THE SEVENTEENTH CENTURY TRILLO:
HISTORICAL PRACTICE FOR THE 21ST CENTURY SINGER

by
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Preface

I arrived at this project curious about the development, documentation, and production of the *trillo* at the turn of the seventeenth century, and how knowledge of these components can lead to a more comprehensive understanding of the unique aesthetic of music in seventeenth-century Italy. Trill variations, vibrato, and the *trillo* have been studied and discussed in several performance, musicological, and scientific contexts over the last fifty years, though without producing secure or consistent conclusions about the *trillo*’s physiological production or its implication on singing style. There are two significant contributors to this issue: first, the seemingly limitless versatility of the human voice; and second, the lack of consistent terminology or descriptions in historical documents and modern research. I have attempted to address these issues by investigating the *trillo* through three lenses: cataloging the presence, definition, and description of the *trillo* in historical sources; assessing comparative measurements of the *trillo* as found in studies by modern voice scientists; and contextualizing the *trillo* through an exploration of its employment in vocal literature from the publication of Giulio Caccini’s *Le nuove musiche* in 160, to its lingering presence in the early eighteenth century.

The first chapter of this dissertation, *Tracing the Trillo*, explores historical writings, beginning in the last quarter of the sixteenth century, that reference the *trillo* or other ornaments performed by using a vocal gesture that I will call “repercussive.” The chapter is divided into sub-genres of publication. I start by evaluating Italian sources for vocal ornamentation and general music from 1590 to 1625 which provide examples of the *trillo* as it was used in seventeenth-century Italian music. To examine the *trillo* in the broader European landscape, I then turn to sources outside of Italy. French writers and composers provide information about how the *trillo* was understood and used in France, and provide context for the *trillo*’s
classification among French ornaments like the *tremblement*. German sources offer further
assessment of Italian and French style by providing contemporary comparison of the two
practices. They also help clarify the ambiguity created by the terms *trillo* and *tremolo*, which had
multiple coexisting definitions. Yet additional information can be found in instrumental sources
that describe how the *trillo* and other vocal gestures were imitated and performed by keyboard,
string, wind, and brass musicians.

Throughout the first chapter, I will describe vocal ornaments using the relevant terms
from each source alongside my own interpretation of the terms. Since there was little to no
consistency in the use of such terminology in contemporaneous publications during the
seventeenth century, it can be confusing to compare sources that regularly adopt different terms,
though describe identical practices. I have tried my best to be clear in each case. It has been the
practice of past scholars to create “working definitions” for terms that can otherwise be
problematic, for example H. Wiley Hitchcock’s use of *tremolo* in the place of *trillo* in his
translation of Caccini’s *Le nuove musiche*. I have found this to compound the confusion of
terminology and have therefore opted to leave such terminology untranslated. Instead, I
frequently devise antonymic words such as “repercussive” or “oscillating” to characterize each
ornament based on whether it is performed on a static pitch or includes pitch alternation.

Chapter two, *The Trillo in Voice Science*, examines the *trillo* research through multiple
scientific fields. The rising interest in human anatomy in the sixteenth century resulted in
anatomical drawings of the structural cartilages and suspensory muscles of the larynx, and
descriptions of voice productions. Following a brief overview of anatomy sources, I introduce
research about the *trillo* from the discipline of modern voice science, and investigate, through a
new study, how the *trillo* compares to other vocal gestures based on acoustic analysis and video
observation of vocal production. In previous research about the *trillo*, the instructional letter of Giovanni Camillo Maffei has been identified among the first significant writings on vocal production and pedagogy. In her translation of Maffei’s letter, Carol McClintock regards his description of the anatomy, physiology, and physics of voice as having “little value for the modern student.”¹ That the vocal fold physiology during *trillo* production is different from standard Classical vocal gestures refutes this notion. In order to better understand Maffei’s letter and other historical descriptions of voice, I sought a general knowledge of human anatomy and anatomical terms as circulated in sources from the early modern period. I then turn to a review of voice science literature about the *trillo*. There is a small group of studies on the *trillo* complete in the 1980s by a research team comprised of Jean Hakes, Thomas Shipp, and E. Thomas Doughtery.² They studied the *trillo*, as it was performed by early music singers of the time, through acoustic analysis, and compared it with other vocal gestures such as non-vibrato singing, vibrato, exaggerated vibrato, and the oscillating trill. Several related investigations soon followed as the singing community sought further conclusions about the virtuosic nature of seventeenth- and eighteenth-century music. With the help of Dr. Rita Patel and Dr. Steven Lulich of the Indiana University Speech and Hearing department, I fashioned a study to recreate several parameters measured by previous scholars, and to observe the vocal folds during *trillo* phonation through high-speed video endoscopy. Our findings were largely consistent with earlier studies, suggesting that *trillo* repercussion rates are roughly twice as fast as the oscillating trill, and that the *trillo* is produced using different vocal fold formation than an oscillating trill and normal phonation.

² Relevant citations are given within the chapter.
The third and final chapter of this dissertation presents a selection of case studies in vocal literature that focus on the trillo or embellishment with similar repercussive features, and speculates on the lasting influence of the trillo on vocal writing of later periods. While theoretical writing and scientific results can provide conceptual information about the trillo, understanding how it was practiced and its key role in vocal composition are of somewhat greater significance to performers interested in seventeenth-century and other early modern vocal music. I start with compositions by Giulio and Francesca Caccini, who together demonstrate the cadential, pedagogical, and expressive employment of the trillo as it developed in Italian monody. I similarly examine other seventeenth-century works composed by Claudio Monteverdi, Giovanni Felice Sances, and Henry Purcell, and continue into the early eighteenth century with the music of G.F. Handel. In the conclusion of this chapter, I briefly discuss the residual influence of the trillo in the eighteenth century, including descriptions found in later vocal treatises, as well as the lasting impact of glottal articulation as an expressive tool through the Classical period.

I hope this study will bring new perspectives and insight to those invested in early music and historical performance, to anyone interested in voice production and its role in historical aesthetics, and to singers interested in exploring early modern vocal music.
Abstract

The purpose of this project is to investigate the development, documentation, and production of the *trillo* at the turn of the seventeenth century, and to assess how knowledge of these components can lead to a more comprehensive understanding of the unique aesthetic of music in seventeenth-century Italy. This study of the *trillo* is organized in three sections: an overview of the presence, definition, and descriptions of the *trillo* found in historical sources for singers and instrumentalists, both within Italy and elsewhere in Europe; a review of early-modern anatomical sources, and comparative measurements of the *trillo* as found in studies by modern voice scientists; and a contextual exploration of the *trillo*’s employment in vocal literature from the early seventeenth century to the middle of the eighteenth. Practically, these components together suggest that the *trillo*, and the associated glottal articulation, had a lingering impact on vocal production and composition well into the eighteenth century.
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Chapter 1: Tracing the *Trillo*

The employment of the *trillo* as a vocal ornament flourished alongside the development of monody in Italy at the turn of the seventeenth century. The definition of *trillo*, a vocal ornaments characterized by repercussion on a single pitch, has been widely accepted in the field of historical performance and voice science. It appears in several treatises and historical documents which identify it as an essential ornament in seventeenth-century repertory, and was used as a cadential or preparatory ornament, informing vocal technique for *passaggi*, rapid passagework, featured predominantly in vocal music from early modern Italy and England. The *trillo* as a concept is rather ambiguous and the term is frequently entangled with vibrato, *tremolo*, various trills, and French ornaments. It can be difficult to understand precisely how these vocal gestures were defined and described, how they related to one another, and whether any of the terms are synonymous. In this chapter, I will review the most significant historical writings about the *trillo* and its relationship to contemporaneous terms and practices.

Though the introduction to Giulio Caccini’s *Le nuove musiche* (1601) is widely upheld as the exemplar for defining the *trillo*, descriptions and written examples of the *trillo* appear in dozens of music treatises published between 1580 and 1750. This collection of writings includes general music instruction, ornamentation and diminution treatises, pedagogical writings specifically for singers, as well as instrumental treatises for string and wind players. Each category provides a unique perspective of the performance and employment of the *trillo*, as well as how its function and performance changed throughout the sixteenth and seventeenth centuries.

Before diving into the rich pedagogical and musical tradition of the *trillo*, perhaps it is helpful to trace the presence of repercussive ornaments that predate it. The two practices that
stand out most clearly are the reiterative component of the cantus cadential function found plentifully in polyphonic compositions of the fifteenth and sixteenth centuries, and the repercussive leading-tone cadence found in diminution treatises in the second half of the sixteenth century. While no direct causal connection has been made, these two models suggest a plausible development of the trillo from a single reiteration to an unmeasured string of repercussive articulations.

The reiterative component characteristic of the trillo was a fixture in fifteenth-century cadential formulas. Figure 1.1 shows the final cadence from Guillaume DuFay’s Christe – Missa L’homme Armé, which features a rearticulated note in the cantus line in preparation for the cadential movement to G between the cantus and contratenor lines. The reiteration typically occurs prior to the suspension created on the antepenultimate note. This is a formulaic cadential pattern and is typically employed in the voice part with the cantus function, which approaches a cadence by an ascending minor second, contrary to the descending major second of the tenor function. In this formula, the rearticulation helps to build cadential anticipation, which is released to the leading tone in the following measure.

![Figure 1.1 Cadential Formula from Guillaume Du Fay Christe – Missa L’homme Armé](https://josquin.stanford.edu/cgi-bin/jrp?a=notationNoEditText&f=Duf1004)

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In the late Renaissance and seventeenth century, ornamentation practices were documented throughout Europe in dozens of diminution treatises. These publications first appeared in the second quarter of the sixteenth century, with Silvestra Ganassi’s *Opera Intitulata Fontegara* (1535) among the earliest, and reached critical mass in the decades approaching the seventeenth century. They outline ornamental graces and division structures in the Italian, French, English, German and Spanish traditions, and range from general music instruction to technical manuals for specific instruments, including voice. It is in these same treatises that many accounts of the *trillo* are preserved. The remainder of this chapter will include analyses and comparison of *trillo* descriptions in three general categories: Italian vocal sources published generation surrounding Caccini’s *Le nuove musiche* (1601) – roughly 1590-1620; ornamentation treatises and sources written outside the Italian peninsula, primarily in French and German; as well as instrumental treatises that reveal the *trillo*’s adaptability to performance on instruments, and the limitations of the ornament. I hope that this manner of organization will help to contextualize the scope and perspective of each author’s contribution.

**Italian Vocal Treatises 1593-1620**

The *trillo*, as a component of *passaggi* or cadential structures, can be found in several Italian diminution treatises published in the second half of the sixteenth century. In many of these examples, the rearticulations occur on the leading tone or penultimate note before a cadence, or variously within long strings of *passaggi*. Though not always explicitly described, such examples can be found in the exhaustive diminution tables provided by Giovanni Luca Conforto, Giovanni Battista Bovicelli, and Lodovico Zacconi, who wrote three of the most significant vocal treatises in scope and content before Giulio Caccini’s *Le nuove musiche*.
Conforto (1593)

In his 1593 treatise *Breve et facile maniera d’essercitarsi a far passaggi*, Milanese falsettist Giovanni Luca Conforto (1560-1608) includes the term “trills” in his written-out ornaments on page 25. He provides two variants of the “trills,” both of which include rearticulated sixteenth notes written on the same pitch, with the number “3” printed several times below each set of repercussions. Conforto specifies in the preface that the “3” superscribed below two sixteenth notes or at the end of a cadence indicates a *trillo*, which increases the speed or number of reiterations, in addition to improving the perception of the voice:

The other three, which is shown below two sixteenth notes (chrome), or over the end of a cadence, I mean nothing other than a *trillo*, which doubles the number [of notes or repercussions], embellishes the voice, and covers many defects.  

He later remarks that the “3” inscribed below three notes of equal values represents a triplet or hemiola figure.

Each *trillo* example is followed by a shortened version of the same ornamented interval, labeled “mezzo.” The first pair of *trilli* is displayed in Figure 1.2.

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4 Giovanni Luca Conforto, *Breve et facile maniera d’essercitarsi a far passaggi* (Rome: 1593), 3R. “L’altro tre, che si vede sotto duoi crome, overo nel fine delle cadenza, altro non voglio dire che trillo, che rendendo al doppio il numero, imbellisce il canto, & copre molti difetti.”

5 Ibid.

6 Conforto. 25.
The first *trillo* ornament is an ascending half-step cadence from G# to A. After the initial G# is sounded, there is a *ribattuta di gola* or “rebeating” of the throat that precedes the *trillo*. A half-turn or lower neighbor tone figure completes the ornament, resolving to A. Similarly, the mezzo *trillo* that follows includes the same initial *ribbatuta di gola* and concluding half turn, but the length of the *trillo* between is shorted by half. Whereas the first *trillo* takes place over the length of a semi-breve, the mezzo *trillo* takes place over a minim. This distinction clarifies that Conforto has written the number of sixteenth notes to fulfill the necessary length of time for the ornament, rather than indicating a precise number of reiterations. The “3” printed below two sixteenth notes indicated a rate of reiteration that is faster than the values printed.

Conforto’s second pair of *trilli*, displayed in Figure 1.3, looks similar to the first pair, but the ornament outlines a descending cadence by half-step, from C to B. This example does not include an initial *ribattuta di gola*, but moves directly from C to B, with the reiterations performed on resolving pitch, before concluding with an ascending half turn that resolves to the cadence by a descending minor third. The example in Figure 1.4 offers yet another example how a *trillo* may be notated, with a “3” superscribed beneath two eighth notes, in this case a variant of a mezzo *trillo*.

