Bach).

Table 30. ANOVA results for the dependent variable of interpretation/expressiveness/dynamic control with the independent variable of acoustical/unorganized placement of voices

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Mean Difference</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acoustically Placed</td>
<td>2.900</td>
<td>1.165</td>
<td>.262</td>
<td>3.07</td>
<td>.0820</td>
</tr>
<tr>
<td>Unorganized</td>
<td>2.638</td>
<td>1.235</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 31. ANOVA results for the dependent variable of interpretation/expressiveness/dynamic control with the independent variable of voice part placement (mixed/sections)

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Mean Difference</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mixed</td>
<td>2.725</td>
<td>1.263</td>
<td></td>
<td>.34</td>
<td>.5601</td>
</tr>
<tr>
<td>Sections</td>
<td>2.813</td>
<td>1.148</td>
<td>.088</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 32. ANOVA results for the dependent variable of interpretation/expressiveness/dynamic control with the independent variable of musical texture (piece)

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Mean Difference</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyphonic (Bach)</td>
<td>2.763</td>
<td>1.161</td>
<td></td>
<td>.01</td>
<td>.9336</td>
</tr>
<tr>
<td>Homophonic (Verdi)</td>
<td>2.775</td>
<td>1.253</td>
<td>.012</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 33. ANOVA results for the dependent variable of interpretation/expressiveness/dynamic control with the independent variable of choir (see Figure 60)

<table>
<thead>
<tr>
<th>Choir</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Mean Difference</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Choir 1</td>
<td>2.225</td>
<td>1.043</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Choir 2</td>
<td>3.313</td>
<td>1.109</td>
<td>1.088</td>
<td>52.70</td>
<td>.0001</td>
</tr>
</tbody>
</table>

Figure 60
Main effect favoring choir 2 over choir 1 for the dependent variable of interpretation/expressiveness/dynamic control
Table 34. ANOVA results for the dependent variable of interpretation/expressiveness/dynamic control with the independent variable of judge (see Figure 61)

<table>
<thead>
<tr>
<th>Judge</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Judge 1</td>
<td>2.313</td>
<td>1.306</td>
<td>3.58</td>
<td>.0083</td>
</tr>
<tr>
<td>Judge 2</td>
<td>3.063</td>
<td>1.366</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Judge 3</td>
<td>2.781</td>
<td>1.157</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Judge 4</td>
<td>3.063</td>
<td>.840</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Judge 5</td>
<td>2.625</td>
<td>1.185</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 61
Main effect of judge for the dependent variable of interpretation/expressiveness/dynamic control
Table 35. Interaction of the independent variables of judge and musical texture (piece) for the dependent variable of interpretation/expressiveness/dynamic control (see Figure 62)

<table>
<thead>
<tr>
<th>Judge</th>
<th>Polyphonic (Bach)</th>
<th>Homophonic (Verdi)</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Mean Difference</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.625</td>
<td>2.000</td>
<td>1.360</td>
<td>1.211</td>
<td>.625</td>
<td>6.90</td>
<td>.0001</td>
</tr>
<tr>
<td>2</td>
<td>2.438</td>
<td>3.688</td>
<td>1.153</td>
<td>1.302</td>
<td>1.250</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2.750</td>
<td>2.813</td>
<td>1.390</td>
<td>.911</td>
<td>.063</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>2.875</td>
<td>3.250</td>
<td>.806</td>
<td>.856</td>
<td>.375</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>3.125</td>
<td>2.125</td>
<td>1.025</td>
<td>1.147</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 62
Interaction of judge and musical texture (piece) for the dependent variable of interpretation/expressiveness/dynamic control
Table 36. Interaction of the independent variables of musical texture (piece) and acoustical/unorganized placement of voices for the dependent variable of interpretation/expressiveness/dynamic control (see Figure 63)

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Mean Difference</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyphonic (Bach) Acoustically Placed</td>
<td>2.725</td>
<td>1.086</td>
<td></td>
<td>5.08</td>
<td>.0259</td>
</tr>
<tr>
<td>Polyphonic (Bach) Unorganized</td>
<td>2.800</td>
<td>1.244</td>
<td>0.075</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Homophonic (Verdi) Acoustically Placed</td>
<td>3.075</td>
<td>1.228</td>
<td>0.600</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Homophonic (Verdi) Unorganized</td>
<td>2.475</td>
<td>1.219</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 63
Interaction of musical texture (piece) and acoustical/unorganized placement for the dependent variable of interpretation/expressiveness/dynamic control
Testing Of Hypotheses

The four hypotheses were tested in their null form with an alpha level of .05. The alternate hypotheses present the expected direction of difference.

**Null Hypothesis 1**

*In a sectional formation, there is no significant difference in CSI ratings when voices are acoustically placed than with an unorganized placement—regardless of texture for the following dependent variables:*

A. Overall blend  
B. Instances of noticeable individual voices  
C. Overall balance of voice parts/Intensity  
D. Intonation  
E. Rhythmic precision/Ensemble/Diction  
F. Interpretation/Expressiveness/Dynamic control

**Alternate Hypothesis 1**

*In a sectional formation, CSI ratings are significantly higher when voices are acoustically placed than with an unorganized placement—regardless of texture for the following dependent variables:*

A. Overall blend  
B. Instances of noticeable individual voices  
C. Overall balance of voice parts/Intensity  
D. Intonation  
E. Rhythmic precision/Ensemble/Diction  
F. Interpretation/Expressiveness/Dynamic control

**Null Hypothesis 2**

*In a mixed formation, there is no significant difference in CSI ratings when voices are acoustically placed than with an unorganized placement—regardless of texture for the following dependent variables:*

A. Overall blend  
B. Instances of noticeable individual voices  
C. Overall balance of voice parts/Intensity  
D. Intonation  
E. Rhythmic precision/Ensemble/Diction  
F. Interpretation/Expressiveness/Dynamic control
Alternate Hypothesis 2

In a mixed formation, CSI ratings are significantly higher when voices are acoustically placed than with an unorganized placement—regardless of texture for the following dependent variables:

A. Overall blend
B. Instances of noticeable individual voices
C. Overall balance of voice parts/Intensity
D. Intonation
E. Rhythmic precision/Ensemble/Diction
F. Interpretation/Expressiveness/Dynamic control

Null Hypothesis 3

For polyphonic music, there is no significant difference in CSI ratings when voice parts are arranged in a sectional formation than when voice parts are arranged in a mixed formation—regardless of acoustical/unorganized placement of voices for the following dependent variables:

A. Overall blend
B. Instances of noticeable individual voices
C. Overall balance of voice parts/Intensity
D. Intonation
E. Rhythmic precision/Ensemble/Diction
F. Interpretation/Expressiveness/Dynamic control

Alternate Hypothesis 3

For polyphonic music, CSI ratings are significantly higher when voice parts are arranged in a sectional formation than when voice parts are arranged in a mixed formation—regardless of acoustical/unorganized placement of voices for the following dependent variables:

A. Overall blend
B. Instances of noticeable individual voices
C. Overall balance of voice parts/Intensity
D. Intonation
E. Rhythmic precision/Ensemble/Diction
F. Interpretation/Expressiveness/Dynamic control
Null Hypothesis 4

For homophonic music, there is no significant difference in CSI ratings when voice parts are arranged in a mixed formation than when voice parts are arranged in a sectional formation—regardless of acoustical/unorganized placement of voices for the following dependent variables:
A. Overall blend
B. Instances of noticeable individual voices
C. Overall balance of voice parts/Intensity
D. Intonation
E. Rhythmic precision/Ensemble/Diction
F. Interpretation/Expressiveness/Dynamic control

Alternate Hypothesis 4

For homophonic music, CSI ratings are significantly higher when voice parts are arranged in a mixed formation than when voice parts are arranged in a sectional formation—regardless of acoustical/unorganized placement of voices for the following dependent variables:
A. Overall blend
B. Instances of noticeable individual voices
C. Overall balance of voice parts/Intensity
D. Intonation
E. Rhythmic precision/Ensemble/Diction
F. Interpretation/Expressiveness/Dynamic control

Testing Null Hypotheses 1 and 2

The following analysis reports data testing hypotheses 1 and 2 for each dependent variable. The alpha level for all tests is .05.

Overall Blend

Table 1 presents a P value of .0267 indicating a significant main effect of acoustical/unorganized placement of voices. The main effect favors acoustical placement of voices over unorganized placement for either a sectional or mixed formation, therefore, rejecting null hypotheses 1 and 2 for the dependent variable of overall blend. The following alternate hypotheses, then, are true for this variable:
**Alternate Hypothesis 1**

In a sectional formation, CSI ratings are significantly higher when voices are acoustically placed than with an unorganized placement—regardless of texture for the dependent variable of overall blend.

**Alternate Hypothesis 2**

In a mixed formation, CSI ratings are significantly higher when voices are acoustically placed than with an unorganized placement—regardless of texture for the dependent variable of overall blend.

It can be noted that the interaction presented in Table 6 and Figure 49 indicates that the main effect favoring acoustical placement of voices is primarily due to its effect on the homophonic piece (Verdi) with almost no effect of the polyphonic piece (Bach).

**Instances Of Noticeable Individual Voices**

Table 8 presents a $P$ value of .0741 indicating no significant main effect of acoustical/unorganized placement of voices for either a sectional or mixed formation, therefore, failing to reject null hypotheses 1 and 2 for the dependent variable of instances of noticeable individual voices.

**Overall Balance Of Voice Parts/Intensity**

Table 13 presents a $P$ value of .2927 indicating no significant main effect of acoustical/unorganized placement of voices for either a sectional or mixed formation, therefore, failing to reject null hypotheses 1 and 2 for the dependent variable of overall balance of voice parts/intensity.

**Intonation**

Table 19 presents a $P$ value of .0302 indicating a significant main effect of acoustical/unorganized placement of voices. The main effect favors acoustical placement of voices over unorganized placement for either a sectional or mixed formation, therefore,
rejecting null hypotheses 1 and 2 for the dependent variable of intonation. The following alternate hypotheses, then, are true for this variable:

**Alternate Hypothesis 1**

In a *sectional* formation, CSI ratings are significantly higher when voices are acoustically placed than with an unorganized placement—regardless of texture for the dependent variable of intonation.

