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AN EXPLORATION OF VOICE CLASSIFICATION CRITERIA: A SURVEY OF LITERATURE, OPERA ARCHITECTURE, AND A NUMERICAL METHOD OF ARIA ANALYSIS

By Aaron R. Redburn

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Acknowledgements

After years of personal assessment into my own voice type, the question that would become the genesis for this paper arose. What exactly makes a voice type and who decides what I am? This began a journey that has spanned nearly four years and I am still just scratching the surface of the immense history surrounding voice types and the art of their assignment. It is my hope that someone out there who is dictating their life by the often-misunderstood methods of voice categorization be freed to explore and sing what makes them happy, not what they feel they *have* to sing.

A huge thank you to Dr. Randal Rushing who has been my constant guide and voice of reason through this process. Immense thanks Dr. Josef Hanson, without whom this document simply wouldn't exist. Your hours of mentorship and your dedication to this project exemplify the professorial spirit we need in higher education. Many thanks to Dr. Kyle Ferrill, whose idea of passaggio-variance rankings inspired this document. Finally, thank you to Dr. Albert Nguyen, your genuine passion for education and incredible encouragement throughout this process have been invaluable. Each of you have continually shown me that this journey is worth every second.

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An enormous thank you to my parents. You've never allowed me to say, "I can't." Thank you also to my parents-in-law, who've endured dozens of hours of tedious discussion on a topic they've never asked me about. Finally, a never ending thank you to my sweet wife, Shannon Redburn. I have never fallen and I have never mis-stepped, because you've carried my mind and spirit every step of the way.

Abstract

The concepts of voice categorization have existed for centuries, but a unified system for the singers of the world is a much more recent idea. This document aims to explore the unified systems proposed by Rudolf Kloiber and Richard Boldrey, carefully examine the various aspects that contribute to voice classification, survey the differences in opera architecture, and serve as a foundation for the idea of a new and expanded method. A review of modern and historical texts regarding voice classification is presented. The concepts of voice equality across performance venues are introduced using architectural and physical analysis of performance venues across Europe and the United States and the acoustics of the orchestra and operatic voice. Finally, an in-depth analysis of five tenor aria packages is presented. The arias are analyzed using proprietary methods, the text of Kloiber and Boldrey, and historical assessment of the singers who sang the role's premiere.

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Introduction

The creation of a unified vocal categorization method by Rudolf Kloiber has given singers a guide by which to engage with opera for more than half a century. Its use has proliferated throughout Europe and the Americas and been expanded upon by the likes of Richard Boldrey in the early 1990's. Its origins and methods of categorization, however, remain largely unknown. This allows the rise of many questions and concerns, particularly with the community's adoption of the texts as a veritable rule book.

Seventy years after the publishing of Kloiber's *Handbuch der Oper*, the aim of this document is to reexamine and explore the various aspects that account for a true voice classification. These include basic discussions on acoustics, study of various opera houses, and in-depth analysis of arias across a broad range of voice sizes and types. The combination of these factors points towards the need for an expanded and strongly clarified voice categorization method for a new era of opera.

CHAPTER 1: The State of the Fach System

The Kloiber System

The *Fach* system is a method of opera role categorization used by opera houses around the world, though primarily in Germany. The German word *Fach* (plural, *Fächer*) means "compartment," and the Fach system serves to divide roles within the operatic repertory into distinct compartments, displaying their similarity and ability to be performed by the same singer. Addressed later in this chapter, various Fächer have also come to be colloquially used to reference a singer's own vocal abilities and color. The origins of the Fach system lie in the concepts of repertory theatre, in which a single opera house would perform multiple operas at once, usually on a rotational schedule. These opera houses are extremely common in Europe, but very few opera companies in the United States maintain a true repertory season, the primary example being the Metropolitan Opera. In order to maintain such challenging schedules, opera companies must cast versatile and resilient singers.

Out of this repertory theatre concept in Germany came the genesis of what is now known as the Fach system. Nearly every opera house in Germany is state-funded, utilizing direct arts funding from the federal government in order to run the houses and pay the singers. It is this monetary backing that created the problem the Fach system aims to remedy. In order to most effectively provide high-quality repertory opera to the people of Germany, the state's funding must be utilized extremely carefully. This responsibility means that each house must be able to perform a variety of operas at once while employing the smallest number of singers possible. Thus, the Fach system proper was created. By assigning a contracted singer to a specific voice category, the opera house receives a diagnosis for the singer as to what could be assigned to them throughout the repertory season. With just a few singers hired, the span of operas available can

be narrowed and settled on in order to create a balanced season for the house. Unfortunately, this can result in an extremely taxing workload for the singers hired.

The industry standard for Fach categorization came in 1951 with Rudolf Kloiber's *Handbuch der Oper* (Gr.: 'manual of the opera').[1] In this book, Kloiber condenses commentary and educated opinion into two volumes, meticulously outlining the Fach of each role in the opera as well as orchestral and theatrical notes. Kloiber was a renowned German conductor and musicologist, writing several other celebrated musicological manuals and serving as conductor at the Stadttheater Regensburg and of several orchestras. In addition to Kloiber's contributions, further writing and editing was provided by Wulf Konold, a German musicologist and dramaturge, chief dramatic advisor and opera director for a half dozen opera houses throughout Germany. These writings by Kloiber and Konold have become the standard reference for a true German Fach system.

In order to accomplish this task, Kloiber's *Handbuch der Oper* does not just take into account the size of the voice. Perhaps best outlined by Pearl Yeadon McGinnis, author of *The Opera Singer's Career Guide: Understanding the European Fach System*, the Fach system sets out to utilize a single word, or occasionally two, to categorize more than half a dozen aspects of the singer and their career, a task one might argue could require a more delicate categorization method.[2] In her estimation, the Fach system breaks down as follows: "Fach = voice + range + size + timbre + physical build + age and experience + desire + frequency of performance." In addition to this categorization method, Kloiber also divides his established Fächer into two

[1] Rudolf Kloiber and Wulf Konold, *Handbuch Der Oper*, 2 vols. (Kassel, Germany: Bärenreiter-Verlag, 1985).

[2] Pearl Yeadon McGinnis, *The Opera Singer's Career Guide: Understanding the European Fach System*, ed. Marith McGinnis Willis (Lanham, MD: Scarecrow Press, 2010).

separate purposes. In the *Besetzungsfragen: Die Solisten* (Gr.: 'Casting Questions: The Soloists') section of Kloiber's second volume, the voice types are divided into two categories: the *Seriöse Fächer* (Gr.: 'serious categories') and the *Spiel und Charakterfächer* (Gr.: 'play and character categories'). Kloiber outlines in this chapter that his intention is to divide the roles between those that carry and demonstrate the drama of the role through music, the Seriöse Fächer, and those that utilize talented acting and often humor to bring the character to life, the Spiel und Charakterfächer. Additionally, Kloiber specifies that this is simply a generalization and both categories require quality singing and acting. His estimation of the division of these functions is as follows:[3]

Seriöse Fächer	**Spiel und Charakter Fächer**
Lyrischer Sopran	*Lyrischer Koloratursopran*
Jugendlich-dramatischer Sopran	*Spielsopran*
Dramatischer Koloratursopran	*Charaktersopran*
Dramatischer Sopran	*Spielalt*
Dramatischer Mezzosopran	*Spieltenor*
Dramatischer Alt	*Charaktertenor*
Tiefer Alt	*Spielbariton*
Lyrischer Tenor	*Charakterbariton*
Jugendlicher Heldentenor	*Spielbaß*
Heldentenor	*Charakterbaß*
Lyrischer Bariton	*Schwerer Spielbaß*
Kavalierbariton	
Heldenbariton	
Seriöser Baß	

[3] Rudolf Kloiber and Wulf Konold, *Handbuch Der Oper*, vol. 2 (Kassel, Germany: Bärenreiter-Verlag, 1985), 1041-1043.

The Boldrey System

Richard Boldrey is a well-known voice coach and opera conductor, currently on the faculty at Northwestern University's Bienen School of Music. Particular engagements of note within his esteemed career include a stint as the assistant conductor to Carlo Bergonzi and two periods as the assistant conductor of the Lyric Opera of Chicago. In 1994, Boldrey published his *Guide to Operatic Roles & Arias*, a reference guide for operatic role and aria investigation. After a quarter century in the opera industry, Boldrey published his book in the hopes that it would help singers find suitable opera repertoire when they have only one point of reference from which to begin their research. Boldrey summarizes this in his Introduction chapter saying, "With only one starting point–voice category, role, aria, singer, composer, or opera–a singer can open this book and discover the music appropriate for her to sing."[4] Boldrey's guide condenses an enormous amount of information into a relatively small book, including a list of arias and voice categorizations.

With this inclusion of voice categorizations, Boldrey's *Guide to Operatic Roles & Arias* is utilized by some as a new Fach system for a new generation. Despite Boldrey's statement in his introductory chapter that voice classifications are "...of course, arbitrary"[5], he does prescribe voice categories not only to roles, as does Kloiber, but ventures to assign voice classifications to well-known opera singers throughout history.[6] Utilizing this area of reference can be confusing, however, as Boldrey's intent for this singer categorization is actually intended to represent the Fächer of the roles the singer was famous for and not intended as commentary on the voice type of the actual singers themselves. Boldrey then spends the rest of the chapter detailing and

---

[4] Richard Boldrey, *Guide to Operatic Roles & Arias* (Redmond, WA: PST ... Inc., 1994), 1.

[5] Ibid, 2.

[6] Ibid, 405-437.

defining the distinct differences of the voice type and clarifying how he precisely considered each voice type before ultimately naming them.

It is clear that Boldrey still emphasizes the importance of categorization as a tool and he presents a unique take on the method of categorization. While Kloiber often utilizes a single Fach, or occasionally two, Boldrey freely uses multiple voice categorizations to describe the voice type of a role. He does so, utilizing a unique method to demonstrate his decision on a primary voice type for the role and then indicating the secondary voice types that could also sing the role. He clarifies as follows:

> "...there are voice categories that describe the role. The author's choice for the main, best-suited category for the role appears in caps. For example, '•LYRIC BASS, dramatic bass' means the role is best suited for lyric basses, but can be sung, or is often sung, by dramatic basses. The author's choice can tell you whether the role leans toward the heavier or lighter side of the voice."[7]

All instances of Boldrey categorizations within this document will utilize this same format, indicating the primary voice category in all capital letters, with Boldrey's secondary categorizations in lower case.

The Singer-Fach Conflation

In an unfortunate misunderstanding of the original concepts of the Kloiber and Boldrey categorization methods, it is possible that some singers are misusing the texts. Both Kloiber and Boldrey created guides intended to group arias and roles into sets that could be sung by the same person. Some may, perhaps unconsciously, reverse engineer these concepts into a list of roles, procured by Kloiber or Boldrey, that they are *allowed* to sing, rather than a list of suggestions for

[7] Boldrey, *Guide to Operatic Roles and Arias*, xi.

exploration. Kloiber and Boldrey are creating educated estimations of the appropriate voice for each role. These are intended as operatic guides, however, not rules.

Noteworthy or Missing Classifications

When addressing the concepts of voice categorization, many commonplace phrases and categorical ideas come to light. This section serves to address some examples of the ideas not utilized by Kloiber or Boldrey in their personal voice categorizations, but acknowledged in their texts. Capitalization rules are taken from the example of Boldrey throughout his *Voice Categories — The Terms by Nationality* section of his introductory chapter.[8] Categorizations such as *Zwischenfach*, Soubrette, and Character Tenor are all addressed in Chapter 5.

***Leggero* vs. Light Lyric**

Leggero, or "light" in Italian, is a voice categorization term utilized across Italy and France. It is also frequently misspelled as "legg*i*ero", a Corsican translation of the word "light" that echoes the harmony of many voice categorizations between Italy and France, as shown in Boldrey's introduction. It is utilized across all voice types, often paired with the term *lirico*, or lyric. This is used to differentiate between the lighter and more flexible *leggero-lirico*, light lyric, and the more present *lirico*, or "full" lyric. Interest arises, however, when one focuses on the tenor and soprano variations and utilizations of this term.

In the case of the soprano voice type, the leggero voice classification seems to be intended specifically for roles that are categorized by Kloiber and Boldrey as *coloratura* roles, or roles that involve a substantial ability to move the voice and demonstrate range exceeding the expectations of the "standard" soprano counterpart. In Boldrey's voice categorization chart, this is demonstrated in both the French and Italian categorizations for this voice type, the *Soprano*

[8] Boldrey, *Guide to Operatic Roles and Arias*, 15-16.

léger and the *Soprano leggero-lirico*, respectively.[9] The connection can be made specifically to the coloratura voice types with the further comparison to their German counterparts, the *Koloratursoubrette* and the *Lyrischer Koloratursopran*. In Boldrey's Italian comparison section, he lists the Soprano leggero-lirico as "Light Lyric Coloratura Soprano", "Full Lyric Coloratura Soprano", and "Light Lyric Soprano". In this instance, Boldrey is utilizing multiple categories to delineate, perhaps, more finite differences in the individual pieces of repertoire. The French and German delineation of the voice types, however, is clearer, though still murky. For their "Light Lyric Coloratura Soprano", "Full Lyric Coloratura Soprano", and "Light Lyric Soprano" variations, the French have a clearer delineation with the *Soprano léger*, *Soprano-demicaractère*, and *Soprano-lyrique*. The German categorizations for these are *Koloratursoubrette*, *Lyrischer Koloratursopran*, and *Lyrischer Sopran*. In both the French and German categorizations, the lyric (lyrique/Lyrischer) categorization includes both the Light Lyric and Full Lyric categorizations used by Boldrey. The range expectations of the various soprano *Fächer* in the German system are often co-delineated with the term *Hoher Sopran*, or "higher" soprano.

Similar investigation can be useful when considering the categorization of the "Light Lyric Tenor". In addition to the previously discussed leggero voice types, the *Tenor leggero* and *Ténor-léger*, Boldrey includes four other unique voice types in this category. First, the *Tenore di grazia* (It.: 'tenor of grace'), which is considered to be the lighter side of the Italian *Tenore lirico*.[10] Though the term has been used to categorize roles and singers in a variety of repertoire, it is primarily utilized to categorize the tenor roles of Rossini and Donizetti. Often conflated with the Tenore leggero, there is, perhaps, an argument to be made to separate the two definitively, as

[9] Boldrey, *Guide to Operatic Roles and Arias*, 15-16.

[10] J.B. Steane, "Tenore Di Grazia (Opera) (It.: 'Graceful Tenor')", 2002.

an extension of the already accepted Light Lyric Coloratura and the standard Light Lyric. This would begin to align with the previously discussed French and German separations of a clear "coloratura" voice type and a lighter counterpart to the standard lyric categorizations. In the Italian side of the argument, Boldrey also lists the *Tenore bianco*, or "white tenor", but thorough searches have yielded little evidence to actually categorize this voice type within this document. The strongest correlation able to be drawn with this voice category comes from the German Fach system's use of the categorization of *Italienischer Tenor*, or Italian Tenor. The German system is acknowledging the presence of a specific and stylistic voice that could only be described as aligning with the operatic tradition of Italy. In the case of Tenore bianco, it could be speculated that the Italian voice categorization tradition is recognizing a voice type that could align with what many colloquially refer to as the "Irish" tenor. This so-called "white tenor", in a more traditional sense, could be in the same category as the *Tenorino*, a term often applied to the smallest and lightest of tenor voices.

On the French side of voice categorizations, Boldrey cites two additions to the Ténor-léger that sit under the umbrella of Light Lyric Tenor. The first is the *Haute-taille* (Fr.: 'high tenor'), the uppermost portion of the three *parties intermédiares*, a method of delineation most commonly used among the Baroque string orchestra. This is the highest of the three "tenor voices", the *haute-taille*, the *taille*, and the *basse-taille*.[11] The outer portions of this trio, the *haute-taille* and *basse-taille* are commonly used in reference to the male leads of Lully and Rameau. The final French voice type listed by Boldrey is the *Haute-contre* (Fr.: 'high counter').

[11] It should be noted that Boldrey also utilizes the Basse-taille categorization in his voice categories comparison chart, but comes into conflict with famed vocal pedagogue Manuel García in his treatment of the voice type. Boldrey places the Basse-taille with eight other voice types under the umbrella of Light Lyric Baritone. In García's *Traité complet de l'art du chant* (Fr.: 'Complete Treatise on the Art of Singing'), however, the Basse-taille is listed as the lowest of the male voice types and presented as "sonorous and powerful".

In all the annals of voice categorization history, there is, perhaps, no voice category more hotly contested than that of the Haute-contre. Numerous English treatises translate this as "countertenor" (Cotgrave, 1611; Pepusch, 1724; Bailey, 1726; Prelleur, 1731; Rousseau/Waring, 1779), while the parts were being sung in Italy by the *Contralto*.[12] This confusion is stretched even further when the writings of Joseph de Lalande, an 18th century traveler, astronomer, and writer, are taken into account. In his *Voyage en Italie*, de Lalande declares that the French Haute-contre were absolutely not Falsetists, male singers who utilize the *falsetto* register of their voice to achieve the vocal heights of their roles.[13] This would, of course, be in stark contrast to the modern singer's expectations of a male singing the countertenor or contralto roles proposed under the Haute-contre umbrella. This delineation of "ultra-high" tenor-like or soprano-like singing, along with the florid expectations of the Leggero categories, supports the need and premises of a push for an expanded and better-separated voice categorization method.

The *Baryton-Martin*

The *Baryton-Martin*, also commonly spelled *Bariton-Martin*, is a primarily French voice classification, used to denote a baritone of exceptional abilities in his upper register, usually presenting with a more tenor-like quality and lacking the deeper lower register of his baritone counterparts. The voice type is named after French baritone Jean-Blaise Martin, who was touted as a representative of the free, lyric French school of singing with brilliant facility in singing higher notes and a lighter vocal quality.[14] Many today might simply categorize this as a "high lyric baritone", but descriptions of this voice seem to counter the idea that it is simply a Lyric

[12] Owen Jander, ed. Ellen T. Harris, 2001.

[13] Ibid.

[14] J.B. Steane, "Baryton Martin", 2002.

Baritone with a terrific upper extension.[15] Additionally, the presence of the *Bariton léger* on Boldrey's reference chart, a leggero form of the baritone voice type, and the *Hoher Bariton*, the high German baritone, progress the idea that the baritone voice categorization family may require new assessment, and that, like its tenor brother, the "light lyric" category deserves a sufficient revision and expansion.

This "blended" voice type can also be a challenge to categorize for the teacher or singer themselves. The characteristics of color, weight, and range are a confusing landscape for the baritone and tenor to navigate. The primary concern of the navigation of this voice category is the age, volume, and direction of the voice. This voice may indeed be a high set baritone, which may then be subject to discussion regarding its further classification. However, voices with exceptionally warm characteristics as well as a high extension can also often be pushed in the direction of the *Heldentenor*, the heroic tenor lead, primarily of the Wagner operas. The initial categorization of this Fach during Wagner's time was, in fact, first called the *Tenorbariton* and represents the largest-voiced portion of this category of voices.[16] With the addition of the idea of the "Baritenor", many times this voice unfortunately incorrectly falls into the *Zwischenfach* category, further discussion of which occurs in Chapter 5.

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[15] Steane lists several historical examples of the Baryton-Martin voice type within his Grove Music Online article, including: Jean Périer, Gabriel Soulacroix, Mattia Battistini, Yury Mazurok, and Jean-Blaise Martin himself. Each is listed by Boldrey as a full lyric baritone or FULL LYRIC BARITONE, with Martin's roles simply being noted as "...lying very high in the voice…". Boldrey, *Guide to Operatic Roles and Arias*, 409, 424, 425, 428, 432.

[16] Boldrey, *Guide to Operatic Roles and Arias*, 16.

CHAPTER 2: Establishing the Methodologies of Decibel Analysis

Section Purpose and Summarized Methodology

This chapter is intended to orient the reader for a better understanding of the relationship between the singer and the orchestra. The way in which a singer is capable of being heard over an orchestra without amplification is an important base on which the arguments within this document are built, particularly with regard to the voice degradation in the opera houses, discussed in Chapter 3, and the size of orchestras listed in Chapter 4. For the orchestral analysis utilized in this document, a four-step process was used. First, each orchestration was pulled directly from the full score. Second, each instrument was assigned a maximum output in decibels. Third, the maximum output of each instrument was reduced by 25% to account for the average playing volume during an opera. Finally, the instrumental outputs were then added using the logarithm discussed in the *Orchestral Acoustics* section of this chapter, resulting in a numerical representation of the orchestral output present during an opera.

A Brief Overview of Operatic Vocal Acoustics

For the purposes of this document, little information on the science of vocal acoustics is necessary, but this short section serves to sequester any substantial questions. The concept of decibels is of substantial importance when discussing any matter of sound. The decibel (dB) is a unit used to measure sound levels. The most challenging aspect of its use is that the decibel scale is not linear, but instead logarithmic, meaning that the measurements are not directly related to each other, one after another. Physics and mathematical explanations inform that a doubling in acoustical energy equals an increase of approximately 3dB. So, 9dB is twice as loud as 6dB and 3dB is half as loud as 6dB. However, in the physics of sound there is a substantial difference in what is perceived by the human ear and what is the mathematical reality. Of particular note is the

concept of "Just Noticeable Difference," or JND. JND is part of a branch of psychology, called psychophysics, that is used to note the amount which something must change in order for it to be perceived as a change. In the case of decibels, a unit of measurable physics, see **Figure 1** for the formula used to discuss JND:

$$\frac{\Delta I}{I} = k$$

Figure 1: Weber's Law of Just Noticeable Differences[17]

Despite the physical math of the decibel being doubled in energy at 3dB, the "Just-Noticeable Difference" is far more complicated. In standard acoustical discussion, a difference of 1dB is commonly used to reference a JND, which mathematically would be represented by a 33% increase or decrease. However, acoustical consulting and design firm ABD Engineering & Design has reported customers not perceiving a noticeable difference in sound output until increases of up to 5dB, approximately a 166% difference according to the math, and customers reported not hearing a doubling in sound until the source was increased by a full 10dB, a mathematical increase of 233%.[18] It is this order of magnitude that many bodies utilize to categorize sound safety and magnitude, citing a difference of 10dB to be the equivalence of two times the perceived sound. So, using an industry standard of 70dB, 80dB would be considered

[17] Frank Schieber, "Weber's Law of Just Noticeable Differences," *Weber's Law of Just Noticeable Differences* (University of South Dakota Internet Psychology Lab, 0AD), last modified 0AD, accessed March 5, 2021, http://apps.usd.edu/coglab/WebersLaw.html.

[18] ABD Engineering and Design, "How Much Is a Decibel? Sound Perception Vs. Reality," *ABD Engineering & Design*, accessed March 17, 2021, https://www.abdengineering.com/blog/perception-vs-reality/.

twice as loud and 60dB would be perceived as half as loud. Both the mathematical and JND perception should be considered when looking at decibel levels throughout this document.

In the case of the opera singer, there are additional acoustical factors to be considered. First, higher voice types have an innately higher fundamental frequency which means they are perceived as louder due to the human ear's sensitivity to higher pitches. This fundamental pitch, using the soprano as an example, can exist in a plausible range of 250 to 1,500 Hertz (Hz).[19] Second, the orchestra is fundamentally the strongest in the 500Hz range, meaning there is substantial competition between the two.[20] The singer, however, is able to produce a series of overtones ranging from 2,000Hz to 4,000 Hz. Commonly called the "singer's formant", this peak at an average of 3,000Hz sits not only in a frequency range that well exceeds the drop off of the orchestra, but also directly in a range to which the ear is the most sensitive. Third, the opera singer utilizes substantial and consistent vibrato during their singing. This cyclic and minimal altering of pitch aids the auditory system in differentiating the voice from the instruments of the orchestra. Finally, in reference to the orchestral decibel levels described in the following section, a basic understanding of human decibel output is of use. In research for this document, several voices were measured with a decibel meter at one meter. These singers all considered themselves to be in the "lyric" category of their voice types and registered decibel measurements of approximately 100dB at the peak of their output. In 2018, Bulgarian mezzo-soprano Smilyana Zaharieva broke the Guinness World Record for a sung note at 113.8dB.[21] Annalisa Wray of

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[19] "Why Can an Opera Singer Be Heard over the Much Louder Orchestra?," *Scientific American* (Scientific American, June 18, 2007), last modified June 18, 2007, accessed March 17, 2021, https://www.scientificamerican.com/article/expert-opera-singer/.

[20] Ibid.

[21] "Loudest Mezzo-Soprano Vocal Note (Female)," *Guinness World Records*, accessed March 17, 2021, https://www.guinnessworldrecords.com/world-records/526437-loudest-mezzo-soprano-vocal-note-female.

Ireland holds the world record for the loudest shout, 121dB.[22] For the purposes of considering the singing voice and the perception of increased volume, this would imply that Zaharieva, possibly the loudest voice in the world, is perceived at a volume of approximately two to two-and-a-half times louder than the average maximum output of a "lyric" singer. When considering the orchestral decibel calculations included in the next section of this document, please consider this "max" vocal output of 113.8dB as the largest voice in the world.