![Figure 1.3 Conforto’s Descending Half-Step Trillo](image)

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7 Conforto, 25.
Also included in the ornaments [on page 25] are several varieties of groppo, which always include oscillating pitches and conclude with a half turn. The groppi do not include a “3” beneath them, or any indication that the speed of oscillation is quicker than notated. Conforto has therefore clarified the coexistence of oscillating groppi and repercussive trilli, which could be used to ornament the same stepwise cadential internals. In diminution examples written throughout the rest of his treatise, Conforto uses the mezzo trillo, notated in figure 1.4, most frequently. The longer trillo and groppo are included only in longer cadential structures.

Bovicelli (1594)

Just one year after Conforto’s publication Giovanni Battista Bovicelli (1550-1594), a composer and singer at the Sistine Chapel in Rome, published Regole, Passaggi di Musica. The treatise was written as a practical manual for singers, and includes charts of ornamented intervals, instructions for ornamenting multi-voices compositions, and detailed instructions on syllable length and text placement. Like Conforto, Bovicelli includes examples of groppi, which he calls groppetti, as well as a static-note ornament which he calls tremolo. The groppetti are notated in various ways: equal note values, accelerating note values, strictly alternating pitches, or alternating pitches with decoration or turns throughout. He explains the groppetti first in a

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8 Conforto, 25.
section about negotiating text underlay\textsuperscript{9} and then expands his parameters in a subsequent section when instructing how to arrange the notes for passaggi. In the latter section, Bovicelli lists two groppetti variants; the groppetto raffrenato (restrained groppo), which changes course to alternate an ascending second from the ornamented pitch, and the groppetto de note uguali (groppo of equal notes), which does not include acceleration like the other groppo forms. The groppo variants named above are shown in figure 1.5.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{groppetti.png}
\caption{Bovicelli’s groppetti\textsuperscript{10}}
\end{figure}

\textsuperscript{9} Giovanni Battista Bovicelli, \textit{Regole, Passaggi di Musica}, (Venice: Giacomo Vincenti, 1594), 8.
\textsuperscript{10} Ibid., 12.
Immediately following his extended description of the groppetti, Bovicelli provides a description of the tremolo, though without a clearly notated example. Bovicelli’s statements about the tremolo describe a trembling of voice over a single note, which moves by step and can be used in place of accenti when the note values become too small for accenti to be performed with grace:

The tremolo is nothing other than a trembling of the voice over a single note, which seeks to move by step; nor can the tremolo di viva voce be formed in any other manner, and this must be done over the indicated notes; a warning, wait at least until the third note to place a new syllable, as was said in discussion of the words…One cannot make accenti on quarter notes (semiminime); because the accenti would all be sixteenth and thirty-second notes, which are very fast and can be performed in only one way, [instead] you are welcome to give a tremolo, but fast (unformed), not formed.11

The final directive includes mention of Bovicelli’s tremolo variants, of which there are two; the tremolo formato and tremolo non formato. Notated examples for each variant are provided in Figure 1.6. The tremolo is to be performed on the dotted noted marked with the symbol “Λ.” The first example, which includes a “Λ” over two notes, is a variation of the tremolo formato, replacing the dotted notes from the first example with note values in written-out equivalents.

11 Bovicelli, 12-13. “Il tremolo nondimeno, che non è altro, che un tremar di voce sopra ad una stessa nota, ricerca, che le note vadino sempre per grado, nè in altra maniera si può formare il tremolo di viva voce, e questo si deve fare sopra alle note segnate; avvertendo, che almeno sino alla terza nota non vi si soggionga nova sillaba, come anco s’è detto di sopra, parlando della parole… Il che non si può fare ne gli accenti, che si formano sopra alle seminimime: perché questi accenti, essendo tutti di semicrome, e biscrome, che sono velociissime non si possono far più che in una maniera sola, se bene si può dare il tremolo, ma veloce, e non così formato”
Bovicelli’s treatise holds a firm place as one of the most important vocal treatises before Caccini, and yet his *tremolo* description and vaguely-notated examples have stifled scholars. Sian Honea has deemed Bovicelli’s description “inadequate and confusing,” and Frederick Neumann lists Bovicelli’s *tremolo* as an oscillating trill. I don’t find either statement to offer a

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12 Bovicelli, 13.
satisfactory interpretation. The first statement in Bovicelli’s description, “Il tremolo nondimeno, che non è altro, che un tremar di voce sopra ad una stessa nota,” which word-for-word translates to, “The tremolo, nevertheless, is nothing other than a trembling of voice atop [sopra ad] a single [una stessa] note,” clearly identifies an ornament on one pitch which has a trembling quality. The word “tremble” is a potentially problematic translation, as it is a close cognate with the French ornament *tremblement* and is frequently used to describe the gentle oscillation of vibrato.

Bovicelli’s next statement seems to create the most confusion, with the mention of stepwise motion and syllabic placement potentially interpreted to contradict the initial description of an ornament on a single note. To my understanding, Bovicelli’s description provides a definition of the *tremolo* only in a non-restrictive relative clause, which provides additional relevant information, but is otherwise describing the features of the notated examples. Therefore, the stepwise motion describes the relationship of the notes on either side of the *tremolo*, and the instruction to wait until the third note to change syllable is contextualized to a musical phrase, rather than a continued description of the *tremolo* itself.

Following these points of clarification, I return to Bovicelli’s initial description of a single-note ornament which results in a trembling quality of voice. This leads me to conclude that Bovicelli’s *tremolo* is the same repercussive ornament as Conforto’s *trillo*. Further evidence for this conclusion is provided by analysis of Bovicelli’s two tremolo variants: *tremolo formato* and *tremolo non formato*. As can be seen in figure 1.6, the variants are included in a phrase which is notated twice, once with larger note values, and then again with smaller note values. The *tremolo formato* is indicated for longer note values, and the *tremolo non formato* for smaller note values – the only perceivable difference between the two tremolo is the amount of time allocated for performance. Based on the third example, where a variation of the *tremolo formato*
occurs with two notes in place of a dotted note, I conclude that the longer notes of the *tremolo formato* allow time for varied repercussion speed or acceleration, whereas the *tremolo non formato*, must only be quick repercussions without acceleration. In the ornamented motets at the end of the treatise, Bovicelli frequently uses various *groppetti* as his primary cadential ornament. The “Λ” symbol which Bovicelli used previously to indicate where *trilli* should be performed does not appear within his compositions, and it is unclear how the *trillo* was practically applied in Bovicelli’s compositions.

**Zacconi (1596)**

Another important treatise for contextualizing the production and use of the *trillo* is Lodovico Zacconi’s (1555-1627) *Prattica di musica*, a general music treatise published in 1596. Like Bovicelli, Zacconi uses the word *tremolo* to describe a vocal ornament which is closely related to production of *passaggi*. Sian Honea posits, and I agree, that Zacconi’s *tremolo* is most likely static-note repercussions, and not an oscillating trill. In book 1, chapter 66, amid a description of how to produce *gorgia* and *passaggi*, Zacconi likens the relationship between the *tremolo* and *passaggi* to the ease with which one can guide a ship once already in motion:

> Still, I say that the *tremolo*, that is a trembling of the voice and the true door through which to enter *passaggi* and learn the *gorgie*, because the ship moves more easily if first it is set in motion; than from the beginning when you wish it to move. And the jumper jumps better if he first prepares the jump.\(^{16}\)

Within seventeenth-century vocal repertory, especially that of Caccini, it is common to find *trilli* preceding or amidst long phrases of *passaggi*. Zacconi suggests that the two are intimately

\(^{16}\) Lodovico Zacconi, *Prattica di musica* (Venice: Bartolomeo Carampello, 1596): 60. “dico ancora, che il tremolo, cioè la voce tremante è la vera porta d’intrar dentro a passaggi, & di impataonirse delle gorgie, perche con piu facilità se ne va la Naue quando che prima è mossa; che quando nel principio la si vuol mouere. & il saltatore meglio salta, se prima che salta si promoue al salto.”
connected, likely similar in technique and production such that quick, repercussive motion of the
tremolo would successfully prepare the vocal folds for gorgia and passagework that with a
desired effect of clean, glottal articulation as its defining characteristic. The trillo is essentially
gorgia or glottal articulation on one pitch, produced with a technique that is transferrable to
passaggi and other types of vocal agility.

Zacconi also comments on the quality of articulation required for the tremolo, urging that
it not be forced or tedious:

This tremolo must be succinct and faint; because the excessive and forced wearies and
annoys; It is of such a nature that one should always use, so that use converts it to habit,
because this continued use of the voice aids and easily urges the movement of the gorgia,
and wonderfully facilitates the principles of passaggi; this movement that I speak of must
not occur if not with the proper haste, gallant, and intensity.¹⁷

This description reflects the desire for glottal articulation that is relatively gentle and elegant in
quality. Since varying degrees of harshness in articulation are possible, these aesthetic
descriptions are important for modern performers to use as an interpretive guide. In their article
“Singing Passaggi: Modern Application of a Centuries-old Technique,” Joy Sherman and
Lawrence R. Brown offer a continuum of glottal articulations, which is displayed in Figure 1.7.

¹⁷ Zacconi, 60. “Questo tremolo deue essere succinto, & vago; perche l'ingordo, & forzato tedia, & fastidisce: Et è
di natura tale che vsandolo, sempre vsar si deue; accioche l'uso si conuerti in habito; perche quel continuo mouer
di uoce, aiuta, & uolontieri spinge la mossa delle gorgie, & facilita mirabilmente i principij de passaggi; Questa
mossa che io dico non deue essere se non con giusta fretta, ma gagliarda, & vehemente.”
The trillo, Zacconi’s tremolo, falls under the glottal articulation category, slightly more intense than a balances onset (“sweet attack”), and less intense that Manuel García’s coup de glotte. The glottal articulation category seems somewhat broad compared to the other classifications, and it may itself contain more variations. Since it will be discussed later in this dissertation, I would add the vocal gesture of giggle between the coup de glotte and the hard glottal attack.

The vocal treatises of Conforto, Bovicelli, and Zacconi represent a crucial period of transition in the ten years before the publication of Giulio Caccini’s (1555-1618) Le nuove musiche. From these sources several patterns emerge. First, the trillo is typically discussed and notated in close proximity to the groppo. From Zacconi’s description, it appears that the concepts of dispositione and gorgie link the two ornaments together in vocal production. Second, in pedagogical writings the trillo is described as occurring on a single pitch. When it is demonstrated through notation, the trillo appears as eighth or sixteenth notes on a static pitch, and appears in either static or accelerating note values. Though the lack of consistency in terminology and notation has mislead scholars, it is clear that notation of an oscillating ornament,

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the *gruppo*, was possible and that oscillating pitches were not used to represent the *trillo*. These two patterns will return in other sources yet to be discussed.

**Caccini (1601)**

The application of the *trillo* is found in its most clear and elaborate form in the preface and compositions within Giulio Caccini’s *Le nuove musiche*. Caccini was a composer and pedagogue in Florence at the turn of the seventeenth century. Through his affiliation with the rich cultural patronage of the Medici family, he is associated with the development of monody, birth of opera, and the musical aesthetics of the Florentine Camerata, who sought to revive the dramatic performance style of Ancient Greece by prioritizing clarity of text and rhetorical delivery. The *trillo* was a standard feature in cadential structures and *passaggi* in the monodic compositions of Caccini and his contemporaries. Caccini was a celebrated instructor who was best known for teaching voice to his wives and daughters, most notably his first daughter Francesca. Caccini’s introduction to *Le nuove musiche* provides a clear description and notation of the most important vocal ornaments employed in monody, as well as aesthetic and performance instructions for their recreation. His explanation of the *trillo* and *gruppo* is as follows:

> The trillo, described by me on one note only, has been demonstrated in this way for no other reason, except because in teaching it to my first [late] wife and now to the other living one, along with my daughters, I have observed no other rule than this very one in which it is written, both the one and the other [i.e., both the trillo and the gruppo], namely commencing from the first quarter-note and striking each note repeatedly in the throat on a vowel “a” up to the final breve, and similarly the gruppo… This trillo and gruppo, because they are a necessary step toward many things that are described and effects of that elegance that is much to be sought after in good singing.  

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Caccini provides the most clearly notated depiction of an exercise for training the *trillo*, which is shown in figure 1.8. The close relationship between the *trillo* and the *gruppo*, and the mention of their pedagogical importance is reminiscent of the *tremolo* descriptions provided by Bovicelli and Zacconi. Caccini often uses the *trillo* and *gruppo* within cadential structure, favoring the *trillo* for soprano function (descending whole-step), and the *gruppo* for tenor function (ascending half-step).

![Figure 1.8 Giulio Caccini’s “Teaching Trillo”](image)

I have deemed figure 1.8 Caccini’s “teaching trillo” to encompass his indication that he wrote out the *trillo* to match the way he taught the *trillo* to his wife and daughters. Caccini’s teaching *trillo* is comprised of repercussions on a single pitch that accelerate through the length of one breve. It is essentially a vocal exercise, which can be a beneficial pedagogical tool for modern singers. It is also a simple guide for how the *trillo* could be used as a cadential ornament when indicated on a breve, which occurs frequently in the monody of Giulio and Francesca Caccini.