**Alternate Hypothesis 2**

In a *mixed* formation, CSI ratings are significantly higher when voices are acoustically placed than with an unorganized placement—regardless of texture for the dependent variable of intonation.

**Rhythmic Precision/Ensemble/Diction.**

Table 25 presents a \( P \) value of .0013 indicating a significant main effect of acoustical/unorganized placement of voices. The main effect favors acoustical placement of voices over unorganized placement for either a sectional or mixed formation, therefore, rejecting null hypotheses 1 and 2 for the dependent variable of rhythmic precision/ensemble/diction. The alternate hypotheses, then, are true for this variable:

**Alternate Hypothesis 1**

In a *sectional* formation, CSI ratings are significantly higher when voices are acoustically placed than with an unorganized placement—regardless of texture for the dependent variable of rhythmic precision/ensemble/diction.

**Alternate Hypothesis 2**

In a *mixed* formation, CSI ratings are significantly higher when voices are acoustically placed than with an unorganized placement—regardless of texture for the dependent variable of rhythmic precision/ensemble/diction.
Interpretation/Expressiveness/Dynamic Control

Table 30 presents a $P$ value of .0820 indicating no significant main effect of acoustical/unorganized placement of voices for either a sectional or mixed formation, therefore failing to reject null hypotheses 1 and 2 for the dependent variable of interpretation/expressiveness/dynamic control. Although the $P$ value does not quite reach the significance level of .05, the interaction in Table 36 and Figure 63 illustrates that the homophonic piece (Verdi) benefited substantially from acoustical placement as compared to the static rating for the polyphonic piece (Bach). These findings are very similar to the interaction for the dependent variable of overall blend (see Table 6 and Figure 49).

Testing Null Hypotheses 3 and 4
As Interacting Hypotheses

In one respect, null hypotheses 3 and 4 can be considered interacting hypotheses. This interpretation proposes that polyphonic music is better rendered in a sectional formation; whereas, homophonic music is produced better in a mixed formation. (an opinion prevalent in the literature) To make this finding, a significant interaction must be present for the independent variables of voice part placement (mixed/sections) and musical texture (piece) in the direction of alternate hypotheses 3 and 4—which would also reject null hypotheses 3 and 4.

The only relevant finding in this regard is for the dependent variable of intonation, but is confounded in a three-way interaction including the choir variable. Table 24 and Figure 56 indicate that, for Choir 1, the polyphonic piece (Bach) scored a higher intonation rating in a sectional formational than in a mixed formation; the homophonic piece (Verdi) scored a higher intonation rating in a mixed formation than in a sectional formation. For this choir, it looks as if null hypotheses 3 and 4 can be rejected for the dependent variable of intonation in the expected direction of alternate hypotheses 3 and 4;
however, statistical significance cannot be substantiated because of the confounding third variable (choir) in the interaction.

The confounding issue is that, for Choir 2, the results were reversed—that is, the polyphonic piece (Bach) scored higher in a mixed formation than in a sectional formation; the homophonic piece (Verdi) scored higher in a sectional formation than in a mixed formation. Not only was the direction reversed, but the mean differences were greater. For Choir 2, then, the data also appears to support a rejection of null hypotheses 3 and 4 for the dependent variable of intonation, but in a reverse direction of the alternate hypotheses. Again, statistical significance cannot be substantiated because of the three-way interaction. This interaction raises questions as to the effect of choir differences (e.g. voice types, numbers of voices on each part) on the decision of the proper formation in regard to musical texture for the dependent variable of intonation.

For all other dependent variables, no significant interactions were found with musical texture (piece) and voice part placement (mixed/sections)—therefore, failing to reject null hypotheses 3 and 4 for these variables.

**Testing Hypotheses 3 and 4 Separately**

When testing hypotheses 3 and 4 separately, other data become useful in determining the decision to reject or fail to reject the hypotheses for each dependent variable. When the ANOVA results present a main effect for voice part placement (mixed/section), the main effect does not discriminate between homophonic (Verdi) and polyphonic (Bach) textures. When these main effects occurred, a t test was run on the mean differences of the mixed and section ratings for each texture (piece) separately. The combined data present a picture enabling the investigator to reject or fail to reject hypotheses 3 and 4 for each dependent variable.
Overall Blend

Table 2 presents a $P$ value of .0066 indicating a significant main effect for voice part placement favoring a sectional formation over a mixed formation for the dependent variable of overall blend. Table 7 and Figure 50 point out that this main effect is due primarily to the strong preference for the sectional formation by judges 1 and 2. Table 37 and Figure 64 show how each musical texture (piece) was rated for mixed and sectional formations. For the polyphonic texture (Bach), the $P$ value of .1567 causes a failure to reject null hypothesis 3 for the dependent variable of overall blend. (It was the average of the polyphonic and homophonic scores that caused the main effect in the ANOVA results.) For the homophonic texture (Verdi), the $P$ value of .0219 causes null hypothesis 4 to be rejected for the dependent variable of overall blend, but in the reverse direction indicated in alternate hypothesis 4. In other words it was hypothesized that the homophonic piece (Verdi) would score significantly higher in the mixed formation. Instead, the significant difference favored the sectional formation.

Table 37. Paired observation $t$ test of the independent variables of musical texture (piece) and voice part placement (mixed/sections) for the dependent variable of overall blend (see Figure 64)

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Mean Difference</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Polyphonic (Bach)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mixed</td>
<td>2.775</td>
<td>1.143</td>
<td>-1.430</td>
<td>.1567</td>
<td></td>
</tr>
<tr>
<td>Sections</td>
<td>3.100</td>
<td>.871</td>
<td>.325</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Homophonic (Verdi)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mixed</td>
<td>2.800</td>
<td>.966</td>
<td>-2.338</td>
<td>.0219</td>
<td></td>
</tr>
<tr>
<td>Sections</td>
<td>3.275</td>
<td>.847</td>
<td>.475</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Instances Of Noticeable Individual Voices

Table 9 presents a $P$ value of .0086 indicating a significant main effect of voice part placement (mixed/sections) favoring a sectional formation over a mixed formation for the dependent variable of instances of noticeable individual voices. Table 38 and Figure 65 show how each musical texture (piece) was rated for mixed and sectional formations. For the polyphonic texture (Bach), the $P$ value of .1378 causes a failure to reject null hypothesis 3 for the dependent variable of instances of noticeable individual voices. (It was the average of the polyphonic and homophonic scores that caused the main effect in the ANOVA results.) For the homophonic texture (Verdi), the $P$ value of .0328 causes null hypothesis 4 to be rejected for the dependent variable of instances of noticeable individual voices, but in the reverse direction indicated in alternate hypothesis 4. In other
words, it was hypothesized that the homophonic piece (Verdi) would score significantly higher in the mixed formation. Instead, the significant difference favored the sectional formation.

Table 38. Paired observation \( t \) test of the independent variables of musical texture (piece) and voice part placement (mixed/sections) for the dependent variable of instances of noticeable individual voices (see Figure 65)

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Mean Difference</th>
<th>( t )</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Polyphonic (Bach)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mixed</td>
<td>2.525</td>
<td>1.219</td>
<td></td>
<td>-1.499</td>
<td>.1378</td>
</tr>
<tr>
<td>Sections</td>
<td>2.900</td>
<td>1.008</td>
<td></td>
<td>.375</td>
<td></td>
</tr>
<tr>
<td><strong>Homophonic (Verdi)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mixed</td>
<td>2.500</td>
<td>1.109</td>
<td></td>
<td>-2.173</td>
<td>.0328</td>
</tr>
<tr>
<td>Sections</td>
<td>3.050</td>
<td>1.154</td>
<td></td>
<td>.550</td>
<td></td>
</tr>
</tbody>
</table>

Figure 65
\( t \) test for musical texture (piece) and voice part placement (mixed/sections) for the dependent variable of instances of noticeable individual voices
**Overall Balance Of Voice Parts/Intensity**

Table 14 presents a $P$ value of .7633 indicating no significant main effect of voice part placement (mixed/sections) for the dependent variable of overall balance of voice parts/intensity. Therefore, the data fail to reject null hypotheses 3 and 4 for this variable.

**Intonation**

Table 20 presents a $P$ value of .8078 indicating no significant main effect of voice part placement (mixed/sections) for the dependent variable of intonation. Therefore, the data fail to reject null hypotheses 3 and 4 for this variable. The relevance of the significant three-way interaction of voice part placement (mixed/sections), choir, and musical texture (piece) was presented above in the section discussing the testing of hypotheses 3 and 4 as interacting hypotheses.

**Rhythmic Precision/Ensemble/Diction**

Table 26 presents a $P$ value of .8700 indicating no significant main effect of voice part placement (mixed/sections) for the dependent variable of rhythmic precision/ensemble/diction. Therefore, the data fail to reject null hypotheses 3 and 4 for this variable.

**Interpretation/Expressiveness/Dynamic Control**

Table 31 presents a $P$ value of .5601 indicating no significant main effect of voice part placement (mixed/sections) for the dependent variable of interpretation/expressiveness/dynamic control. Therefore, the data fail to reject null hypotheses 3 and 4 for this variable.
Results of the Singer Evaluation Survey

The Singer Evaluation Survey (SES) was administered to the members of choir 1 and choir 2 on the day of the experiment (see Appendix B). Thirty-four singers in choir 1 responded; 33 in choir 2. Tables 39 through 41 present the results for each choir separately and as a combined group. Table 39 reveals that 100% of the respondents believe there is some or much value in acoustically placing voices. Tables 40 and 41 show a marked preference for acoustically placed formations. Choir 2, however, had more singers preferring unorganized formations than choir 1. This was somewhat expected because some of the singers with larger voices had indicated that they enjoyed the opportunity not to be buried deep within the choir.

For the polyphonic piece (Table 40), choir 1 preferred the acoustically placed sectional formation followed closely by the acoustically placed mixed formation. Choir 2 preferred the acoustically placed mixed formation followed by the acoustically placed sectional formation. For the homophonie piece (Table 41), choir 1 showed a preference for the acoustically placed mixed formation followed by the acoustically placed sectional formation. Choir 2 showed equal preference for the acoustically placed sectional and acoustically placed mixed formations. For this piece, several singers in choir 2 indicated a preference for the unorganized formations.
Table 39. SES question 1: What value do you see in acoustically placing voices to achieve compatibility with surrounding singers?