Orchestral Acoustics

Orchestral size plays an essential role in the determination of the appropriate voice type for a specific character. If the orchestral output is minimal, the voice does not necessarily need to be large to be heard by the audience. For the purposes of this document, the use of decibels will remain constant as an unwavering variable in the discussion. However, several issues arise when trying to create a fair use of these decibel measurements when comparing individual players and instruments. The first of these is varying output. In order to combat the variance in output of each instrument and individual, the analysis will only utilize seventy-five percent of the instruments "available" output. Please reference **Table 1** for the numbers used in the following calculations and Appendix A for the sources of these decibel maximums. The sources for these decibel maximums were balanced to represent the best estimation for a maximum instrumental output for each individual instrument represented in the Table 1. This is an approximate estimation and instruments were not individually measured for this document. However, it is the hope that with this balanced maximum from multiple sources, this will not only serve to combat individual variance in output, but also aid in the combined decibel output calculations, safely

[22] "Loudest Shout (Individual)," *Guinness World Records*, accessed March 17, 2021, https://www.guinnessworldrecords.com/world-records/67535-loudest-shout-individual.

assuming that at no one time is the entire opera orchestra playing at the maximum volume at the exact same time.

The other primary problem is the combination of multiple sources of decibel output. Due to the order of magnitude regarding decibels, they are not capable of being added linearly. This can be expressed in the idea that two violins are not twice as loud as one, but rather ten violins are twice as loud as one. The most challenging nature of measuring sound pressure levels (SPL) as decibels is that they are innately logarithmic and cannot simply be added. Each number must be antilog-ed, then added or subtracted, and then re-log-ed.[23] See **Figure 2** for the logarithmic equation:

$$L_T = 10\log(10^{-(diff\ in\ dB)/10} + 1) + smallest\ number$$

Figure 2. Decibel Addition/Subtraction Logarithmic Equation[24]

For the purposes of calculating the decibels output by each individual orchestra, as specified by the composer of the opera, this is the formula that is used.

So, for further clarification, the process is as follows. Each instrument will be given a maximum decibel output, then each of those values will be reduced by 25% to utilize an "average" output for each instrument, then each of those values will be added together using the formula outlined above, resulting in the "average" decibel output for each individual opera orchestra, as outlined by the composer. This document maintains an equal calculation across all arias and operas analyzed in order to facilitate a logical and balanced discussion, not to present a hard measurement or completely accurate calculation of real-world output. When a specific number of string players are not listed in the orchestration, the suggestions written by Kloiber in

[23] Don Davis and Eugene Patronis, "Using the Decibel – Part 3: Combining Decibels and Using Log Charts," *Electronic Engineering Times*, June 11, 2008.

[24] Ibid.

his *Besetzungsfragen: Das Orchester* (Gr.: 'Casting Questions: The Orchestra') section will be used.[25] For the purposes of accounting for small opera houses and

Table 1. Numbers used in Logarithmic Calculations

Instrument	**Approx. dB Output**	**75% of Peak for Analysis**	**Instrument**	**Approx. dB Output**	**75% of Peak for Analysis**
Violin	95dB	71.25dB	Bassoon	110dB	82.5dB
Viola	95dB	71.25dB	Trumpet	110dB	82.5dB
Cello	110dB	82.5dB	Horn	105dB	78.75dB
Double Bass	85dB	63.75dB	Trombone	115dB	86.25dB
Harp	50dB	37.5dB	Tuba	110dB	82.5dB
Flute/Piccolo	105dB	78.75dB	Piano	105dB	78.75dB
Oboe	110dB	82.5dB	Timpani	105dB	78.75dB
Cor Anglais	110dB	82.5dB	Cymbals	120dB	90dB
Clarinet	115dB	86.25dB	Snare Drum	120dB	90dB
Bass Clarinet	115dB	86.25dB	Bass Drum	105dB	78.75dB

colleges/universities, the smallest strings section suggested as proper balance by Kloiber will be used in the calculations of orchestral output. For this distribution and other balanced suggestions, please see **Table 2**. When only a percussion player is listed, the measurement of the "Cymbals" will be utilized to compensate for the combined playing of other percussion instruments as it represents a higher overall decibel estimation, rather than underestimating for the sake of argument.

[25] Kloiber, *Handbuch Der Oper*, vol. 2, 1065.

Table 2. Balanced Instrumentation Suggestions[26]

Players:				
Violin I	Violin II	Viola	Cello	Bass
6	6	4	2 (3)	2
8	8 (6)	5 (4)	4	4 (3)
10	10 (8)	7 (6)	6 (5)	6 (5)
12	12 (10)	8	6	6
14	14 (12)	10	8 (7)	8 (7)
16	16 (14)	12 (10)	10 (8)	8

[26] Kloiber, *Handbuch Der Oper*, vol. 2, 1065.

CHAPTER 3: A Comparison of American and European Opera Architecture

Section Purpose and Summarized Methodology

This section is intended to explore the similarities and differences between European and American opera houses. Each represents the single largest opera house in its country or the most prominent, if the largest was not a currently operating house. The primary focus of the analysis of this chapter is the interior dimension of each house and the distances between the singer and the audience. Calculations were performed through careful consultation of seating plans, interior photos, and published numbers by the opera house's management teams. The number of seats, both wide and deep, plus any aisles present, were used to calculate the area of the theatre, and the number of present floors, both within the hall and the exterior were considered to then calculate the height and volume. These schematics and interior photos were also used to discern an approximate total depth to the farthest seat in the hall, and the Pythagorean Theorem was then used to calculate that distance. This analysis is intended to be cursory and equally calculated across all houses, meaning that if an element of the calculation is incorrect, it is commensurably incorrect for all houses.

Establishing the Grounds of a Cursory Analysis

While theatre architecture and, particularly, theatre acoustics are extremely complex subjects, this chapter serves to lay the groundwork for the assertion that each unique performance venue must be considered a separate yet highly influential factor in determining the voice categorization of a specific role. While many singers and teachers utilize the colloquialism of, "I'm a 'big house' ____, but a 'small house' ____", the true implications of the variance in opera houses are explored to greater lengths here. This does not, however, serve to provide any true acoustical measurements or proper analysis done by an actual acoustician.

This basal analysis starts with a simple understanding of the concept of sound. In the case of the opera singer and orchestra, sound is a vibration, propagating as an acoustic wave, through the air. With no microphonal support, the initial sound iterates from a single point and spreads in the direction of the vocal tract, or simply, forward. This makes base decibalic understanding much simpler, as there is a single point of origin. For clarification, this document only utilizes the relative unit, decibels, not an absolute measurement, such as watts per square meters.

With this basic establishment of the concept of sound, for the purposes of this paper, it is the case that a larger volume of air for these acoustic waves to travel through will reduce the efficacy of the initial decibel level produced by the singer. It is this fact that the primary concepts of theatrical acoustic design wish to overcome. As outlined by C.R. Nave at Georgia State University, the purpose flow chart of Auditorium Acoustics is as follows:

> **Auditorium Acoustics** must overcome the **Inverse Square Law** and the **Bass Loss Problem** by judicious use of **Reverberation** provided by the **Architecture of the Enclosure** and assisted, if necessary, by **Sound Reinforcement**[27]

This document stops this analysis at the first hurdle, the Inverse Square Law.[28] By discussing this factor, a discussion can logically ensue about the space by clarifying the loss in perceived decibels by its audience members, in relation to its size and capacity. In simpler terms, if the hall were acoustically "dead", or had zero acoustic reinforcement for the singer, what would the

[27] "Auditorium Acoustics" *HyperPhysics*, accessed March 17, 2021, http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html.

[28] Don Davis and Eugene Patronis, "Using the Decibel – Part 2: Expressing Power as an Audio Level," *Electronic Engineering Times*, June 4, 2008.

volume of the singer look like at the extreme ranges of distance of each individual house? To accomplish this, the Inverse Square Law by Ratio equation is used. **See Figure 3** and **Figure 4**.

$$\frac{I_2}{I_1} = \left[\frac{d_1}{d_2}\right]^2$$

Figure 3. Inverse Square Law by Ratio[29]

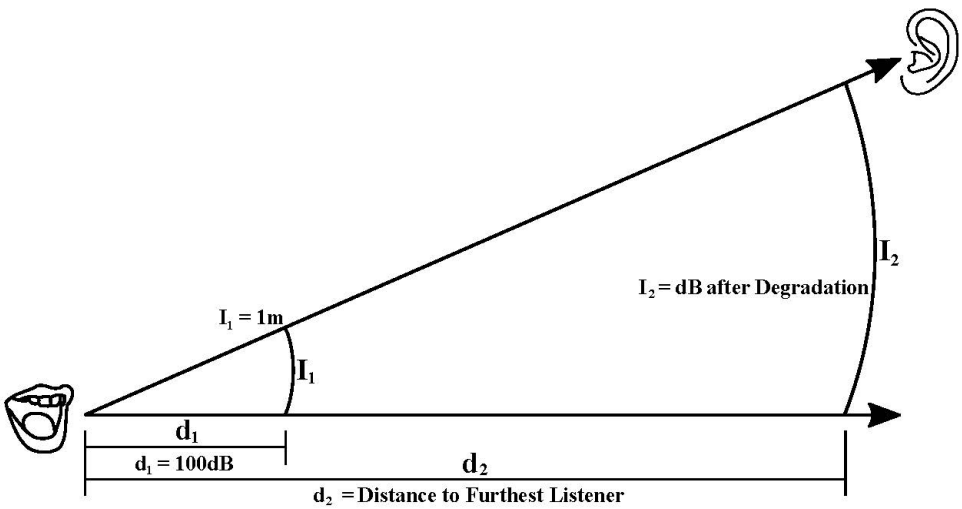

Figure 4. Visual Demonstration of Inverse Square Law by Ratio

In the analysis of these opera houses, an example decibel reading of 100dB (I_1) at a distance of 1m (d_1) from the singer's mouth is utilized. Then, the distance of the farthest seat (d_2) is used to yield the audible degradation perceived by the audience (I_2).

Next, how these distances were calculated must be clarified. The architecture and internal dimensions of the analyzed opera houses is extremely difficult to ascertain without the measurements being formally given by the architect or opera house themselves. This was only the case in a single hall, the Opéra Bastille, home of the Paris National Opera. In all other cases,

[29] "Auditorium Acoustics"

careful consideration of interior photos, seating charts, and blueprints were used to ascertain the approximate interior dimensions of the theatres. Careful consideration was taken to account for balcony overlaps, addressing the widest points in the hall, additional ceiling height exceeding that necessary for a patron to stand, etc. See **Table 3**.

Table 3. Architectural Approximations used to Perform Calculations

Object "Measured"	Meters	Feet	Inches
Depth of a Row	1	3.2	39.37
Width of a Single Seat	0.5	1.64	19.68
Width of an Aisle	1.5	4.92	59
Height of a Floor	4.25	13.94	167.3

While these measurements may seem superficial, detailed attention was paid to average the available measurements of theatre seat dimensions and further analysis was paid to find the mean of the measurement of aisles and "floors" by architects and companies around the world. These sources can be found in Appendix B for further explanation.

Most importantly, the following analysis seeks to create a baseline for a discussion on the differences between European and American opera houses. The measurements were carefully taken and calculated, and the means for these measurements were consistent across all houses in question. This consistency is noted in the hope that, should an approximation be proven inaccurate, the opera house's internal dimension estimations are all equally skewed, and thus, still able to be used for cursory comparison.

Munich *Nationaltheater* - *Bayerische Staatsoper*

The *Nationaltheater* (Gr.: 'national theatre') in Munich, Germany, is the current home of the world renowned *Bayerische Staatsoper* (Gr.: 'Bavarian State Opera'). The house is in its third iteration, after the first Nationaltheater, designed by Karl von Fischer in 1810, burned down during a production, and the second iteration, designed by Leo von Klenze, was destroyed during an air raid on October 3rd, 1943. A favorite house of composer Richard Wagner, he premiered five of his iconic operas at the Nationaltheater before building his own operatic home, the *Festspielhaus* (Gr.: 'festival hall') in Bayreuth. The current theatre, built in 1963, echoes the original design by von Fischer, but on a larger scale and with focus around the "royal box", a seating area positioned in the center of the back wall of the house. The theatre currently seats 2,100 patrons, making it the largest opera house in Germany, and its newest stage is 2,500 square meters, not only the largest stage in Germany, but also the third largest in the world.

The house is built in a horseshoe style, and contains no interior aisles to navigate or, for the purposes of this document, to measure. The ground floor seats 828 audience members, is twenty-two rows deep and, at its widest point, forty-nine seats across. This leaves 1,272 seats, distributed across five floors, all approximately three rows deep. Utilizing all of these available measurements, the Nationaltheater of Munich has an approximate volume of 14,545.5m^3 from the edge of the stage forward. So, for a singer's voice to reach each of the patrons, they are filling a basic ratio of 6.9m^3 per audience member attending the opera. Finally, using the Pythagorean Theorem and the established depth and height of the theatre, a calculation for "maximum" singing distance can be made. This results in an approximate distance of 36.5m for a voice to leave the edge of the stage and hit the ears of the farthest patron in the theatre.

Finally, an acoustical degradation can be established. As outlined in the beginning of this chapter, this serves only to provide a cursory example of what the voice must overcome to be heard, before acoustical support is rendered. Utilizing the Inverse Square Law by Ratio equation, where d_2 equals 36.5m, the 100dB base is degraded to 68.8dB. While a loss of only 31.2dB may seem minimal, this means that the audience member in the farthest seat from the singer in the Munich Nationaltheater is perceiving the singer as eight times softer than the voice actually is at its source.

Opéra Bastille - Paris National Opera

In stark contrast to the Munich Nationaltheater, the Opéra Bastille is the epitome of the modern opera house. Officially completed in 1990, the enormous structure has become the home of France's principal opera company, the Paris National Opera. The theatre's interior reflects its age with a cool color palette and a blend of curves and harsh right angles. Not only was the theatre intentionally designed without a royal or president's box, it was designed to feature no boxes of any kind. Each and every seat in the hall represents the same visibility and level of comfort for the audience, although the 15th row is labeled the VIP row and does contain the "presidential seat".[30]

The largest opera house in France, it is built in a raked arena style and seats 2,745 audience members across a ground floor and two additional balconies. There are additional seats on a few narrow balconies floating on the left and right sides of the theatre. The architectural design of the two extremely large balconies does present some overlap, with the floors below, but allows unfettered sightlines to the stage. Utilizing the measurements provided by the Opéra

[30] Tours and Travel, "Opéra Bastille - Introduction," *Tours and Travel* (ETIPS Inc., 2021), last modified 2021, accessed March 27, 2021, https://www.toursandtravel.app/en/points-of-interests/paris/op%C3%A9ra-bastille---introduction/407.

Bastille themselves, the interior volume of the theatre is approximately 30,720m^3, more than double that of the Munich Nationaltheater. A singer's voice, in order to reach each of the patrons, is filling a basic ratio of 11.2m^3 per audience member attending the opera. However, because of the significantly shallower nature of the theatre's design, the farthest patron from the edge of the stage is only approximately 37.7m away, just 1.2m further than in the Munich Nationaltheater.

With this information, an acoustical degradation can be established. This serves only to provide a cursory estumate of what the voice must overcome to be heard, before acoustical support is rendered. Utilizing the Inverse Square Law by Ratio equation, where d_2 equals 37.7m, the furthest set of ears, the 100dB base is degraded to 68.5dB. This loss of only 31.5dB means that the audience member in the farthest seat from the singer in the Opéra Bastille is perceiving the singer as eight times softer than the voice actually is at its source. In this particular case, the acoustics of the Opéra Bastille are of note. Many have complained about the nature of the acoustics of the house, particularly with how it addresses the "Bass Loss Problem" described by Nave.[31] The complaints even made it to the ear of Russell Platt while writing a review of the house for *The New Yorker*, but he insists that his seats in the orchestra section were non-problematic.[32] Nonetheless, it is of great importance when comparing the space to other opera houses analyzed here.

[31] "The Bass Loss Problem" *HyperPhysics*, accessed March 17, 2021, http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html

[32] Russell Platt and James B. Stewart, "We'll Never Have Paris," *The New Yorker*, accessed March 11, 2021, https://www.newyorker.com/culture/culture-desk/well-never-have-paris.

Teatro alla Scala

The Teatro alla Scala, more colloquially known as La Scala, stands firmly in the annals of opera history as the proving ground for fledgling and tenured opera singers alike. The oldest opera house being considered for analysis here, the current iteration of the theatre was inaugurated on August 3, 1778. An exception to the rules of this document, the Teatro alla Scala is not, in fact, the largest opera house in Italy. That distinction belongs to the Teatro Massimo Vittorio Emanuele, but its current operatic productions could not be compared to the works accomplished by the other houses analyzed here. Thus, the Teatro alla Scala has been substituted as a fair comparison to the likes of the Bayerische Staatsoper or the Metropolitan Opera.

Quite a large theatre in its own right, La Scala seats a respectable 2,030 patrons. With just 670 of those audience members seated on the ground floor, the theatre distributes the remaining 1,360 across six balconies, including the *loggione*, a large and often cramped gallery, where many of opera's most vocal critics prefer to reside. The theatre is twenty-three rows deep and thirty-six seats across. Combined with the full seven stories of the opera house, this gives the theatre an interior volume of approximately 12,803.8m^3. Divided over the occupancy of the space, this represents a ratio of 6.3m^3 of space per audience member. Despite variances in all aspects of the two houses, these calculations closely resemble that of the substantially newer Munich Nationaltheater. Considering the height of the opera house, it is of note that the depth still brings the maximum singing distance to approximately 40m.

Expecting similarities to continue, an acoustical degradation for La Scala can be established. Utilizing the Inverse Square Law by Ratio equation, where d_2 equals 40m, the furthest set of ears, the 100dB base is degraded to 67.9dB. Continuing the loss trends, the 32.1dB loss still means that the audience member in the farthest seat from the singer in the Teatro alla

Scala is perceiving the singer as eight times softer than the voice actually is at its source. Of note are the acoustical properties of the hall. As a portion of the proceedings of the 22nd International Congress on Acoustics in 2016, a ranking of twenty-two of the world's top opera houses, by acoustic parameters, was published.[33] The study first utilized the feedback of many great opera conductors on what they felt was the most acoustically superior opera house in which they had attended an opera or conducted. The Teatro alla Scala placed third on this subjective ranking list. Next, an analysis tool referred to as PROMETHEE II was utilized to properly analyze each house. PROMETHEE II is a Multi Criteria Decision Making (MCDM) technique called the Preference Ranking Organization METHod for Enrichment Evaluation.[34] This allowed the acoustician teams to handle multivariate analysis that was both quantitative and qualitative and create an objective ranking of the houses. Despite the praise it received from the subjective conductors, the Teatro alla Scala ranked eighteenth out of twenty-two opera houses analyzed.

The Royal Opera House

The Royal Opera House in Covent Garden is the current home of The Royal Opera. The structure represents the third iteration of the theater, after the first two theatres perished to fires in 1808 and 1856. Though several portions of the structure date to its final formal rebuild in 1858, much of what is currently seen and utilized was part of a grand reconstruction and renovation beginning in the 1980's and continuing through the 1990's. The current theatre still echoes the original 1858 design by Edward Middleton Barry, but with many modern improvements. The theatre seats 2,256 patrons, a remarkable feat considering the performable

[33] "Rank-Ordering Opera Houses According to Their ... - ICA2016," accessed March 5, 2021, http://www.ica2016.org.ar/ica2016proceedings/ica2016/ICA2016-0502.pdf.

[34] Maysam Abedi et al., "PROMETHEE II: A Knowledge-Driven Method for Copper Exploration," *Computers & Geosciences* 46 (September 2012): 255-263.

area of the stage is only 245.8 square meters, a tenth the size of the entire stage of the Munich Nationaltheater.

The house is built in a narrow horseshoe style, and contains two interior aisles on the ground floor. This ground floor seats just 486 audience members and is a shallow twenty rows deep and, at its widest point, thirty-one seats across. This leaves 1,770 seats distributed across four floors, with the highest floor utilizing a scalloped roof structure on all three sides to allow for additional seating in a raked style. Utilizing all of these available measurements, the Royal Opera House has an approximate volume of just 7,078.1m^3 from the edge of the stage forward. So, for a singer's voice to reach each of the patrons, they are filling an incredibly efficient ratio of 3.14m^3 per audience member attending the opera. Again, using the Pythagorean Theorem and the established depth and height of the theatre, a calculation for "maximum" singing distance can be made. Resulting, in this case, in an approximate distance of 27.7m for a voice to leave the edge of the stage and hit the ears of the farthest patron in the theatre.

With this knowledge, an acoustical degradation can be established. Utilizing the Inverse Square Law by Ratio equation, where d_2 equals 27.7m, the furthest set of ears, the 100dB base is degraded to 71.2dB. Despite the substantially more efficient use of space, a 28.8dB loss still means that the audience member in the farthest seat from the singer in the Royal Opera House is perceiving the singer as eight times softer than the voice actually is at its source.

The Metropolitan Opera House

Nestled into the Lincoln Center for the Performing Arts, the Metropolitan Opera House represents the pinnacle of opera for many in the world. Though the initial home of the Metropolitan Opera Company was opened in 1883, the current theater was opened in 1966. This is the largest, by seats, of the three American opera houses that will be used for comparison in

this document. Though it is now one of the most technologically advanced theaters on earth, its initial planning dates back to the 1920's, but was abandoned in 1933 by John D. Rockefeller in favor of the now iconic Rockefeller Center. More than thirty years later, at the behest of the New York Philharmonic Society and the Metropolitan Opera Company, Wallace Harrison, chief architect for the Lincoln Center, was chosen to design an opera house as the centerpiece for this new complex. Harrison was also notably an architect on the Rockefeller Center itself, the very project that stymied the new opera house by three decades.

Though it echoes the brilliant and royal designs of its European counterparts, the Metropolitan Opera House was built on a massive scale. With seats alone, the house will host 3,794 audience members, with standing room for an additional 245 guests. At 4,039 combined seats, it has nearly double the capacity of the Munich Nationaltheater, the Teatro alla Scala, and the Royal Opera House. Adding to its immense size, approximately 1,584, around 40%, of those seats are on the ground level. The theatre distributes the remaining 2,210 patrons across five additional balconies, including a raked uppermost level, similar to the Royal Opera House. The theatre is thirty-seven rows deep and fifty-four seats across. Combined with the full six stories of the opera house, this gives the theatre an interior volume of approximately 25,953.2m^3. In spite of this massive jump in volume, when this space is divided over the occupancy of the space, this represents a ratio of 6.8m^3 of space per seated audience member. This is a remarkable use of space and represents a very similar ratio of design to that of its European cousins. Considering the height of the opera house, this brings the maximum singing distance to approximately 45m. Of note on the accuracy of these estimations, the Metropolitan Opera themselves also advertise the farthest seat in the house as being 45m from the stage.

With this slightly larger increase in distance, an acoustical degradation for The Met can be established. Utilizing the Inverse Square Law by Ratio equation, where d_2 equals 45m, the furthest set of ears, the 100dB base is degraded to 66.9dB. This is just one decibel quieter than the measurements of The Met, however, the 33.1dB loss means that degradation is approaching another half magnitude loss. So, the audience member in the farthest seat from the singer in the Metropolitan Opera House is perceiving the singer as eight, almost eight and a half, times softer than the voice actually is at its source. Of note are the acoustical properties of the hall. In the subjective portion of the International Congress on Acoustics report, The Metropolitan Opera House ranked eighth on the list. However, it was ranked third out of twenty-two opera houses analyzed with PROMETHEE II.[35] This would, no doubt, logically combat a large sum of the acoustical degradation calculated.

War Memorial Opera House - San Francisco Opera

Though the gargantuan outer facade of the War Memorial Opera House echoes the triumphant European designs of halls like the Munich Nationaltheater, the classically designed interior represents the design philosophies of the Opéra Bastille. Designed by Arthur Brown Jr. and G. Albert Lansburgh, the reserved yet powerful exterior serves as a memorial to those served during World War I. Since opening in 1932, the enormous structure has been the home of the San Francisco Opera. The theatre's interior reflects its age with grandiose halls and a theater design boasting gold walls and lush red seats.

Similar in design to the Opéra Bastille, it is built in a raked arena style and seats 3,146 audience members across a ground floor and three additional balconies, with standing room for an additional 200 guests. The architectural design of the two extremely large balconies and one

[35] "Rank-Ordering Opera Houses."

small u-shaped balcony, does present some overlap with the floors below. Approximately 1,174 audience members can be seated on the ground floor, leaving 1,972 patrons to be spread across the three balconies. Accounting for overlap, this means the house is approximately forty-eight rows deep and forty-six seats wide at its widest point. Utilizing these measurements, the interior volume of the theatre is approximately 23,924.2m^3, quite similar to that of the Opéra Bastille. Contrasting the Opéra Bastille's use of space, however, a singer's voice, in order to reach each of the patrons, is filling a basic ratio of only 7.6m^3 per audience member attending the opera. However, because of the significant length of the theatre's design, the farthest patron from the edge of the stage is only approximately 52.5m away, nearly fifteen meters further than the Opéra Bastille.