The gradual acceleration, written by Caccini in ever-diminuting note values, may be an important component of Bovicelli’s *tremolo formato*. The adjective *formato*, meaning formed, shaped, or trained, seems to indicate gradual development of the ornament, much like what is written out by Caccini. In contrast, Bovicelli’s *tremolo non formato*, would suggest a quicker,

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non-developing ornament which is performed at a single speed the whole time. Throughout the repertory, *trilli* can be found on varying note lengths, from eighth notes amid *passaggi* to penultimate cadential breves. Caccini’s teaching *trillo* and Bovicelli’s delineation between the *trillo formato* and *non formato* indicates a wide range of flexibility with regard to performance of the *trillo*. Whereas *trilli* placed on longer note values allow for variety of rhythm, acceleration, repercussion speed, and affect, *trilli* on shorter note values have fewer options but to be sung as quick, unprepared repercussions. This principle is reflected in the diminutive note values in Bovicelli’s examples, the *trillo formato* being given larger note values than the *trillo non formato*.

**Rognoni (1620)**

After Caccini, the next most significant and comprehensive historical documentation of the *trillo* can be found in Francesco Rognoni’s (1570-1626) 1620 treatise *Selva di vari passaggi*. Like many authors before him, Rognoni discusses the *trillo* and *groppo* together, demonstrating the close relationship between the two ornaments. His most significant contribution to the discussion of the *trillo* and the lack of clear terminology, is his inclusion of the terms *tremolo* and *trillo* to identify two separate ornaments. Although there is some confusion about the terms used in earlier sources, Rognoni indicates their coexistence and supplied notated examples of each. Following a dedication to Sigismondo III of Poland, he provides ten numbered instructions to the reader about vocal ornaments. The *tremolo* is discussed in number three:

> The tremolo one makes often, but with grace, and one ought to take care not to make it as some do, without a termination, so that they seem like goats. For the most part, the tremolo is made on the value of the dot of each note.

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Rognoni’s notated “tremolo in two forms” is shown in figure 1.9. The description is somewhat confusing and does not appear to match the notated examples. Sian Honea similarly notes that Rognoni’s examples do not match the rhythmic description, and remarks that he believes Rognoni’s *tremolo* to be the same ornament as Bovicelli’s *tremolo*. As indicated by the previous section about Caccini, I am skeptical of this assessment. From Rognoni’s notated examples, it appears that the active portion of the *tremolo* occurs during the first half of a minim or semibreve note value, followed by a held pitch for the second half. The entire exercise is printed on a single note.

![Figure 1.9 Rognoni’s Tremolo Examples](image)

Rognoni’s description of the *groppo* and *trillo* immediately follows the *tremolo*, and closely adheres to information found in previous sources.

The groppo, as it seems to me, ought to be written in this way, such as the greater part of knowledgeable men have written it, and so also the trillo, everyone who wants to learn this trillo or groppo needs to be careful to attack and strike each note in the throat on the vowel “a” up to the last breve or semibreve, which trillo or groppo is made mostly on the penultimate note of any cadence or final [cadence].

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22 Francesco Rognoni, *Selva di Varii Passaggi* (Milan: Filippo Lomazzo, 1620), 1
23 Honea, Rognoni Translation, 6.
Rognoni has provided and confirmed several important pieces of information in this description: the close relationship between the *trillo* and *groppo*, their frequent employment as cadential ornaments, that they are performed for the duration of the indicated note value, and that they are created in the throat. He also provides three notated examples of the *trillo*, shown in figure 1.10 – curiously, both the *tremolo* and *trillo* are notated on a single pitch.

![Figure 1.10 Rognoni’s Trillo Examples](image)

The first two examples demonstrate how a *trillo* could be performed over a minim or a semibreve. In each instance, the repercussions occur for the entire duration of the note following an initial preparation. The *trillo sopra la minima* includes an initial longer note before the quick repercussions. The *trillo sopra la semibreve* includes two initial *ribattuta di gola* prior to the repercussions. The third example is an exact replica of Caccini’s teaching *trillo* and indicates steady acceleration through decreasing note values. Rognoni supports the earlier notion of considerable flexibility in how the *trillo* is performed, especially when indicated on a longer note value.

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24 Rognoni, 1.
In the diminution tables that occupy the rest of the treatise, Rognoni frequently includes repercussions within cadential structures, though with no indication of which ornament, the *trillo* or *tremolo*, is intended. In many instances, like Figure 1.11, the passage in question includes accelerating note values and thirty-second notes (with two flags), matching the notes values of the *gruppo* and *trillo* examples. These can be clearly identified as *trilli*. In other instances, like Figure 1.12, the intention is less clear, though the repercussions over the entirety of note value would suggest a *trillo*. Yet in other examples, Rognoni simply uses “T.” over two eighth notes to indicate an ornament, as in Figure 1.13. There is no indication of whether the T. is intended to represent a *trillo* or *tremolo*. There are no contextual examples that clearly replicate the *tremolo* model in Figure 1.9, and it is unclear how a *tremolo* would be notated or performed on note values smaller than a minim.

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*Figure 1.11 Rognoni’s Trillo Contextualized*\(^{25}\)

*Figure 1.12 Rognoni’s Repercussions Contextualized*\(^{26}\)

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\(^{25}\) Rognoni, 43.

\(^{26}\) Ibid., 4.
Considering Francesco Rognoni’s lineage, it is compelling to consider his *tremolo* as a form of vibrato. His father, Riccardo Rognoni, was an important musician in Milan and founder of one of the earliest violin schools. Riccardo published a two-part treatise for strings and voices *Passaggi per potersi* and *Il vero modo di diminuire* in 1594, the same year as Bovicelli’s publication. While Riccardo did not mention or include any kind of repercussive ornament, it is interesting that Francesco’s written *tremolo* is reminiscent of expressive vibrato used by string players, typically placed either at the onset or conclusion of contextually long notes. The use of the *trillo* and *tremolo* as instrumental ornaments will be discussed later in this chapter.

From Rognoni’s writing and examples, there are a few notable conclusions to be perceived about his *tremolo* and *trillo*. First, Rognoni and other authors specify that the *trillo* and *groppo* are made in the throat, which is connected to the concept of *gorgia*, the clarity of articulation associated with performance of *passaggi*. Rognoni does not mention throat articulation in his section about the *tremolo*. As will be demonstrated in the second chapter of this dissertation, the throat articulation of the *trillo*, and by extension the *groppo*, correlates to different patterns of vocal fold vibration than vibrato or a whole-tone trill, a relative of the French *tremblement*. It is also important to emphasize that Rognoni notated both the *tremolo* and  

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27 Ibid., 6.
trillo on a single pitch. This indicates to me that either the tremolo does not have an oscillating change of pitch, or that any fluctuation in pitch is imperceptible to the ear, likely smaller than a semitone.

The treatises of Conforto, Bovicelli, Zacconi, Caccini, and Rognoni document vocal practice in Northern Italy spanning thirty years surrounding the turn of the seventeenth century. With the development of monody, the trillo emerged as a versatile component of vocal pedagogy, suggesting that the ornament holds a critical position as stylistic pinnacle in the singing of passaggi and gorgia, and crucial element for understanding singing aesthetics during the early modern period. As will be demonstrated in the third chapter of this dissertation, the trillo evolved considerably during the seventeenth century, eventually becoming an expressive tool to convey strong human emotion and to imitate nature.

Sources Outside Italy

Music treatises and literary courses published outside of Italy form an important genre of additional resources for conceptualizing and understanding the trillo. When Italian style is discussed in French sources, the trillo is compared to the tremblement, the dominant French cadential ornament, and also to the flattement and battement. Treatises by German authors, who observed both Italian and French practices, provide a broader perspective of how the ornaments operated within each tradition.

One important French source for clarifying terminology and definitions is Sébastien de Brossard’s (1655-1730) Dictionnaire de musique, published in Paris in 1703. The title page boasts a collection of terms in Greek, Latin, Italian and French that encompass music history and theory of both ancient and modern traditions. Within the dictionary, Brossard lists tremolo and
trillo as separate entries, and outlines two definitions for each. His tremolo entry describes an ornament which is meant to imitate the tremulant\textsuperscript{28} stop of an organ.\textsuperscript{29} He also describes the ornament’s frequent application for both voices and string instruments, in the latter case within one bow stroke.\textsuperscript{30} At the end of the definition, he suggests that the tremolo is similar to the French tremblement.

Brossard’s definition of trillo is nearly twice as long as his tremolo listing and includes an image reminiscent of Caccini’s teaching trillo. In this extensive passage, Brossard suggests two definitions for trillo, indicating two separate ornaments and vocal processes:

\textit{Trillo} or plural trilli, which is often found abbreviated as T, Tr., or simply a small t., is for both voices and instruments. It is often the indication of alternating beating of two conjunct degrees, such as fa-mi or mi-re. In this, you begin at the upper [degree], and end up on the lower – and this is called the Cadence or Tremblement in French. However, it is found often in Italian music as an indication that one must beat many times on the same degree, the same sound; at first a little slowly, and in the end with as much quickness and speed as the throat can make.

However, properly it is the Italian Trillo, at least as much as one can express in ordinary notes, because it is diminished by the example, which only gives a rough idea the liveliness with which it should be done. Frequent use and a good teacher can impart it better than anything one could write about it. It is also often that which we call double cadence or pour de gosier. The Italians use this ornament on every cadence, some lasting two, three or four measures. It serves to lift or revive the voice, releasing elongated tension.\textsuperscript{31}

\begin{footnotesize}
\begin{itemize}
\item[28] Tremblent
\item[29] Sébastien de Brossard, \textit{Dictionnaire de Musique} (Paris: Christophe Ballard, 1703).
\item[30] Ibid.
\item[31] Ibid., “Trillo, au plur. Trilli, qu’on trouve souvent marqué en abrégré par un T. ou par Tr. Ou simplement par un petit t tant pour les Voix que pour les Instrument. C’est souvent la marque qu’on doit battre fort vite alternativement, ou l’un après l’autre deux Son en degré conjoints comme fa,mì ou mi,\textit{re} et c. De manière qu’on commence par le plus haut, et qu’on finisse par le bas, et s’est là proprement la Cadence ou le Tremblement à la Francoise. Mais c’est aussi tres souvent sur tout dans les Musique Italiennes, une marque qu’on doit rebattre plusieurs fois dur le même degré, le même Son; d’abord un peu lentement, et sur la fin avec autant de vivacité et de Vitesse que le gosier le peux faire. (Page?)

Or c’est le proprement le veritable Trillo à l’Italienne, du moins autant qu’on le peut exprimer par les Notes ordinaires, car il fait avoiyer que l’exemple qu’on vient de donner en est une idée tres grossiere en comparaison de la vivacité avec la quelle cela se doit faire, ce qu’on grand usage et un bon Maître peuvent mieux apprendre que tout ce qu’on en pourroit écrire. C’est aussi souvent ce que nous apellons double cadence, pour de gosier. Les Italiens se servant sur tout de cet agreeement sur le fin de certaines Teneus de deux, trois, quatre, et de mesures. Ce qui fort comme à releve, ou resusciter la Voix du'une tension trop longue pourrait avoir fait relacher.”
\end{itemize}
\end{footnotesize}
In the first two sentences, Brossard clearly describes an oscillating ornament, which like the *tremolo*, he compares to the French *tremblement* or *cadence*. He then describes the Italian *trillo*, which is characterized by repercussions on a single pitch and is accompanied by the notated example shown in Figure 1.14. Like Caccini’s teaching *trillo*, this example demonstrates the acceleration featured in cadential and other long-note *trilli*.

![Figure 1.14 Brossard’s Trillo](image)

Another important component of the Brossard’s second *trillo* definition is the notion of repercussions occurring in the throat. This is the same distinction made by Rognoni and other Italian authors. The mention of throat articulation scarcely appears in descriptions of the *tremolo* or other ornaments related to the French *tremblement*. Brossard’s definitions of *trillo* and *tremolo* document the coexistence of two distinct types of ornaments: a decidedly Italian ornament featuring repercussions on a single pitch, and a more generally used ornament that oscillates between two pitches.

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32 Brossard.
Brossard’s definition of the *tremolo* and first *trillo* definition, characterizing an oscillating ornament, correlates with accounts of the *tremblement* and *cadence* in the French vocal treatises of Jean Millet and Benigne de Bacilly in the second half of the seventeenth century. Though these treatises are the most significant writing about seventeenth-century singing in France, the lack of French sources directly contemporary to Caccini creates a gap of some two generations – a historical difference that could be problematic when trying to equate practices across multiple traditions. The earlier of the two French sources, Jean Millet’s (1618-1684) *La belle méthode ou l’art de bien chanter* was published in 1666. Millet names the *tremblement* among a list of four principle vocal ornaments. He describes its function as a cadential ornament for long notes and indicates that in order to learn it, one must find a teacher who has been given it by nature. He also includes a very confusing notated example, which Barbara Thomas has described as “resembling a combination of the Italian *trillo*, *ribattuta* and *tremolo*.” Her transcription of Millet’s ornament is shown in Figure 1.15.

![Figure 1.15 Millet’s Tremblement](image)

34 Ibid. 15.
35 Ibid., 15, 45.
Two years later, Bénigne de Bacilly (1625-1692) published the first of four editions of Remarques curieuses sur l’art de bien chanter, au particulièrement pour ce qui regard le chant français. One of Bacilly’s primary objectives was to influence a style of singing based on declamation, much like the objective of monody composers in Italy. His writing is similar to Bovicelli’s in exhaustive detail about syllable length and style of declamation. In his chapter about vocal ornamentation, Bacilly lists three things to note about les cadences: (1) there are many instances when performance of a cadence is implies but not marked, (2) a proper cadence is “beaten in the throat,” (3) the cadence involves connection with another note, typically the note below. He also lists three common flaws of cadence: trop serèe (too tight), trop promte (too quick), trop rude (too rough). 36 Though the latter describes as an unseemly beating in the throat resultant from a lack of disposition or nature to perform a proper trill, these three flaws all describe a beating between two notes. 37 There is no indication of a static-note repercussions.