<table>
<thead>
<tr>
<th></th>
<th>Choir 1</th>
<th>Choir 2</th>
<th>Combined</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Value</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Some Value</td>
<td>47.1%</td>
<td>42.4%</td>
<td>44.8%</td>
</tr>
<tr>
<td>Much Value</td>
<td>52.9%</td>
<td>57.6%</td>
<td>55.2%</td>
</tr>
</tbody>
</table>

Table 40. SES question 2: For the polyphonic selection (Bach), which formation did you prefer?

<table>
<thead>
<tr>
<th></th>
<th>Choir 1</th>
<th>Choir 2</th>
<th>Combined</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acoustically Placed Sections</td>
<td>50%</td>
<td>27.3%</td>
<td>38.8%</td>
</tr>
<tr>
<td>Unorganized Sections</td>
<td>5.9%</td>
<td>9.1%</td>
<td>7.5%</td>
</tr>
<tr>
<td>Acoustically Placed Mixed</td>
<td>41.2%</td>
<td>51.5%</td>
<td>46.3%</td>
</tr>
<tr>
<td>Unorganized Mixed</td>
<td>2.9%</td>
<td>12.1%</td>
<td>7.5%</td>
</tr>
</tbody>
</table>

Table 41. SES question 3: For the homophonic selection (Verdi), which formation did you prefer?

<table>
<thead>
<tr>
<th></th>
<th>Choir 1</th>
<th>Choir 2</th>
<th>Combined</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acoustically Placed Sections</td>
<td>41.2%</td>
<td>33.3%</td>
<td>37.3%</td>
</tr>
<tr>
<td>Unorganized Sections</td>
<td>2.9%</td>
<td>18.2%</td>
<td>10.4%</td>
</tr>
<tr>
<td>Acoustically Placed Mixed</td>
<td>55.9%</td>
<td>33.3%</td>
<td>44.8%</td>
</tr>
<tr>
<td>Unorganized Mixed</td>
<td>0%</td>
<td>15.2%</td>
<td>7.5%</td>
</tr>
</tbody>
</table>
The choir members also provided comments, positive and critical, which are insightful to the results of this study. Following are the comments received for each question on the SES. For the comments on questions 2 and 3, the singer's formation choice is given in parentheses.

**Question 1 comments:**

1. My level of confidence is raised when I sing by a neighbor with whom I feel comfortable.

2. Acoustical placement helps blend.

3. I really noticed a difference in our section.

4. It feels like one voice—my own voice with surrounding voices.

5. Not only does acoustical placement help overall sound, but it helps individuals feel more comfortable with surrounding voices.

6. It made me less conscious of sticking out.

7. There is some value in acoustical placement, but a good singer will try to blend with any neighboring voice.

8. I wonder if the sound doesn't just come together anyway, and **good, better, and best** is subjective.

9. Perhaps acoustical placement is more effective at the high school level than with more mature voices.

10. For our choir, other factors such as reading ability, pitch matching, personality, and height are important considerations. In a smaller, more elite group, acoustical placement may serve a stronger purpose.
**Question 2 comments:**

**Answer key:**

A. Acoustically Placed Sections
B. Unorganized Mixed
C. Acoustically Placed Mixed
D. Unorganized Mixed

1. (A) I prefer sections because I didn't know the piece well.
2. (A) It is easier to sing my own part in sections.
3. (A) In a fugue, it is hard to keep good intonation when mixed (45 frantic singers)
4. (A) Sections are best unless singers know the piece very well.
5. (C) I prefer a mixed formation even though it is harder to carry my part.
6. (C) A mixed formation is more difficult, but the blend is better.
7. (C) In a mixed formation I can hear myself better.
8. (D) The unorganized mixed formation forces singers to listen more, thus strengthening the choir.
9. (D) In the unorganized mixed formation, I was in the front row. Because of my large voice, I am usually in the back. Being in the front allowed me to gauge my sound by the choir behind me.

**Question 3 comments:**

1. (C) I like a mixed formation for hearing other parts.
2. (C) I like the acoustically placed mixed formation because I knew this piece better.
3. (C) The key to a good sound is in creating a "ringing" sound. I can do this better when singing by another part.
4. (C) In homophonic music, good intonation is better achieved when surrounded by the other chord parts.
5. (C) I prefer mixed, but I feel like I am sticking out.
6. (C) A mixed arrangement helps develop musicianship.
7. (C) In a mixed formation, everyone has to "pull their own weight".

8. (A) I felt more confident in sections for this large work.

9. (A) Although choosing sections, I preferred listening to the other choir in mixed.

10. (A) For some reason, intonation seemed better in sections.

11. (B) I'm used to an unorganized sectional formation.

Results of the Director Evaluation Survey

Following the experiment, the directors of choir 1 and choir 2 completed a survey to provide their opinion and evaluation of the study. They were asked to comment on the acoustical placement of voices and to give their preference of formation for both experimental pieces (see DES; Appendix B). The results of the survey for each director are summarized below: (The director of choir 1 is referred to as director 1; the director of choir 2 as director 2)

Results of the DES for Director 1

Director 1 felt that the acoustical placement had a more noticeable effect on the mixed formation than on the sectional formation. In general, however, he noticed a bigger difference between the mixed and sectional formations regardless of acoustical placement. Director 1 believed that both mixed formations produced a better overall blend, balance of voice parts, and ensemble, particularly in the homophonie piece. In the polyphonic piece, he thought each section had a better internal ensemble in either of the sectional formations, although overall balance was better in the mixed formations.

This director heard fewer individual voices in the mixed formations, particularly in the acoustical placed mixed, on both the homophonic and polyphonic piece. (This is surprising, in that the presence of noticeable individual voices is often a criticism of mixed formations.) He also believed intonation was better in the mixed formations. However,
he felt that, in the polyphonic piece, rhythmic precision, particularly attacks and released, was better in the sectional formations.

Regarding interpretation, director 1 believed the mixed formations were decidedly better. Dynamics, especially crescendi and decrescendi, were much easier to control. (This evaluation is contrary to the opinion of many proponents of the sectional formation, stating that dynamics are more easily controlled in sections.) He did not, however, notice much difference between the acoustically placed and unorganized forms of the mixed formations. Diction concerns seemed relatively the same in all formations, in the opinion of director 1.

Taking everything into consideration, director 1 preferred the acoustically placed sectional formation for the polyphonic piece because of the good internal (sectional) ensemble in this formation. He notes, however, that balance was not as good in either of the sectional formations because certain parts tended to over-sing. Director 1 definitely preferred the acoustically placed mixed formation for the homophonic piece. Balance, blend, interpretation, and just about every other aspect were noticeably better than in the sectional formations, and slightly better than in the unorganized mixed formation.

**Results of the DES for Director 2**

Director 2 felt that acoustical placement of voices was a logical and important procedure for achieving the maximum blend potential. He viewed acoustical placement as an effective tool in dealing with part balance problems, especially in the mixed arrangement. Director 2 felt that establishing an acoustically placed sectional blend and tone quality in either a sectional or mixed formation should have a positive effect on all musical elements, specifically related to precision. During rehearsal, however, he did not particularly perceive this achievement. He attributes this to the fact that a great amount of
time was given to learning the polyphonic piece, and not enough time for critical observation.

Director 2 explains that because this choir has the most campus-wide appeal and function, he allows a very diverse and broad spectrum of vocal and musical abilities in its membership. For this reason, neither blend nor balance is easily established by selection of singers. He takes the available singers and concentrates on vowel manipulation and singing procedures. Furthermore, he finds it essential to match stronger musicians with weaker ones in order to cover the repertoire requirements. Even with these special concerns, director 2 is much in favor of careful placement of voices. When the choir was singing their best at the experiment, he observed clear gains in the acoustically placed formations.

Director 2 also noted a concern to all during the experiment, that is, the number of trial performances and the length of the experiment. He felt that by the end of the experiment, both choirs were too tired to provide valid examples.

Regarding director 2's preference of formations, he chose the acoustically placed mixed formation for the polyphonic piece. He adds that he would normally have expected the acoustically placed sectional formation to be best for this type of piece, but it did not seem to be the case from his location. For the homophonic piece, director 2 also chose the acoustically placed mixed formation.
CHAPTER V
SUMMARY AND CONCLUSIONS

Purpose of the Study

The purpose of the present study was to investigate the effect of various choral formations on choral sound. The main thrust was to determine if careful placement of voices in their best acoustical position is, indeed, beneficial to the resultant choral sound. Other aspects to the study involved assessment of a mixed versus sectional formation and the possible influence of musical texture.

Procedures

Two intact college choirs were the experimental units used to assess the effect of various choral formations and musical textures (independent variables) on the dependent variables of choral sound. The independent variables were as follows:

(A) Choral Formations Regarding Acoustical Placement of Voices (establishment of these formations is discussed in Chapter III)

(level 1)
Formation in which voices are placed in their best acoustical position in relationship to surrounding voices.

(level 2)
Formation in which voices are unorganized without regard for acoustical placement.

(B) Choral Formations Regarding Voice Part Placement (establishment of these formations is discussed in Chapter III)

(level 1)
Homogeneous grouping of voice parts in sections.

(level 2)
Mixing the voice parts throughout the choir.

133
(C) Musical Texture (represented by the two choral pieces)

(level 1)
Polyphonic; Lobet den Herrn, J. S. Bach

(level 2)
Homophonic; excerpt from Requiem, Verdi

(D) Choir

(level 1)
Choir 1

(level 2)
Choir 2

(E) Judge

(level 1-5)
Judges 1-5

Including the panel of judges as an independent variable proved to be an excellent and insightful method of assessing reliability. As opposed to a single reliability score, this method revealed how the judges' ratings—consistent or inconsistent—entered into the significance of the findings for each variable.