With this information, an acoustical degradation can be established. Utilizing the Inverse Square Law by Ratio equation, where d_2 equals 52.5m, the furthest set of ears, the 100dB base is degraded to 65.6dB. This loss of 34.4dB means that the audience member in the farthest seat from the singer in the War Memorial Opera House is perceiving the singer as nearly eight and a half times softer than the voice actually is at its source.

Civic Opera House - Lyric Opera of Chicago

An architectural icon of its own right, the Civic Opera House, home to the Lyric Opera of Chicago, stands in the middle of the Civic Opera Building, a forty-five story office building with two twenty-two story wings. It is also the second largest opera house in North America, by seating. Commissioned by Samuel Insull, the hall was inaugurated in 1929 and echoes the period with floods of Art Deco influence and is often referred to as "Insull's Throne," with the design of the building holding similarities to a chair facing westward. The interior of the Ardis Krainik auditorium, the building's main performance space, is full of scalloped and gilded designs, with

soft maroon seats spread across a massive ground floor and three large balconies, two of which are strongly raked.

Spread across the four levels are 3,563 seats, with approximately 1,449 on the ground floor. This leaves 2,114 seats spread across the upper three balconies. Similar in design to the Opéra Bastille and the War Memorial Opera House, the Civic Opera House does not utilize any type of wrapping design, but instead utilizes a large and shallowly raked main floor, approximately forty-eight rows deep and forty-six seats wide, with three large overlapping balconies. The height of these balconies is of significant note. The Civic Opera House management advertises the height of the ceiling as seven stories high and the highest seats sitting at approximately six stories, approximately 56m from the edge of the stage. Utilizing that height measurement and accounting for balcony overlaps, the theatre has an approximate volume of 31,843.5m^3. Though not the largest by seats, this makes the Civic Opera House the largest opera house compared in this document, and likely one of the largest in the world. Eclipsed only by the Opéra Bastille, this means that a singer's voice, in order to reach each of the patrons, is filling a basic ratio of only 8.94m^3 per audience member attending the opera.

Accounting for the previously discussed ceiling height differences, an acoustical degradation can be established. Utilizing the Inverse Square Law by Ratio equation, where d_2 equals 56m, the furthest set of ears, the 100dB base is degraded to 65dB. This loss of 35dB marks the largest degradation calculated here. An audience member in the farthest seat from the singer in the Civic Opera House is perceiving the singer as eight and a half times softer than the voice actually is at its source. Supporting this is the 2016 ranking addressed previously, in which The Civic Opera House ranked twelfth on this subjective ranking list. As further scientific agreement, the PROMETHEE II analysis placed the Civic Opera House at a rank of twenty-

second out of twenty-two opera houses analyzed. This means that not only is the Civic Opera House the largest house by volume with the worst acoustic degradation analyzed, it also objectively lacks the much-needed acoustical reinforcement to overcome such a massive space.

Table 4. Opera House Comparison Chart

Opera House Comparison Chart					
Opera House	**Seats**	**Ground Level Seats**	**Approx. Volume**	**Seat/Space Ratio**	**Max Singing Distance**
Munich Nationaltheater	2,100	828	14,545.5m^3	6.9m^3/seat	36.5m
Opéra Bastille	2,745	Unavailable	30,720m^3	11.2m^3/seat	37.7m
Teatro alla Scala	2,030	670	12,803.8m^3	6.3m^3/seat	40m
Royal Opera House	2,256	486	7,078.1m^3	3.14m^3/seat	27.7m
Metropolitan Opera House	3,794	1,584	25,953.2m^3	6.8m^3/seat	45m
War Memorial Opera House	3,146	1,174	23,924.2m^3	7.6m^3/seat	52.5m
Civic Opera House	3,563	1,449	31,843.5m^3	8.94m^3/seat	56m

CHAPTER 4: Aria Analysis

Section Purpose and Simplified Methodology

This chapter serves to explore the musical elements that may factor into the categorization of certain opera arias. Twenty-five arias are presented with a condensed explanation of historical and numerical data gathered. This includes the categorizations assigned by Kloiber and Boldrey, the creator of the role, the length by number of individual occurrences of phonation, the range of the aria, the True Tessitura (detailed below), the average pitch of the piece, and the orchestra's decibel output at 75%. Unless otherwise noted, the orchestra output was calculated using the smallest balanced string section suggested by Kloiber, shown in Chapter 2. To accomplish this task, each aria was played into a proprietary program, resulting in a set of raw MIDI data, used to calculate average pitch and length, and the True Tessitura data. The number of occurrences of each pitch are plotted below each reference table. It is essential to note that this analysis is intended to reflect only the aria of each character, not the role. Further research must occur in order to apply these findings to the entirety of each role.

Choosing Arias

The purpose of this section is to survey the ideas within Kloiber and Boldrey's text and investigate them on a new and different level. The tenor opera repertory was chosen. The decision was primarily based upon the presence of multiple styles of Fach categorizations, some missing categories discussed in Chapter 1, and the differences in categorizations found among Boldrey and Kloiber's writings. The arias are categorized by the primary voice type as listed by Boldrey, as the more current and expanded text of the two. Each set of five arias was designed to represent an audition package: a set of five arias of versatile origin, be that linguistically, compositionally, historically, or tonally. Please note that Boldrey does list "dramatic" and

“heroic” voices as separate categories, but with further investigation into Kloiber’s handbook and other texts, the decision was made to combine the two into a single package, assuming a singer of the “dramatic” package could sing the “heroic” package, and vice versa.

Terminology

For the purposes of this aria analysis, a semantic clarification is necessary. First, there must be an explanation on the use of quotation marks. It is the premise of this section and of this document, in large part, that the language surrounding of many of these categorizations is arbitrary. While certain elements are based in musical concepts or helpful when discussing the quality of the voice, they don’t necessarily represent the only option for the description of an individual role or singer. As such, quotation marks have been utilized for all ideas outside of simply “tenor”. That is to say, without a detailed basis for what an actual Light Lyric Tenor role is in comparison to a Full Lyric Tenor role and so on, it is referred to here as “light” lyric tenor. Lyric is not in quotes out of respect for the concepts laid out by Kloiber and Boldrey’s continued use of the term, at least acknowledging the basic concepts of separate purposes and vocal requirements for varying voice types. Those being the concepts of *Lyrischer* (Gr.: ‘lyrical’), a role that must provide theatrical emphasis in addition to beautiful singing, and *Heldenfach* (Gr.: ‘heroic category’), a role that utilizes vocal ability and the written music to establish the drama.

The second instance of the presence of a unique word is that of “True Tessitura”. This will be discussed in the next section, but due to its proprietary nature, it is worth mentioning here. Tessitura, in the case of the voice, is the pitch span in which a majority of pitches lie for a particular aria. True Tessitura aims to give a definitive range in which the aria deviates from a specific central note range.

Methodology

The genesis of this document came with the collaboration between the author and concert organist and organ improvisation master Dr. Matthew Gender. After lengthy discussion and multiple revisions, Dr. Gender developed a computer program that would allow the direct input of individual notes, which would then be output as MIDI notes, which could then be used for multiple calculations and data translations. Dr. Gender utilized the tools of a software called Cycling '74 Max, the self-proclaimed "software for experimentation and invention". All direct input, output, and data translations can be found in the Appendix for further experimentation or reference.

This MIDI output allows for note tracking and accounting, as well as the ability to average each aria to a single pitch. This is not necessarily a specifically useful measurement on its own, but does serve as a useful comparison tool between arias and voice categorizations. It also allows for each note to easily be accounted for and the result of this is referenced as length. This does not take into account the specifics of time for the aria, but represents the number of individual phonations that the voice must go through in order to sing the aria.

This MIDI data is then translated into what is proprietarily called "True Tessitura" data. The True Tessitura is based on the vocal concept of the *zona di passaggio* (It.: 'area of passage'), an area of particular challenge for the singer, which serves as the gateway to various registers. In the case of the tenor voice, this has been set, for these purposes, as E4 and F4. This serves as the transition into the tenor's upper register. For these calculations, E4 and F4 are considered neutral, or 00. Then, each pitch ascending or descending from this neutral zone gains a positive or negative score, respectively, by half step. For example, the tenor high "c", C5, would be scored a +07, as it is seven half steps above the F4 neutral area. Likewise, middle "c", C4, is

scored -04 because it is four half steps below E4. These scores are then combined and averaged to result in a plus/minus variance from the zona di passaggio, meaning that, on average, a pitch within the aria lies within an area within that variance. In some cases, this results in a True Tessitura that expands beyond the given range of an aria; this can be due to the strong focus of the pitch content being substantially below or substantially above the zona di passaggio. Much like the average pitch, the True Tessitura does not necessarily represent a specific piece of data for categorization, but rather serves as another metric of comparison between arias, roles, and voice types.

The Pitch Distribution graph located above each aria serves to provide a visual representation of the numerical data gathered. This graphic can help to expose structures of composition and trends in pitch use for the purposes of comparison. The pitches used to produce these charts do not include grace notes. For a clear example of this data, reference Figure 5.

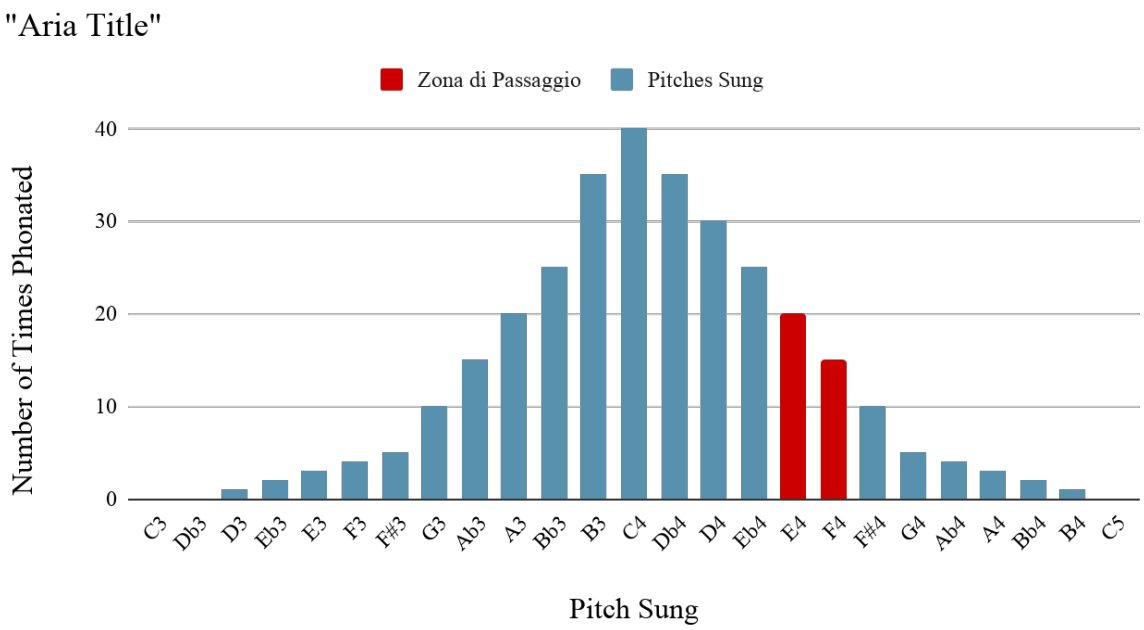

Figure 5. Sample Pitch Distribution [Key]

“Character” Tenor Arias

Table 5. Aria Reference Chart: King Kaspar, “This is my box”

“This is my box” - *Amahl and the Night Visitors*, Gian Carlo Menotti			
Role	King Kaspar	**Length**	202 Pitches
Aria Location	Act I	**Range**	C#3 - Ab4
Kloiber	Unlisted	**True Tessitura**	B3 - “Bb4” (±5.27)
Boldrey	COMIC TENOR	**Average Pitch**	B3 (59)
Premier Voice	Andrew McKinley	**Orchestra at 75%**	94.7dB

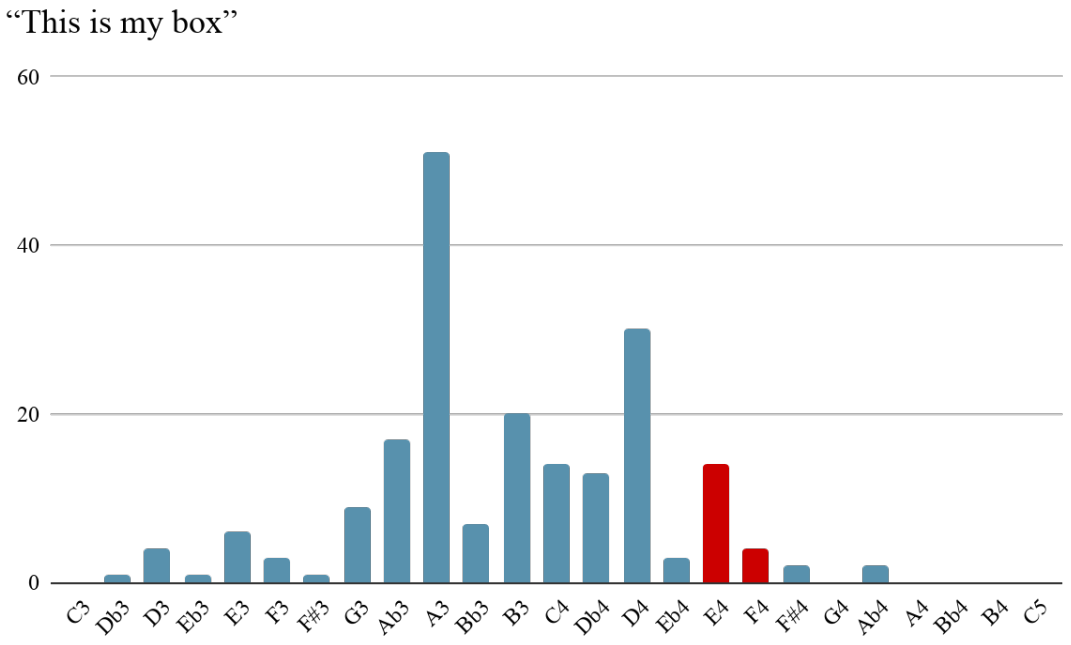

Figure 6. “This is my box” [Pitch Analysis Chart]

This aria continues a historical trend of “character” tenor repertoire being much lower in central pitch value and remarkably repetitive. More than 25% of the pitch content of this aria is a singular pitch, A3. Regardless of this pitch focus, the average pitch remains a B3, the same as three of the other four arias analyzed here. The orchestra, however, is the smallest of all those

considered here, only 94.7dB, which is approximately 75% as loud as the largest analyzed, Wagner's *Siegfried* orchestra at 100.1dB.

Perhaps the most important factor when considering the categorization of this aria is its creator. Andrew McKinley created two roles for Menotti, the other being Nika Magadoff in *The Consul*. Kloiber categorizes Magadoff as Spieltenor, while Boldrey refers to it simply as "COMIC TENOR". Interest arises, however, when the rest of McKinley's career is considered. He notably performed Malcolm in Verdi's *Macbeth* (Kloiber: Lyrischer Tenor, Boldrey: LIGHT LYRIC TENOR), Turiddu in Mascagni's *Cavalleria rusticana* (Kloiber: Jugendlicher Heldentenor, Boldrey: full lyric tenor, SPINTO TENOR, dramatic tenor), and Prince Shuysky in Musorgsky's *Boris Godunov* (Kloiber: Heldentenor, auch Jugendlicher Heldentenor, Boldrey: LIGHT LYRIC TENOR). If Menotti chose McKinley for the premiere performance, it is likely that he did not intend it to be sung by a smaller voice.

Table 6. Aria Reference Chart: Beppe, "O, Colombina, il tenero fido Arlecchin"

"O, Colombina, il tenero fido Arlecchin" - *Pagliacci*, Ruggero Leoncavallo			
Role	Beppe, *actor*	**Length**	119 Pitches
Aria Location	Act II	**Range**	E3 - A4
Kloiber	Spieltenor	**True Tessitura**	C4 - A4 (±3.95)
Boldrey	COMIC TENOR, light lyric tenor	**Average Pitch**	C4 (60.14)
Premier Voice	Francesco Daddi	**Orchestra at 75%**	98.1dB

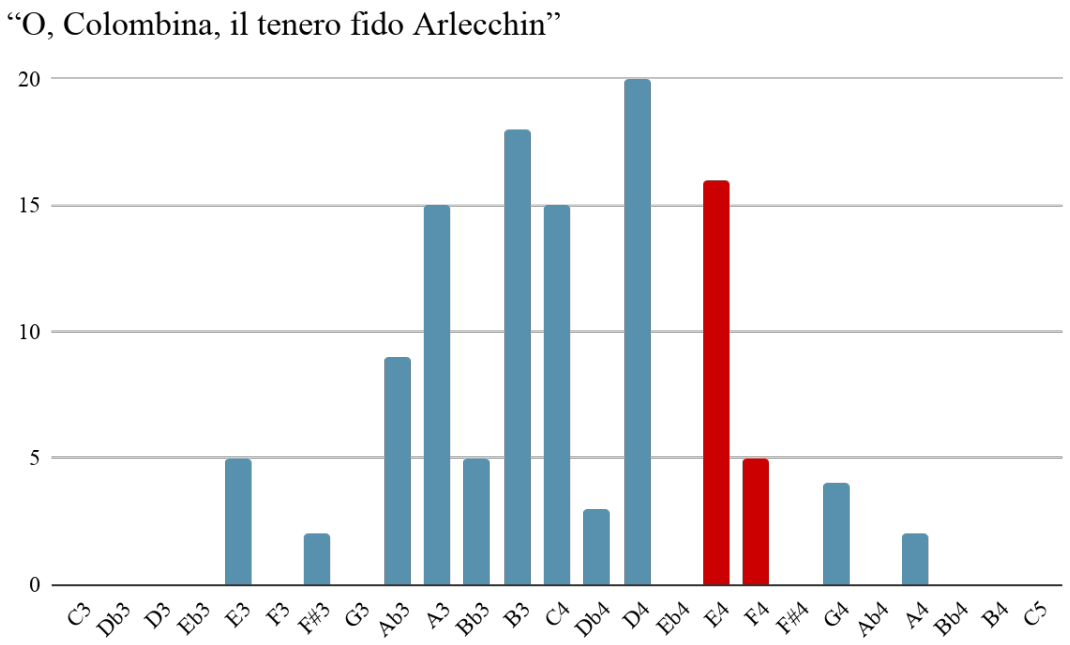

Figure 7. "O, Colombina, il tenero fido Arlecchin" [Pitch Analysis Chart]

Perhaps a hallmark of "Character" tenor singing, nearly all of the melodic material within Beppe's aria register at or below the zona di passaggio as outlined earlier in the chapter. With a substantial orchestra present and the lead tenor character in the opera, Canio, being categorized by both Kloiber and Boldrey as a Heldentenor, perhaps the categorization of Beppe as purely a "comic" tenor could be expanded upon. This is a possible argument to separate Kloiber's idea of singing oriented "serious" voice types and the more acting-oriented "character" voice types from their actual vocal size. While Beppe may not deal with the orchestra in full force, it could be suggested that the role be cast with a voice of substantial enough size that it compliments that of Canio.

Little is known about Francesco Daddi, the originator of the role, but he was regarded as one of the great Italian character singers of his time. Considering the singers who have sung the

aria after him - Luciano Pavarotti, Roberto Alagna, Alfredo Kraus, and Beniamino Gigli - to name a few, it is safe to assume that this aria takes substantial power and lyricism.

Table 7. Aria Reference Chart: Guillot, "J'enfourche aussi Pégase"

"J'enfourche aussi Pégase" - *Manon*, Jules Massenet			
Role	Guillot	**Length**	140 pitches
Aria Location	Act IV	**Range**	E3 - A4
Kloiber	Charaktertenor, auch Spieltenor	**True Tessitura**	Bb3 - "B4" (±5.99)
Boldrey	COMIC TENOR	**Average Pitch**	B3 (58)
Premier Voice	Pierre Grivot	**Orchestra at 75%**	97.2dB

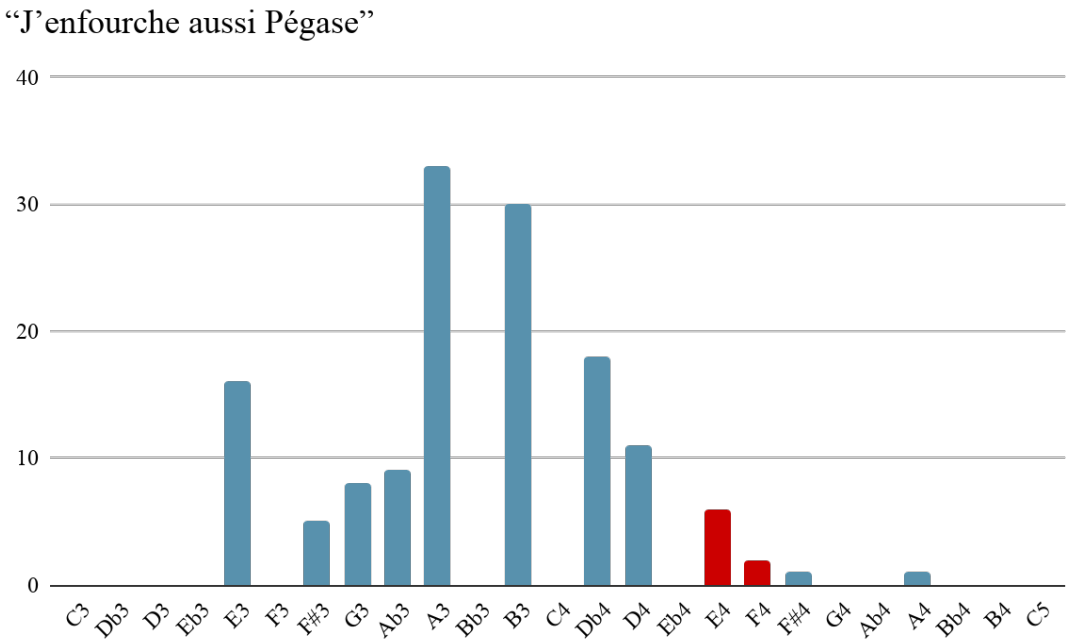

Figure 8. "J'enfourche aussi Pégase" [Pitch Analysis Chart]

Nearly 93% of the pitch content of "J'enfourche aussi Pégase" exists below the zona di passaggio. This lends credence to the hypothesis that arias labeled by Boldrey and Kloiber as "charaktertenor" or "comic tenor" require not only fantastic acting skills, but also an ability to

maintain a tessitura far below the averages for other tenor fächer. Despite the decibel approximation for the overall opera, accompaniment for this aria is rather scarce and does enable the singer to sing such a low tessitura without needing the power of a higher baritone.

Quite a bit is known about the originator of the role, and thus the composer's intention. Pierre Grivot was a career creator of "secondary" tenor roles, particularly in French opera. His premiere as Monostatos with the Paris *Opéra-Comique* and the pitch analysis of that aria echoes the sentiment that Grivot likely had plentiful abilities in the lower two-thirds of his voice.

Table 8. Aria Reference Chart: Mime, "Als zullendes Kind" [Starling Song]

"Als zullendes Kind" [Starling Song] - *Siegfried*, Richard Wagner			
Role	Mime	**Length**	153 pitches
Aria Location	Act I, Scene 1	**Range**	Eb3 - Gb4
Kloiber	Charaktertenor, auch Spieltenor	**True Tessitura**	Bb3 - "B4" (±6.04)
Boldrey	COMIC TENOR	**Average Pitch**	B3 (58)
Premier Voice	Max Schlosser	**Orchestra at 75%**	100.1dB

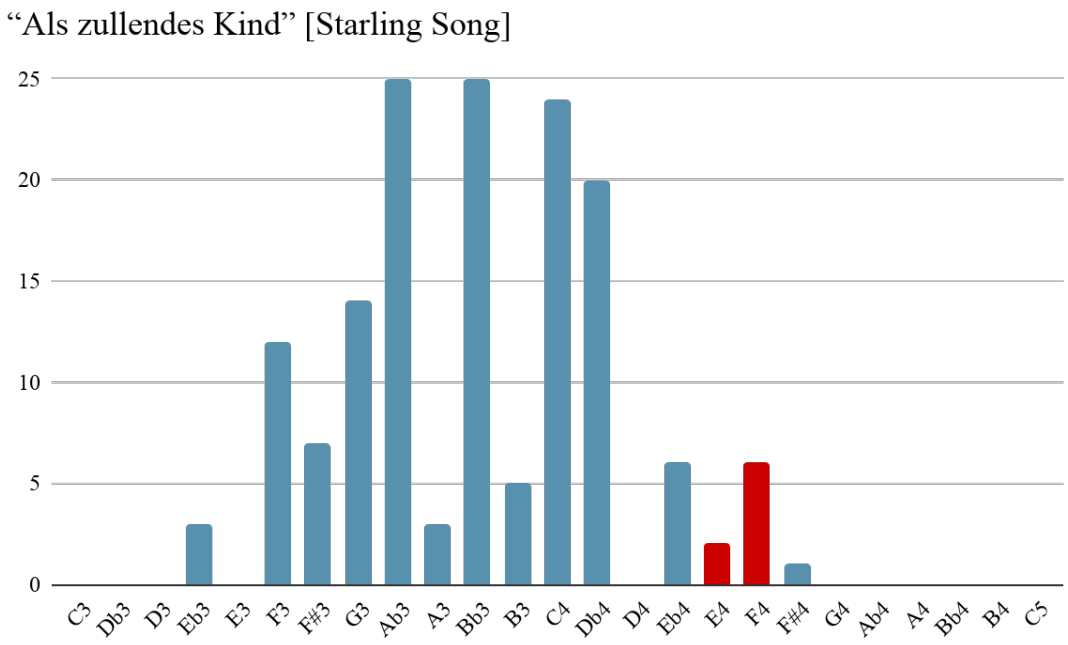

Figure 9. "Als zullendes Kind" [Pitch Analysis Chart]

Of all the discussion and considerations of assigning an aria category, perhaps none is more pertinent or confusing than that of the Wagnerian Charaktertenor. More than one hundred of the one hundred and fifty-three pitches sung in this aria lie in the space of a fourth, from Ab4-Db4. This follows suit with the average pitch of the piece being B3, the same as several other arias analyzed as "character" tenor arias. Again, the discussion must arise that the tessitura much more comfortably lies in the range of a baritone. It is clear that trends emerging in the data suggest this "character" designation is primarily a choice of color, independent of the pitch content. It is clear that this could be sung much more richly and efficiently by a baritone. The massive 100.1dB orchestra seems to support the variability in voice size that can be required to sing certain character roles. Even in the casting of complimentary voice types, Mime (the character singing this particular aria) being cast as a larger voice than other arias analyzed here seems likely.