In addition to French sources, which either reflect a uniquely French practice, or compare French and Italian ornaments, German sources provide yet another perspective on the coexistence of oscillating and repercussive trill ornaments. Michael Praetorius’ (1571-1621) Syntagma Musicum (1615-1619) and Christoph Bernhard’s Von der Singe-Kunst oder Manier (1650) are the most significant sources in this category. Praetorius includes both trillo and tremolo in the ornament descriptions found in the third section of Syntagma Musicum. He offers the following description of the trillo:

There are two kinds of trillo. One occurs on a unison, either on a line or a space, when many notes are rapidly repeated. This is the type used by Claudio Monteverdi.

The second trillo is performed in a variety of ways. Indeed, it is impossible to learn how to perform a trillo properly from what has previously been written; it can only be learned

36 Bénigne de Bacilly, Remarque curieuses sur l’art de bien chanter (Paris: C. Blageart, 1688), 165.
37 Ibid., 164-167.
through the resources and demonstrations of a teacher, so that one learns by observing the other, just as one bird learns from another. Since I have yet not seen another Italian writer’s description of this type of *trillo* other than that by the aforementioned Giulio Caccini, but only the letters “t,” “tr,” or “tri” over the notes on which a *trillo* should be executed, I have deemed it necessary to include here some types in passing, so that the beginners of the present day will see and be informed of approximately what will be called a *trillo*.\(^{38}\)

This description is accompanied by two notated examples. The first, shown in Figure 1.16, includes several *trillo* variations intended to emphasize Praetorius’ description of Monteverdi’s *trillo*. The first variation is Caccini’s teaching *trillo*, followed by a similar acceleration in smaller note values, a third example initiated by several *ribattuta di gola*, and a final example with equal sixteenth notes. Although Praetorius creates two distinct examples of the *trillo* – one attributed to Caccini, and another to Monteverdi, I do not believe that Praetorius’ “Monteverdi” *trillo* is altogether a different ornament. A second chart of *trilli*, intended to accompany the description of Caccini’s *trillo* highlights instances where Caccini included *trilli* within *passaggi*, rather than as a cadential ornament. It is true that these types of *trilli* are more plentiful in Caccini’s compositions than in Monteverdi’s. This is not to suggest two entirely different ornaments or vocal processes, just to demonstrate the variety in *trillo* application by different composers, and the amount of flexibility and expressive capability afforded over longer note values.

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Praetorius’ definition of *tremolo* may include a crucial piece of information about its origin and performance, as well as the coexistence of the *trillo* and *tremolo*. He identifies the *tremolo* as a “wavering of the voice on a note,” and one that organists call a mordent.\(^{40}\) This is accompanied by several notated examples, including an “ascending” and “descending” note alternation, which either oscillates above or below the initial note. That Praetorius links the *tremolo* with organ practice and the *trillo* with vocal practice is a uniquely important separation. As will be discussed further in a later section dealing with instrumental practice for the *trillo*, this repercussive vocal ornament proves challenging for several instruments, most significantly keyboard and plucked string instruments. Differences in Italian and French vocal ornaments notwithstanding, the coexistence of the alternating *tremolo* and repercussive *trillo* in Italian music of the seventeenth century is likely resultant from their instruments of origin; the *tremolo*

\(^{39}\) Ibid., 237.

\(^{40}\) Kite-Powell, Praetorius Translation, 218
from keyboard and instrumental practice, and the *trillo* from the vocal practices of *gorgia* and *passaggi*.

Christoph Bernhard (1628-1692) echoed many of Praetorius’ descriptions in his 1650 treatise *Von der Singe-Kunst oder Manier*. He provides a comprehensive description of the *trillo*, which identifies it as the most difficult ornamental device. He specifies its creation in the throat, and that it should not change the quality of voice such that it has a bleating quality.\(^4^1\) Additionally, he recommends that one learn the *trillo* through frequent practice, a statement reminiscent of Zacconi and other authors discussed previously.\(^4^2\) Bernhard is the only writer to provide *trillo* examples that include dynamic indications within the ornament. These markings further emphasize the use of the *trillo* as an expressive or affective device with great variety in articulation, speed, and volume.

In an interesting passage about unornamented notes, Bernhard mentions the role of the *trillo* and the *tremolo*:

> The *fermo*, or keeping the steady voice, is required on all notes excepting where the *trillo* or *ardire* is used, and particularly the ornament of the *fermo* is to be understood, because the *tremolo* (which otherwise on the organ sounds good because of the change, the organ being able to make a tremolo on all pitches the same) is a fault, which is not used among old singers for artfulness but rather insinuates itself because they are not able to hold the voice steady. Whoever desires more evidence of the evils of the *tremolo*, let him listen to an old man making a *tremolo* when he is alone. Then he will be able to judge why the *tremolo* is not used by the foremost singers, unless on the *ardire*…\(^4^3\)

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\(^{4^2}\) Ibid., 7.

\(^{4^3}\) Honea, Bernhard Translation, 4-5.
This passage reveals several aesthetic principles of seventeenth century singing and insinuates a second definition of *tremolo*, which is different from the intentional oscillating ornament described by Praetorius. The primary vocalization being described in the passage, the *fermo*, should be understood as a confidence of voice that is free from unseemly vocal faults.

Specifically in this case, Bernhard warns against the *tremolo*, which to him is a successful ornament for organs, but unseemly in the voice. The description of the unstable vocal quality of older singers indicates that this *tremolo*, likely a model of the *tremulant* organ stop, is a vibrato which is obtrusive to the natural sound of a healthy voice. The instability in older voices is resultant from presbylarynx, or the ossification of soft cartilage during the aging process. I would encourage that this not be confused with the gentle oscillation of healthy vibrato, and that *fermo* not be understood as a description of straight-tone singing. The other ornament mentioned in this passage, *ardire*, is described later as tremolo or vibration made on the last note of a cadence.\(^44\) Though the description is rather unclear, I would imagine this is the oscillating cadential ornament called *tremolo* by Praetorius.

The sources in this section provide an interesting lens through which to view the development and employment of the *trillo*. Through their descriptions and notated examples, the accounts of Brossard, Praetorius and Bernhard reiterate two important points: that the repercussive *trillo* of Caccini and Monteverdi was identified as a predominantly Italian ornament throughout Europe, and that in the seventeenth century, it coexisted with an oscillating cadential ornament that is different from the *groppo*. Bernhard’s writing also reveals two definitions of *tremolo*, a term that could either identify an oscillating cadential ornament or a variation of vibrato akin to the tremulant stop on an organ. These coexisting principles suggest a melting pot

\(^44\) Ibid., 12
of musical styles and innovation that spread through seventeenth-century Europe. Though the terms may take on a more unified and singular definition in the eighteenth century and beyond, for this snapshot of history, understanding the terminology is heavily reliant on contextual and cross-referenced information.

**The Trillo in Instrumental Treatises**

The final category of sources through which to contextualize the trillo is the parallel practice of instrumental ornamentation. During the second half of the sixteenth century, the rise in publication of diminution treatises impacted both vocal and instrumental idioms. Exhaustive interval tables provided endless opportunities for transformation of multi-voice motets into elaborately decorated solo pieces for a single instrument, accompanied by either organ or ensemble. Several treatises include the trillo, groppo and other vocal ornaments in lists of graces, which could be used to modestly ornament a piece or create a moment of respite amid more virtuosic passaggi. This section will provide a brief sampling of accounts of the trillo from instrumental treatises.

Wind instruments, by nature of their construction and operation through exhalation, are perhaps that most comfortably able to reproduce a single-pitch repercussive ornament. Evidence of the trillo’s interpretation for wind instruments can be found in Girolamo Fantini’s (1600-1675) 1638 trumpet treatise *Modo per Imparare a sonare di Tromba*. He does not provide descriptions or name ornaments specifically but does include the abbreviations “G.” and “Tri.” for groppo and trillo, which can be found on page 11 of the publication. His notated examples are displayed in Figure 1.17. Though the placement of the symbols is somewhat misleading, I

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45 Girolamo Fantini, *Modo per Imparare a sonare di Tromba* (Frankfurt: Daniel Vuatsch, 1638)
believe he intends to label the oscillation in the first measure of each example as the *groppo* and the quick iterations that follow as the *trillo*.

Figure 1.17 Fantini’s *Groppo* and *Trillo*\(^{46}\)

Though only included in one example, the small 3 above the “a” in the first line matches the *trillo* notation of Conforto and Bernhard. It indicates note values which are further subdivisions of the notated values. It is interesting that the second measure of each example contains only a single vowel, whereas the *groppo* is to be articulated by tongued consonants that interrupt vowel shapes. It is possible that this notation reveals a limitation of the trumpet, that at some point the oscillations may become too fast or fatiguing to maintain and could then transition to repercussions that do not involve tonguing.

\(^{46}\) Ibid., 11.
In the excerpts and application exercises that occupy the bulk of the treatise, the *trillo* can be found in an example called, “Esercizio di Passaggi detto il Maffei,” likely authored by vocal pedagogue Giovanni Camillo Maffei, who wrote at length about the *trillo* and glottal articulation. In this excerpt, the *trillo* occurs only at cadences, like the one shown in Figure 1.18. The letters “tr.” appear over this and other notated *trilli*, as well as above several other cadence varieties of both ascending and descending seconds. I cannot imagine that all “tr.” symbols throughout the treatise represent the repercussive *trillo*, especially with dozens of composers represented in the excerpts, but we can be certain of Fantini’s direction in clearly notated examples like those in Maffei’s excerpt.

![Figure 1.18 Fantini’s Esercizio di Passaggi detto il Maffei](image)

In the bowed-string idiom, a description of the effect and performance of the *trillo* can (perhaps) be found in Jean Rousseau’s (1644-1699) treatise *Traité de la Viole*. He provides an overview of ornamentation in the third section, entitled *Des Agréments*. Therein, he discusses the cadence, or *tremblement* at length through the course of four chapters, during which he describes how to perform a *cadence* with and without *appuyé*, or upper neighbor suspension. In each case, he characterizes an oscillating ornament, and even describes the *cadence* as having two distinct parts: the *appuyé* (suspension) and the *tremblement* (oscillation). The ornament described by Rousseau that is most similar to the *trillo* is the *batement*:

The *batement* is made when two fingers are pressed together, one pressing on the string and the other beating gently. The *batement* imitates a certain sweet agitation in the voice.

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47 Fantini, 78
in songs, that is why it should be practiced whenever the note value allows, and it lasts the entire duration of the note.48

Rousseau lists the batement amid la langueur and la plainte as ornaments that escape adequate definition in writing. He also lists the batement in the introduction to Les Agréments as ornaments that needs that requires frequent practice by viol players in order to imitate the voice, but that singers would be less likely to practice them because they are more idiomatic and naturally suited to the voice:

The standard ornaments that the voice practices are la cadence ou tremblement, the port de voix, l’aspiration, la plainte, la cheute and la double cadence. The viol practices those same ornaments, as well as playing le martellement, le batement, and le langueur, which are not specified for voice [to practice], because [the voice] practices them naturally, but it is necessary to specify them for instrument, because we would not practice them otherwise.49

For Rousseau, the voice and the viol are deeply connected. He names the viol as the instrument most like the voice and recommends the voice as the model upon which viol players should base their ornaments.

In modern scholarship, the employment of the trillo by string players has been discussed by violinist Stanley Ritchie in his book Before the Chinrest. His characterization of the trillo and tremolo are reminiscent of the two trillo definitions from Brossard’s dictionary of musical terms.

Of the trillo, Ritchie says:

The trillo, not to be confused with the trill, is an ornament frequently found in Italian music of the late sixteenth and early seventeenth century… it consists of the accelerated repetition of a note, usually on a cadence… it is a typical vocal embellishment but

48Jean Rousseau, Traité de la viole (Paris: Christophe Ballard, 1687), 101. “Le batement se fait lors que deux doigts estant pressez l’un contre l’autre, l’un appuye sur la chorde, et le suivant la bat fort legerement. Le batement imite une certaine agitation douce de la Voix sur les Sons; c’est pourquoy on le pratique en toutes rencontres quand la valeur de la Nate le permet, et il doit durer autant que la Note”.
49Rousseau, 75. “Les agréments ordinaires que la Voix pratique sont, la Cadance ou Tremblement, le Port de Voix, l’Aspiration, la Plainte, la Cheute et la double Cadence. Le Viole doit pratiquer ces mesmes Agrément, ausquels il faut encore ajouté le Martellement, le Battement et la Langueur, qui ne sont point specifies pour la Voix, parce qu’elle les pratique naturellement, mais il faut les specifier pour l’Instrument, parce qu’on ne les pratiqueroit pas autrement.”
perfectly acceptable for use on the violin. One may opt to do something more complex by combining the ribattuta and the trillo.\textsuperscript{50}

This is immediately followed by a description of the tremolo:

The tremolo, in turn, should not be confused with the modern ornament of the same name. In early seventeenth-century violin technique, tremolo was a kind of right-hand vibrato...a pulsation on one pitch in imitation of the tremulant organ stop.\textsuperscript{51}

Finally, in the keyboard idiom, the groppo and tremolo are described in Girolamo Diruta’s (1546-1625) monumental treatise Il Transilvano (1593). As mentioned earlier in this section, it would seem that the construction and operation of keyboard instruments are fundamentally at odds with the concept of an unmeasured, repercussive ornament. The time limitations of the instrument’s haptic response would severely limit the speed at which an imitation of the trillo could be navigated on a keyboard. Additionally, the effect of the gentle repercussion may be entirely lost by the repetitive plucking of strings on a harpsichord. As evident in other string instruments, there is never a recommendation that the trillo be imitated by plucking or pizzicato techniques. This chasm, in addition to the existence of a tremulant stop, could be a feasible source of the conflict and confusion between the terms trillo and tremolo in the sixteenth and seventeenth century.