The dependent variables measured with the Choral Sound Inventory developed by the investigator were:

(A) Overall blend

(B) Instances of noticeable individual voices

(C) Balance of voice parts/Intensity

(D) Intonation

(E) Rhythmic precision/Ensemble/Diction

(F) Interpretation/Expressiveness/Dynamic control

The Treatment Choirs

The criteria for selection of the treatment choirs were: (1) Similar size and ability level; (2) Reputable choral program; (3) Reasonable proximity to the investigator;
(4) Time for the project and coordination of schedules. The choirs and directors chosen
were The Ohio Wesleyan University Choral Art Society, Robert Nims, Director,
Delaware, Ohio; and The Otterbein College Concert Choir, Craig Johnson, Director,
Westerville, Ohio.

The Choral Pieces

The only criterion for the selection of the choral pieces was that they meet the
requirements for the independent variable of texture—one polyphonic and one
homophonic. The polyphonic piece chosen was the concluding "Alleluia" section of
piece chosen is from the final section, "Libera me", of Requiem by Verdi (pp. 182-185),
G. Schirmer edition.

The Panel of Judges

A minimum of five sets of ratings was recommended for proper statistical
analysis. Upon recommendations by the choral experts on the investigator's committee,
five judges were chosen for their reputation as outstanding choral directors, their fine
choral ear, and their experience with judging choral ensembles. The judges selected were
Lloyd Kaufmann, Rosedale Bible Institute, Irwin, Ohio; Joyce Stonebraker, Westerville
North High School, Westerville, Ohio; Joe Thrower, Reynoldsburg High School,
Reynoldsburg, Ohio; Mark Hutsko, Worthington High School, Worthington, Ohio; and
Cindy Brewer, Dublin High School, Dublin, Ohio.

Instruments of Evaluation

The judges rated the choirs on the Choral Sound Inventory (CSI) developed by
the investigator. The criteria for its construction were that it thoroughly measure the
dependent variables and be concise and efficient for the many performance trials being
rated. A Likert-type scale of 1 to 5, with 5 indicating strong agreement, was the method of response. (The Choral Sound Inventory is presented in Appendix B)

The literature suggests that the attitudes and morale of choir members, as well as their satisfaction with their placement in a formation, affects the choral sound produced. Purely as a descriptive assessment, the Singer Evaluation Survey (SES) was administered to the participating choir members. (The Singer Evaluation Survey is presented in Appendix B)

Because of the choir directors' significant involvement and their familiarity with their respective choir, their evaluation of the study was insightful. A more subjective, expository instrument, the Director Evaluation Survey (DES), was completed by Professor Johnson and Professor Nims. (The Director Evaluation Survey is presented in Appendix B).

The Site for the Experiment

The site for the actual experiment was mutually agreed upon by the investigator and the participating directors to be the concert hall in the Battelle Fine Arts Center at Otterbein College, Westerville, Ohio.

The Experiment/Collection of Data

The experiment took place on April 30, 1990 from 4:00-6:00 p.m. at the Battelle Fine Arts Center, Otterbein College, Westerville, Ohio. The parties involved were the investigator, the two choirs and directors, the five judges, and a tape recording technician. All performance trials were tape recorded only for reference, and not for analysis.

A computer-generated random ordering of 32 integers was applied to the choirs, musical pieces, and choral formations. The resulting random order used for the experiment is presented in Appendix C.
The judges were seated in the balcony with a visual shield directly in front of them. This method of visual screening posed no threat of distorting the choral sound. The judges rated each performance trial on the Choral Sound Inventory. The data collected were subjected to a five factor, full factorial analysis of variance and, for some data, a paired observation t test, using the SAS statistical package at The Ohio State University.

Results

In the first part of this section, results and discussion will be presented regarding the effect of the independent variables on each dependent variable. The next section will present the results of the tests for the null hypotheses. Following this analysis will be a summary and discussion of the singer and director evaluation survey results.

Analysis and Discussion of the Effect of Independent Variables

On Each Dependent Variable

To assess the effect of the independent variables on choral sound it is necessary to look at the effects on each dependent variable individually. A synthesis of effects, including consideration of unique characteristics of this study, will allow readers to determine the relevance of these findings to their own choral situation.

Overall Blend

Probably the single most important factor regarding the judgement of choral sound is blend. Even with this being the case, the term blend may not mean the same thing to everyone. As stated in Chapter II, there are two primary approaches to the concept of choral blend. The first approach recognizes individual voice differences as assets to blend. The second approach proposes that singers must manipulate their technique and tone to achieve a similar color, thus, creating blend. Many choral directors find
themselves embracing both a freedom of vocal production while striving for a certain degree of homogeneity. In this study, overall blend was effected by the independent variables as follows.

Table 1 and Figure 47 indicate a significant main effect of acoustical/unorganized placement of voices favoring acoustical placement over unorganized placement. This finding is enlightened by the interaction of acoustical/unorganized placement with musical texture (piece) shown in Table 6 and Figure 49. The data reveal that it was the homophonic piece (Verdi) that benefited significantly from the acoustical placement, whereas the polyphonic piece (Bach) only slightly improved. One could speculate, then, that musical texture might be one determining factor regarding a decision to acoustically place singers for the achievement of overall blend. However, it could also have been other piece characteristics (e.g. tempo) that contributed to the effectiveness of the acoustical placement. Since a choir will perform pieces of both textures, this finding supports the concept that acoustical placement of voices can only be beneficial for overall blend.

Table 2 and Figure 48 indicate a significant main effect of voice part placement favoring a sectional formation over a mixed formation. Insight into this main effect can be seen in the interaction of voice part placement (mixed/sections) with the judge variable. Table 7 and Figure 50 point out that the strong preference for the sectional formation by judges 1 and 2, compared to the fairly static ratings of the other judges, is the reason for the main effect. This preference of a sectional formation for overall blend refutes some opinion in the literature that overall blend is better rendered in a mixed formation, especially for singers with moderate to high vocal ability, and when the music is familiar.
According to the data in Tables 3, 4, and 5, there was no significant main effect of the independent variables of texture (piece), choir, or judge on the dependent variable of overall blend.

**Instances of Noticeable Individual Voices**

For the dependent variable of instances of noticeable individual voices, Table 8 indicates no significant main effect of acoustical/unorganized placement of voices, although the data approach significance favoring acoustical placement. Table 9 and figure 51 indicate a significant main effect of voice part placement favoring a sectional formation over a mixed formation. Critics of the mixed formation would agree with this finding, citing noticeable individual voices as a common problem with a mixed formation.

Tables 10, 11, and 12 indicate no significant main effect for the independent variables of musical texture (piece), choir, and judge on this dependent variable.

**Overall Balance of Voice Parts/Intensity**

In this study overall balance of voice parts/intensity refers to the relative levels of loudness among voice parts appropriate to a particular style. Tables 13-17 indicate no significant main effect of any of the independent variables on overall balance/intensity. Table 18 and Figure 52 indicate a significant interaction of the independent variables of judge and choir. The data reveal that the strong preference for Choir 2 by judges 3 and 4 are inconsistent with the other three judges' static ratings and even reversed preference for Choir 1.

**Intonation**

For the dependent variable of intonation, Table 19 and Figure 53 indicate a significant main effect favoring acoustical placement of voices over an unorganized
placement. Proponents of acoustical placement would concur that intonation is certainly improved when attention is given to compatibility of voice types.

Table 20 indicates no significant main effect of voice part placement (mixed/sections). A lack of a consistent preference can also be seen in the interaction data (Table 24 and Figure 56).

Table 21 and Figure 54 indicate a significant main effect of musical texture (piece) favoring the polyphonic piece (Bach) over the homophonic piece (Verdi). Overall, the intonation was better for the polyphonic piece, but an interesting, significant three-way interaction occurred with the independent variables of choir, voice part placement (mixed/sections), and musical texture (piece). Table 24 and Figure 56 show that, for Choir 1, the polyphonic piece (Bach) scored a higher intonation rating in a sectional formation than in a mixed formation; the homophonic piece (Verdi) scored a higher intonation rating in a mixed formation than in a sectional formation. For Choir 2, the direction was reversed. The polyphonic piece (Bach) scored a higher rating in a mixed formation than in a sectional formation; the homophonic piece (Verdi) scored a higher rating in a sectional formation than in a mixed formation. It is apparent that for the dependent variable of intonation, the relatedness of voice part placement (mixed/sections) and musical texture (piece) is inconclusive. One can speculate that the differences in the choirs (voice types, numbers on each part, etc.) affected the disparity in ratings.

Table 22 and Figure 55 show a significant main effect of the choir variable favoring Choir 2 over Choir 1 for the dependent variable of intonation. So regardless of the disparity of direction seen in the above interaction, the overall average intonation score is significantly higher for Choir 2. Table 23 reveals no significant main effect for the independent variable of judge for intonation.
**Rhythmic Precision/Ensemble/Diction**

Rhythmic precision is defined well by Triplett (1971/1972) as "exactness in the treatment of various aspects of choral music as it proceeds in time" (p. 8). Some directors contend that choral blend cannot be achieved without good precision. Others consider rhythmic unity as a requirement of good ensemble performance associated more with diction than blend. Regardless of how it is addressed, rhythmic precision/ensemble/diction is an important aspect of choral sound. It was effected by the independent variables as follows.

Table 25 and Figure 57 indicate a significant main effect favoring acoustical placement of voices over unorganized placement. Proponents of acoustical placement of voices would agree that voice compatibility not only benefits the quality of choral tone, but also the natural rhythmic flow of the music.

Table 26 shows no significant main effect of voice part placement (mixed/sections) for this variable. This might surprise some choral experts who feel that rhythmic unity is better achieved in a sectional formation, especially with polyphonic music. Table 27 indicates no significant main effect of musical texture (piece).

Table 28 and Figure 58 show a significant main effect of the choir variable favoring Choir 2 over Choir 1 for rhythmic precision/ensemble/diction. Table 29 and Figure 59 indicate a significant main effect of the judge variable. This is due to the low rating of judge 1 and the high rating of judge 2 compared to the static ratings of the other judges.

**Interpretation/Expressiveness/Dynamic Control**

This dependent variable is probably the most subjective of all. This was evidenced in the resulting data. Table 30 indicates no significant main effect of
acoustical/unorganized placement of voices, although the data approach significance favoring acoustical placement. The significant interaction of acoustical/unorganized placement with musical texture (piece) shown in Table 36 and Figure 63 is almost identical to the interaction of these same two variables for overall blend. The homophonic piece (Verdi) benefited substantially from the acoustical placement, whereas the polyphonic piece (Bach) improved only slightly.