The originator of the role, Max Schlosser, adds even more clarity to these concepts. First, Schlosser did sing several baritone roles later in his career, including several Wagner roles. This, of course lends further credence to the blending idea of baritonal power lying within the categorization of "character" tenor. However, the interesting argument of color as the basis for this voice type is in conflict with the other repertory that Schlosser became known for. Rossini's Count Almaviva (Kloiber: Lyrischer Tenor, Boldrey: LIGHT LYRIC TENOR), Weber's Max (Kloiber: Jugendlicher Heldentenor, Boldrey: spinto tenor, DRAMATIC TENOR), and Flotow's Lyonel (Kloiber: Lyrischer Tenor, Boldrey: light lyric tenor, FULL LYRIC TENOR) were all noted roles performed by Schlosser during his tenure at the Munich Hofoper.

Table 9. Aria Reference Chart: Monostatos, "Alles fühlt der Liebe Freuden"

"Alles fühlt der Liebe Freuden" - *Die Zauberflöte*, Wolfgang Amadeus Mozart			
Role	Monostatos	**Length**	200 pitches
Aria Location	Act II, Scene 9 (No. 13)	**Range**	D3 - E4
Kloiber	Spieltenor, auch Charaktertenor	**True Tessitura**	Bb3 - "B4" (±5.93)
Boldrey	COMIC TENOR	**Average Pitch**	B3 (58)
Premier Voice	Johann Joseph Nouseul	**Orchestra at 75%**	97.8dB

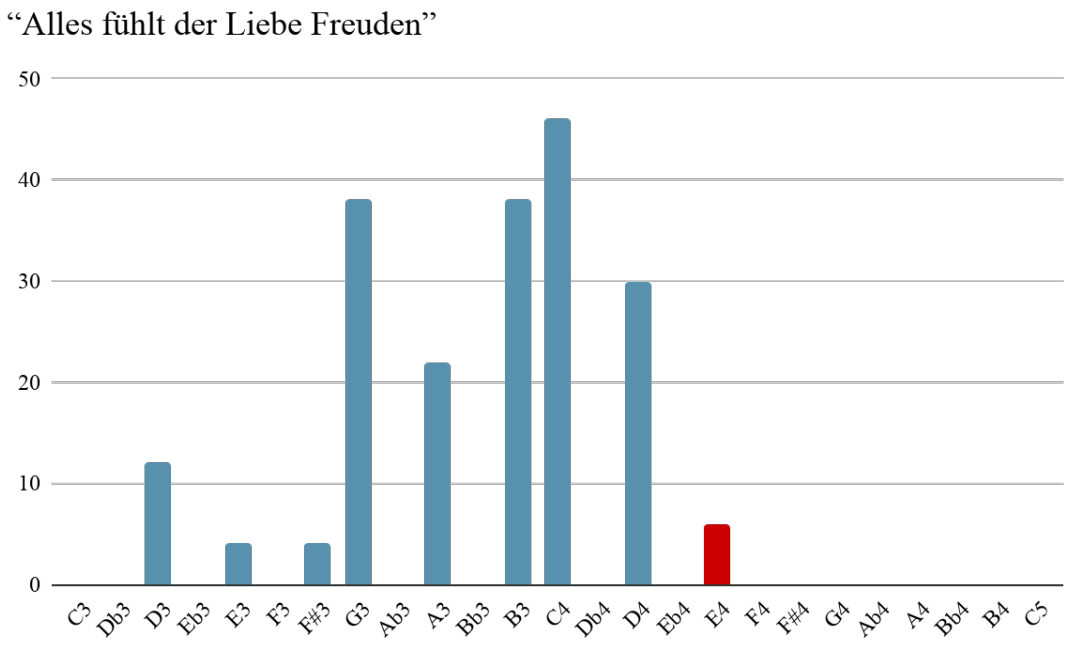

Figure 10. "Alles fühlt der Liebe Freuden" [Pitch Analysis Chart]

A remarkable presentation of data to represent the "character" tenor genre, nearly half of the pitches sung in the aria are B3 or C4. All but a few of the sung pitches lie in a fifth centered around the average pitch, B3. In distinct contrast to the vocal requirements of the arias analyzed within this category, the aria peaks at an E4. With the contrast of suggestions by Boldrey and Kloiber regarding the categorization of the role of Tamino (as discussed later in this chapter), it is important in this instance for the size and quality of the voice to be cast carefully to contrast the house's choice of their Tamino. With an average decibel measurement of 97.8dB for the orchestra, it does need to remain a voice capable of being carried over the orchestration throughout the opera.

Little information was found about the originator of the role, Johann Joseph Nouseul, other than that he was a member of a theatre company formed by Emanuel Schikaneder, the librettist for *Die Zauberflöte*.

A Discussion of the “Character” Tenor

The “character” tenor genre presents a number of factors that not only break the mold of a single voice type, but also present multiple stylistic characteristics of several different Fach categories. The most harmful conclusion that could be made by a teacher or student would be aligning the character/comic/buffo tenor with a small voice. This could be construed by a misinterpretation of Boldrey’s list of voice types, which appear to be presented by size, as being in order from smallest to largest. Kloiber, on the other hand, lists these roles at the back of the tenor section of his *Handbuch der Oper*, immediately after Heldentenor. A delineation between voice size and role purpose is essential. Many factors determine each voice type, and in the case of the pure “character” tenor categorization, voice size is not necessarily one of these.

The creators of these roles, in three out of five instances, are notable singers of significantly larger repertoire. This is, however, quite possibly a selection bias due to an attempted representation of a varied audition package. Assuming that the composer's intention is of relative validity to the reader, there is a strong argument that singers with exceptional acting abilities, regardless of voice color or size, should be considered for these roles. Additionally, the data suggests the possibility that the casting of these “character” roles alongside the opera’s “serious” roles should be much more similar in size than one may assume. Utilizing these original castings, evidence suggests that the singers chosen were cast as exceptional actors and singers capable of complimenting the leading roles of the operas.

Of note here is also the average decibel output of the orchestras for these arias in comparison to that of the rest of the arias analyzed. With an average decibel production of 97.58dB, these opera orchestras are less than one half of one order of magnitude smaller than the largest orchestras addressed in this analysis.

"Light Lyric" Tenor Arias

Table 10. Aria Reference Chart: Arturo, "A te, o cara"

"A te, o cara" - *I Puritani*, Vincenzo Bellini			
Role	Lord Arturo Talbo	**Length**	170 pitches
Aria Location	Act I	**Range**	A3 - C#5
Kloiber	Jugendlicher Heldentenor	**True Tessitura**	D#4 - F#4 (±1.30)
Boldrey	LIGHT LYRIC TENOR	**Average Pitch**	D#4 (63)
Premier Voice	Giovanni Battista Rubini	**Orchestra at 75%**	97.3dB

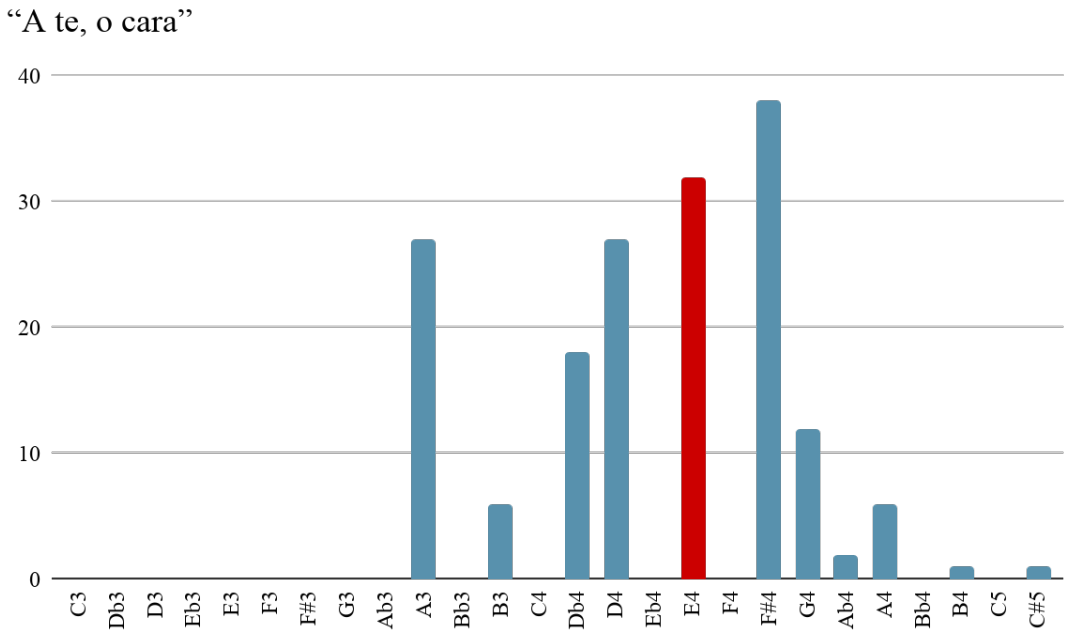

Figure 11. "A te, o cara" [Pitch Analysis Chart]

A seemingly apparent enigma of voice categorization, this aria of Arturo stands apart from many within the tenor repertoire. The aria has an extremely narrow "True Tessitura", even when compared to other "light lyric" arias considered here, and an average pitch that lies just outside of the zona di passaggio. It cannot be ignored that Boldrey and Kloiber so greatly differ on how they categorize this role. Perhaps the most justifiable argument to be made for this is Kloiber's approach to blending concepts of character, vocal ability, and weight resulting in the

categorization of a "young hero". The most likely conclusion to be drawn is that this aria, with a fairly substantial 97.3dB orchestral average, requires a voice of some volume and weight, but with the flexibility and height associated with the Leggero style of voice, perhaps explaining Boldrey's categorization of "light" lyric.

Adding clarity to this argument is the creator of this role, Giovanni Battista Rubini. Rubini is considered to be one of the most influential forces of the *bel canto* (It.: 'beautiful singing') era, creating several roles for Bellini and establishing himself as one of Paris's premiere singers of Rossini and Donizetti.[36] In the case of voice type, Rubini was reported to have incredible coloratura and an upper extension to a ringing high F5.[37] When it comes to vocal weight, however, it appears that Kloiber's argument may hold less water. Famed writer and tenor Stefan Zucker, the self-proclaimed last member of a long lineage of singers having been taught Rubini's technique by Rubini himself, writes that Rubini was said to have been barely audible in all but his highest register and sang with a "slightly veiled" tone.[38] Rubini's technique, however, was enough to keep him employed as an icon of high and flexible bel canto singing. It is of note that if Zucker was in fact a direct descendant of Rubini's pedagogy, his technique certainly worked. In 1980, Zucker set the record for the highest note sung by a tenor in full voice, sustaining an A5 for 3.8 seconds. As an argument for some debate as to the appropriate Fach for this aria, it has been sung by a variety of voices in major opera houses all over the world, including Giuseppe Di Stefano, Luciano Pavarotti, Alfredo Kraus, Nicolai Gedda, Juan Diego Florez, and Javier Camarena.

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[36] Stefan Zucker, "Last of a Breed: Giovanni Battista Rubini Ruled as the Paragon of Virtuoso Tenors, King of the High F's," *Opera News* 46, no. 12 (February 13, 1982).

[37] Geoffrey Green, Voices in a Mask: Stories (Evanston, IL: Northwestern University Press, 2008).

[38] Zucker, "Last of a Breed".

Table 11. Aria Reference Chart: Fenton, “Dal labbro il canto”

“Dal labbro il canto” - *Falstaff*, Giuseppe Verdi			
Role	Fenton, *one of Nannetta’s suitors*	**Length**	141 pitches
Aria Location	Act III, Scene 6	**Range**	D#3 - Bb4
Kloiber	Lyrischer Tenor	**True Tessitura**	Db4 - Ab4 (±3.29)
Boldrey	LIGHT LYRIC TENOR	**Average Pitch**	Db4 (61)
Premier Voice	Eduardo Garbin	**Orchestra at 75%**	98dB

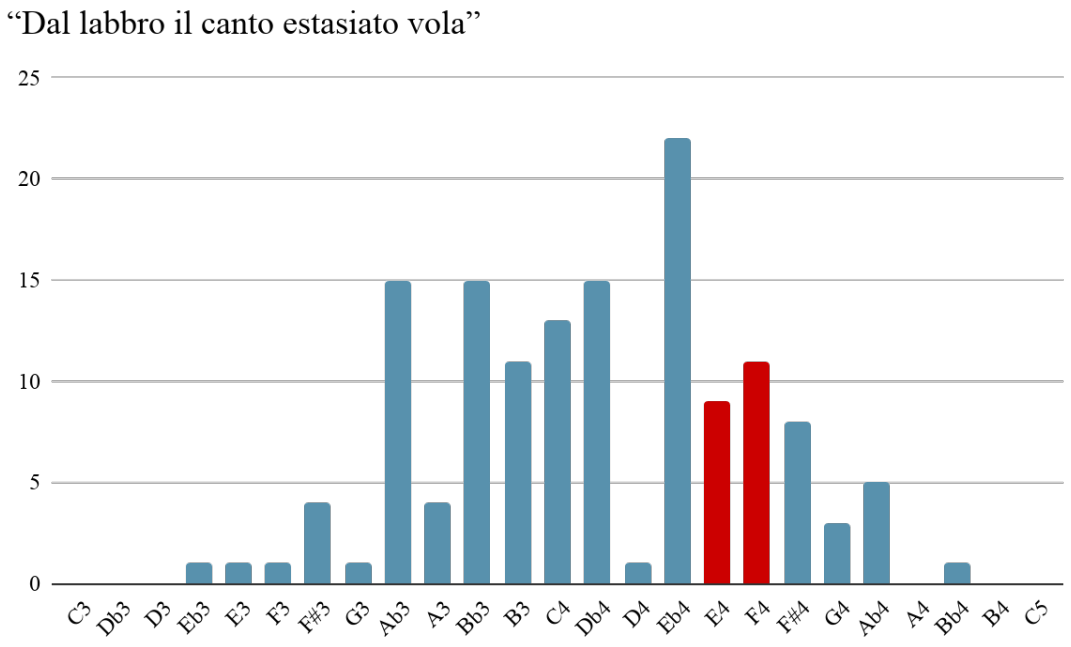

Figure 12. “Dal labbro il canto” [Pitch Analysis Chart]

At an average pitch a minor third higher than most of the “character” tenor arias analyzed, the pitch frequency and spread of this particular aria personifies the need for voice categories. The spread of primary pitches across this aria spans nearly an octave, and the time spent in the zona di passaggio is substantial. As discussed in Chapter 1, it appears that in the case of these roles, Kloiber is utilizing the category of Lyrischer tenor as a representative of what Boldrey refers to as both Light Lyric Tenor and Full Lyric Tenor. The Verdian orchestra does

present a substantial orchestra to sing over, but as a pairing for Nannetta (Fenton's soprano counterpart) in this opera, the writing and size suggestions seem appropriate.

Looking at the creator of this role does add an interesting element of confusion to the discussion. Eduardo Garbin, in addition to creating the role of Fenton, also created the role of Milio in Leoncavallo's *Zazà*. After a long tour, the Metropolitan Opera premiere of *Zazà* was recast with tenor Giulio Crimi. Crimi was a tenor of substantial voice, having sung the roles of Radames, Canio, Turiddu, and Andrea Chénier at the Metropolitan Opera. It would seem to be a strange transition for the originator of the role, a "light lyric" tenor, to be recast for a tenor regularly singing "dramatic" repertoire. Exploring what else is known about Garbin's career does lead to a 1908 production of *Tosca* at Covent Garden, indicating a push into substantially larger repertoire than "light" lyric. This evidence chain suggests that perhaps the intention of Verdi was a voice of some power and weight.

Table 12. Aria Reference Chart: Prologue, "It is a curious story" [Prologue]

"It is a curious story" [Prologue] - *The Turn of the Screw*, Benjamin Britten			
Role	Prologue	**Length**	225 pitches
Aria Location	Act I, Scene 1	**Range**	Db3 - G4
Kloiber	Unlisted	**True Tessitura**	C4 - A4 (±4.28)
Boldrey	LIGHT LYRIC TENOR	**Average Pitch**	C4 (60)
Premier Voice	Peter Pears	**Orchestra at 75%**	93.5dB

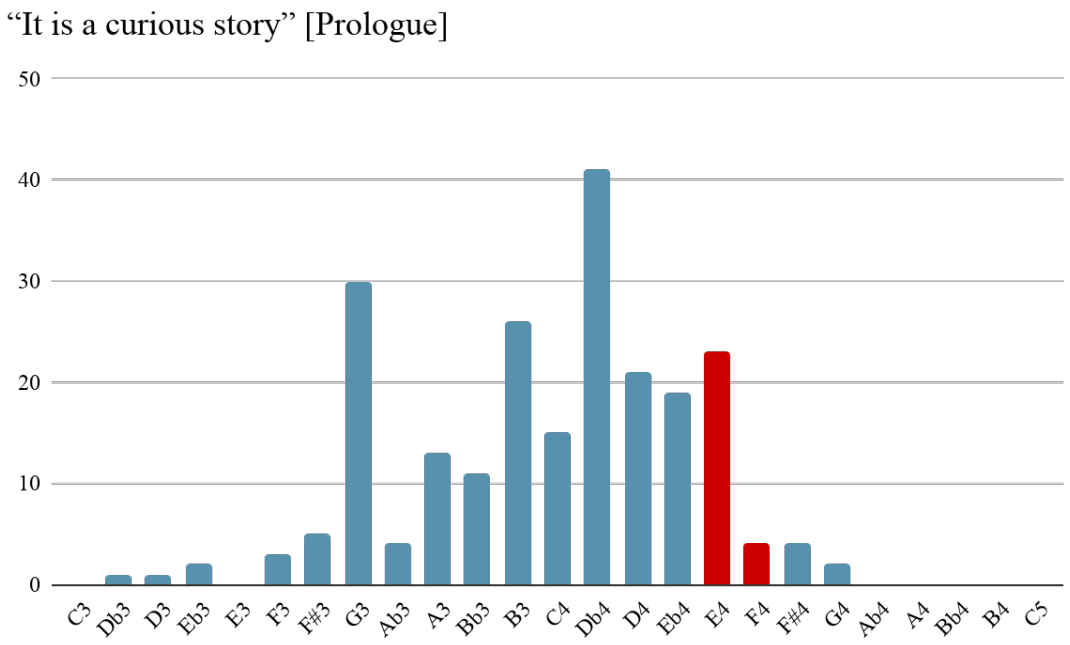

Figure 13. "It is a curious story" [Pitch Analysis Chart]

This aria represents a synthesis of factors that further represents the need for a delineation between the previously discussed Leggero tenor and the proverbial "light lyric". The frequency and spread of pitches sung look almost like that of a "character" tenor aria, but the spread is wider and higher. However, the spread is not nearly as high as the other arias analyzed here. Additionally, the spread is far more focused below the zona di passaggio. Combined with the fairly light 93.5dB orchestra, this is a fantastic example of an aria for a lighter voice, capable of navigation through and just below the passaggio, but without the necessity of access to extreme highs.

An interesting discussion arises with the voice categorization of the originator of the role. Peter Pears represents a confusing and enigmatic commentary on an expansion of the Fach system. As the creative and life partner of composer Benjamin Britten, Pears created the roles of Peter Grimes (Kloiber: Heldentenor, auch Jugendlicher Heldentenor, Boldrey: DRAMATIC TENOR), Male Chorus (Boldrey: FULL LYRIC TENOR), Albert Herring (Kloiber: Lyrischer

Tenor, Boldrey: COMIC TENOR, light lyric tenor), Flute (Kloiber: Lyrischer Tenor, auch Spieltenor, Boldrey: FULL LYRIC TENOR), Gustav von Aschenbach (Kloiber: Charaktertenor, Boldrey: FULL LYRIC TENOR), Captain Vere (Kloiber: Jugendlicher Heldentenor, auch Charaktertenor, Boldrey: FULL LYRIC TENOR), and several others. Clearly the voice of Peter Pears, the intentions of Benjamin Britten, and the analysis by both Kloiber and Boldrey, do not align with one another. Kloiber and Boldrey have represented roles that were not just premiered by, but also written for the same exact voice as: Comic Tenor, Charaktertenor, Spieltenor, Light Lyric Tenor, Lyrischer Tenor, Full Lyric Tenor, Jugendlicher Heldentenor, and Heldentenor. With the exception of the Spinto classification, that is, essentially, every tenor voice category possible being assigned to the same singer. Pears not only premiered the roles, but he sang the same roles in many opera houses around the world, including the Royal Opera House and the Metropolitan Opera House, both of which can be compared in Chapter 3.

Table 13. Aria Reference Chart: Tamino, "Dies Bildnis ist bezaubernd schön"

"Dies Bildnis ist bezaubernd schön" - *Die Zauberflöte*, Wolfgang Amadeus Mozart			
Role	Tamino	**Length**	218 pitches
Aria Location	Act I	**Range**	F3 - Ab4
Kloiber	Lyrischer Tenor, auch Jugendlicher Heldentenor	**True Tessitura**	Db4 - Ab4 (±2.53)
Boldrey	LIGHT LYRIC TENOR	**Average Pitch**	D4 (62)
Premier Voice	Benedikt Schack	**Orchestra at 75%**	97.8dB

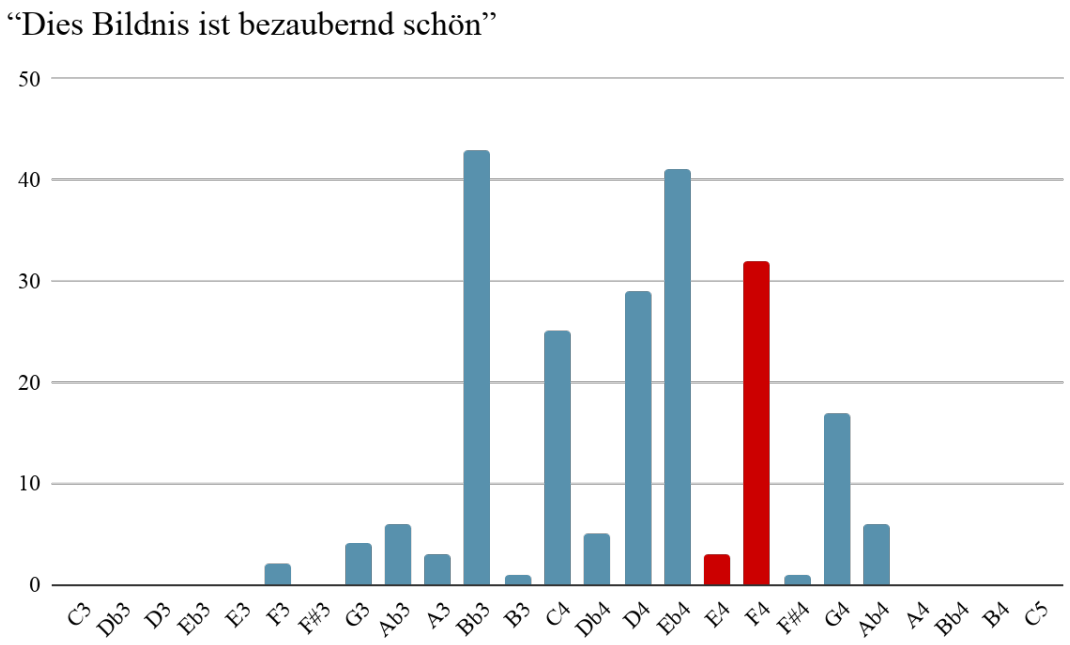

Figure 14. "Dies Bildnis ist bezaubernd schön" [Pitch Analysis Chart]

The role of Tamino stands among three separate voice categories if both Kloiber and Boldrey are considered. Kloiber lists the role as both Lyrischer Tenor and Jegendlicher Heldentenor. A similar case to Bellini's Lord Arturo, discussed above, this mix reflects Kloiber's attempt to categorize the voice, the character, and the role in one simple phrase. With an average orchestral volume of 97.8dB, it is safe to assume that the perhaps fuller Lyrischer side of the Fach would suffice in just singing the aria. The character, however, is quite literally the Jugendlicher Heldentenor, a young prince, the hero of the story. Even more interesting than this is Boldrey's categorization of the role as a straight "light lyric." It is safe to assume that Boldrey considered Kloiber's books in the writing of his own and it is curious that he would not employ his categorization technique to establish something more encompassing. It is possible that his focus for this categorization was on the orchestra and composer. While, in his opinion, Tamino

may be “light lyric” in volume or orchestration, the voice quality must be that of the heroic young prince, perhaps justifying Kloiber’s categorization.