In Diruta’s examples, the groppo and tremolo are both oscillating ornaments, though they differ in speed, direction of oscillation, and finger usage. In Diruta’s examples the groppo always oscillates with the lower neighbor to the primary note, whereas the tremolo always oscillates with the upper neighbor. Though there is probably flexibility for varying speeds in performance, Diruta’s groppo examples are always written in eighth (semiminim) and sixteenth (chrome)


\textsuperscript{51} Ibid., 68.
notes. Tremolo examples are exclusively notated in thirty-second (semichrome) notes. In the dialogue about the groppo, Diruta instructs that it is to be made with the fourth and third fingers of the right hand or the second and third fingers of the left.\textsuperscript{52} He later instructs that the tremolo is played primarily with the second and third fingers of right hand and the third and second fingers of the left.\textsuperscript{53}

**Conclusion**

The sources discussed in this section are among the foremost instructional treatises of the sixteenth and seventeenth centuries, and the most important sources for assessing the character and performance of the trillo in vocal repertory, as well as its application in instrumental music. It is clear from these sources that the trillo was primarily an Italian vocal ornament that emerged in the last quarter of the sixteenth century, flourished with the development monody in the first half of seventeenth century, and perhaps was used less frequently beyond the mid-seventeenth century. It is included in a few French sources but does not seem to have a parallel structure or use in contemporaneous French vocal music. It would, however, be a necessary ornament for French singers who studied or sang in the Italian style. The frequent use of the term tremolo has historically posed challenges in studying and understanding the trillo. Sources published outside Italy help clarify that both the trillo and tremolo accumulated multiple definitions in the seventeenth century. “Trillo” would have been used to identify both the repercussive ornament that is the subject of this study, as well as a slower beating that imitated the tremulant stop of an organ. The word “tremolo” was used by a few authors, most notably Bovicelli, to describe, by my assessment, the same repercussive ornament identified by the word trillo. More commonly,

\textsuperscript{52} Girolamo Diruta, *Il Transilvano* (Venice: Alessandro Vincenti, 1597), 19.

\textsuperscript{53} Ibid.
tremolo was used to identify an oscillating ornament of the same nature as the French cadence or tremblement. Another definition of tremolo is a vocal ornament in imitation of the tremulant stop of an organ, which may be considered a type of vocal vibrato. By that definition, tremolo is synonymous with the second definition of trillo.

The critical difference between the trillo and the tremolo is the behavior of the vocal folds. In most sources, the trillo and groppo are closely connected to the term gorgia, the throat articulation associated with the performance of passaggi in the late sixteenth and early seventeenth centuries. An investigation and comparison of these phonation types is provided in the second chapter of this study.
Chapter 2: The *Trillo* in Voice Science

Another lens through which to study the *trillo* is voice science and anatomy. From the sixteenth-century developments in anatomical study to the high-speed laryngeal imaging available today, it is clear that comprehensive understanding of the *trillo*, and of vocal function in general, involves interdisciplinary collaboration between scholars, singers, vocologists and speech language pathologists, among others. This section developed from an independent study guided by Dr. Rita Patel, with research support from Dr. Steven Lulich, both of whom serve on the Speech Language Pathology faculty at Indiana University - Bloomington.

The impetus for this second section is to investigate the term “throat articulation,” a loose translation of the concept of *cantare con la gorgia* “to sing with the throat,” that developed through the diminution treatises of the sixteenth century. In his 1562 letter on singing, vocal pedagogue and doctor Giovanni Camillo Maffei makes mention that “the method of making the throat suitable and fit for *passaggi* has never been written, either by the ancients nor by the moderns.”[^54] He goes on to explain that it would take someone who is a musician, doctor and philosopher, much like himself, to authoritatively speak on the subject. He describes the character of a “passaggio voice” as:

> delicate and controlled with intention of pleasing the ear, it produces a difference from the delicate voice that one hears in laughing and similarly in cough, which, however is delicate but is not controlled, nor does it please the ear… it cannot be produced unless from a pliable and soft instrument[^55]  

[^55]: Honea, Maffei Translation, 15.
The paragraph that follows is perhaps the most widely quoted passage from Maffei’s letter, where he discusses precisely where passaggi are made:

I want to talk about the place where diminutions are made. It is the same place where voice is formed, that is, the cartilage called cimbalara, as we have seen, which, when it is constricted or dilated by the sinews we have mentioned...breaks and strikes the air so minutely that the desired singing is produced by everyone.  

Without the context of other vocal anatomy, it is not immediately clear which cartilage he refers to as cimbalara. The following passage from an Italian anatomy and medicine book from 1845 makes clear that cimbalara is the name of the arytenoid cartilage, which include the vocal folds in their structure.

The part above the trachea, where the voice is formed, has three cartilages; the large one in the front appears like a graven target or shield (thyroid cartilage), another cartilage, without a name, occupies the space left by the first (cricoid cartilage), and a third cartilage, in the middle, is called the cimbalara (arytenoid cartilage), and a tab/tongue similar to that of a flute (epiglottis).

This is a basic description of the four structural cartilages of the larynx and is consistent with modern vocal pedagogy.

Maffei’s letter of 1562 is among the earliest pedagogical writings to identify vocal structures and their functions. While his anatomical specificity certainly is unique among contemporaneous music writings, his letter is dated twenty years after discourse-altering advancements in the field of human anatomy. Published in 1543, Andreas Vesalius’ De Humani

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57 Salvatore de Renzi, *Storia della Medicina in Italia* (Napoli: 1845), 261-262. “La parte superiore della trachea destinata alla formazione della voce ha tre cartilagini, una anteriore più grande, detta clipeata o scutata; un altra cartilagine, senza nome, compie lo spazio lasciato della prima; ed una terza cartilagine e posta in mezzo e chiamasi cimbalara, ed a una linguetta simile a quella del flauto.”
*Coporis Fabrica*, is an enormous, seven-volume publication which provides detailed accounts of the structures and systems of the human body. It is among the most famous works in the history of medical studies and is largely credited as the foundation of modern studies in human anatomy.\(^{58}\)

Andreas Vesalius (1514-1564) was born in Brussels, son of the chief apothecary at the court of Holy Roman Emperor Charles V. He studied at the University of Leuven, a program which was heavily influenced by Arab medicine, explaining references to Turkish customs and names throughout Vesalius’ writing.\(^{59}\) He later received a Doctorate from the University of Padua, where he became familiar with anatomical dissection techniques and was eventually tasked with giving anatomical demonstrations.\(^{60}\) As his research progressed, he grew increasingly critical of the ancient texts of Galen, the Greek physician whose writings were among the most important to survive from antiquity. Vesalius discovered that Galen’s view of human anatomy came not from dissection of the human body, but instead from simian (primate) dissections. With Vesalius’ dissection of human bodies, his findings would set a new standard of knowledge.

*De Humani Coporis Fabrica* includes over 140 illustrations of anatomical structures discovered through cadaver dissection. The first book includes the anatomy of the human skeleton, including detailed drawings of the primary vocal structures. Figures 2.1 and 2.2 include Vesalius’ image of the entire vocal apparatus – lungs, trachea, laryngeal structure, as well as a further dissected chart of each laryngeal cartilage independently.

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\(^{60}\) Ibid.
Figure 2.1 Vesalius’ Vocal Apparatus\textsuperscript{61}

Figure 2.2 Vesalius’ Laryngeal Structures\textsuperscript{62}

\textsuperscript{61} Andreas Vesalius, \textit{De Humani Corporis} (Basel: Johann Oporinus, 1555), 151.
\textsuperscript{62} Ibid., 152.
Vesalius’ overview of the cartilage structures includes both physical descriptions, points of connection and etymological explanations for the formal names. For example, the first [thyroid] cartilage is so named because of its resemblance to an elongated Turkish shield, the second [cricoid] cartilage is ring shaped, taking its name from resemblance to Turkish archery thumb rings, and the third [arytenoid] cartilage derives from the Greek word for ladle, as its shape resembles the spout of a jug. Vesalius also described the nature of voice production:

The cleft in the larynx is formed in the middle of the laryngeal cavity by two processes of the third cartilage covered by a fatty membrane. They call this cleft *glottis* (Latin *lingula*) from a similarity to the tongues formed from two thin reed strips pressed together in wind instruments.

This accurately describes the glottis at the space between the two vocal folds, which are indeed structures of the third [arytenoid] cartilage and are covered by a mucous membrane. In the preface to the modern edition of Vesalius’ treatise, editor and Professor of Medicine John Burd Carman deemed Vesalius’ anatomy as accurate, largely complete and “comparable in all important ways with modern standard descriptions provided in comprehensive textbooks.”

He also explains that Vesalius’ most significant innovation to the field of anatomy was the use of the human body for dissections, where his predecessors primarily dissected horses, pigs, dogs and other animals, and speculated that their structures would correspond to human anatomy.

In book six of *De Humani Coporis Fabrica*, Vesalius writes at length about the function of the vocal mechanism, and the interconnectedness of its parts. He explains the bore-like nature of the pharynx, likening it to the tubing of pipes, flutes, and horns. He also describes the delicate balance of symmetry and strength that is needed for air to impact the cartilage of vibration.

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63 Richardson and Carman, Vesalius Translation, 364.
64 Ibid.
65 Ibid., xxxvi.
About the interconnectedness of the vocal apparatus, Vesalius compares the relationship between the vocal folds and the surrounding musculature to the ineffectiveness of the tibia without its surrounding ligaments and membranes. For vocal folds alone create only sound, much like lip vibration and adjustments made by brass players, whereas the resonators impacting the shape of the bore ultimately determine the sound that it heard.66

Another source to document anatomical investigation that has recently garnered attention is the drawing collection of Leonardo DaVinci. In the later period of his life, namely the years between 1508 and 1513, DaVinci directed his research efforts toward human anatomy and other scientific interests. He dissected roughly thirty human corpses and his writings include the first clear descriptions of coronary vascular occlusion, asteriosclerosis and cirrhosis of the liver.67 While his drawings are perhaps more intricate and detailed than Vesalius’, Martin Clayton and Ron Philo have assessed that DaVinci’s drawings are “based on a blend of traditional (and often ancient) beliefs, animal dissections, proportional analysis and mere speculation.”68

One of DaVinci’s drawings from Anatomical Manuscript A, shown in Figure 2.3, includes several drawings of laryngeal structures. DaVinci drew nearly a dozen iterations of laryngeal structure from different angles. While largely correct, there are several variations in the proportions and shape of laryngeal structures, perhaps suggesting some derivation from animal dissections.69 For example, there is considerable variation in the depictions of the thyroid cartilage – each of three thyroid cartilage depictions are indicated with red arrows in Figure 2.3. Whereas the upper and middle images are similar, both to each other and to the shield-shape

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66 Vesalius, 446-447.
68 Ibid., 14.
69 Ibid., 166.
depicted by Vesalius, the thyroid cartilage in the left drawing appears to be larger, longer, and more angled in shape than the others.

Figure 2.3. Larynx Drawings of Leonardo da Vinci

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70 Clayton & Philo, 167 – DaVinci drawings 57a.
While DaVinci’s drawings are largely correct and demonstrate increased interest and understanding in anatomy nearly 35 years before Vesalius’ publication, several issues surrounding their lack of circulation make them a problematic source. Upon DaVinci’s death in 1519, his drawings were left to his longtime friend, Francesco Melzi and disappeared from public view until the eighteenth century. For nearly 200 years, the drawings were sold and privately held by noblemen in Italy, Spain and England, eventually ending up in the collection of King George III and later published in Albrecht von Haller’s 1774 publication *Bibliotheca Anatomica*.71 DaVinci’s drawings are still held in the Royal Library at Windsor castle and were published in facsimile between 1898 and 1916, with a complete facsimile available in 1979.72 In their final assessment of DaVinci’s drawing, Martin Clayton and Ron Philo observe, “He is an oddity – a scientist who made great strides in his field and yet had no perceptible influence on its wider development.”

What is clear from the work of Vesalius and DaVinci is that anatomical study was highly advanced nearly half a century before Maffei’s letter on singing. While his anatomical and functional descriptions are correct, they are hardly novel when placed amongst the anatomical development and writings from a generation earlier. Much like the intention of this dissertation, Maffei’s work served an interdisciplinary purpose which brought relevant anatomical and functional knowledge to the world of singing so that it might be useful to singers and teachers of *passaggi*.

71 Clayton & Philo, 26.
72 Ibid., 29.
The *Trillo* in Modern Voice Science

A small body of modern scientific research about the *trillo* flourished between 1985 and 1992, with much of it produced between 1987 and 1990 by a team composed of Jean Hakes, Thomas Shipp, and E. Thomas Dougherty. In each of three studies, the team employed various forms of acoustic analysis to compare production of the *trillo* to production of straight tone, exaggerated vibrato, and the oscillating trill. In their preliminary study, “Acoustic Properties of Straight Tone, Vibrato, Trill, and Trillo,” they analyzed recordings of four singers who specialized in early music, including two who were “in demand for important performances of new music as well as for their usual work in early music.”