Table 31 shows no main effect for voice part placement (mixed/sections). This refutes some opinion in the literature that reports interpretation, expressiveness, and dynamics to be under greater control in a sectional formation.

Table 32 indicates no significant main effect of musical texture (piece). It is not really expected that one texture would be more expressive than another. It is interesting to note the judge differences concerning texture with the significant interaction in Table 35 and Figure 62. Judges 1 and 5 preferred the polyphonic piece (Bach), while judges 3, 4, and especially judge 2, preferred the homophonic piece (Verdi) for interpretation/expressiveness/dynamic control.

Choir 2 was the overwhelming favorite for this variable as seen with the significant main effect of choir in Table 33 and Figure 60. Table 34 and Figure 61 indicate a significant main effect for the judge variable, due primarily to the low score of judge 1.
Results of Hypotheses Testing

Null and Alternate Hypotheses 1 and 2

Null Hypothesis 1

In a sectional formation, there is no significant difference in CSI ratings when voices are acoustically placed than with an unorganized placement—regardless of texture for the following dependent variables:

A. Overall blend
B. Instances of noticeable individual voices
C. Overall balance of voice parts/Intensity
D. Intonation
E. Rhythmic precision/Ensemble/Diction
F. Interpretation/Expressiveness/Dynamic control

Alternate Hypothesis 1

In a sectional formation, CSI ratings are significantly higher when voices are acoustically placed than with an unorganized placement—regardless of texture for the following dependent variables:

A. Overall blend
B. Instances of noticeable individual voices
C. Overall balance of voice parts/Intensity
D. Intonation
E. Rhythmic precision/Ensemble/Diction
F. Interpretation/Expressiveness/Dynamic control

Null Hypothesis 2

In a mixed formation, there is no significant difference in CSI ratings when voices are acoustically placed than with an unorganized placement—regardless of texture for the following dependent variables:

A. Overall blend
B. Instances of noticeable individual voices
C. Overall balance of voice parts/Intensity
D. Intonation
E. Rhythmic precision/Ensemble/Diction
F. Interpretation/Expressiveness/Dynamic control
Alternate Hypothesis 2

In a mixed formation, CSI ratings are significantly higher when voices are acoustically placed than with an unorganized placement—regardless of texture for the following dependent variables:

A. Overall blend
B. Instances of noticeable individual voices
C. Overall balance of voice parts/Intensity
D. Intonation
E. Rhythmic precision/Ensemble/Diction
F. Interpretation/Expressiveness/Dynamic control

Results of the test for null hypotheses 1 and 2

When the analysis of variance presents a significant main effect of acoustical/unorganized placement of voices, the effect is for both mixed and sectional formations, thus, causing a rejection of null hypotheses 1 and 2 for a particular dependent variable. If the main effect favors acoustical placement of voices over unorganized placement, alternate hypotheses 1 and 2 are accepted for this variable.

Null hypotheses 1 and 2 are rejected at the .05 level, and alternate hypotheses 1 and 2 are accepted for the following dependent variables:

Overall Blend ($P = 0.0267$)
Intonation ($P = 0.0302$)
Rhythmic precision/Ensemble/Diction ($P = 0.0013$)

The data indicate a failure to reject null hypotheses 1 and 2, therefore, rejecting alternate hypotheses 1 and 2 for the following dependent variables:

Instances of Noticeable Voices ($P = 0.0741$)
Interpretation/Expressiveness/Dynamic Control ($P = 0.0820$)
Overall Balance of Voice Parts/Intensity ($P = 0.2927$)
Null and Alternate Hypotheses 3 and 4

Null Hypothesis 3

For polyphonic music, there is no significant difference in CSI ratings when voice parts are arranged in a sectional formation than when voice parts are arranged in a mixed formation—regardless of acoustical/unorganized placement of voices for the following dependent variables:
A. Overall blend
B. Instances of noticeable individual voices
C. Overall balance of voice parts/Intensity
D. Intonation
E. Rhythmic precision/Ensemble/Diction
F. Interpretation/Expressiveness/Dynamic control

Alternate Hypothesis 3

For polyphonic music, CSI ratings are significantly higher when voice parts are arranged in a sectional formation than when voice parts are arranged in a mixed formation—regardless of acoustical/unorganized placement of voices for the following dependent variables:
A. Overall blend
B. Instances of noticeable individual voices
C. Overall balance of voice parts/Intensity
D. Intonation
E. Rhythmic precision/Ensemble/Diction
F. Interpretation/Expressiveness/Dynamic control

Null Hypothesis 4

For homophonic music, there is no significant difference in CSI ratings when voice parts are arranged in a mixed formation than when voice parts are arranged in a sectional formation—regardless of acoustical/unorganized placement of voices for the following dependent variables:
A. Overall blend
B. Instances of noticeable individual voices
C. Overall balance of voice parts/Intensity
D. Intonation
E. Rhythmic precision/Ensemble/Diction
F. Interpretation/Expressiveness/Dynamic control
Alternate Hypothesis 4

For **homophonic** music, CSI ratings are significantly higher when voice parts are arranged in a mixed formation than when voice parts are arranged in a sectional formation—regardless of acoustical/unorganized placement of voices for the following dependent variables:

- A. Overall blend
- B. Instances of noticeable individual voices
- C. Overall balance of voice parts/Intensity
- D. Intonation
- E. Rhythmic precision/Ensemble/Diction
- F. Interpretation/Expressiveness/Dynamic control

Results for testing null hypotheses 3 and 4 as interacting hypotheses

There is some opinion in the literature regarding the relationship of voice part placement (mixed versus sections) with musical texture. Many choral experts are of the opinion that polyphonic music is better rendered in a sectional formation for better clarity of musical line. And, for homophonic music, overall sound and blend is better achieved in a mixed formation. For this to be found true in this study, a significant interaction must be present between voice part placement (mixed/sections) and musical texture (piece) favoring the direction indicated in alternate hypotheses 3 and 4—which would also reject null hypotheses 3 and 4.

The only relevant finding in this regard is for the dependent variable of intonation, but is confounded in a three-way interaction including the choir variable. Table 24 and Figure 56 indicate that, for Choir 1, the polyphonic piece (Bach) scored a higher intonation rating in a sectional formation than in a mixed formation; the homophonic piece (Verdi) scored a higher intonation rating in a mixed formation than in a sectional formation. For this choir, it looks as if null hypotheses 3 and 4 can be rejected for the dependent variable of intonation in the expected direction of alternate hypotheses 3 and 4;
however, statistical significance cannot be substantiated because of the confounding third variable (choir) in the interaction.

The confounding issue is that, for Choir 2, the results were reversed—that is, the polyphonic piece (Bach) scored higher in a mixed formation than in a sectional formation; the homophonic piece (Verdi) scored higher in a sectional formation than in a mixed formation. Not only was the direction reversed, but the mean differences were greater. For Choir 2, then, the data also appear to support a rejection of null hypotheses 3 and 4 for the dependent variable of intonation, but in the reverse direction of the expected alternate hypotheses. Again, statistical significance cannot be substantiated because of the three-way interaction. This interaction raises questions as to the effect of choir differences (e.g. voice types, numbers of voices on each part) on the decision of the proper formation in regard to musical texture for the dependent variable of intonation.

For all other dependent variables, no significant interactions were found with musical texture (piece) and voice part placement (mixed/sections)—therefore failing to reject null hypotheses 3 and 4 for these variables.

**Results for null hypotheses 3 and 4 tested separately**

When testing hypotheses 3 and 4 separately, other data become useful in determining the decision to reject or fail to reject the hypotheses for each dependent variable. When the ANOVA results present a significant main effect for voice part placement (mixed/section), the main effect does not discriminate between homophonic (Verdi) and polyphonic (Bach) textures. When these main effects occurred, a t test was run on the mean differences of the mixed and section ratings for each texture (piece) separately. The combined data present a picture enabling the investigator to reject or fail to reject hypotheses 3 and 4 for each dependent variable.
**Overall blend**

For overall blend, there was a significant main effect of voice part placement favoring a sectional formation for both musical textures. A paired observation t-test produced the following results:

<table>
<thead>
<tr>
<th>Musical Texture</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyphonic texture</td>
<td>Fail to reject null hypothesis 3 ( (P = .1567; \text{see Table 37}) )</td>
</tr>
<tr>
<td>Homophonic texture</td>
<td>Reject null hypothesis 4 in the reverse direction of alternate hypothesis 4 ( (P = .0219; \text{see Table 37}) )</td>
</tr>
</tbody>
</table>

**Instances of noticeable individual voices**

For instances of noticeable individual voices, there was a significant main effect of voice part placement favoring a sectional formation for both musical textures. A paired observation t-test produced the following results:

<table>
<thead>
<tr>
<th>Musical Texture</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyphonic texture</td>
<td>Fail to reject null hypothesis 3 ( (P = .1378; \text{see Table 38}) )</td>
</tr>
<tr>
<td>Homophonic texture</td>
<td>Reject null hypothesis 4 in the reverse direction of alternate hypothesis 4 ( (P = .0328; \text{see Table 38}) )</td>
</tr>
</tbody>
</table>

**Overall balance of voice parts/intensity**

ANOVA results produced no significant main effect of voice part placement (mixed/sections)

<table>
<thead>
<tr>
<th>Musical Texture</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyphonic texture</td>
<td>Fail to reject null hypothesis 3</td>
</tr>
<tr>
<td>Homophonic texture</td>
<td>Fail to reject null hypothesis 4</td>
</tr>
</tbody>
</table>
**Intonation**

ANOVA results produced no significant main effect of voice part placement (mixed/sections)

Polyphonic texture Fail to reject null hypothesis 3
Homophonic texture Fail to reject null hypothesis 4

**Rhythmic precision/ensemble/diction**

ANOVA results produced no significant main effect of voice part placement (mixed/sections)

Polyphonic texture Fail to reject null hypothesis 3
Homophonic texture Fail to reject null hypothesis 4

**Interpretation/expressiveness/dynamic control**

ANOVA results produced no significant main effect of voice part placement (mixed/sections)

Polyphonic texture Fail to reject null hypothesis 3
Homophonic texture Fail to reject null hypothesis 4

**Summary of the Results of the Singer Evaluation Survey and the Director Evaluation Survey**

The experimenter felt it was important to solicit the choral singers' reactions to the benefits of the acoustical placement they experienced in this investigation. Other Choral experts agree that the singers' attitudes are vital in the overall process of producing good choral sound. Triplett (1971/1972) states, "Precise choral performance is impossible to achieve unless choir members feel a strong allegiance to the group and a sense of unity within the chorus" (p. 156). Draper (1972) also places a degree of responsibility for choral sound on the emotional state of the singer. Although some problems are physical
and mechanistic (which need to be addressed), these problems must be dominated by the emotional state. He refers to this inner quality when he exclaims, "It is only when the fire of determination has been kindled, when a feeling of elation takes hold, and the heart fills up with joy that things begin to happen" (p. 13).