In regard to the composer's intent, very little is known about Benedikt Schack, the originator of the role. He was a composer and friend of Mozart as well as Emanuel Schickaneder, the librettist of *Die Zauberflöte*, as well as its first Papageno. It is thought that the opera and its casting was the result of a collaboration among the three friends and several other composers who collaboratively wrote *Der Stein der Weisen* (Gr.: ‘the philosopher’s stone’), another fairy-tale opera and one considered to be a precursor to *Die Zauberflöte*.[39] The structure and source of the operas are comparable and featured a cast and crew in nearly identical roles. Mozart composed, Schickaneder both wrote and sang, Schack sang the lead tenor role, and Franz Xaver Gerl, the creator of Sarastro, played an intimidating bass in both. The trio of Mozart, Schack, and Gerl, along with Mozart’s brother-in-law, was the first to sing the beginning measures of the *Lacrimosa* of Mozart’s Requiem. The quartet purportedly sang these early measures as Mozart wept, just 11 hours before he passed away.[40]

Table 14. Aria Reference Chart: Tonio, “Ah, mes amis/Pour mon âme”

“Ah, mes amis/Pour mon âme” - *La fille du régiment*, Gaetano Donizetti			
Role	Tonio, *A young Tyrolean*	**Length**	346 pitches
Aria Location	Act I	**Range**	G3 - C5
Kloiber	Lyrischer Tenor	**True Tessitura**	D4 - G4 (±1.62)
Boldrey	LIGHT LYRIC TENOR	**Average Pitch**	Eb4 (63)
Premier Voice	Mécène Marié de l'Isle	**Orchestra at 75%**	97.2dB

[39] Peter Branscombe, *W.A. Mozart Die Zauberflöte* (New York, NY: Cambridge University Press, 1991), 35.

[40] *Allgemeine musikalische Zeitung*, issued July 25, 1827.

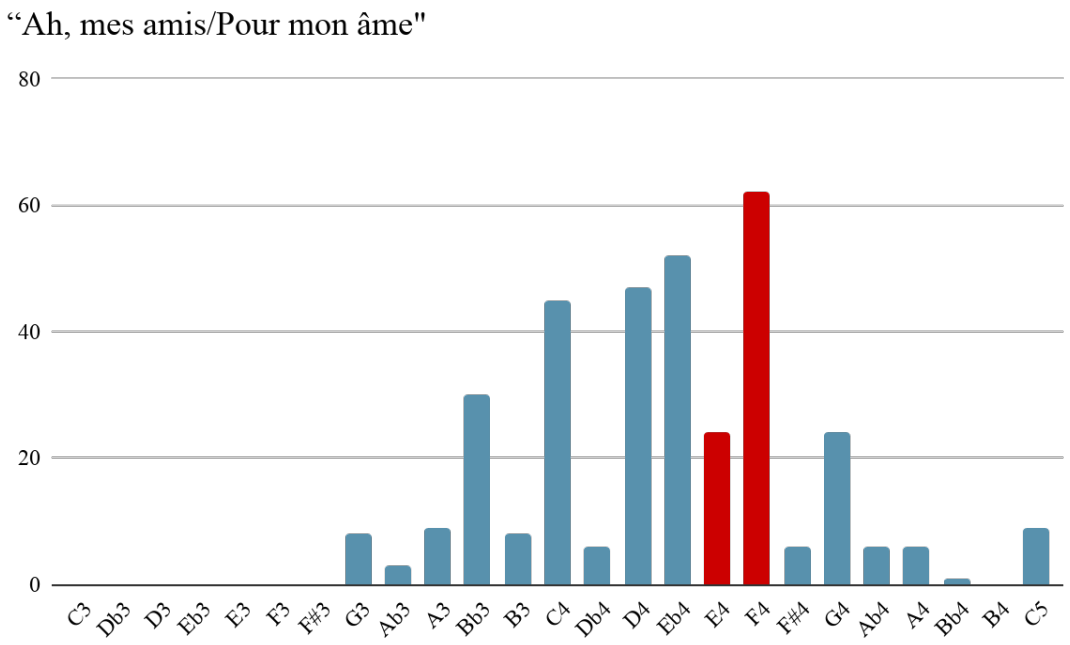

Figure 15. "Ah, mes amis/Pour mon âme" [Pitch Analysis Chart]

Of all the singers of the tenor repertoire, perhaps none are more enviable than those who can triumphantly sing Tonio's legendary "Ah, mes amis". With no fewer than eight high c's and nearly always nine, the aria stands as one of the most difficult and taxing within the tenor repertoire. It is a remarkable 346 pitches long with an extremely narrow "True Tessitura" of just a fourth with an average pitch of Eb4. That is to say, the challenge of the piece does not simply lie in its remarkable nine high C's, but the tessitura of the piece is exceedingly high and the repetition of these pitches is remarkable. Kloiber and Boldrey appear to agree, landing this role somewhere in the "light lyric" category. This is a possible example of a leggero category being appropriate for a role, should an expanded Fach system be considered.

Even more incredible than the aria itself is the man who premeried it. Mécène Marié de l'Isle was a French opera singer of enormously confusing vocal proportions. While singing in Paris, he sang Raoul (Kloiber: Jugendlicher Heldentenor, Boldrey: FULL LYRIC TENOR, spinto tenor), Max (Kloiber: Jugendlicher Heldentenor, Boldrey: spinto tenor, DRAMATIC

TENOR), Eléazar (Kloiber: Jugendlicher Heldentenor, Boldrey: SPINTO TENOR, dramatic tenor, heroic tenor), Arnold (Kloiber: Lyrischer Tenor, Boldrey: FULL LYRIC TENOR, spinto tenor, dramatic tenor) and then transitioned to singing full-fledged baritone roles across France, including the creation of Robert in Verdi's *Les vêpres siciliennes* and Phanor in Gounod's *La reine de Saba*. This must have been a remarkable voice to behold and would lend credence to the idea that Donizetti intended the harrowing heights of Tonio's aria to, in fact, be intentionally heroic in vocal character.

A Discussion on the "Light" Lyric tenor

As discussed in Chapter 1, the "light lyric" category is ripe for dissection and expansion. There can be no argument that these arias do have some similarities: a tessitura that floats close to the zona di passaggio and the necessity of a competent upper extension, to name a few. What makes a true "light lyric" voice, however, is an unclear criterion for both Kloiber and Boldrey. In Kloiber's case, the Spieltenor and Lyrischer Tenor blend this line, with no distinction between what many refer to as "light lyric" and roles that are more often called "full lyric". Boldrey makes this distinction between the light and full categories, which perhaps opens the door for even further expansion. For the purposes of this document, it seems there needs to be a three to four-part distinction when it comes to the concepts of using the word Lyric. At minimum, a distinction needs to be made between roles that are "light lyric" and roles that are Leggero. The soprano Fächer have already separated into "coloratura" roles and standard roles. The same needs to be done for the other voice types, though this delineation may not be as important for the baritone and bass voice types. This is particularly of importance here, for the "light lyric" tenor. Simply regarding arias, it would seem a possible argument that a separation could be made between the singer that performs the role of Tamino, in Mozart's *Die Zauberflöte*, and the singer

of Tonio, in Donizetti's *La fille du régiment*, as a staple role in their repertoire. Of course, some voices are more adept at handling extreme ranges or coloratura than others, but a separation of roles by these qualities could prove beneficial. Consider the following as a conceptual order: Leggero, Spieltenor (for operetta and other light "secondary" roles), Light Lyric, Lyric. The "Character" tenor designation is not present in this order and, as discussed previously, could be considered an addition to the Fach categories above. For example, roles could be labeled as Lyric Tenor (Character), or Dramatic Tenor (Character). This demonstrates the physicalization and purpose of the roles, while also addressing the voice that would best compliment the orchestra size and the other roles within the opera.

"Full Lyric" Tenor Arias

Table 15. Aria Reference Chart: Le Chevalier des Grieux, "En fermant les yeux" [La Rêve]

"En fermant les yeux" [La Rêve] - *Manon*, Jules Massenet			
Role	Le Chevalier des Grieux	**Length**	169 pitches
Aria Location	Act II	**Range**	E3 - A4
Kloiber	Lyrischer Tenor	**True Tessitura**	Db4 - Ab4 (±3.44)
Boldrey	light lyric tenor, FULL LYRIC TENOR	**Average Pitch**	C4 (60)
Premier Voice	Jean-Alexandre Talazac	**Orchestra at 75%**	97.2dB

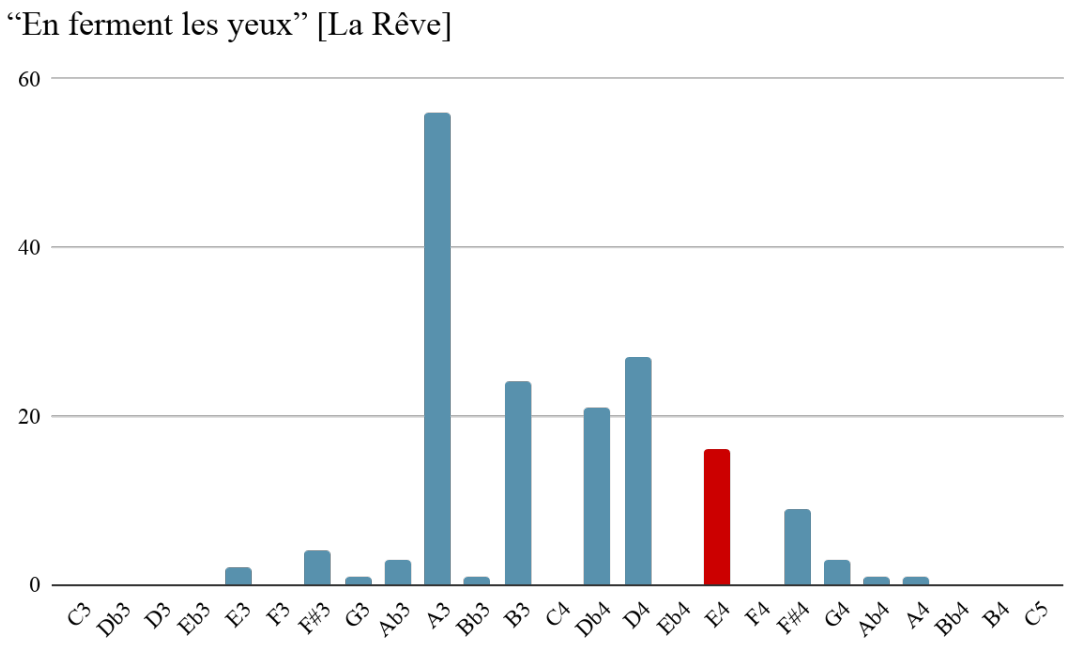

Figure 16. "En fermant les yeux" [Pitch Analysis Chart]

A sparse representation of the Chevalier des Grieux's music, this aria presents an interesting comment on the melodies of the "full" lyric tenor. Nearly all of the aria is sung on just four pitches, Ab3 to D4. A departure from the focus of the "light lyric" tenor discussed above, there is minimal singing around the passaggio, with the vast majority of output coming from E4. The substantially lower central pitch of C4 also demonstrates this aria's shift downward from those previously discussed, though this is likely the result of the repeated A3 in the first section of the aria. While Boldrey utilizes the light lyric and full lyric designations for this role, it is well known in the vocal community to be a "growing role", meaning that the weight and volume necessary to sustain the role grows as the opera progresses. The vocal abilities necessary at the beginning of the opera would not allow a singer to be heard, or even sustain themselves into the last act.

With regard to the composer's intent, the creator of the role was Jean-Alexandre Talazac. Talazac presents a remarkably versatile voice and perhaps lends to the role's reputation as being

one that requires a variety of vocal weights. During his time at the Paris *Opéra-Comique* he was the creator of three additional roles: Hoffmann (Kloiber: Jugendlicher Heldentenor, Boldrey: FULL LYRIC TENOR, dramatic tenor), Gérald (Kloiber: Unlisted, Boldrey: LIGHT LYRIC TENOR), and Mylio (Kloiber: Unlisted, Boldrey: LIGHT LYRIC TENOR, full lyric tenor). Eleven years after his *Opéra-Comique* debut, Talazac began his tenure at the Royal Opera House and performed two roles of note for a discussion on voice type: Edgardo (Kloiber: Lyrischer Tenor, Boldrey: light lyric tenor, FULL LYRIC TENOR, spinto tenor) and Raoul (Kloiber: Jugendlicher Heldentenor, Boldrey: FULL LYRIC TENOR, spinto tenor). This is a clear demonstration of the power that Talazac was capable of across a variety of roles and could have been an element of his voice that Massenet was utilizing in his composition.

Table 16. Aria Reference Chart: Lensky, "Kuda, kuda vï udalilis"

"Kuda, kuda vï udalilis" [Lensky's Aria] - *Eugene Onegin*, Pyotr Il'yich Tchaikovsky			
Role	Vladimir Lensky	**Length**	305 pitches
Aria Location	Act II, Scene 2	**Range**	D#3 - G#4
Kloiber	Lyrischer Tenor	**True Tessitura**	C4 - "A4" (±4.24)
Boldrey	light lyric tenor, FULL LYRIC TENOR, spinto tenor	**Average Pitch**	C4 (60)
Premier Voice	Dmitri Usatov/Mikhail Medvedev	**Orchestra at 75%**	97.2dB

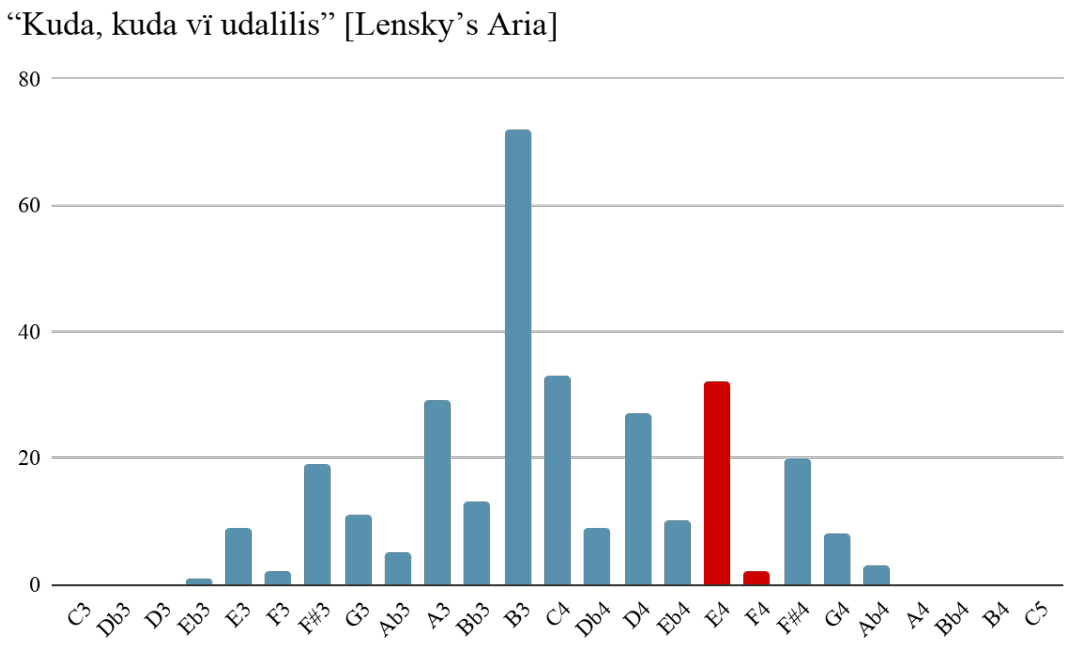

Figure 17. "Kuda, kuda vï udalilis" [Pitch Analysis Chart]

With a strong peak present in nearly every aria analyzed within this section, none have the pitch repetition of Lensky's Aria. More than a third of the aria is sung on just one half step, B3 and C4. This demonstrates a trend within the lyric arias that seem to relate loosely to a slightly higher tessitura than that of "character" tenor arias analyzed, but slightly lower than the "light lyric" tenor arias, and several instances of singing in and above the zona di passaggio, but without it being a primary feature of the voice category. The true topic of note with the role of Lensky, however, lies in the multi-Fach analysis presented by Boldrey. As explained in Chapter 1, Boldrey utilizes this style of categorization to demonstrate the variance in voices capable of singing the same role, or at least voices that commonly sing the role. Ruther research would certainly be required, but with this multi-Fach analysis from Boldrey presented, it would be valuable to understand if certain roles encompass certain aspects of multiple Fächer, while others remain cleaner cut. Meaning, perhaps during the length of *Eugene Onegin*, the singer performing Lensky will experience the height and florid singing of the "light lyric" category, the sustained

legato and melodic singing of the "full lyric" category, and the pushed volume and piercing high of the "Spinto" category. Alternatively, of course, perhaps it is simply as Boldrey suggests and is written in a style that allows performance by multiple voice types. Nonetheless, a future research area is certainly opened with this secondary style of assessment.

In contrast to many operas, *Eugene Onegin* had two distinct premieres, the first was performed by the students of the Moscow Conservatory (Mikhail Medvedev) and the second was its professional debut at the Bolshoi Theatre in Moscow (Dmitri Usatov). Very little is known about either of these tenors, but a few ideas could be implied by Tchaikovsky's choice for the initial premiere. Simply interpreting that the initial creator of this role was a twenty-seven-year-old college student subjectively gives credence to the idea that Lensky was originally intended for the likes of a young lyric tenor, thus Kloiber's Lyrischer Tenor interpretation and the "light/full" lyric portion of Boldrey's analysis. Additionally, the performance recordings of Fritz Wunderlich, Jerry Hadley, and Rolando Villazon lend further credence to the "light/full" lyric analysis.

Table 17. Aria Analysis Chart: Lyonel, "Ach, so Fromm"/"M'apparì tutt'amor"

"Ach, so Fromm"/"M'apparì tutt'amor" - *Martha*, Friedrich Flotow			
Role	Lyonel, *his foster brother*	**Length**	161 pitches
Aria Location	Act III	**Range**	F3 - Bb4
Kloiber	Lyrischer Tenor	**True Tessitura**	D4 - G4 (±2.32)
Boldrey	light lyric tenor, FULL LYRIC TENOR	**Average Pitch**	D4 (62)
Premier Voice	Joseph Erl	**Orchestra at 75%**	97.6dB

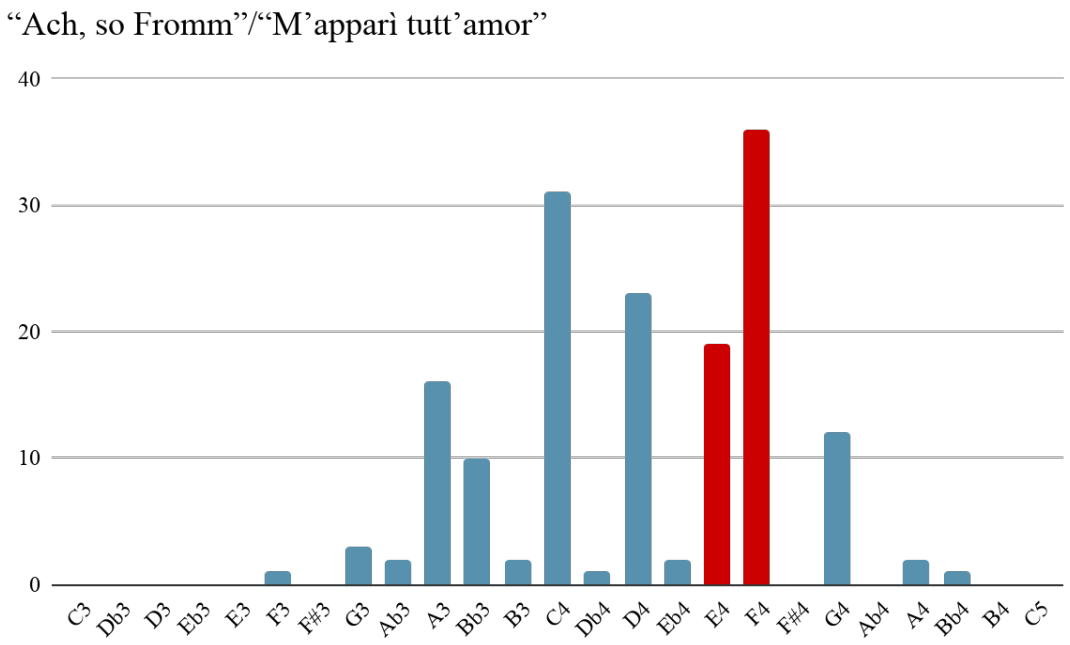

Figure 18. "Ach, so Fromm"/"M'apparì tutt'amor" [Pitch Analysis Chart]

A welcome serenade for most audience members, this aria presents a variable étude in not just passaggio navigation, but genuine controlled singing in the passaggio. Nearly a third of the entire aria exists in the passaggio with a True Tessitura of just plus or minus two half steps. This perfect fourth represents nearly 60% of the aria existing in a very small gap around the passaggio. Also, higher than most of the other arias analyzed here, the average pitch of this particular aria is D4. This presents an extremely challenging sing for the tenor, regardless of voice type. This challenging composition supports both Boldrey's and Kloiber's analysis of the proper voice for the aria.

Little is known about the originator of the role, Joseph Erl. However, of interesting note is the categorization of his voice in several different family histories of the Erl family on multiple Vienna history websites. He is listed as: Joseph Erl, Opernsänger (Heldentenor). This is, of course, not a verifiable point of data for analysis of the voice type for Lyonel. Another notable point on the proliferation of this aria is its adoption by Giovanni Matteo Mario, one of the most

iconic and celebrated lyric tenors of the 19th century. The creator of Ernesto in Donizetti's *Don Pasquale*, Mario was cited as a champion of "M'apparì tutt'amor" and the role of Lyonel.

Table 18. Aria Reference Chart: Rodolfo, "Che gelida manina"

"Che gelida manina" - *La Bohème*, Giacomo Puccini			
Role	Rodolfo, *a poet*	**Length**	233 pitches
Aria Location	Act I	**Range**	Eb3 - C5
Kloiber	Jugendlicher Heldentenor, auch Lyrischer Tenor	**True Tessitura**	Db4 - Ab4 (±3.39)
Boldrey	FULL LYRIC TENOR, spinto tenor	**Average Pitch**	Db4 (61)
Premier Voice	Evan Gorga	**Orchestra at 75%**	98.2dB

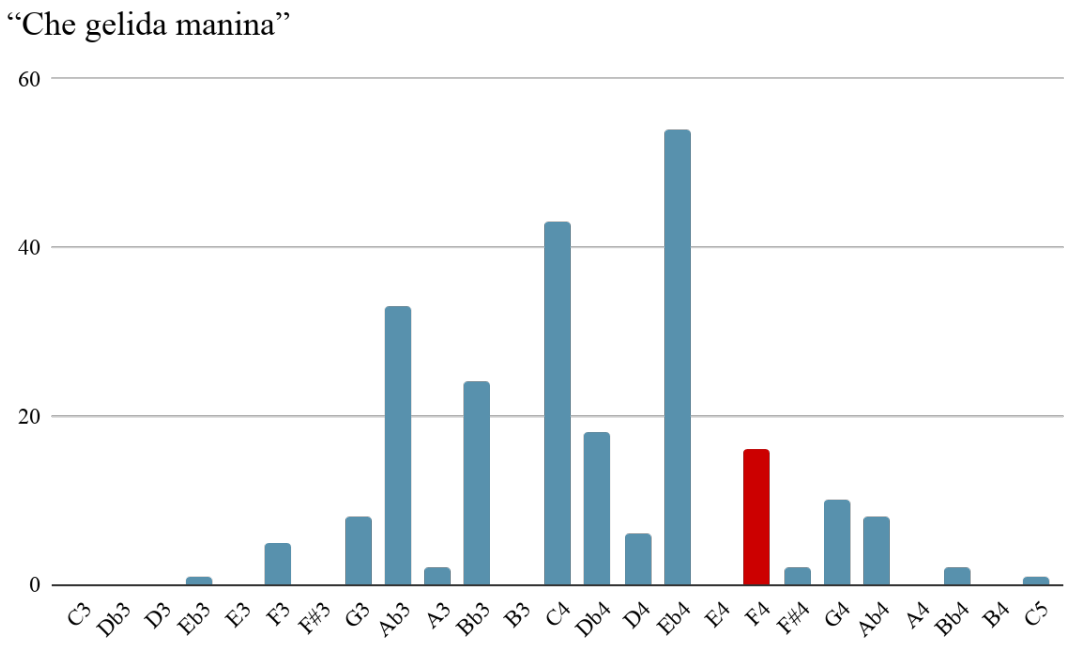

Figure 19. "Che gelida manina" [Pitch Analysis Chart]

Perhaps the most iconic tenor aria of all time, the challenges of "Che gelida manina" lie beyond the concepts of tessitura and range, and firmly sit in the compositional style of Puccini. First, nearly a quarter of the pitches lie one half step from the established passaggio, an extremely taxing area of the tenor voice. While the pitch structure, flexibility, range, and tessitura of this aria would lead a singer to believe that this is, in fact, a lyric aria, it is in the phrasing and orchestration of Puccini that push it out of the grasp of a standard lyric tenor. The length of Puccini's phrasing forces the tenor to negotiate his breath and vocal weight in a way that one might describe as simply preservation. This light and borderline calculated style of singing leaves little room for mistakes and yields a voice that is possibly not capable of performing the piece at a high volume while navigating it. It is for this reason that both Kloiber and Boldrey's voice categorizations make substantial sense. The aria is lyric in style and structure, but Puccini's compositional style requires a voice of larger weight or volume to effectively perform the aria in a lyric way. Thus, Kloiber's inclusion of Jugendlicher Heldentenor and Boldrey's inclusion of Spinto cannot be ignored, but, in fact, reflect the delicate balance of voice that is necessary to perform the aria effectively.