They describe the *trillo* as “a one-pitch ornament, with reiteration of the sound at varying intervals,” and outline two different types of *trillo* production. The first is “initiated immediately at phonation onset,” while the second is “initiated with slow pulses” that gradually speed up to match the first. These two types of production demonstrate the difference between the trillo as placed amid *passaggi*, and Caccini’s teaching *trillo*, which may have also been used as a cadential pattern.

Figure 2.4 presents fundamental frequency variation and an oscillographic wave form of each type of *trillo* over a 5 second period. Hakes, Shipp and Dougherty’s Figure 9 is a recording of a *trillo* initiated immediately at phonation onset, and Figure 10 is a *trillo* with slower initial pulses. The difference between these two examples can be seen between seconds one and two in the oscillographic wave forms. The slower pulses appear in clearer separation in second two before the speed of the first *trillo* is reached. In this case, Hakes, Shipp and Dougherty measured

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74 Ibid., 149.
75 Ibid.
a trillo rate of 7.4 hertz, or oscillations per second.\textsuperscript{76} They found a similar oscillation rate in the second half of the trillo in the example on the right, their named “Figure 10.”

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure24.png}
\caption{Acoustic Imaging of Two Trillo Variations\textsuperscript{77}}
\end{figure}

After publishing their initial findings in 1987, the same team published a more complete study, “Acoustic Characteristics of Vocal Oscillations: Vibrato, Exaggerated Vibrato, Trill and Trillo” in 1988. The removal of straight tone from this second publication is likely due to the difficulty in determining oscillation rates in a sound that is characterized by imperceptibility of oscillation. This study focuses on the oscillation rate, frequency extend, and jitter of each vocal ornament produced by ten early music singers.\textsuperscript{78} Exaggerated vibrato was defined as “vibrato wherein the singer allows the frequency range to extend as much as possible,” and the definition of trillo was expanded from the previous article as “performed either on a single note or as a technique for executing rapid scale-like passages.”\textsuperscript{79} They go on to explain the production of the trillo for the purpose of their study:

\textsuperscript{76} Hakes, et al. (1987), 149.
\textsuperscript{77} Ibid., 154.
\textsuperscript{79} Ibid., 326.
Perceptually, it is heard as a rhythmic interruption, or near interruption, of phonation that typically begins slowly with individual pulses separated by a short silent period and then often increases in rate to something resembling a vocal imitation of machine gun firing, albeit without the accompanying cacophony.\textsuperscript{80}

Though lacking in grace, this description does a fine job of characterizing the \textit{trillo} to a lay reader or non-specialist.

The average oscillation rates reported in this study can be found in Table 2.1. The team concluded that the \textit{trillo} has significantly higher oscillation rates and jitter measures than vibrato, exaggerated vibrato, or the oscillating trill. They credit these distinctions to an entirely different use of the vocal mechanism: “vibrato and trill from oscillating pitch-changing musculature and trillo by faster-acting muscles of vocal fold adduction and abduction.”\textsuperscript{81}

<table>
<thead>
<tr>
<th>Phonation Type</th>
<th>Oscillation Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vibrato</td>
<td>5.68 Hz</td>
</tr>
<tr>
<td>Exaggerated Vibrato</td>
<td>5.82 Hz</td>
</tr>
<tr>
<td>Oscillating Trill</td>
<td>6.48 Hz</td>
</tr>
<tr>
<td>Trillo</td>
<td>9.31 Hz</td>
</tr>
</tbody>
</table>

\textbf{Table 2.1 Mean Oscillation Rates of Vibrato, Exaggerated Vibrato, Trill, and Trillo}\textsuperscript{82}

In the discussion that concludes the article, Hakes outlines a shift in \textit{trillo} performance practice in the second half of the twentieth century.

There are still two schools of producing trillo. One is about the 1950 school, the old-fashioned kind which was pulsed from the diaphragm and was much slower; and the

\textsuperscript{80} Hakes, et al. (1988), 326.
\textsuperscript{81} Ibid., 329.
\textsuperscript{82} Ibid., 327.
contemporary\textsuperscript{83} which are measured where everybody’s going as fast as he can, with, as they described to me, a very light stroke of breath.\textsuperscript{84}

In their final study, “Trillo Rates Exhibited by Early Music Singers,” Hakes, Shipp and Dougherty sought to compare the oscillation rates in the slow and fast trilli. Slow, measured trilli were characterized by interaction between the abdominal and laryngeal muscles, resulting in mostly discontinuous iterations and slower oscillation than the quicker trilli that are in practice today.\textsuperscript{85} The quicker, variable rate trilli are modeled after Caccini’s teaching trillo from Le Nuove Musiche (1601). This trillo is described as:

The newer trillo, which is initiated with the traditional beginning of a few slow, sometimes disconnected utterances, erupts when the singer releases a string of light cascades of vowel repetitions capable of reaching extremely high rates.\textsuperscript{86}

The results of this study reported slow trillo rates ranging from 2.01 to 6.88 Hz, the upper end of which would represent the threshold of control a singer has over reiterations before the rate becomes unmeasured. Fast trillo rates ranged from 7.46 to 12.42 Hz, further supporting the mean of 9.31 Hz from the 1988 study, nearly encompassing the oscillation rate of 7.4 Hz reported in 1987.

The designations of a trillo being formed or unformed, fast or slow function in two different, though related categories of identification. The terms formed and unformed describe the vocal preparatory gesture, or lack thereof. The formed trillo contains initial, separate vocal gestures that gradually accelerate until the articulation becomes unmeasured, or uncontrolled by the singer. This concept encompasses Caccini’s teaching trillo, and may also included long

\textsuperscript{83} 1980’s
\textsuperscript{84} Hakes, et. al. (1988), 331.
\textsuperscript{86} Ibid., 305.
cadential trilli, depending on how they are performed. Conversely, the unformed trillo is performed with little to no preparatory gesture and is most frequently performed amid passaggi or when the note value is too small to accommodate preparation or acceleration. This type of trillo may include a ribattuta di gola as a quick preparation, but largely does not involve acceleration. The terms fast and slow are used to classify trilli based on the speed of same-note repercussions. The defining factor in this classification whether the singer maintains control over each repercussion. If Caccini’s teaching trillo is seriously considered as a pedagogical tool, its goal is to train the muscle coordination to produce a fast trillo. The fast trillo contains largely uncontrolled repercussions. The rate of the fast trillo may have considerable variation from singer to singer, but relative lack of control indicates that relatively little variation in fast trillo rates in a single singer. During a slow trillo, the singer maintains control over each repercussion. This categorization encompasses both the preparatory, accelerating repercussions of Caccini’s teaching trillo, and several varieties of notated repercussion, such as the sixteenth note repercussions found in Monteverdi’s “Duo Seraphim.” The trillo, therefore has two tiers of classification under the system described here. First, a trillo may either be formed or unformed. Within those categorizations, a formed or unformed trillo can either be fast or slow. All of these categorizations, formed, unformed, fast, and slow, are ultimately a result of performance practice and the actual performance of a singer. They may be suggested by the notation found in various repertories, but the printed notation cannot confirm any of the categorizations named here.

In 1992, Lawrence Brown and Ronald Scherer conducted a study called “Laryngeal Adduction in Trillo,” in which they tested the hypothesis that alternating adduction and

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87 See section 3, Figure 3.4
abduction of the vocal folds is the primary characteristic of the *trillo*. They accurately describe the *trillo* as a written and improvised vocal gesture from the sixteenth and seventeenth centuries and highlight the significance of studying it:

> The study of the *trillo* is important not only from the pedagogical view of preparing singers for performances using this vocal ornament, but also from the scientific view of understanding phonatory control in general.

Though their data was not collected simultaneously, Brown and Scherer studied the *trillo* through both acoustic analysis, laryngeal imaging, and electroglottography. Their findings of a mean iteration rate at 9.4 Hz corroborate those reported by Hakes, et al., and their electroglottogram (EGG) signals corroborate earlier reports that there is no actual silence between iterations of the *trillo*. Figure 2.5 displays their schematic of the larynx as seen through video laryngoscopy during *trillo* production. They describe the *trillo* as having a dilated phase and a constricted phase, characterizing small changes in the space between the vocal processes. Ultimately, they concluded that “three measure of laryngeal adduction [EGG width, EGG height, $Q_a$ (closed quotient)] indicated that the reiterations of the same note corresponded to rapidly alternating laryngeal abduction/adduction.” While they calculated the glottis to be “about two and a half times wider at the vocal process in the dilated (abducted) phase *trillo* compared to the constricted (adducted) phase,” they neither describe a full opening nor full closing of the glottis, as would be expected during breathing, or significant movement of the arytenoid cartilages.

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89 Brown and Scherer, 27.
90 Ibid., 29.
91 Ibid., 35
92 Ibid., 32.
Three years later, Lawrence Brown partnered with Joy Sherman to publish “Singing Passaggi: Modern Application of a Centuries-Old Technique,” an article examining articulation strategies employed by choral musicians during melismatic passages. They identified four potential strategies – (1) mentally repronouncing the vowel, (2) abdominal or diaphragmatic

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93 Brown & Scherer, 32.
pulsation, (3) adjusting vibrato to match the rate of passaggi and (4) glottal articulation characterized by alternating adduction and abduction. In order to analyze these techniques, they used acoustic analysis, laryngeal imaging and an airflow transducer. It should be noted that their research was not conducted using iterations on the same note, but rather a melismatic passage where the pitch changes every sixteenth note. Their microphone and electroglottograph waveforms, shown in Figure 2.6, document clearer aural separation between notes with the use of glottal articulation than in either of the other three techniques.

![Waveforms](image_url)

**Figure 2.6 Sherman & Brown’s Simultaneous Microphone and EGG Waveforms.**

The pinched portions of the microphone waveform for glottal articulation represents significant decreases in sound between pitches. While abdominal pulsations have a similar, though less dramatic pattern, both vowel repetition and vibrato matching involve relatively high

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94 Sherman and Brown, 28.
95 Sherman and Brown, 29.
volume between pitches, reducing the aural perception of separation. Robert Greenlee described this phenomenon in his 1987 article “Dispositione di Voce: Passage to Florid Singing:”

Either periodic fluctuations of pitch and volume of vibrato, or the pressure from a short pulse in the diaphragm, is used to make one note seem separate from the next. But the articulation is only an acoustic illusion, because the muscles of the larynx do not lock into specific notes but instead cross all frequencies between any two notes (a very quick portamento).96

Although Sherman and Brown’s laryngeal imaging is not included in the article, they do describe glottal articulation as unique among the four techniques:

The adductory musculature (primarily lateral cricoarytenoids) hold the medial and anterior portions of the glottis approximated, while the posterior portion of the glottis, including the arytenoid structures, opens and closes with each note of the passage. It appears that the interarytenoid muscles (transverse and oblique) are largely responsible for this laryngeal “valving” mechanism.97

It is unclear how they determined the exact muscles responsible for each action without monitors for muscle engagement. Unless the singer was breathing or simulating inspiration (breathing in) between each note, it is unlikely that the arytenoid cartilage structures would separate while maintaining anterior closure of the vocal folds. This is the first study to have examined glottal articulation through laryngeal imaging. While it’s possible that their subject did have the laryngeal positioning described, the technique does not seem sustainable or particularly healthy over a long period of time.

Sherman and Brown’s third method of study involved comparing airflow waveforms. Like their findings in the previous two methods, glottal articulation was quite different from the

97 Sherman & Brown, 31.
other three techniques. The airflow form, shown in Figure 2.7, presents clear fluctuations in airflow between pitches, indicating some sort of airflow impedance.

![Glottal Articulation](image)

**Figure 2.7 Airflow Waveform of Glottal Articulation**

Research about the *trillo* is also passively mentioned in voice science articles about voice production in giggle gestures and the role of diaphragmatic activity in singing. In 1997, a research team including Ingo Titze studied the giggle to determine the frequency and number of vocalized bursts created, hypothesizing that a neuromechanical oscillator is the activator of rhythmic vocalizations. They reported a mean giggle frequency of 5.4 Hz, though several giggles were 7.0 Hz or higher. This figure is just below the frequency rate of vibrato (5.68 Hz) and exaggerated vibrato (5.82 Hz) reported by Hakes, Shipp, and Dougherty, which is

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98 Sherman & Brown, 30.
100 Ibid., 647.
significantly lower than their reported *trillo* rates. However, giggles that are above 7.0 Hz could be more closely related to the *trillo*, reported at 9.31 Hz.\(^{101}\)

Through insertion of bipolar hooked-wire electrodes, Titze et al. also analyzed the activity of the posterior cricoarytenoid (PCA), and either the lateral cricoarytenoid (LCA) or thyroarytenoid (TA), the primary muscles of onset and offset respectively. They found that these muscles remained “potentiated throughout the giggle... neither muscle shuts down, but they alternate in raising and lowering the activity to produce the repeated voice onsets and offsets.”\(^{102}\)

The group goes on to suggest the possibility that the reiteration speed is heavily reliant on the muscles:

> LCA and TA activities lead voice onset by 30-35 milliseconds, and PCA activity leads voice offset by 20 milliseconds, on average. These lead times are very close to the twitch activation time reported in the literature for these muscles, which suggests that the frequency of the giggle bursts may ultimately be limited by the speed of the muscles.\(^{103}\)

While the giggle seems to share a characteristic repercussion, the lack of control over output makes it difficult to compare to the *trillo* or coordinated glottal articulation. Titze et al. tentatively posited that fundamental frequency, loudness, voice quality and vowel are not specifically controlled during giggle outbursts.\(^{104}\)

Another area of research related to *trillo* production involved investigation into the role of the diaphragm during singing. In 1987, a research team composed of Rolf Leanderson, Johann Sundberg and Curt von Euler employed the *trillo* as one of five vocal exercises through which to analyze diaphragmatic activity. They describe the *trillo* as “a special kind of trillo, which is sometimes used in vocal renaissance music. It consists of several repetitions of the same note

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103 Ibid.
104 Ibid., 644.
interleaved by short silent intervals during which the vocal folds are abducted.” Though this description is not entirely accurate, it does seem to describe the same vocal function.