The point is that the singers need to feel good about themselves and the sound they are producing individually and as a choir. How singers feel about their surrounding partners is a question posed by this study. The evaluation survey revealed that 100% of the respondents believed their was some or much value in acoustically placing voices for proper compatibility. They indicated a marked preference for acoustically placed formations for both the polyphonic and homophonic pieces. (see chapter IV for data and singers' comments)

The director evaluation survey revealed that the directors also saw value in the acoustical placement process, although not as overwhelming as the singers' responses. Director 1 preferred the acoustically placed sectional formation for the polyphonic piece because of the good internal (sectional) ensemble in this formation. He notes, however, that balance was not as good in either of the sectional formations because certain parts tended to over-sing. Director 1 definitely preferred the acoustically placed mixed formation for the homophonic piece. Balance, blend, interpretation, and just about every other aspect were noticeably better than in the sectional formations, and slightly better than in the unorganized mixed formation.

Director 2 preferred the acoustically placed mixed formation for the polyphonic piece. He adds that he would normally have expected the acoustically placed sectional formation to be best for this type of piece, but it did not seem to be the case from his location. For the homophonic piece, director 2 also chose the acoustically placed mixed formation.
Conclusions

The results of this study substantiated by statistical significance lead to the following conclusions:

Acoustical placement of voices is beneficial to the achievement of overall blend, particularly for homophonic texture. Although confounded by judge inconsistency, a sectional formation is superior to a mixed formation for the achievement of overall blend.

A sectional formation is superior to a mixed formation for reducing the instances of noticeable individual voices. Overall balance of voice parts is colored by characteristics of the choir, as indicated in this study by an interaction of the judge and choir variables.

Acoustical placement of voices significantly benefits choral intonation. In this investigation, overall choral intonation was better for the polyphonic piece than for the homophonic piece. However, the significant interaction of texture with voice part placement and with choir allows the investigator only to conclude that differences in choir characteristics apparently affect the relatedness of musical texture and voice part placement regarding choral intonation.

Acoustical placement of voices significantly benefits the rhythmic precision/ensemble/diction aspect of choral performance. One can also conclude that differences in choir characteristics impacts upon this performance aspect, indicated by the main effect of the choir variable. The significant effect of the judge variable leads to the conclusion that rhythmic precision/ensemble/diction is difficult to assess.

Regarding interpretation/expressiveness/dynamic control, it appears that a homophonic texture benefits significantly more from acoustical placement of voices than polyphonic texture. The interaction of the judge and texture variables leads to the conclusion that the relatedness of musical texture to the performance aspect of interpretation/expressiveness/dynamic control is perceived differently even by experts.
From the significant main effect of the choir variable, one can make the obvious conclusion that one choir, due to its unique characteristics and leadership, can perform more expressively than another. It may also be concluded that the assessment of interpretation/expressiveness/dynamic control is subject to inconsistency, as seen in the main effect of the judge variable.

Conclusions regarding the hypotheses for this investigation are presented as follows:

The acoustical placement of voices for compatibility of singers benefits every variable of choral sound tested in this study, regardless of whether the singers are placed in a sectional or mixed formation. The areas of choral sound that benefit the most from acoustical placement are overall blend, intonation, and rhythmic precision/ensemble/diction.

Concerning the relatedness of voice part placement to musical texture, it can be concluded that a sectional formation is more effective for both polyphonic and homophonic textures for variables of overall blend and instances of noticeable individual voices. Regarding intonation, it appears that differences in choir characteristics affect whether choral intonation is better rendered in a sectional or mixed formation. No other conclusions can be reached regarding the choice of a sectional or mixed formation. One may infer, however, by the shortage of significant preferences, that the choice of a sectional or mixed formation is not as important to choral sound as some may have thought. And also, that a mixed formation appears to show very little advantage at all.
Discussion and Implications

The primary question of this study regarded the effect of carefully placing singers in their best acoustical and compatible positions with surrounding voices on the resultant choral sound. The method by which this placement was accomplished is discussed in Chapter III.

In this study, there was improvement for every dependent variable when voices were acoustically placed as opposed to an unorganized placement. The improvement was statistically significant at the .05 level for the dependent variables of overall blend, intonation, and rhythmic precision/ensemble/diction. The data approached statistical significance favoring acoustical placement for the dependent variables of instances of noticeable individual voices (.0741), and for interpretation/expressiveness/dynamic control (.0820). The dependent variable least effected was overall balance of voice parts/intensity (.2927), but with also a mean difference favoring acoustical placement. For this variable the judges were listening for relative levels of loudness of voice parts. Apparently the acoustical placement of voices did not significantly aid in the achievement of an appropriate balance.

Both interactions involving acoustical/unorganized placement of voices were with the independent variable of musical texture (piece). For both overall blend and interpretation/expressiveness/dynamic control, the homophonic piece (Verdi) benefited significantly more from acoustical placement than the polyphonic piece (Bach).

When considering all factors, it is clearly evident by the results of this study that careful placement of voices in their best acoustical and compatible positions significantly benefits the achievement of good choral sound. To ignore these benefits would be as irresponsible as dismissing any other accepted tool for achieving good choral sound.
The investigator acknowledges that certain practical considerations (e.g., reading ability, height, personality) sometimes play a role in determining an appropriate formation. But ultimately it is the choral sound and how it communicates that supersedes all other criteria. This study indisputably reveals the positive effect of acoustically placing voices.

Implications derived from this study are seminal to the choral art. Although generalizability of these findings must be approached with care, the significance of the concept of acoustical placement of voices is applicable to all choral ensembles beyond the voice change period.

The benefits are clear. The practical implication is that choral directors must appropriate the time necessary to place the voices. The placement takes approximately one hour for each section. If the choir is auditioned, careful notes during the voice assessment (e.g., size of voice, vibrato, unique qualities) will save time when working with the entire section.

Another practical implication is that many choral directors feel they lack the skill and ear necessary to implement a method of acoustical placement. The writer suggests that these directors simply take the time to study the techniques in this document and others (see list of references), then approach the task realizing that much learning takes place in the process. It is surprising and encouraging to notice the input of the singers as the process unfolds.

This inexperience of choral directors points to another critical implication for the teachers of choral conductors. Although the subject of formations is addressed briefly in many choral methods texts, the importance of voice compatibility and careful placement is often neglected. This writer encourages teachers of college choral conducting courses to provide students with practical, hands-on experience with these techniques.
The whole issue of sectional versus mixed formations was addressed in this investigation, resulting with some unexpected findings. The data indicate a significant preference for a sectional formation, regardless of texture, for overall blend and for the control of noticeable individual voices. The finding for overall blend refutes some opinion in the literature suggesting that blend is better achieved in a mixed formation. The other finding does support opinion of many experts, that is, that noticeable individual voices is less of a problem in a sectional formation.

It is interesting to note that, in this investigation, the mixed formation offered very little advantage. Although the directors and many of the singers indicated a preference for the mixed formation, the resulting sound revealed that the mixed formation either presented no advantage or proved to be inferior to the sectional formation.

An opinion that has surfaced from surveys of students and directors is that the mixed formation yields substantial benefits for blend when singers are secure on their parts. An initial, above average level of musical ability is also a helpful attribute when using a mixed formation. However, when the musicianship level is not high, a mixed formation is generally viewed as a technique for improving it. These factors may, indeed, be valid, but the evidence from this study indicates that, for the sound of the final performance, the choice of either a sectional or a mixed formation is not as important as one might think; but that a sectional formation may provide a better overall blend.

One could continue to cite complexities and diverse criteria for selecting the appropriate choral formation. One cannot escape, nor would it be desirable to, the subjectivity of the choral art that prohibits the arrival at a perfect, single, best method of placing choral singers in a formation. Again, this study has proven the legitimacy and positive outcome of acoustical placement of voices. This valuable tool cannot be ignored.
in the process of achieving the primary objective of choral performance, that is, effective communication through the choral medium.

**Recommendations for Further Research**

The writer first encourages research in any area of choral performance, and not to allow the inherent subjectivity to limit investigations that will strengthen the choral art. Regarding the topic of acoustical placement in choral formations, the writer suggests further research for all types of choirs at all age levels beyond the voice change period. Controlled experiments can be undertaken on a smaller scale that would significantly augment this area of study. For instance, working with one choir rather than two, with fewer trial performances, would streamline the experiment and reduce fatigue of the singers and directors. In fact, working with one’s own choir would allow scheduling flexibility, and permit finer adjustments of the formations. Familiarity with voices, personalities, and musical abilities would also be helpful. Working with varied textures is recommended, but tempi and dynamic variations might also prove to be significant.

The three-way interaction of voice part placement (mixed/sections), musical texture (piece), and choir for the dependent variable of intonation (see Table 24 and Figure 56) presents a question that could be clarified by further research. One could set out to determine what choir characteristics (e.g., voice qualities, director’s techniques, vocalises, etc.) might cause the disparity of intonation ratings in regard to the relationship of musical texture and voice part placement.

For the dependent variable of overall blend and interpretation/expressiveness/dynamic control, this study showed that the homophonic piece benefited significantly more from acoustical placement than the polyphonic piece. Further research using different pieces would substantiate or reject this pattern.
Continued investigation into the benefits of sectional versus mixed formations is also recommended, including varied methods of creating mixed formations.
LIST OF REFERENCES


Scott, D. W. (1960). A study of the effect of changes of vocal intensity upon the
harmonic structures of selected singing tones produced by female singers. 
*Dissertation Abstracts, 21,* 1964-1965. (University Microfilms No. 60-05325)

Iowa City, IA: Iowa University Press.


slow-wave V potential. *Journal of the acoustical Society of America,* August,
557.