The creator of the role, Evan Gorga, provides fascinating commentary on the voice category of Rodolfo. For the creator of a role considered to be "lyric plus," Gorga's genesis proves to be of particular interest. At just 29 years old, he made his professional debut singing the role of Ernani (Kloiber: Jugendlicher Heldentenor, Boldrey: spinto tenor, DRAMATIC TENOR). He made his premiere stepping in for the well-respected Francesco Tamagno, the creator of Verdi's *Otello* and a tenor with not just an enormous voice, but with access to his upper register that was so easy and powerful, references to it were written into his obituary in the *New York Times*. Gorga, however, was not so lucky. Shortly after rehearsals for *La Bohème*

began, it was clear that he would not be able to handle the high tessitura of the role. At the time of the premiere, he was not able to sing the role in the keys currently published, and the opera had to be transposed down for him. This demonstrates just how difficult the role of Rodolfo is. It was written for a tenor with an exceptionally sized and weighted voice, but Gorga was unable to sing the role as it is expected to be sung by today's tenors. Rodolfo must be a voice flexible enough to handle its high tessitura, heroic enough in color to be the true romantic lead, powerful enough to maintain its incredibly lengthy phrases, and sufficient in range to bring its color to a compelling high C.

Table 19. Aria Reference Chart: Tom Rakewell, "Here I stand/Since it is not by merit"

"Here I stand/Since it is not by merit" - *The Rake's Progress*, Igor Stravinsky			
Role	Tom Rakewell	**Length**	269 Pitches
Aria Location	Act I, Scene I	**Range**	E3 - A4
Kloiber	Jugendlicher Heldentenor	**True Tessitura**	C4 - A4 (±4.37)
Boldrey	FULL LYRIC TENOR	**Average Pitch**	C4 (60)
Premier Voice	Robert Rounseville	**Orchestra at 75%**	95.9dB

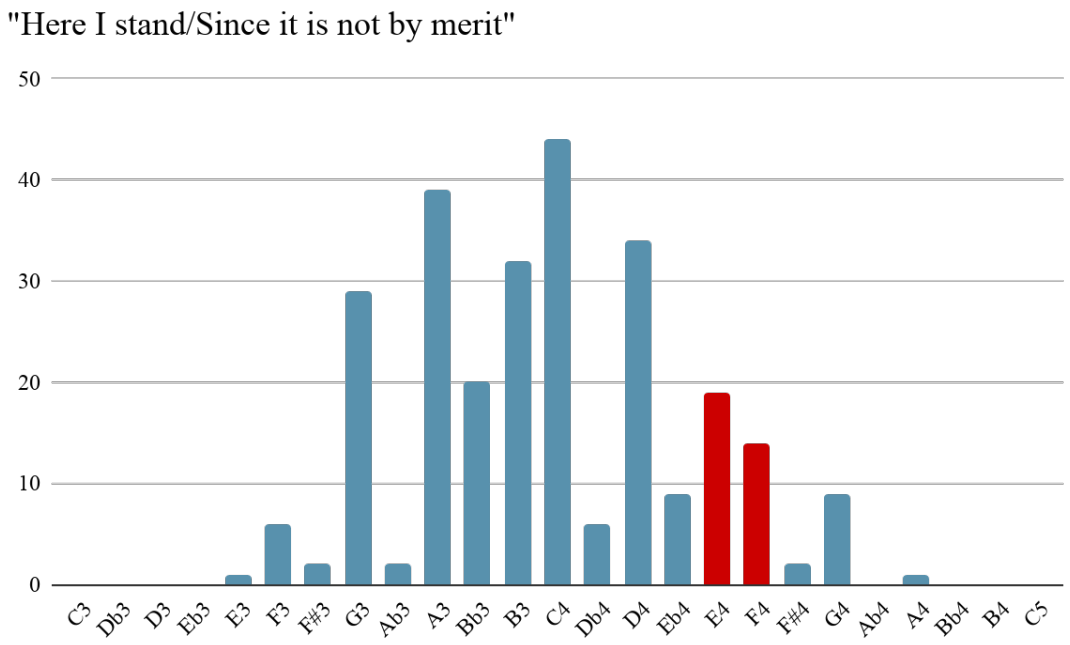

Figure 20. “Here I stand/Since it is not by merit” [Pitch Analysis Chart]

Continuing the trend of arias with a remarkably concentrated central pitch, the semi-atonal nature of this aria does not skew it away from its more tonal brothers analyzed in this section. Much like “Kuda, kuda vï udalilis”, just over a quarter of this aria is centered around just two pitches, B3 and C4. The mountainous pattern here is significantly taller, with steeper sides than that of Lensky’s Aria. This is a dense concentration of pitch within just a fourth, from A3 to D4. Combined with the strong presence of the zona di passaggio, this yields an expectedly wide True Tessitura of ±4.37. This piece also includes a lighter orchestration in comparison to its lyric counterparts. Interestingly, Kloiber and Boldrey seem to interpret this information quite differently. Perhaps due, in part, to the structure of the aria and pitch spread, Kloiber has listed the hearty piece as Jugendlicher Heldentenor, but its winding atonal melodies may require a more nimble and flexible voice. With a slightly lower central pitch than an aria like “Che gelida manina”, Boldrey’s assignment of FULL LYRIC TENOR also seems appropriate.

Depending on the analyzer's approach to color, acting ability, and weight, the creator of the role of Tom Rakewell is of important note. Robert Rounseville is a tenor positioned in an expansive time in opera history. He was a pioneer of opera, the filming of opera, and of the Broadway stage. He portrayed Hoffmann (Kloiber: Jugendlicher Heldentenor, Boldrey: FULL LYRIC TENOR, dramatic tenor) in the world's first full color production of an opera using cinematic techniques, Powell and Pressburger's *The Tales of Hoffmann*. Of course, with recording techniques, his voice type is not necessarily discernible. For the premiere of *The Rake's Progress*, however, his vocal prowess is highly evident in his co-stars, Elisabeth Schwarzkopf and Jennie Tourel. He was also the creator of the first Candide (Boldrey: FULL LYRIC TENOR) and maintained a steady career of operetta and musical theatre throughout his life. Though much harder to ascertain true voice size by comparison, he was cast as Don José (Kloiber: Jugendlicher Heldentenor, Boldrey: full lyric tenor, spinto tenor, DRAMATIC TENOR) and the Chevalier de la Force (no analysis available) for NBC's *Opera Theatre* in 1953 and 1957, respectively. His co-star for the latter work was none other than Leontyne Price. With a voice this versatile and seemingly respected by many major names in the opera world, it was likely Stravinsky's intent not just to cast a vocalist with an instrument of respectable size and weight, but someone who could truly bring it to life on stage.

A Discussion on "Full" Lyric Tenors

Though often seemingly stuck between its lighter and more nimble "light lyric" cousin and the pushed nature of the Spinto, the "full" lyric tenor repertoire clearly carves a space for itself in the nature of its composition. The nature of these arias seems to be built around a single pitch, visible in the distinct pyramidal structure of the pitch distribution in each graph. This contrasts strongly with the more evenly high distributions of the arias analyzed within the "light"

lyric section of this document. Of interest, however, is the relationship to the "character" tenor arias analyzed. Both categories demonstrate some semblance of this pyramidal structure, while the "full" lyric arias distinctly span a larger range and present with a higher pitch at the peak of the pyramid. Analyzing the originators and previous categorizations for these roles, it is clear that the responsibilities of the "full" lyric tenor are distinct in comparison to its cousin categorizations. The focus is distinct in its naming - lyric. These roles must revolve around the beauty of the voice and its line. They do not require the varied and adept acting skills to flesh out the "character" roles, they cannot only focus on the vocal agility and range of the "light" lyric roles, and their fame and attractiveness does not originate in the singer's ability to push dramatically beyond the orchestra like the Spinto or "dramatic" tenors. To put it simply, it must be a voice of elegance. The hallmark of this particular Fach is the beauty of line and tone, with sustained legato and ease of access around the registers of the voice. It does not require incredible flexibility, or earth-shattering volume, or a piercing and easy upper extension, but the warmth and line of the hero.

"Spinto" Tenor Arias

Table 20. Aria Reference Chart: Cavaradossi, "E lucevan le stelle/Oh! dolci baci"

"E lucevan le stelle/Oh! dolci baci" - *Tosca*, Giacomo Puccini			
Role	Mario Cavaradossi, *Tosca's lover*	**Length**	113 pitches
Aria Location	Act III	**Range**	F#3 - A4
Kloiber	Jugendlicher Heldentenor	**True Tessitura**	C4 - A4 (±4.08)
Boldrey	full lyric tenor, SPINTO TENOR	**Average Pitch**	C4 (60)
Premier Voice	Emilio De Marchi	**Orchestra at 75%**	98.3dB

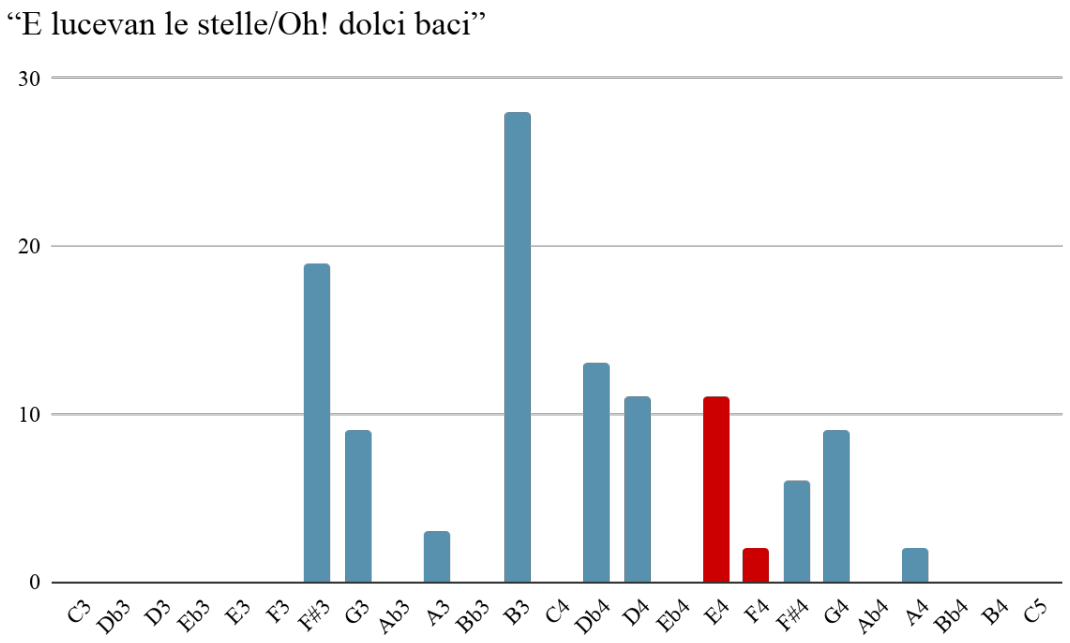

Figure 21. "E lucevan le stelle/Oh! dolci baci" [Pitch Analysis Chart]

A substantially more condensed and evenly spread aria than those analyzed previously, "E lucevan le stelle" presents a similar central "spike" like its "full" lyric counterparts. However, the pitch frequency and spread do not create the distinct pyramid discussed above. The rather shallow slope centers around nearly half of the pitches placed within a fourth, from D4 to G4. Also of note is a substantial number of F#3's, a challenge to continually voice over an orchestral average of 98.3dB. Boldrey and Kloiber seem to agree on the voice necessary to sustain not just this aria, but the rest of the role. As the step between Kloiber's Lyrischer Tenor and Heldentenor, the use of Jugendlicher Heldentenor seems to closely echo Boldrey's categorization of Spinto. Additionally, the use of *Italienischer Tenor*, often used to categorize this style of larger italianate singing, is usually conflated with the Italian's *Lirico-spinto* designation.

The creator of the role, Emilio De Marchi, was hand-picked by Puccini and represented the composer's intent in opera houses the world over, including premiere performances at the Royal Opera House and the Metropolitan Opera. Marchi was a singer of substantial vocal size,

quite appropriate for a role that requires the ability to "push" beyond that of its lyric counterparts. Just in his time with the Met, Marchi sang the Met premiere of Verdi's Ernani (Kloiber: Jugendlicher Heldentenor, Boldrey: spinto tenor, DRAMATIC TENOR), Radames (Kloiber: Jugendlicher Heldentenor, auch Heldentenor, Bouldrey: spinto tenor, DRAMATIC TENOR, heroic tenor), and Don José (Kloiber: Jugendlicher Heldentenor, Bouldrey: full lyric tenor, spinto tenor, DRAMATIC TENOR), to name a few.

Table 21. Aria Analysis Chart: Carlos, "Fontainebleau! Forêt immense et solitaire/Je l'ai vue"

"Fontainebleau! Forêt immense et solitaire/Je l'ai vue" - *Don Carlos*, Giuseppe Verdi			
Role	Don Carlos, *Infante of Spain*	**Length**	255 pitches
Aria Location	Act I	**Range**	F3 - A4
Kloiber	Jugendlicher Heldentenor	**True Tessitura**	Db4 - Ab4 (±3.25)
Boldrey	full lyric tenor, SPINTO TENOR, dramatic tenor	**Average Pitch**	Db4 (61)
Premier Voice	Jean Morère	**Orchestra at 75%**	97.8db

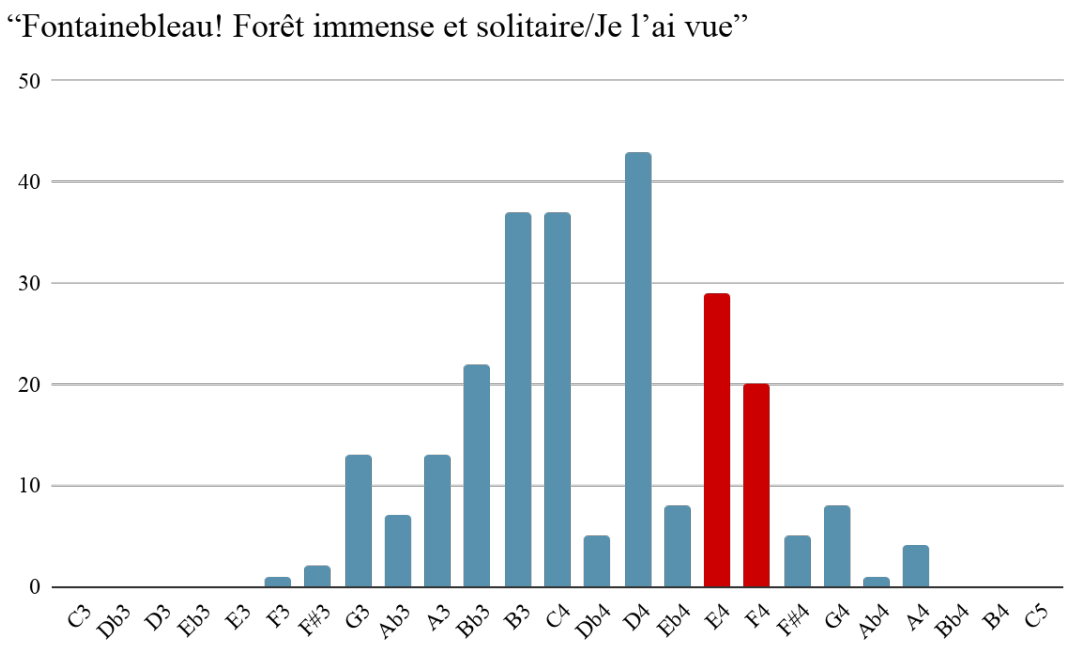

Figure 22. "Fontainebleau! Forêt immense et solitaire/Je l'ai vue" [Pitch Analysis Chart]

Perhaps an echo of Boldrey's reasoning for labeling the aria as partially "full lyric tenor," the pitch frequency and dispersion of this aria is remarkably similar to the structures of the "full" lyric aria analyzed earlier in this document. It is clearly centered around the pitch of D4 with sloping dispersion in each direction. However, the pitches most closely related to the central pitch of D4, B3 and C4, and E4 and F4, are also plentiful. This, not shockingly, results in a slightly higher than average mean pitch of Db4. Boldrey does include a more encompassing categorization of the role, but it does appear that he and Kloiber primarily agree that this role requires a size and/or color that varies from that of the average lyric tenor.

The original creator of the role, Jean Morère, was not a career-long singer, with an active time period of just 10 years. For voice categorization comparison, he had two roles of note in his repertory, both of which continue his trend of Verdi singing: Manrico (Kloiber: Jugendlicher Heldentenor, Boldrey: spinto tenor, DRAMATIC TENOR) and Riccardo (Kloiber: Jugendlicher Heldentenor, Boldrey: full lyric tenor, SPINTO TENOR, dramatic tenor). Perhaps of more importance is the creator of the role in Verdi's Italian translated and revised version, Francesco Tamagno. For further understanding of the implications of this casting, please reference the analysis of "Che gelida manina".

Table 22. Aria Reference Chart: Michele, “I know that you all hate me”

“I know that you all hate me” - *The Saint of Bleecker Street*, Gian Carlo Menotti			
Role	Michele	**Length**	225 pitches
Aria Location	Act II	**Range**	D3 - C5
Kloiber	Unlisted	**True Tessitura**	C4 - A4 (±3.99)
Boldrey	full lyric tenor, DRAMATIC TENOR	**Average Pitch**	C4 (60)
Premier Voice	David Poleri (Davis Cunningham)	**Orchestra at 75%**	98.3dB

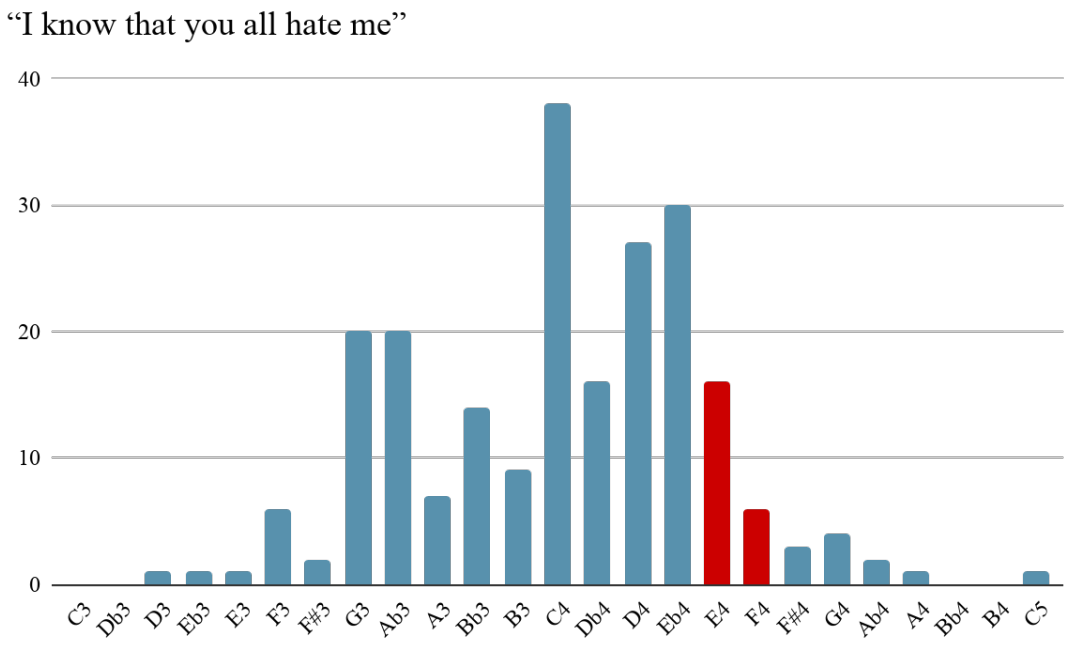

Figure 23. “I know that you all hate me” [Pitch Analysis Chart]

Another lengthy and steep pyramid, this aria requires a significant ability to sustain almost half of the aria in the space of just a minor third, C4 to Eb4. In addition to the taxing middle voice singing, the aria requires access to both a strong D3 and piercing C5 in a moment of dramatic power.

Very little is known about the originator of the role, David Poleri, but the opera premiere was cast with alternating performers, and the second night’s singer, Davis Cunningham, had a

more prevalent career, particularly with television. During his tenure with the New York City Opera he performed the roles of Hoffmann (Kloiber: Jugendlicher Heldentenor, Boldrey: FULL LYRIC TENOR, dramatic tenor), Rodolfo (Kloiber: Jugendlicher Heldentenor, auch Lyrischer Tenor, Boldrey: FULL LYRIC TENOR, spinto tenor), and several others. This certainly gives further credence to the idea that the role of Michele is written for a voice louder than the typical "full" lyric voice.

Table 23. Aria Analysis Chart: Pinkerton, "Amore o grillo"

"Amore o grillo" - *Madama Butterfly*, Giacomo Puccini			
Role	B.F. Pinkerton, *Lieutenant in the United States Navy*	**Length**	117 pitches
Aria Location	Act I, Scene 4	**Range**	F3 - Bb4
Kloiber	Lyrischer Tenor	**True Tessitura**	C4 - A4 (±4.19)
Boldrey	spinto tenor, DRAMATIC TENOR	**Average Pitch**	C4 (60)
Premier Voice	Giovanni Zanatello	**Orchestra at 75%**	98.2dB

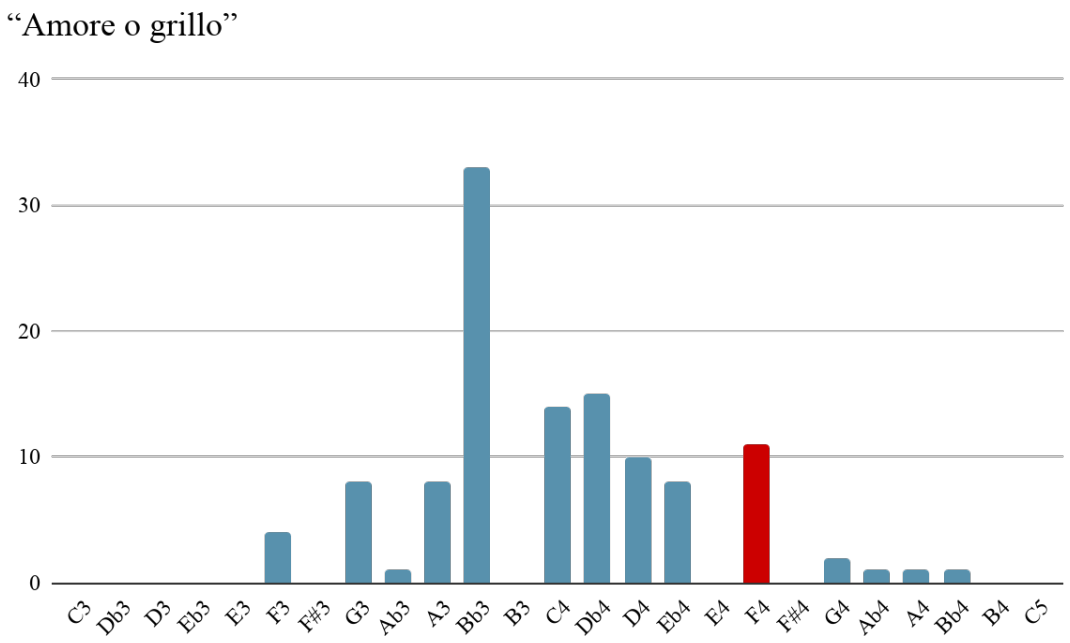

Figure 24. "Amore o grillo" [Pitch Analysis Chart]

The voice categorizations assigned to this aria by Kloiber and Boldrey present a fascinating contention. Perhaps supporting Kloiber's assessment, the structure of this piece is remarkably similar to the "full" lyric arias analyzed in this document. The piece teeters on a repeated pitch of Bb3 for almost a third of the aria. The piece is weighted far more toward the right of the Bb3 with G3-F4, representing a similar number of occurrences. Singing above the passaggio in this piece is also minimal.