Figure 2.8 is a chart of esophageal, gastric, and transdiaphragmatic pressure, as well as fundamental frequency and sound level during the trillo as performed by their participants. At the one-second mark beneath the sound level, we can observe five oscillations. This indicated the performance of the slow trillo studied by Hakes, Shipp, and Dougherty, in which there is no sound connecting iteration, and the glottis is likely to abduct between each burst.

![Trillo Chart]

**Figure 2.8 Trillo Patterns as Measured by Leanderson, et. al.**

The fundamental frequency (F₀) line, which includes disconnection between each iteration further confirms that the sound stopped between each iteration. Leanderson et. al., described this function as “rhythmical closing and opening of the glottis.”

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106 Ibid., 264.
107 Leanderson, et al., 264.
the glottis between iterations explains their finding that “quick reductions of subglottal pressure required during the unvoiced segments of the trillo was obtained by phasic diaphragmatic activity reducing the intrathoracic pressure to zero.”^108 Phasic diaphragmatic activity describes the rapid response of the diaphragm to other stimuli, like the opening and closing of the glottis, and is contrary to tonic (non-phasic) activity which adapts more slowly and affects a stimulus.

Though there is ample research available through modern voice science, all studies about the trillo discussed above were conducted between 1987 and 1995. The research is nearly thirty years old and was conducted during the rapid growth of early music as an independent field in the United States. Because of this, the definition and performance of the trillo, as well as understanding of its historical significance and development has not yet been fully established. With support from Dr. Rita Patel and Dr. Steven Lulich, a key part of my original research has involved the voice science lab at Indiana University, using my own voice and trillo technique as a case study.

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^108 Leanderson, et al., 263.
The Trillo: A Comparative Study

In order to recreate and evaluate findings of the scholars discussed previously in this section, we created a comparative study to analyze five vocal functions: straight tone, intentional vibrato, oscillating trill, and two variations of trillo, formed and unformed. The formed and unformed distinctions closely correlated to Bovicelli’s bifurcation of trillo formato and trillo non formato. The former, associated with Caccini’s teaching trillo, involves rapid acceleration. The latter, two ribattuta di gola followed by unmeasured repercussions without acceleration. Our comparison between these vocal functions encompassed acoustic analysis, laryngeal imaging, and measurement of diaphragmatic activity. Each exercise was completed on the penultimate note of a descending whole-step cadence from G4 to F4 on the vowel [i] at the pitch standard A4 = 415 Hz, as displayed in Figure 2.9.

![Figure 2.9 G4-F4 Descending Whole-Step Cadence.]

Description of Vocal Functions

Notated examples of functions 3-5 can be found in Figure 2.10.

1. **Straight Tone**: Intentional limitation of audible pitch oscillation, created with healthy, well balanced, efficient vibration, such that at any moment, consistent and natural vibrato could be voluntarily released.

2. **Vibrato**: Intentional release of vibrato, which in healthy voice function produces audible oscillations that are consistent in both rate and extent.
3. **Oscillating Trill**: A standard upper-note trill, beginning on A4, with pitch oscillation between A4 and G4 that gradually increased in rate, before descending to F4.

4. **Formed Trillo**: Modelled after Giulio Caccini’s teaching *trillo*, as printed *Le Nuove Musiche* (1601), the formed trillo rapidly accelerates from quarter-note pulses to the quickest reiterations possible for a given singer.

5. **Unformed Trillo**: The unformed *trillo* includes several *ribattuta di gola* [rebeating of the voice], which descend from A4 to G4, before erupting into the quickest iterations possible for a given singer.

![Oscillating Trill](image1)

![Formed Trillo](image2)

![Unformed Trillo](image3)

**Figure 2.10 Notated Examples of Oscillating Trill, Unformed and Formed Trillo.**
Description of Instruments Used

1. Omni-directional microphone mounted 10-12 centimeters from the mouth at a 45-degree angle, used for collection of audio recording for acoustic analysis. Sampling rate > 44.1 kHz, Quantization >16 bits

2. Bands for measuring respiratory kinematics were placed around the subject’s waist and chest to measure movement and changes in lung volume between the abdomen and the thorax.

3. A flexible endoscope high-speed video endoscopy was used to visualize and monitor the vocal folds during various types of phonation, positioned in full view of laryngeal structures.

Findings

Acoustic analysis of exercises trimmed to one second duration revealed oscillation rates for vibrato, oscillating trill and trillo similar to those observed by Hakes, Shipp, and Dougherty in 1988. The trillo and vibrato rates also fall within the oscillation rate ranges published by the same team in 1990. Table 2.2 displays how each oscillation type compared with the precedent studies. These figures were determined by counting oscillations during a one-second frame. The straight-tone example was not included in the acoustic analysis due to lack of clear oscillation occurrences. This may have also been the case for Hakes, Shipp, and Dougherty, who included straight-tone in their initial trillo study, but not in later iterations.
### Phonation Type | Rate (Hakes, et.al 1988) | Rate (Current)
--- | --- | ---
Vibrato | 5.68 Hz | ~ 5Hz
Exaggerated Vibrato | 5.82 Hz | N/A
Oscillating Trill | 6.48 Hz | ~7 Hz
Trillo | 9.31 Hz | N/A
Trillo (Unformed/Slow) | N/A | ~7 Hz
Trillo (Formed/Fast) | N/A | ~12 Hz

**Table 2.2 Oscillation Rates of Vibrato, Oscillating Trill, Formed Trill**

The rates of the formed and unformed *trilli* were nearly twice as fast as the oscillation rate for vibrato. Though the oscillation rates for vibrato and the oscillating trill are more similar, the two exercises differ in extent. The oscillating trill has the greater extent of the two. The similarity in oscillation rates of the unformed and formed *trillo* indicates that the preparation, or lack of preparation prior to the most accelerated oscillation rate does not appear to impact the speed of oscillation.

The high-speed video endoscopy also revealed differences between the *trillo* variations and other types of phonation. The *trilli* samples are noticeably more erratic and occasionally contain a more dilated glottis than other samples. The formed *trillo*, modelled after Caccini’s teaching *trillo*, includes a peculiar vocal fold behavior. During the gaps between each iteration, prior to the most accelerated version, the vocal folds do not fully abduct and there is no movement of the arytenoid cartilages. One would expect the arytenoid structures and glottis to open during inhalation, and it is possible to breathe between these slow pulses. When there is no
breath between pulses, the vocal folds instead are momentarily suspended, coming to relative rest, with the vocal folds dilated and slightly bowed, while the arytenoid cartilages remain approximated. This repeated alternation between phonation and suspension results in a lateral pulsing of the vocal folds. It may be this alternation that, over time, trains the vocal folds for trillo phonation and with training, becomes second nature.

The bands measuring diaphragmatic activity and abdominal muscle engagement indicated more activity during the trillo variation than other phonation types. Straight tone and vibrato demonstrated a steady decrease in lung volume, though the vibrato resulted in a rougher graph line. The oscillating trill followed a similar pattern, but with a slight plateau half-way through the decrease in lung volume. Both the formed and unformed trillo showed an initial drop, but then straighten out once the trillo resolved to a sustained pitch.

**Conclusion**

Through this study, I have contributed to voice science research and historical performance practice in order to shed new light on how the trillo is physically produced. The acoustic analysis and high-speed video endoscopy samples reveal that the trillo’s quick repercussions oscillate nearly twice as fast as, and with a different glottal formation than vibrato or the conventional, whole-tone trill. The dilation of the vocal folds during the trillo variations indicates a less-efficient phonation type, which allows more air to escape. It is possible that this lower phonation efficiency would result in diminished sustaining ability, as well as projection. Considering the trillo’s decline in the mid-seventeenth century, during the development of opera and construction of larger performance venues, it raises a question about whether the ornament’s relative inefficiency led to its decline.
Seeing Caccini’s teaching *trillo* on video high-speed video endoscopy verifies its importance as a pedagogical tool. The initial slow pulses result in suspended vocal folds. This suspension and lateral pulsation that follows may be precisely the qualities needed to facilitate the increased oscillation of the *trillo*. 
Chapter 3: The *Trillo* in Context

The third and final lens through which to examine the *trillo* is its natural habitat: within the repertory. Analyzing the *trillo* through period sources and with modern voice science equipment provides an ample theoretical framework for understanding the cultural significance and performance requirement but provides little understanding of how the ornament functioned within the repertory and how it developed. Though the earliest significant vocal treatises to describe the *trillo* were published in 1590 and suggest its earlier existence, the *trillo* is most readily associated with the compositional style of Giulio Caccini and his contemporaries at the turn of the seventeenth century. Within the Italian monody genre, the *trillo* was used predominantly in two contexts: it is employed most often as a cadential ornament during long penultimate note, or it is places amid long strings of virtuosic *passaggi*. Understanding the significance of *gorgia*, the throat articulation associated with *passaggi* in the Italian tradition, is critical to understanding the significance and innovation of the *trillo* and how it impacted vocal composition through the Baroque period and beyond.

As I concluded in the earlier stages of this study, which was presented at the “Spheres of Singing” and Indiana University Historical Performance Institute conferences in 2021, the articulation training for the *trillo*, as suggested by Caccini, was a vocal innovation that had lasting implications for vocal composition. The throat articulation, which produced precision and clarity for *passaggi* and other passage work throughout the seventeenth century, likely long outlived the *trillo*’s ornamental use. The *trillo* is, in essence, throat articulation performed on a single note, using a technique that is transferable to other decorative and ornamental structures. As revealed in chapter 2, Caccini’s teaching *trillo* published in *Le Nuove Musiche* results in repeated and accelerating alternation between vocal fold vibration and suspension, followed by
quick articulation during which the vocal folds are slightly bowed. The initial alternations prove to be an effective training tool for vocal fold behavior that becomes a new vocal habit, which can eventually be created without the preparatory gestures. The end result is quick repercussions at a rather involuntary, or uncontrolled rate – which is either formed by preparatory gestures or initiated without preparation. The latter option, which I associate with Bovicelli’s trillo non formato, is the trillo employed amid passaggi. In this context, the speed and note values do not allow time for preparatory gestures.

Throughout the rest of this section, I will analyze the trillo and throat articulation in score examples of vocal repertory from the seventeenth century and beyond. In order to document the lingering implications of the trillo and its articulation on vocal repertory in later periods, this section will also include brief analyses of trillo sources that emerged in the late seventeenth and eighteenth centuries. Though these sources are of little consequence to the discussion of the trillo’s early development in Chapter 1, they help shed new light on the lingering traces of the trillo in the music of Handel, Mozart, and their contemporaries.
Giulio Caccini *Le nuove musiche* (1601)

In the introductory material to his first publication, Caccini inserted three short compositions, “Cor mio deh non languire,” “Ahi dispietato Amor,” and “Deh dove son fuggite,” in which includes several examples of his essential ornaments, including the *trillo*. Whereas ornaments in full compositions following the preface are notated mostly with abbreviations (T., Tr., G., Exc., etc.), the short compositions at the beginning include fully written ornament names.

In Figure 3.1, the score for “Ahi dispietato Amor,” Caccini employs three written *trilli* and probably an implied fourth, which I have indicated in red brackets. The second and third *trilli* in this example are notated with two eighth notes, marked *trillo*, above amid *passaggi* on a single vowel. These are examples of an unformed *trillo*. The first example, on a longer dotted note, could be either a formed or unformed *trillo* depending on the tempo. The longer note value allows more time for preparatory gestures of affectual expression. The final example is an implied *trillo* on a long penultimate cadential note. Caccini rarely marks these *trilli* throughout the publication, but ornamentation of some kind, either a formed *trillo*, *groppo* for leading tones, or *messe di voce*, is implied stylistically.
Figure 3.1 Giulio Caccini “Ahi dispietato Amor”\textsuperscript{109}

\textsuperscript{109} Caccini, Preface.
In his second publication, *Nuove musiche e nuova maniera di scriverle*, Caccini demonstrated more virtuosic use of passaggi and more frequent use of the *trillo*. He indicates three *trilli* throughout the course of “Tutto’l di piango,” marked in red in Figure 3.2. In this piece, Caccini uses the *trillo* to express mourning. The text is the first stanza of a Petrarchan sonnet that describes inconstant grief and weeping. Caccini employs the *trillo* amid particularly strong affectual text phrases, including “miseri mortali” (miserable mortals), “raddoppiars’I mali” (redoubled ills), and “spendo’l mio tempo lagrimando” (spend my time weeping). Each of these *trilli* is marked on a dotted note, allowing time for preparatory or affect-inspired iteration, possible to stimulate weeping. As in example 3.1, I’ve marked the penultimate note as another likely place for a *trillo* or other cadential ornament.
Figure 3.2. Giulio Caccini “Tutto’il di piango”\textsuperscript{110}

\textsuperscript{110} Giulio Caccini, \textit{Nuove Musiche e nuova maniera di scriverle} (Florence: Zanobi, Pignoni, e Compagni, 1614), 27.
Francesca Caccini *Primo libro delle musiche* (1618)

Giulio Caccini’s composition and ornamentation practices were developed and expanded by his daughter Francesca, whom he taught composition and singing. Though perhaps overshadowed by her father in modern scholarship, Francesca was a prolific composer who had a successful career as a singer, music teacher, and court musician to the Medici in Florence in the first half of the seventeenth century. She utilized the *trillo* extensively in her 1618 publication *Primo libro delle musiche*, which includes sacred and secular monodies and several duets.