*Choral Journal, 16*(2), 9-11.


Trevor, B. W. (1977). The influence of vibrato upon vocal blend (Doctoral
International, 38,* 3136A.

training choral conductors (Doctoral dissertation, University of Southern

Publishing.

56-57.


1950), 22.


*Choral Journal, 8*(1), 15-18.

APPENDIX A

INVESTIGATOR'S QUESTIONNAIRE RESULTS
Results of the Investigator's Questionnaire

1. Question number one identified 32 respondents who represented 61 high school, college, church, and community choir directorships.
2. When determining your choir formation, to what extent are you concerned with acoustical properties of individual voices and/or combinations of particular voice qualities?
   93.8% response
   A scale of 1 (little concern) to 5 (great concern) yielded 4.03
3. On a scale of 1 (unimportant) to 5 (very important), rate the importance of the following factors in positioning singers:
   A. Intensity or size of voice; 100% response; 4.38
   B. Vibrato characteristics; 100% response; 3.91
   C. Vocal technique; 100% response; 3.59
   D. Reading ability; 100% response; 3.47
   E. Physical height; 100% response; 2.63
   F. Voice compatibility with neighbor; 100% response; 4.19
   G. Personality compatibility with with neighbor; 100% response; 2.52
4. Please discuss the process, if any, you use in positioning the individual singers in your choir. (Several responses are summarized below):
   A. Weston Noble experimentation. It often will change during the course of repertoire/concert preparation.
   B. Weak singers and poor readers are placed between better, more experienced singers.
C. Hear each singer individually and make notes pertaining to categories in question #3.

D. Yearly auditions determine select group positions. In volunteer groups an annual interview is held to assess vocal quality.

E. Front row: A balanced group as if they were the only ones singing (sometimes tenor and bass not in the front row). Second row: Good readers, stronger (but not strongest) voices. Third and fourth rows: Among other things, used to bury overly strong and unblending voices.

F. Based on their audition, develop a tentative seating plan which is revised, as needed, during the first rehearsal. Minor adjustments are made throughout the semester as necessitated by vocal development. By the end of the year, at least two formations (one block, one mixed) are established.

G. Strong singers and leaders behind and surrounding those that need leading.

H. The initial process is done at the time of auditions when singers are placed according to reading and technical abilities. Later, after they have had time to settle, each section is adjusted separately until the desired effect is heard.

I. Recently have begun focusing the most talented in the center of each section. Spreading them around in pockets proved inconsequential.

J. Large voices are usually placed in the back rows in the center.
5. Regarding the individual's responsibility to choral blend, to which of the following philosophies do you most closely agree?

100% response

A. An individual singer must manipulate his/her technique to achieve choral blend; 34.4%
B. An individual singer must sing freely and naturally, using his/her best technique; with proper placement of the voice in a formation, choral blend is achieved; 56.3%
C. No opinion; 6.3%
D. One respondent chose both philosophies; 3.1%

6. Regarding physical space between singers, to which basic philosophy do you adhere?

100% response

A. Singers positioned close together; 43.8%
B. Singers some distance apart; 34.4%
C. No opinion; 18.8%

One respondent answered, "It depends"; 3.1%

7. Without addressing the many variations of the following plans, which basic formation do you consider most effective for achieving the best overall choral sound the majority of the time?

100% response

A. Some type of mixed, quartet or scrambled formation; 50%
B. Sectional or block formation; 50%
C. No opinion; 0%
8. Give the approximate percentage of time you use these basic formations in performance:

100% response

A. Sectional or block formation
   
   Mean; 77.4%
   
   Range; 10%--100%
   
   Median; 90% and 100% (five responses each)

B. Some type of mixed, quartet or scrambled formation
   
   Mean; 22.6%
   
   Range; 0%--90%
   
   Median; 10% and 0% (five responses each)

9. Give the approximate percentage of time you use these basic formations in rehearsal:

100% response

A. Sectional or block formation

   Mean; 82.8%
   
   Range; 20%--100%
   
   Median; 80%

B. Some type of mixed, quartet or scrambled formation

   Mean; 17.2%
   
   Range; 0%--80%
   
   Median; 20%
For each of the following variables (questions 10-17), which type of formation do you favor?

10. Highly contrapuntal literature
   A. Sectional formation; 81.3%
   B. Mixed formation; 3.1%
   No bearing; 15.6%

11. Predominantly homophonic literature
   A. Sectional formation; 25%
   B. Mixed formation; 53.1%
   No bearing; 21.9%

12. Much acoustical reverberation in your rehearsal and/or performance hall (very live)
   A. Sectional formation; 43.8%
   B. Mixed formation; 25%
   No bearing; 31.3%

13. Little acoustical reverberation in your rehearsal and/or performance hall (dead)
   A. Sectional formation; 34.4%
   B. Mixed formation; 37.5%
   No bearing; 28.1%

14. Moderate to high vocal ability and independence of singers
   A. Sectional formation; 6.2%
   B. Mixed formation; 75%
   No bearing; 18.8%
15. Lower vocal ability level and little independence of singers
   A. Sectional formation; 93.8%
   B. Mixed formation; 0%
   No bearing; 6.2%

16. Moderate to large ensemble
   A. Sectional formation; 53.1%
   B. Mixed formation; 31.3%
   No bearing; 15.6%

17. Small chamber ensemble
   A. Sectional formation; 15.6%
   B. Mixed formation; 65.6%
   No bearing; 18.8%

18. In your experience, improved intonation can be achieved with which type of formation?
   100% response
   A. Sectional formation; 9.4%
   B. Mixed formation; 62.5%
   C. No opinion; 28.1%
19. Which type of formation is preferred by your choir members?

100% response
A. Sectional formation; 53.1%
B. Mixed formation; 21.9%
C. No opinion; 12.5%
Equal; 6.3%
For rehearsal--Sectional; For concert--Mixed; 3.1%
Less advanced--Sectional; More advanced; Mixed; 3.1%

20. Music is most quickly learned in which type of formation?

100% response
A. Sectional formation; 93.8%
B. Mixed formation; 0%
C. No opinion; 6.2%

21. The musical growth of the singers is better served by which type of formation?

100% response
A. Sectional formation; 6.2%
B. Mixed formation; 71.9%
C. No opinion; 18.8%
Solely dependent on the stage of development; 3.1%

22. To what extent are you concerned with visual aspects of your formation? (e.g. singers' heights, symmetry)?

96.9% response
A scale of 1 (little concern) to 5 (great concern) yielded 2.94
23. Some feel that communication is aided, from both the singers' and listeners' view, by relating the placement of voices or parts to the musical style. Is this a consideration for you?

96.9% response

A scale of 1 (little consideration) to 5 (great consideration) yielded 2.78
APPENDIX B

INSTRUMENTS OF EVALUATION
CHORAL SOUND INVENTORY

Judge # ______

Trial # ______

1. Overall blend:
   poor -- 1  2  3  4  5 -- excellent

2. Instances of noticeable individual voices: (apart from overall blend)
   frequent -- 1  2  3  4  5 -- infrequent

3. Overall balance of voice parts/Intensity
   poorly balanced; -- 1  2  3  4  5 -- well balanced;
   inappropriate for piece appropriate for piece

4. Intonation:
   poor -- 1  2  3  4  5 -- excellent

5. Rhythmic precision/Ensemble/Diction:
   poor -- 1  2  3  4  5 -- excellent

6. Interpretation/Expressiveness/Dynamic control:
   poor -- 1  2  3  4  5 -- excellent
SINGER EVALUATION SURVEY

1. What value do you see in acoustically placing voices to achieve compatibility with surrounding singers? (circle one)

   No value  Some value  Much value

Comments:

2. For the polyphonic selection (Bach), which formation did you prefer?

   A. _____ Acoustically placed sections
   B. _____ Unorganized sections
   C. _____ Acoustically placed mixed (assigned by the experimenter)
   D. _____ Unorganized mixed

Comments:

3. For the homophonic selection (Verdi), which formation did you prefer?

   A. _____ Acoustically placed sections
   B. _____ Unorganized sections
   C. _____ Acoustically placed mixed (assigned by the experimenter)
   D. _____ Unorganized mixed

Comments:
DIRECTOR EVALUATION SURVEY

1. Please provide your reaction to the process and results of the acoustical placement of voices in your choir to achieve compatibility with surrounding singers. In your response, consider the effect of the placements on these variables:

   Overall blend
   noticeable individual voices
   Overall balance of voice parts
   Intonation
   Rhythmic precision/ensemble/diction
   Interpretation/expressiveness/dynamic control

2. For the polyphonic selection, which formation did you prefer?
   A. ____ Acoustically placed sections
   B. ____ Unorganized sections
   C. ____ Acoustically placed mixed (assigned by the experimenter)
   D. ____ Unorganized mixed

   Comments:

3. For the homophonic selection, which formation did you prefer?
   A. ____ Acoustically placed sections
   B. ____ Unorganized sections
   C. ____ Acoustically placed mixed (assigned by the experimenter)
   D. ____ Unorganized mixed