The creator of this role, Giovanni Zanatello, may bring some clarity to the reasoning behind Boldrey's choice. One of the most celebrated "dramatic" tenors of the early 20th century, Zanatello was the successor of two of the most iconic tenors in history. He first replaced Enrico Caruso, joining tours of the Metropolitan Opera Company, and then proceeded to travel to Italy and succeed Francesco Tamagno, the creator of Otello, at La Scala. It is in this role that he rose to fame, performing and recording the work in excess of three hundred times, a majority of which occurred at La Scala itself with several performances at the Royal Opera House. With this being the voice that premiered Pinkerton, it is understandable that Boldrey lists the role as Dramatic and why the role continues to be cast with larger-than-lyric voices. On an unrelated, but fascinating, note about Zanatello, he was the alleged "discoverer" of coloratura Lily Pons, and a champion for a young Maria Callas.

Table 24. Aria Reference Chart: Walther, “Morgenlich leuchtend in rosigem Schein”

“Morgenlich leuchtend in rosigem Schein” - *Die Meistersinger von Nürnberg*, Richard Wagner			
Role	Walther von Stolzing, *a young knight from Franconia*	**Length**	277 pitches
Aria Location	Act III, Scene 2	**Range**	Eb3 - A4
Kloiber	Heldentenor, auch Jugendlicher Heldentenor	**True Tessitura**	Db4 - Ab4(±2.82)
Boldrey	full lyric tenor, DRAMATIC TENOR, heroic tenor	**Average Pitch**	Db4 (61)
Premier Voice	Franz Nachbaur	**Orchestra at 75%**	97.8db

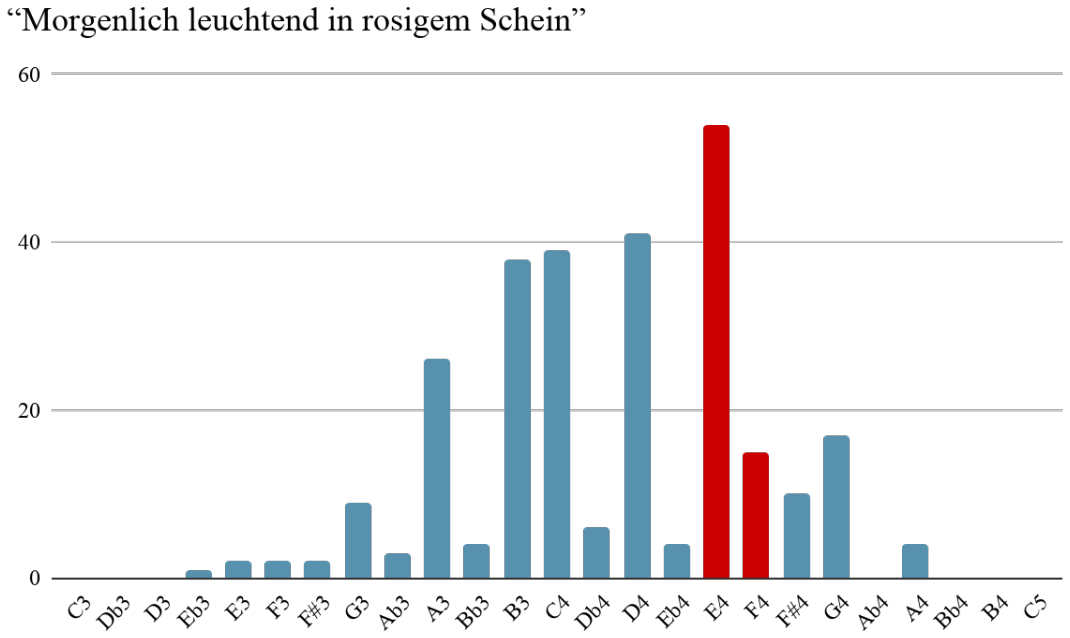

Figure 25. “Morgenlich leuchtend in rosigem Schein” [Pitch Analysis Chart]

A unique analysis and aria in its own right, Walther and other Wagnerian roles are often the subject of vocal categorization debate. Alongside its fellow Spinto roles, the frequency of pitch and its distribution barely echo that of its peers. The only similarity is that which has tied the concepts of “full” lyric and a “pushed” Spinto together, the concepts of a centralized pitch to

the aria. The peak of this aria, however, is the second highest centralized pitch, other than that of "Ach, so fromm", an F4. What this work does not share with the work of Flotow, however, is its slope structure or upper extension. Looking at the graph itself, there is a distinct, nearly forty-five-degree angle from the lowest pitch, Eb3, to the top of the E4 bar. Following that line, the pitch frequency increases the closer the voice gets to the passaggio and then immediately drops off, with less than a quarter of the piece occurring above E4. This is a taxing structure and requires a warm and strong middle voice.

Little is known about the creator of the role, Franz Nachbaur. First, addressing the prevalence of the middle voice strength necessary for the aria, Nachbaur studied with bel canto pedagogue Giovanni Battista Lamperti, likely establishing a solid technique before then working with Bohemian baritone Jan Křtitel Pišek. This would perhaps explain Nachbaur's strength in the lower register. On the topic of voice categorization, Nachbaur also created the role of Froh in Wagner's *Das Rheingold*. In contrast to Walther, Froh is categorized by Kloiber as "Jugendlicher Heldentenor, auch Lyrischer Tenor" and by Boldrey as simply FULL LYRIC TENOR. The answer to the categorization of Walther likely lies in the voice type skipped over by Boldrey in his classification, the Spinto tenor. Over a Wagnerian orchestra and with such intensive middle voice and passaggio singing, it seems it could be ill-advised to consider the role as Lyrischer Tenor, but perhaps the full Heldentenor designation should be reserved for the true heroic leads of Wagner.

A Discussion on the "Spinto" Tenor

A confusing combination of analytical concepts, the Spinto tenor represents a division among the voice types. In contrast to the stylistic and technique-dependent categorizations of the "character" tenor, the "light" lyric tenor, and the "full" lyric tenor, the Spinto is the first voice

classification that can be discussed as having a certain vocal "power" requirement. As shown in this basic and initial aria analysis, the Spinto requires a special ability to push the voice beyond normal lyric singing and sustain a substantial lower register, a large amount of taxing passaggio singing, and still produce piercing high tones, though often not as high as its "full" lyric or "light" lyric counterparts. At its heart, the Spinto transcends the beautiful lines and technique of the lyric voices and brings a thrilling power and metallic quality to roles that are presented with slightly longer lines, slightly more challenging pitch distribution, and slightly louder orchestras. The roles present great vocal risks but promise immense rewards.

"Dramatic/Heroic" Tenor Arias

Table 25. Aria Reference Chart: Anatol, "Outside this house"

"Outside this house" - *Vanessa*, Samuel Barber			
Role	Anatol, *the son of Vanessa's original lover*	**Length**	156 pitches
Aria Location	Act I, Scene 2	**Range**	D3 - Ab4
Kloiber	Unlisted	**True Tessitura**	B3 - "Bb4" (±4.65)
Boldrey	DRAMATIC TENOR	**Average Pitch**	B3 (59)
Premier Voice	Nicolai Gedda	**Orchestra at 75%**	98dB

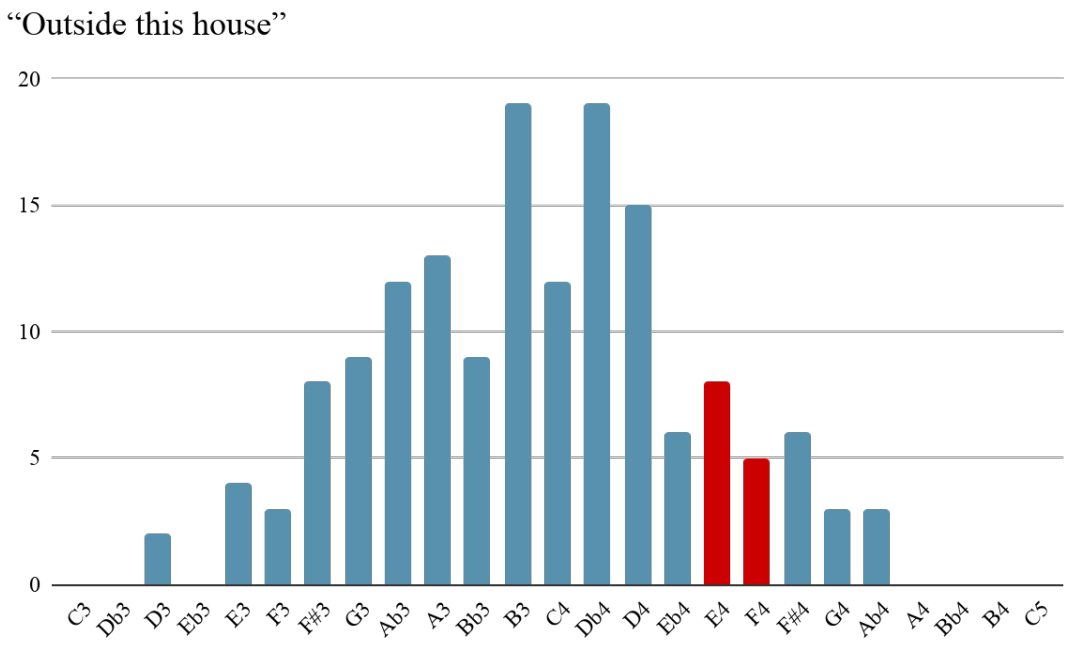

Figure 26. "Outside this house" [Pitch Analysis Chart]

The role of Anatol is an interesting one, particularly considering Boldrey's specific analysis of DRAMATIC TENOR. The piece has a distinctly lower average pitch and wider True Tessitura than the Spinto and "full" lyric arias analyzed and presents with a sort of dual peaked pyramid structure. More than a third of the pitches sung lie in the space of just a major second, B3-C#4. *Vanessa* presents quite a powerful orchestra for Anatol to sing against, 98dB at 75%. With the slope of the chart ending just after the passaggio, this aria requires a substantial ability to sustain middle voice singing.

When discussing the voice categorization for this role, its creator must be acknowledged. Boldrey's bold assignment for this aria and the role as a whole is DRAMATIC TENOR. Barber's choice for his premiere performance, however, was none other than Nicolai Gedda. Gedda was a champion of the lyric repertoire, having produced nearly 200 recordings across a massive range of repertoire. While he did record several larger pieces of the tenor repertoire, including Don José (discussed below), nearly all of the repertoire Gedda performed at genuine

opera houses lie within the lyric category. Further research is required to fully understand why Boldrey has associated such a successful and established voice, well known as a lyric singer, with the dramatic repertoire. It should be noted that in Boldrey's own book he does reference Gedda as: light lyric tenor, FULL LYRIC TENOR, dramatic tenor. However, these singer categorizations are not intended to be utilized as a representation of an actual singer, but rather a summary of the roles they have sung, according to Boldrey's introduction.[41]

Figure 26. Aria Reference Chart: Don José, "La fleur que tu m'avais jetée"

"La fleur que tu m'avais jetée" - *Carmen*, Georges Bizet			
Role	Don José*, Corporal of Dragoons*	**Length**	182 pitches
Aria Location	Act II	**Range**	E3 - Bb4
Kloiber	Jugendlicher Heldentenor	**True Tessitura**	C4 - A4 (±3.89)
Boldrey	full lyric tenor, spinto tenor, DRAMATIC TENOR	**Average Pitch**	C4 (60)
Premier Voice	Paul Lhérie	**Orchestra at 75%**	97.2dB

[41] Boldrey, *Guide to Operatic Roles and Arias*, xiii.

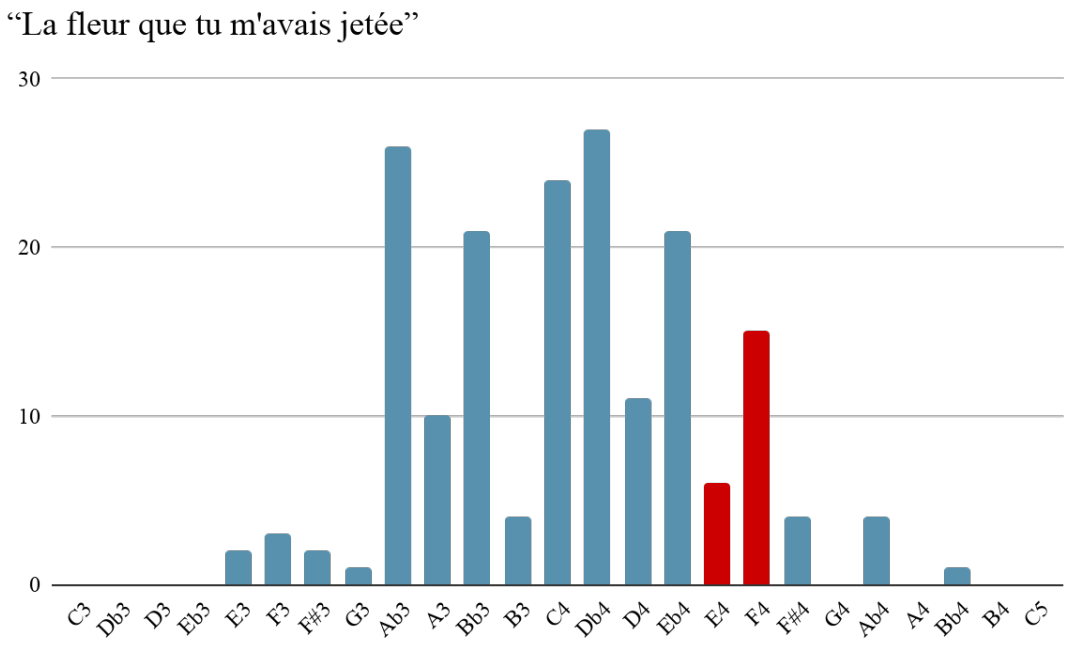

Figure 27. "La fleur que tu m'avais jetée" [Pitch Analysis Chart]

An icon of the dramatic repertoire, Don José represents one of the pinnacles of the French opera. His iconic aria, however, stands apart from the rest of the role as a soft and sweet moment for the character. Nonetheless, what can be drawn from it as a representation of the Fach will be discussed here. First, there is a distinct gathering of pitches, nearly all below the passaggio. In a pattern similar to that of "Outside this house", these present a sort of double peaked pyramid, this time with a much larger space between peaks. Much like Anatol's aria, the slope of the pitch frequency drops steeply off after the passaggio. This again requires a substantial amount of sustained singing in the middle voice, often over a heavy orchestra. Of important note within this aria is Bizet's specific notation of dynamics. At the conclusion of this aria, the voice carrying this middle-voice heavy repertoire must float a sustained pianissimo Bb4.

Paul Lhérie, the creator of the role, is a remarkable example of the dynamic relationship between color and voice size. Lhérie explored a successful career as both a tenor and a baritone, but as Bizet's personal choice to create the role of Don José, there is little evidence elsewhere in

his repertoire that he possessed a remarkably large instrument. In fact, after premiering Don José, Lhérie dove head first into the baritone repertoire, singing the first Posa/Rodrigo in Verdi's revised Italian production of *Don Carlos*. He followed these performances with five more roles at The Royal Opera House, all within the category of lyric baritone. While this does explain Bizet's lower-set writing for his voice, Lhérie likely wasn't singing with the volume and power that many would now consider typical of a "dramatic" tenor. Nonetheless, this tenor ability with the distinct baritonal quality does lend credence to Kloiber's categorization of Jugendlicher Heldentenor and Boldrey's use of Spinto.

Table 27. Aria Reference Chart: Radamès, "Celeste Aïda"

"Celeste Aïda" - *Aïda*, Giuseppe Verdi			
Role	Radamès, *Captain of the Guard*	**Length**	232 pitches
Aria Location	Act I	**Range**	D3 - Bb4
Kloiber	Jugendlicher Heldentenor, auch Heldentenor	**True Tessitura**	C4 - A4 (±3.89)
Boldrey	spinto tenor, DRAMATIC TENOR, heroic tenor	**Average Pitch**	C4 (60)
Premier Voice	Pietro Mongini	**Orchestra at 75%**	98 dB

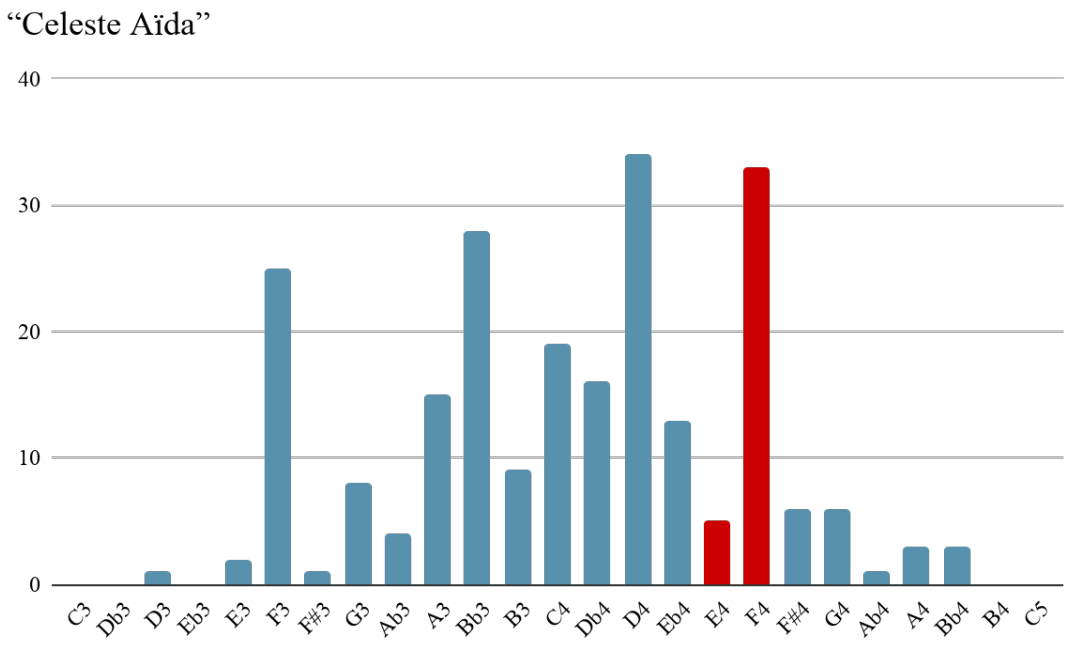

Figure 28. "Celeste Aïda" [Pitch Analysis Chart]

The first aria presented with this particular pitch distribution, Radamès' famed aria abandons the previously seen and outlined "pyramid" structure and expands it widely to four peaks. More than half of the aria's pitches are in the shape of a Bb chord, that is: F3, Bb3, D4, and F4. This is an extremely wide pitch distribution in comparison to the pyramidal structure of the other arias, but does reflect the sudden and steep drop off at the edge of the passaggio. Despite this strange pattern of note distribution, the aria shares the same average pitch and True Tessitura as many of the arias analyzed in this section. Nonetheless, this aria clearly takes a warm and large enough voice to maintain such a low frequency of pitch.

Aïda received two separate and independent premieres, with the role of Radamès changing hands between the two premieres. The first premiere, in Cairo, featured Pietro Mongini. Immediately addressing the low power necessary to effectively perform the role, Mongini first trained as a Bass. However, his tenor performances that followed were not necessarily those one would associate with the highest-power tenor voices available. They

included Edgardo (Kloiber: Lyrischer Tenor, Boldrey: light lyric tenor, FULL LYRIC TENOR, spinto tenor) and Arnold (Kloiber: Lyrischer Tenor, Boldrey: FULL LYRIC TENOR, spinto tenor, dramatic tenor), both of which demonstrate an average categorization below that of "dramatic". The second premiere of the work, in Italy, was performed by Giuseppe Fancelli, a well-loved tenor from both La Scala and the Royal Opera House with a ringing upper register. It was this premiere that Verdi considered to be the real premiere. Fancelli also sang much of the same repertoire as Mongini, but an important addition is his Royal Opera House appearance as Tonio (whose aria was analyzed earlier in this chapter). In contrast to the metallic deep voice of Mongini, Fancelli brought an incredible upper register to the role.[42] These two castings by Verdi confirm the likelihood of his intent for the role to fit more appropriately into the Spinto tenor or Jugendlicher Heldentenor category.

Table 28. Aria Reference Chart: Lohengrin, "In fernem Land"

"In fernem Land" [Narration] - *Lohengrin*, Richard Wagner			
Role	Lohengrin, *a knight*	**Length**	288 pitches
Aria Location	Act III, Scene 2	**Range**	E3 - Ab4
Kloiber	Jugendlicher Heldentenor	**True Tessitura**	Db4 - Ab4 (±3.34)
Boldrey	spinto tenor, dramatic tenor, HEROIC TENOR	**Average Pitch**	Db4 (61)
Premier Voice	Karl Beck	**Orchestra at 75%**	98.2 dB

[42] Elizabeth Forbes, January 20, 2001.

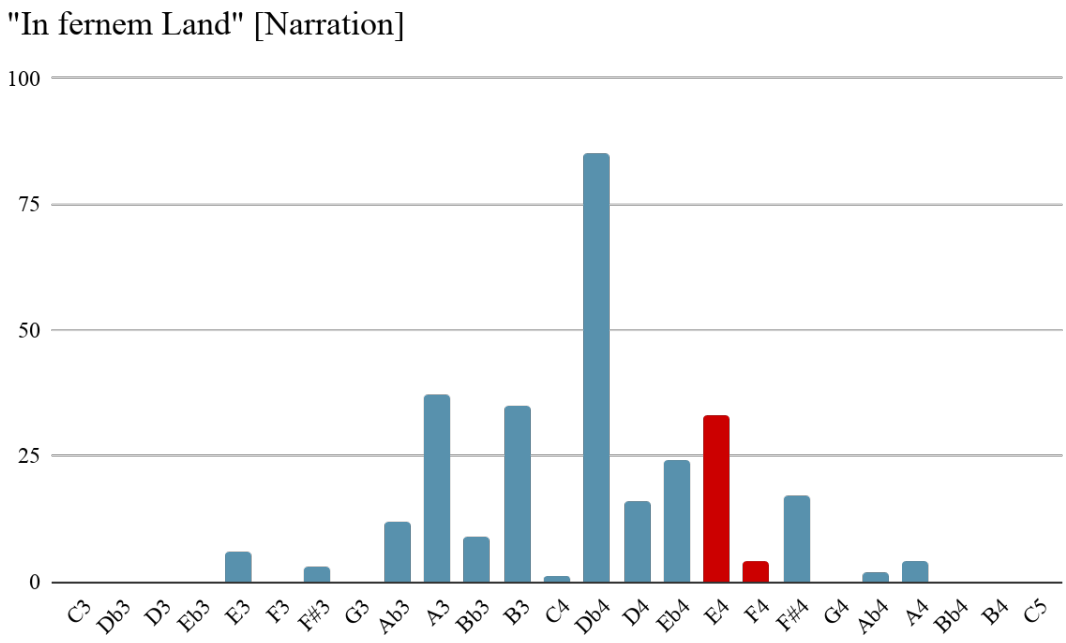

Figure 29. “In fernem Land” [Pitch Analysis Chart]

At first appearing like the lighthouse-esque structures of the Spinto arias analyzed earlier in this document, Wagner continues to set himself apart in unique ways. This aria does not just center around a pitch and migrate higher or lower from there, it is truly centered around the pitch of Db4, with eighty-five of them being sung in the aria. That’s more than double that of any other pitch sung and still more than any two of the other oft-sung pitches combined. Echoing Verdi’s “Celeste Aïda”, this piece is also strangely and loosely built on a chord. In this case, A Major: A3, C#4, and E4. This also mimics the other arias of this section with a need for a powerful middle voice and a steep drop off into the high, after the passaggio.

The creator of the role, Karl Beck, presents a distinct argument that Lohengrin must be sung by a substantially larger voice type. Beck sang a relatively short career, but during his performances across Russia, Germany, and the Czech Republic, he sang roles including Otello (Kloiber: Heldentenor, Bouldrey: dramatic tenor, HEROIC TENOR), Ernani (Kloiber: Jugendlicher Heldentenor, Boldrey: spinto tenor, DRAMATIC TENOR), and Weber’s Max

(Kloiber: Jugendlicher Heldentenor, Boldrey: spinto tenor, DRAMATIC TENOR). These three roles establish Beck as a voice of immense magnitude and power, a voice that earned him the title of "The King of Tenors" during his time in Saint Petersburg.[43] It was this voice, chosen by Wagner and Franz Liszt himself for the premiere, that received reports citing severe deficiency and notes to Wagner, who was not at the premiere, complaining about "the unfortunate choice of singer for the leading part".[44] It is unclear as to which part of the voice was so dissatisfactory to the patrons, but he undoubtedly possessed a large instrument, and thus, the taking on of this role should be done so judiciously.