Figure 3.3 is an excerpt from “Nube Gentil,” one of nineteen spiritual texts set in the collection. This excerpt contains ten instances of *trilli*, which is more or less representative of the ornament’s use throughout the entire collection. Francesca seems to employ the *trillo* as a pedagogical tool or preparatory device to facilitate and maintain the throat articulation required for *passaggi*. Though it is variously indicated in Figure 3.3, it is perhaps more obvious in the third system, beginning with the word “fai.” This word alone contains three *trilli* which are strategically placed before, within, and at the end of highly virtuosic passages, a technique which recalls Zacconi’s adage that “a ship maneuvers most easily when it is first set in motion.” Placement of a *trillo* immediately prior to *passaggi* is a tool to prepare the vocal folds for the *gorgia* that follow. Similarly, the *trillo* in the middle of “fai” can be used as a “reset point” before the *passaggi* continue. This pattern is found in several passages of this excerpt, and throughout the rest of the collection.
Figure 3.3 Francesca Caccini – “Nube Gentil”\textsuperscript{111}

\textsuperscript{111} Francesca Caccini, \textit{Primo Libro delle Musiche} (Florence: Zanobi, Pignoni, e Compagni, 1618), 31-32.
**Claudio Monteverdi *Vespere de la Beata Virgine* (1610)**

Beyond the Caccini family, one of the most widely recognized *trillo* examples in early repertory is found in Claudio Monteverdi’s tenor duet “Duo Seraphim” from *Vespere de la Beata Virgine*. Though Monteverdi indicates *trilli* and other ornaments less frequently than his contemporaries, they are no less idiomatic to his compositions for solo voice. In “Duo Seraphim,” Monteverdi employs the *trillo* on the word “sanctus” in alternated phrases between the two solo voices. While he does not use the markings “trillo,” “tr.,” or other abbreviations, the written out repercussion on a single pitch as unmistakably *trillo*. This may suggest a larger pattern of Monteverdi being more conservative in indicating desired ornaments than the Caccini’s, or a difference in the knowledge level of his singers, such that they needed less explicit instruction than the Caccini’s pupils.

In each instance of *trillo* in “Duo Seraphim,” the repercussions are preceded by several *ribattuta di gola*, a related preparatory ornament which is frequently used in cadential *trilli*. In a way, the *ribattuta di gola* is a more advanced preparatory gesture than the slow pulses in Giulio Caccini’s teach *trillo*. Once the vocal for coordination is mastered, the *ribattuta di gola* provides a more succinct preparatory gesture that can also be used to communicate affect. Figure 3.4 provides an image of the notation from the printed tenor partbook of “Duo Seraphim,” and figure 3.5 shows a score format of the two solo voices together.

Though Monteverdi writes his *trilli* in two different note values, it is not clear how they should be articulated in performance, or whether the note values truly indicate a difference in speed of repercussions. As reported by voice scientists Hakes, Shipp, and Dougherty, there is a slow *trillo* variation which was popular in early music performance in the 1980s. The slow trillo is essentially controlled repercussions on a single note and closely related to the preparatory
gestures in Caccini’s teaching trillo. This interpretation can also be found as late as the 1995 Scholars Baroque Ensemble recording of Monteverdi’s Vespers, sung by Robert Doveton and John Bowen. Referencing the passaging beginning at measure 20 of Figure 3.5, the first trillo iterations, which are notated in sixteenth notes are sung with controlled pulses on each note. The iterations are not quick enough to set off the trillo with involuntary repercussions. The second set of trilli, beginning at measure 24 and notated in thirty-second notes, are fast trilli which are not controlled or individually pulsed. Whether or not this accurately depicts Monteverdi’s intention, it suggests flexibility in interpretation, which allows for spontaneity in each performance.

Figure 3.4 Claudio Monteverdi - “Duo Seraphim”¹¹²

¹¹² Claudio Monteverdi, Sanctissimae Virginis Missa senis vocibus ac Vesperae pluribus decantandae – Tenor (Venice: Ricciardo Amadino, 1610), 23.
Figure 3.5 Claudio Monteverdi – “Duo Seraphim” Score\textsuperscript{114}


Henry Purcell *King Arthur* (1691)

An interesting case study from the late-seventeenth century is the use of repercussive notes in the Frost Scene that opens the third act of Henry Purcell’s semi-opera *King Arthur*. The percussive eighth notes are intended to imitate shivering and teeth chattering while the Cold Genius character is thawing from an icy sleep. In past recordings, one can find an enormous variety in the interpretation of these percussive notes, especially in the choral movement “See we assemble,” shown in Figure 3.6. Many recordings interpret the shivering as quicker repercussions in either the voices or strings.

The *trillo* would have been a known ornament in Purcell’s time, following John Playford’s 1664 publication *A Brief Introduction to the Skill of Musick*.115 Amid this large treatise on music theory related to singing and playing instruments, Playford includes *A brief discourse of the Italian manner of singing*,116 in which includes the first English translation of Caccini’s *Le nuove musiche*, complete with replicas of Caccini’s ornament tables. Over Caccini’s teaching *trillo*, Playford names the ornament “trill, or plain shake.”117 On the next page, includes an ornament table, which over certain dotted figures prescribes “beating of the throte,”118 one of the defining characteristic and frequent descriptions of the *trillo* outlined in Chapter 1. A further connection between Italian and English styles in the seventeenth century has been traced by Alan Mailes, who lists several prominent English composers who traveled to Italy in the first decades of the century, as well as instructor connections with Caccini and Monteverdi.119

116 Playford, 34-49.
117 Ibid., 42.
118 Ibid., 43.
While the exact intention of the repercussive eighth notes in “See we assemble” cannot be known, it is not out of the question to consider a *trillo* variation as a possible influence. It’s likely that the vocal fold suspension reveals in chapter two, a result of Caccini’s teaching *trillo*, would be present during any reiterations without a breath between pulses.
Figure 3.6 Henry Purcell – “See we assemble” *King Arthur*\(^{120}\)

\(^{120}\) Henry Purcell, *King Arthur: An Opera in Five Acts* (London: Musical Aquitarian Society Publications, 1843), 75
Though it was no longer a main-stay of late-seventeenth and early-eighteenth century vocal music, lingering traces of the trillo can be found in the compositions of G.F. Handel. In chapter 27 of his book, Ornamentation in Baroque and Post-Baroque Music, with Special Empasis on J.S. Bach, Frederick Neumann identifies Faustina Bordoni, one of Handel’s most celebrated mezzo-sopranos, as a singer known for her vocal agility and performance of the trillo. In the first edition of Friedrich Wilhelm Marburg’s Historiche-kritische Beyträge zur Aufnahme der Musik (1754), Faustina is mentioned by name, and describes a “lovely and very fast trillo…” as one of her most admirable vocal qualities, and specifies that she sang “many notes on one tone” in quick succession. Handel created five roles for Faustina: Rossane (Alessandro), Alcesta (Admeto), Pulcheria (Riccardo Primo), Emira (Siroe), and Elisa (Tolomeo).

Her first role, Rossane, includes an unmistakable trillo gesture in the aria “Alla Sua gabbia d’oro” from act two of Alessandro, shown in Figure 3.7. The trillo, marked in red, follows the accelerating pattern of Caccini’s teaching trillo, and it’s possible that the coloratura throughout the rest of the aria was informed by Faustina’s ability to perform a trillo, and by extension early seventeenth-century vocal practices. The aria’s affect and vocal demands are remarkably similar to the aria “Nasconde L’usignol,” written for soprano Elizabeth DuParc, in the first act of Deidamia. In the 2001 recording of Deidamia with the Brewer Chamber Orchestra, Julianne Baird interpreted similar accelerated repercussions as Handel’s notation of the trillo.

121 Neumann, 294.
Figure 3.7 G.F. Handel – “Alla sua gabbia d’oro,” *Alessandro*\textsuperscript{122}

Antonio Vivaldi *La Griselda* (1735)

A more measured variation of glottal articulation can be found in Antonio Vivaldi’s 1735 opera *La Griselda*. In the aria “Agitata da due venti,” the character Costanza, an aria about the battle between duty and love, which includes imagery of gusty winds and tumultuous sea. The vocal writing is enormously virtuosity, spanning two full octaves with large leaps, scalar coloratura passages, and sixteenth-note repercussion, all decorating the word “naufragar,” shipwrecked. The written out sixteenth notes pulses in Figure 3.8 are likely measured repercussions, a variant of the *slow trillo*. 
Figure 3.8 Vivaldi “Agitate de due venti,” *La Griselda*\(^{123}\)

**The trillo Beyond the Baroque Era**

It is paradigm-altering to consider the *trillo* and *gorgia* articulation as a major innovation in vocal production and repertory. That the *trillo* itself can be found in the music of Handel, and articulation variants found in the music of Bach, Pergolesi, Mozart, and Bellini, suggests that this essential vocalism introduced at the beginning of the seventeenth century had continuing impact on vocal literature well into the classical period. Though not all of these examples are derivatives of the *trillo* per se, I would suggest that the suspension of the vocal folds between iterations on the same pitch would be a feature of voice production in all cases. Repercussive vocal gestures have been used as expressive devices to emphasize a variety of affects through shivering, weeping, joy, anger, and danger, among ululations and other expressions of the human condition. The variety in affect, speed, and intensity of articulation was likely varied widely during the seventeenth century, and much like the qualities of vibrato and trills, are unique to each singer.
Conclusion

This project has ultimately inspired me to remain curious about aesthetics and musical practices of earlier periods. Here follows a summary of important concluding thoughts informed by the results of my research:

The *trillo* as a repercussive ornament on a single note developed during the second half of the sixteenth century and became an essential ornament for Giulio Caccini in the development of monody. It coexisted in practice with oscillating ornaments of various kinds, which seem to have been more commonly used in instrumental music than in vocal practice of the early seventeenth century. Though the *trillo*’s prominence as an ornament gradually declines during the seventeenth century, the practice of glottal articulation and clarity of coloratura still probably influenced the vocal writing of high Baroque composers, in whose compositions the *trillo* can occasionally be found. We may never be able to trace a seamless connection between vocal practices, but I am convinced that the vocal aesthetics established in the seventeenth century had a lingering effect on vocal writing for a significant portion of the Classical and Romantic periods and is carried on today in the study of early music and historical performance. The rediscovery of period sources has offered compelling evidence to infer use of the *trillo* by later composers.

If Caccini’s printed *trillo* exercise is taken seriously as a pedagogical tool, the sources and scientific studies presented here unveil a form of vocal production that is distinctly different from the expectations of modern, classical vocal phonation. The slow repercussions of Caccini’s exercise would, therefore, play a role in training the coordination of the *gorgia* vocal gesture, which produces the clarity of articulation and throat production described in countless sources from the early modern period.
When interpreting music from a period that predates the development of modern vocal pedagogy, we simple must succumb to the logic that there are historical sources especially useful for helping students to understand and perform early music. The dogmatic inflexibilities and presumed traditions of conservatory culture most often impose later vocal and stylistic practices onto early repertories. While habits of healthy singing are no less applicable to early repertoire, the *trillo* and seventeenth century vocal music establish an important historical moment when the contemporary sources are of critical importance to understand the aesthetics and vocal principles that influenced musical composition. Embracing seventeenth-century practices is likely to inspire singers to be more curious about how vocal music developed throughout history, rather than to look backward from an anachronistic viewpoint. For those singers hoping to better understand seventeenth-century music and the coloratura found in Bach and Handel, I encourage incorporation of Caccini’s teaching *trillo* regularly into vocal practice. The clarity of articulation achieved is surely applicable to music from virtually any period.

The *trillo* is unmistakably different from vibrato and oscillating trill ornaments. The number of oscillations per second is nearly twice as fast in the *trillo* than the other phonation types measured. The repercussions are unmeasured, and therefore allow for greater interpretive freedom, since the *trillo* oscillation rate may accelerate over time, as a singer gains experience and reached an involuntary, but intentionally automated level of skill. Additionally, the vocal fold position during an unformed *trillo* is slightly bowed, suggesting a less efficient type of phonation, which allows air to escape. During the formation of the *trillo*, each preparatory gesture results in alternation between vocal fold vibration and suspension, though without movement of the arytenoids and other laryngeal cartilage structures. There is a considerable amount of flexibility in how the *trillo* is performed, as is the case for most vocal ornaments and
graces. I return often to Jean Rousseau’s statement about the *trillo* as a uniquely vocal ornament that instrumentalists should practice frequently to imitate. If we consider the *trillo* and other repercussive ornaments to be uniquely human, perhaps related to concepts of ululation, it is appropriate that they are employed at various points in music history to express weeping, anger, fear, joy – the full range of affects representative of the complex and dynamic human condition.
Bibliography

Primary


Secondary