   Comments:
APPENDIX C
RANDOMIZED EXPERIMENT SCHEDULE

176
RANDOMIZED EXPERIMENT SCHEDULE

<table>
<thead>
<tr>
<th>Trial</th>
<th>Choir</th>
<th>Piece (by composer)</th>
<th>Formation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Choir 1</td>
<td>Verdi</td>
<td>Acoustically placed sections</td>
</tr>
<tr>
<td>2.</td>
<td>Choir 2</td>
<td>Bach</td>
<td>Acoustically placed sections</td>
</tr>
<tr>
<td>3.</td>
<td>Choir 1</td>
<td>Verdi</td>
<td>Acoustically placed mixed</td>
</tr>
<tr>
<td>4.</td>
<td>Choir 1</td>
<td>Bach</td>
<td>Unorganized mixed</td>
</tr>
<tr>
<td>5.</td>
<td>Choir 2</td>
<td>Bach</td>
<td>Acoustically placed mixed</td>
</tr>
<tr>
<td>6.</td>
<td>Choir 1</td>
<td>Verdi</td>
<td>Acoustically placed mixed</td>
</tr>
<tr>
<td>7.</td>
<td>Choir 2</td>
<td>Bach</td>
<td>Unorganized sections</td>
</tr>
<tr>
<td>8.</td>
<td>Choir 2</td>
<td>Verdi</td>
<td>Unorganized mixed</td>
</tr>
<tr>
<td>9.</td>
<td>Choir 1</td>
<td>Bach</td>
<td>Acoustically placed sections</td>
</tr>
<tr>
<td>10.</td>
<td>Choir 2</td>
<td>Bach</td>
<td>Acoustically placed sections</td>
</tr>
<tr>
<td>11.</td>
<td>Choir 2</td>
<td>Verdi</td>
<td>Acoustically placed sections</td>
</tr>
<tr>
<td>12.</td>
<td>Choir 1</td>
<td>Verdi</td>
<td>Unorganized sections</td>
</tr>
<tr>
<td>13.</td>
<td>Choir 1</td>
<td>Verdi</td>
<td>Acoustically placed sections</td>
</tr>
<tr>
<td>14.</td>
<td>Choir 2</td>
<td>Verdi</td>
<td>Acoustically placed mixed</td>
</tr>
<tr>
<td>15.</td>
<td>Choir 1</td>
<td>Bach</td>
<td>Unorganized mixed</td>
</tr>
<tr>
<td>16.</td>
<td>Choir 1</td>
<td>Verdi</td>
<td>Unorganized sections</td>
</tr>
<tr>
<td>17.</td>
<td>Choir 2</td>
<td>Verdi</td>
<td>Acoustically placed sections</td>
</tr>
<tr>
<td>18.</td>
<td>Choir 1</td>
<td>Bach</td>
<td>Acoustically placed sections</td>
</tr>
<tr>
<td>19.</td>
<td>Choir 1</td>
<td>Bach</td>
<td>Acoustically placed mixed</td>
</tr>
<tr>
<td>20.</td>
<td>Choir 1</td>
<td>Bach</td>
<td>Unorganized sections</td>
</tr>
<tr>
<td>21.</td>
<td>Choir 2</td>
<td>Bach</td>
<td>Acoustically placed mixed</td>
</tr>
<tr>
<td>22.</td>
<td>Choir 2</td>
<td>Bach</td>
<td>Unorganized mixed</td>
</tr>
<tr>
<td></td>
<td>Choir 2</td>
<td></td>
<td>Verdi</td>
</tr>
<tr>
<td>---</td>
<td>--------------</td>
<td>---</td>
<td>------------------------------</td>
</tr>
<tr>
<td>23</td>
<td>Choir 1</td>
<td></td>
<td>Bach</td>
</tr>
<tr>
<td>24</td>
<td>Choir 2</td>
<td></td>
<td>Bach</td>
</tr>
<tr>
<td>25</td>
<td>Choir 1</td>
<td></td>
<td>Verdi</td>
</tr>
<tr>
<td>26</td>
<td>Choir 2</td>
<td></td>
<td>Verdi</td>
</tr>
<tr>
<td>27</td>
<td>Choir 2</td>
<td></td>
<td>Bach</td>
</tr>
<tr>
<td>28</td>
<td>Choir 2</td>
<td></td>
<td>Verdi</td>
</tr>
<tr>
<td>29</td>
<td>Choir 2</td>
<td></td>
<td>Verdi</td>
</tr>
<tr>
<td>30</td>
<td>Choir 1</td>
<td></td>
<td>Bach</td>
</tr>
<tr>
<td>31</td>
<td>Choir 1</td>
<td></td>
<td>Verdi</td>
</tr>
</tbody>
</table>
APPENDIX D

TREATMENT CHOIR FORMATIONS
TREATMENT CHOIR FORMATIONS

Provided below (Figures 66 through 73) are charts of the four experimental formations of the two treatment choirs. Indicated for each singer is the voice part, intensity level (1, soft to 5, loud), and the vibrato assessment (1, no vibrato to 5, big vibrato). It is not feasible to list unique vocal qualities that also influenced placement. (Refer to chapter III for a detailed description of how the formations were created.) Singers shown in bold type were not present at the actual experiment.

Choir 1: 12 Sopranos; 11 Altos; 8 Tenors; 10 Basses

Choir 1: Acoustically Placed Sectional Formation:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>4, 2.5</td>
<td>3.5,3.5</td>
<td>3, 3</td>
<td>3.5, 3</td>
<td>3, 3</td>
<td>4, 4</td>
<td>3, 2</td>
<td>2, 2</td>
</tr>
<tr>
<td>2.5, 2.5</td>
<td>3, 3</td>
<td>3, 1.5</td>
<td>3.5,1.5</td>
<td>3.5</td>
<td>3, 3.5</td>
<td>4, 3</td>
<td>3, 2</td>
</tr>
<tr>
<td>4, 4</td>
<td>3.5, 4</td>
<td>3.5, 3</td>
<td>2.5, 2</td>
<td>2.5</td>
<td>3</td>
<td>4, 3</td>
<td>4, 5</td>
</tr>
<tr>
<td>3.5, 4</td>
<td>4, 4</td>
<td>4, 4, 5</td>
<td>3, 5</td>
<td>4.5</td>
<td>4.5</td>
<td>4</td>
<td>4, 3, 5</td>
</tr>
</tbody>
</table>

Figure 66

Choir 1: Unorganized Sectional Formation:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3, 3</td>
<td>4, 2.5</td>
<td>3.5</td>
<td>3</td>
<td>3.5, 3.5</td>
<td>4, 4</td>
<td>2, 2</td>
<td>3, 3.5</td>
</tr>
<tr>
<td>3.5,1.5</td>
<td>2.5,2.5</td>
<td>3, 3.5</td>
<td>3, 3</td>
<td>3.5</td>
<td>3</td>
<td>3, 1.5</td>
<td>4, 3</td>
</tr>
<tr>
<td>3.5, 4</td>
<td>2.5, 3</td>
<td>3.5, 4</td>
<td>3, 3.5</td>
<td>3, 3.5</td>
<td>3, 4, 4</td>
<td>4, 3, 5</td>
<td>3, 3</td>
</tr>
<tr>
<td>4, 4, 5</td>
<td>4.5</td>
<td>4.5</td>
<td>4, 4, 5</td>
<td>4</td>
<td>4, 4</td>
<td>3, 2</td>
<td>4, 3</td>
</tr>
</tbody>
</table>

Figure 67
## Choir 1: Acoustically Placed Mixed Formation:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>4,4</td>
<td>4,3</td>
<td>4,5</td>
<td>4,4</td>
<td>4,3</td>
<td>4,4</td>
<td>4,5</td>
<td>4,4</td>
<td>4,2,5</td>
</tr>
<tr>
<td>4,4</td>
<td>3,3</td>
<td>4,4</td>
<td>4,4</td>
<td>3,3</td>
<td>4,4</td>
<td>3,2</td>
<td>3,5,3,5</td>
<td></td>
</tr>
<tr>
<td>4,2,5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 68

## Choir 1: Unorganized Mixed Formation:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2,5</td>
<td>2,2</td>
<td>4,4</td>
<td>3,2</td>
<td>4,4</td>
<td>4,4</td>
<td>4,2,5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3,3</td>
<td>4,4</td>
<td>4,2,5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3,5,3,5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4,4</td>
<td>3,2</td>
<td>4,4</td>
<td>3,2</td>
<td>4,4</td>
<td>3,2</td>
<td>4,4</td>
<td>3,3</td>
<td>4,4</td>
</tr>
</tbody>
</table>

Figure 69

## Choir 2: 18 Sopranos; 14 Altos; 5 Tenors; 9 Basses

### Choir 2: Acoustically Placed Sectional Formation:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>4,5,4,5</td>
<td>2,2</td>
<td>3,2</td>
<td>4,5,2,5</td>
<td>3,5,2,5</td>
<td>2,2</td>
<td>4,3,5</td>
<td>3,2</td>
<td>4,5</td>
</tr>
<tr>
<td>4,4</td>
<td>2,5</td>
<td>3,1</td>
<td>3,3</td>
<td>3,2</td>
<td>3,3</td>
<td>3,2</td>
<td>3,5</td>
<td>4,5</td>
</tr>
<tr>
<td>4,5,2,5</td>
<td>3,5,3,5</td>
<td>3,5,5,5</td>
<td>2,2</td>
<td>3,5</td>
<td>3,2</td>
<td>3,5,2,5</td>
<td>3,5</td>
<td>3,5</td>
</tr>
<tr>
<td>3,2</td>
<td>2,5</td>
<td>3,3</td>
<td>2,2</td>
<td>3,5</td>
<td>4,5</td>
<td>1,1</td>
<td>2,1</td>
<td>1,1</td>
</tr>
</tbody>
</table>

Figure 70
Choir 2: Unorganized Sectional Formation:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3,3,5,3.5</td>
<td>4,3.5</td>
<td>3.2,3.5,2.5</td>
<td>3.2</td>
<td>3,3,5</td>
<td>4,5</td>
<td>2,2</td>
<td>4,3</td>
<td>3.5,4.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Choir 2: Acoustically Placed Mixed Formation:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5,4</td>
<td>3.5,5</td>
<td>3.2</td>
<td>2.2</td>
<td>4,3,5</td>
<td>3.5,3.5</td>
<td>3.5,3,5</td>
<td>4,5,4.5</td>
<td>4,3,5</td>
<td>2,1</td>
<td>4,5</td>
<td>3.5,4</td>
<td>3,5</td>
</tr>
</tbody>
</table>

Choir 2: Unorganized Mixed Formation:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5,2</td>
<td>3,3.5</td>
<td>2.5,2</td>
<td>2.2</td>
<td>3,3.5</td>
<td>4.4</td>
<td>3.2</td>
<td>2,1</td>
<td>3,1,5</td>
<td>3.3</td>
<td>3,2</td>
<td>2.5,3</td>
<td>3.5,3</td>
</tr>
</tbody>
</table>

Figure 71

Figure 72

Figure 73