Table 29. Aria Reference Chart: Princ, "Vidino divná"

"Vidino divná" - *Rusalka*, Antonín Dvořák			
Role	Princ [Prince]	**Length**	272 pitches
Aria Location	Act I	**Range**	Eb3 - A4
Kloiber	Jugendlicher Heldentenor	**True Tessitura**	Db4 - Ab4 (±3.32)
Boldrey	dramatic tenor, HEROIC TENOR	**Average Pitch**	Db4 (61)
Premier Voice	Bohumil Pták	**Orchestra at 75%**	98.2 dB

[43] Laura Macy, ed., *The Grove Book of Opera Singers* (New York, NY: Oxford University Press, Inc., 2008), 33.

[44] Richard Wagner, *My Life*, ed. Mary Whittall, trans. Andrew Gray (Cambridge, UK: Cambridge University Press, 1987).

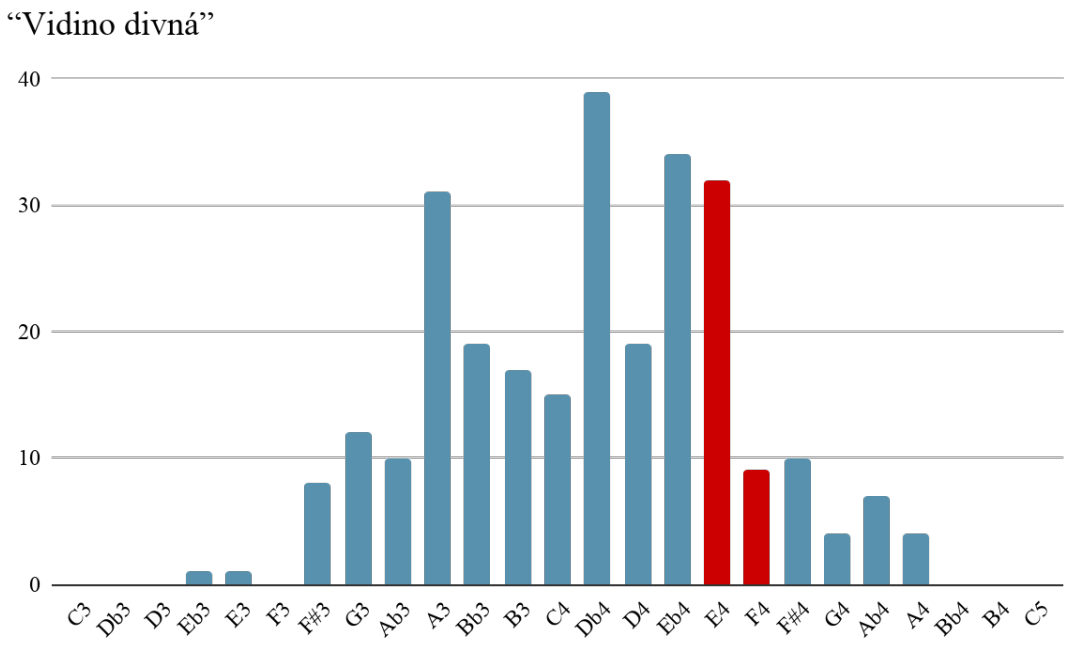

Figure 30. "Vidino divná" [Pitch Analysis Chart]

In this aria, Dvořák writes in a similar structure to Lohengrin's aria, analyzed previously. The aria also outlines the A major chord, but takes the central Db4 and redistributes the repetition of the Wagner, adding substantial density in the middle voice, particularly weighted from A3 to E4. It also features the signature steep drop off after the passaggio, this time on E4. Along with the dense orchestration of 98.2dB at 75%, this requires substantial power in the middle and upper middle registers.

Bohumil Pták, the creator of the role, was a voice of undoubted power, singing the likes of Lohengrin (analyzed previously in this section), but also performing roles abroad like Lensky (analyzed previously in this document), Arnold (Kloiber: Lyrischer Tenor, Boldrey: FULL LYRIC TENOR, spinto tenor, dramatic tenor), and Roméo (Kloiber: unlisted, Boldrey: light lyric tenor, FULL LYRIC TENOR). With this knowledge, it can be assumed that Pták's voice likely possessed not just great vocal power and a substantial middle voice, but also a beautiful lyrical and legato musicality.

A Discussion on the "Dramatic/Heroic" Tenor

It is clear that the "Dramatic/Heroic" Fach represents yet another unique strand of tenor within the fabric of opera. Each of the arias has a distinct lack of singing above the zona di passaggio, meaning an aria that is centralized lower than average. Additionally, these arias each present a unique take on the spike aspect of these analyses. Four out of the five arias analyzed have a distinctly non-singular spike contour, many placing large emphasis on a set of pitches spread out through the tenor's range. Unless these are the result of long runs of singular pitches, this could represent the resilience necessary to sing these arias with such a widely spread primary range. Overall, it seems these arias are distinctly aligned with Kloiber's concept of complex musical dramaticism.[45] They contain an immense amount of taxing singing throughout the extremes of the tenor's range, they are built on melodic structures that feature an exhaustive use of repeated pitches, and they feature orchestras that do reflect the upper portion of decibel output. With the exception of the role of Anatol, each of the premiere singers represent the immense vocal size and deep color that these roles have come to be known for, and in some cases provide anecdotal proof that the singers expected to perform these roles represent a class of singer that transcends the beautiful singing of the Lyrischer voices.

[45] Kloiber, *Handbuch Der Oper*, vol. 2, 1065.

Chapter 5: Further Evidence of Categorization Dissent

Zwischenfach

Within vocal circles, the concepts of *Zwischenfach* (Gr.: 'intermediate categories') can be convoluted to represent singers that are capable of singing arias or roles that belong to multiple Fachs. While this does vaguely represent the meaning of Zwischenfach, modern singers and teachers often use this term in reference to the proverbial "baritenor" or a mezzo-soprano with a great high extension. This is, of course, using the "intermediate" portion of the definition to refer to being between two larger voice categories-- for example, a singer that is between a baritone and a tenor. This does not represent Kloiber's original use of the term. In Kloiber's *Besetzungsfragen: Die Solisten* (Gr.: 'Casting Questions: The Soloists') section of his second volume, Kloiber discusses the need for an understanding that a role or singer can occupy more than one Fach category, thus, the Zwischenfach.[46] However, Kloiber is referencing a voice that has one foot in both the Lyrischer Fächer and the Seriöse Fächer, that is, a singer who is capable of both great feats of vocal power and prowess and also inspired demonstrations of acting while beautifully singing. Kloiber demonstrates this clearly with the following graphical representation:

Figure 31. A Demonstration of *Zwischenfach*[47]

[46] Kloiber, *Handbuch Der Oper*, vol. 2, 1041.

[47] Adapted, Ibid.

While Boldrey does represent multiple voices being capable of singing the same role, the essence of the Zwischenfach designation, he does not directly address the concepts of Zwischenfach. He does, however, also present the crossing of larger voice categories in some of his analyses. Idomeneo, for instance, is listed as "full lyric tenor, DRAMATIC TENOR, lyric bass".[48] Nonetheless, it should be clarified that Zwischenfach is utilized properly only in the description of a voice capable of performing a wide variety of repertoire that aligns with multiple Fächer, not in reference to a voice's color, range, or flexibility.

It should be noted that the lirico-spinto, Jugendlicher, Italienischer, and Kavalier additions to the Italian and German voice classifications could all generally be considered to fit into the ideas of the Zwischenfach. These represent a vocal category that is one step away from, or lacks certain characteristics of, a voice category above or below them.

The Character-Voice and the Soubrette

The primary center of this rejection of a traditional linear Fach system is discussed in the "A Discussion on the 'Character' Tenor" section of Chapter 4. However, it should be reiterated that the voice size and vocal ability of the character-voice should not be a primary function of consideration. These voices, with the addition of the Soubrette, are performers that are prized for their abilities in acting, comedy, and physicality. As demonstrated by the analysis within this document, it would be easily justifiable that these roles be put alongside roles that are representative of their vocal demands with a notation that represents the extra necessity of superior acting abilities.

[48] Richard Boldrey, *Guide to Operatic Roles & Arias* (Redmond, WA: PST ... Inc., 1994), p. 15-16.

Color, Movement, and Voice Size through Age

When examining the Singer-Fach Conflation, it must be considered that singers' voices actively change throughout their life. This is to say, the Fach with which one singer associates during their university studies can, and likely will, change during their growth into full vocal adulthood. Furthermore, this growth will continue throughout the singer's life. This is of particular importance when using the methodology prescribed by Boldrey, that one could view a particular opera singer as their vocal equivalent and ascertain an appropriate Fach for their own voice. This conclusion is, of course, dependent upon the reference singer's stage within their career, whether the performance referenced for comparison was live or recorded, and in what venue they were performing. Pavarotti alone is listed by Boldrey as "light lyric tenor, FULL LYRIC TENOR, spinto tenor, dramatic tenor." Again, this is a representation by Boldrey of a variety of roles sung by Pavarotti and not a representation of the actual singer. However, careful attention should be paid to the timing in a singer's career and when these roles were sung.

CHAPTER 6: The Case Compressed

The primary goal of this document is to survey, analyze, and ultimately question the concepts surrounding voice categorization. While Rudolf Kloiber and Richard Boldrey both established substantial systems for voice categorizations, exactly how their systems originated is relatively unknown. When the singer-Fach conflation is so prominent, these systems would be an attempt to put many individual voices into around thirty categories across all of opera, which was not their intent. Analyzing the appendices and introductory chapters of Kloiber's and Boldrey's texts suggests the need for an expanded system, with many international categories referenced or omitted. In fact, the abundance of individual and unique singers utilizing these systems and the history of the systems themselves could aid in this expansion.

The first aspect analyzed within the scope of voice categorizations is the acoustics of the voice and the orchestra. This bolsters the importance of education on resonance within the teaching of singing. It is not the fundamental pitches sung that are competing with a large orchestra, but the carefully crafted overtone series and formants that carry the voice. However, the size of the orchestra does matter, of course. These concepts lead to an understanding that the primary needs of the singer must revolve around the realization that a composer's, and more importantly, a conductor's, choice of orchestration creates a substantial difference in the Fach necessary to perform the role. As demonstrated in Chapter 4, when all string sections are equal, the decibel output of the opera orchestras are all remarkably similar. They almost certainly lie within one order of magnitude of one another, meaning the loudest orchestra is only twice as loud as the smallest orchestra.

This choice of orchestra, of course, most likely occurs as a repercussion of the space available to the conductor. So, not only will a larger volume of space innately decrease the

perceived volume of a singer's voice, but it also likely gives space for a larger orchestra to fill, to compete with the voice to be heard. The space in which they singer chooses to perform can also be of substantial importance when it comes to vocal effort. The venue's size, acoustical friendliness, height, width, pit size, and pit depth are all significant independent variables that can contribute to a singer's success or failure in their portrayal of a role. A well-planned architectural structure yields a minimal volume of air in relation to the number of audience members present. Additionally, the depth of the space should be strongly taken into consideration, as it greatly affects the effectiveness of the voice's ability to carry through a space.

The analysis of the actual arias sung by these various voice types leads to the discovery of distinct trends and outliers that would likely have cohorts within the rest of the operatic repertoire. Taking these trends and outliers into account, the missing links within the Boldrey and Kloiber systems could begin to be assessed and appropriately incorporated. For the preponderance of arias analyzed and trends assessed, the justification for this is evident. A sample of this systemic expansion may look like the following:

Tenor Voice Types Expanded

"Leggero/Hoher/Coloratura" Tenor: This voice type represents tenors of Rossini, Bellini, Donizetti, and other composers who task their tenor with extreme examples of movement, flexibility, a high tessitura, and exceptional or repeated high.

"Light" Lyric Tenor, Tenore di Grazia: The youthful, lighter, soft counterpart of the Lyric Tenor. These can be young heroes or lovers, or any instance of the typical hero or tenor lead within the confines of a lighter orchestra. This may still include roles within

the bel canto composer's canon, but also includes several of the Mozartian tenors, and much of the French repertoire. For the purposes of balance, this voice type can also serve as a secondary character if the primary character is a larger-voiced tenor.

Lyric Tenor: As proposed by Kloiber, this is the tenor voice category that most closely aligns with the heroic or lead roles in which vocal beauty is still of the utmost importance. These are the music focused roles and likely would historically align best with the tenor repertoire composed before the works of Puccini.

Spinto, Lirico-spinto, Tenore robusto, Jugendlicher Heldentenor: This is the primary example of the Zwischenfach within the tenor repertoire. This could be a lyric voice capable of being temporarily pushed to the levels of vocal theatrics required of the more dramatic roles. Additionally, this could just as easily be the young dramatic voice, not yet developed enough to handle its future challenges. No matter what the case, the voice represents a point of flexibility among the tenor voice, being able to capture in one voice the requirements of the largest lyric roles while being able to equally sustain the singing of lighter dramatic roles.

Dramatic Tenor, Tenore di Forza, Heldentenor: The largest of the tenor voice categories. This is the voice fit for competition with the orchestras of the composers of the last century. Capable of competing with large swaths of brass and percussion in exceptionally large opera houses, these roles push the boundaries of drama with incredible feats of vocal exhibition.

Character Tenor/Comic Tenor: This is not a category of Fach. This is a concept or an addition to a Fach that indicates the expectations of the role. It is clearly evident that the roles previously labeled in this way have no basis or accounting of vocal size. They could

be, or rather should be, performed by a singer of appropriate vocal size and ability to compete with the orchestra and hall present, and complement the singers that have been cast in the primary or lead roles. This could be as simple as something like: Beppe - Lyric Tenor (Character).

Further Research

The next steps for this area of research are threefold. First, an expanded acoustic analysis of other major opera houses around the world. While the International Congress on Acoustics study, mentioned in Chapter 3, began a fascinating process, an expanded study of a larger sampling would be an incredibly useful resource for the modern opera singer. A ranking or rating system of the smaller and mid-level opera houses throughout Europe and the United States would allow agents and emerging opera singers to carefully select contracts that best suit their individual voices and highlight them in the best light possible.

Second, a greater sampling of arias for analysis is necessary. While five aria packages present a worthwhile sampling, a larger pool of roles would allow the researcher to prove or disprove definitive trends demonstrated within vocal categories. Even more important would be findings that lead to a better understanding of the space between the voice types described by Kloiber and Boldrey. The key to understanding these arias as part of a greater whole seems to lie within the average pitch and the graphic representations of the pitches sung.

Third, an expansion of the methods of analysis to encompass entire roles would allow for the kind of compressed analysis offered by Kloiber and Boldrey. Without this complete data, the research done only reflects the arias sung by each character and not the entirety of its performance. If the complete roles approximately reflected the data of the arias, it would perhaps

give traction to a more expedient aria-oriented analysis as a means of rapid comparison and expansion.

Pedagogical Use

The overarching principles and findings of this document have several extrapolations for the vocal pedagogue. First, teacher and student should focus on excluding Fach as primary principle of teaching. A wholistic approach to the voice, focusing on each of the unique instrument's strengths and weaknesses, allows the voice to grow uninhibited. After this maturity, the singer and a trusted teacher can begin exploring categorization for the purposes of aria package development and career focus. In this way, the singer can assess their range, color, ability to move the voice, and other factors discussed here, and allow their voice to select the appropriate category. Within the singer-Fach conflation, it becomes very tempting to assign a voice category, even just in the mind of the teacher, and set the voice on that path. Unfortunately for the student, a poorly chosen path can have lasting consequences. Another important pedagogical aspect of the data presented in this document is the principal of exploration. Exploration of various arias and voice types should be encouraged by teachers, particularly for their more advanced students. The overlap between voice categories is abundantly apparent, and the exploration of a student's neighboring voice types could have beneficial effects. The maintenance or honing of legato, tone, range, lyricism, and embracing of musical drama can be encouraged through the assignment of an aria that steps outside of the norm of the student's package or current voice type. Each of these voice categories would also likely benefit from refining the acting necessities of a corresponding character roles as well. Students can utilize a new aria in a new category to traverse into unexplored areas of their voice and strengthen any portion of their voice that they may find lacking.

Conclusions

In order to compress all of the information analyzed in this document, there should be an expansion of the historical ideas of voice categorizations. The explanation by Pearl Yeadon McGinnis, as laid out in Chapter 1, is a good start: "Fach = voice + range + size + timbre + physical build + age and experience + desire + frequency of performance."[49] The compression of this multivariate analysis into a single category epitomizes the need for further expansion. Rather than utilize the cursory assignments put forth, singers must take responsibility for their own role assignment and vocal growth. They must assess their own vocal abilities, their range, the current weight of their voice, its color, their personality and build, what they love to sing, and what they sing well. Then, they can utilize the groundwork put forth here. Once introspective analysis is done, especially when aided by outside ears, singers can then assess where they would perform the role, who the conductor is, the friendliness of the house, the contract length, and the size of the orchestra. Addressing Boldrey's initial goal for his work, yes, singers can utilize outside sources to begin this journey, particularly if further research continues to produce the patterns demonstrated in the aria analysis presented in this document. However, the singer must accept that this could yield just a handful of roles that they are prepared to sing or are the right fit for. The singer's voice is a wholly individual instrument, and while patterns may indeed emerge, they do not represent a box one must stay in, a commentary on one's vocal ability, or an entitlement to a set of roles. The singer must individually recognize this. Doing so transcends the singular titles associated with the Fach system, or the misinformed perspective that a single singer should be able to perform a role simply because it is supposed to fit them or their voice type. The true

[49] McGinnis, *The Opera Singer's Career Guide: Understanding the European Fach System*, 9.

path to a singer's understanding of the Fach system lies in the exploration of all that the world of opera has to offer and embracing the capabilities and limitations of their own voice.

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APPENDIX A: Instrument Decibel Output Sources

https://www.johnsonstring.com/resources/how-loud-acoustic-violin/#:~:text=At%20full%20volume%2C%20an%20acoustic,drowned%20out%20by%20a%20band.

https://www.violinist.com/discussion/thread.cfm?page=686

http://csef.usc.edu/History/2006/Projects/J1534.pdf

https://courses.physics.illinois.edu/phys406/sp2017/NSF_REU_Reports/2012_reu/Meredith_Powell/Meredith_Powell_Final_Paper.pdf

https://liverpoolacademyofmusic.com.au/worlds-loudest-instrument/

https://academic.oup.com/annweh/article/55/8/893/264708

http://www.lam.jussieu.fr/Membres/LeCarrou/Articles/A4_LeCarrou_HarpAcousticRadiation.pdf

https://www.gcaudio.com/tips-tricks/decibel-loudness-comparison-chart/

https://thefluteexaminer.com/piccolo-playing-and-noise-induced-hearing-loss/

https://music.eku.edu/sites/music.eku.edu/files/ekuhealthandsafety.pdf

https://courses.physics.illinois.edu/phys406/sp2017/NSF_REU_Reports/2008_reu/Nicole_Pfiester_Oboe_Analysis/Sound_Production_Analysis_of_a_Double_Reed_Instrument.pdf

https://www.nytimes.com/2008/04/20/arts/music/20noise.html

http://hyperphysics.phy-astr.gsu.edu/hbase/Music/orchins.html

https://www2.ph.ed.ac.uk/~dmc/PHY-1-MusAc/Tutorials/MusAc-tut5nsol.pdf

https://charlestonhearing.com/which-instruments-put-your-hearing-most-at-risk/

https://www.audioholics.com/editorials/the-decibel-db

https://www.hearnet.com/at_risk/risk_trivia.shtml

https://www.kpo.org.au/current/images/Documents/OrchestraSoundLevels.pdf

https://asa.scitation.org/doi/pdf/10.1121/1.4798317

https://pickmydrumset.com/how-many-decibels-db-loud-is-a-drum-set-and-cymbals/#:~:text=A%20drum%20set%20and%20cymbals%20is%20on%20average%20119dB%20but,what%20instruments%20are%20being%20played.

https://www.electronicdrumadvisor.com/how-loud-are-drum-sets-decibels-db/#:~:text=In%20particular%2C%20snare%20drums%20can,at%20a%20stock%20car%20race.

APPENDIX B: Opera House Interior Sources

Munich Nationaltheater

https://www.staatsoper.de/en/ticket-info/seating-plans-and-prices.html?type=0a%3D0

https://www.staatsoper.de/en/your-visit/faqs.html

https://www.staatsoper.de/en/staatsorchester/history.html

https://www.munich.travel/en/pois/arts-culture/opera-at-its-best

https://operamylove.com/history-of-theaters-and-opera-houses/a-brief-history-of-the-bayerische-staatsoper-bavarian-state-opera-and-its-theaters/

Opéra Bastille

https://www.headout.com/blog/opera-bastille-seating-chart/

https://www.operadeparis.fr/en/services-and-practical-info/seating-plans-and-prices

https://www.operadeparis.fr/en/services-and-practical-info/seating-plans-and-prices/season-20-21/opera-bastille

https://www.operadeparis.fr/en/visits/opera-bastille

http://www.pierocastiglioni.com/projects/61/opera-de-la-bastille

Teatro alla Scala

https://www.teatroallascala.org/en/box-office/seating-plan/boxes-stalls.html

https://www.classicfm.com/radio/shows-presenters/everything-you-ever-wanted-know/facts-la-scala/

https://fulbrightyearitaly.com/2014/12/23/how-italys-famed-la-scala-opera-house-packs-its-seats-with-millennials/

https://commons.wikimedia.org/wiki/File:Teatro_alla_Scala_interior_Milan.jpg

The Royal Opera House

http://static.roh.org.uk/seatmaps/2014-15/autumn/Autumn-2014-SeatingPlan-TicketPrices.pdf

http://static.roh.org.uk/visit/pdfs/seating-plan-price-guide-winter-2012-13.pdf

https://www.archdaily.com/921878/royal-opera-house-stanton-williams

https://londonhuawiki.wpi.edu/index.php/Royal_Opera_House

https://www.playbill.com/article/take-an-unprecedented-look-inside-londons-royal-opera-house

http://www.roh.org.uk/venues/main-stage

Metropolitan Opera House

https://www.metopera.org/globalassets/season/tickets/seat-map/met.seating.charts.feb2019.pdf

https://www.metopera.org/season/tickets/seat-maps/met-opera-seating-zones-description/

https://www.metopera.org/globalassets/season/tickets/seat-map/abt-seating_2019.pdf

http://www.josedarioinnella.com/en/Theaters/V/Metropolitan+Opera+House

https://www.nytimes.com/2017/05/05/arts/music/is-the-met-opera-too-big-and-other-questions-as-its-home-turns-50.html

https://www.nycgo.com/articles/met-opera-guide-nyc

War Memorial Opera House

https://sfopera.com/contentassets/65d90bda5f5741b8ba68cea9e1b84236/wmoh_2020.pdf

https://sfwarmemorial.org/war-memorial-opera-house-seating-charts

https://sfwarmemorial.org/war-memorial-opera-house-technical-specifications

https://sfwarmemorial.org/war-memorial-opera-house

https://sfopera.com/plan-your-visit/seat-upgrade/

https://www.world-architects.com/en/auerbach-glasow-san-francisco/project/san-francisco-war-memorial-opera-house-renovation

Civic Opera House

https://www.lyricopera.org/shows/seating-chart/

https://www.lyricopera.org/about/announcements/new-seating/

https://www.lyricopera.org/about/history/lyric-opera-house-history/

https://www.som.com/projects/civic_opera_house_renovation

https://www.whiskiedwanderlust.com/5-incredible-facts-about-the-civic-opera-house-in-chicago/

Seating and Architectural Averages

https://theskydeck.com/how-tall-is-a-storey-in-feet/#:~:text=The%20height%20of%20each%20storey,average%20of%20about%2014%20feet.

https://www.researchgate.net/figure/Typical-tall-building-height-calculator-according-to-CTBUH-a-Left-Residential-60_fig3_317510960

http://www.wecaneugene.org/news/2016/4/8/how-tall-is-a-story

https://www.wsj.com/articles/SB10001424052748703580104575361281784399058

http://theatreprojects.com/en/news/view/207/wall-street-journal-features-theatre-projects-white-paper-size-matters

https://www.thestar.com/business/2014/11/26/seat_squeeze_from_planes_to_trains_to_theatres.html

APPENDIX C: Aria Analysis Data

"This is my box" - *Amahl and the Night Visitors*, Gian Carlo Menotti

Note Input:

A3 G#3 G#3 A3 A3 G#3 G#3 A3 A3 E4 D4 C#4 D4 D4 C4 Bb3 A3 A3 A3 A3 A3 C4 D4 A3 G3 D3 A3 C4 A3 C4 A3 C4 D4 F4 E4 D4 C4 A3 G3 E3 B3 B3 A3 A3 D4 B3 D4 B3 D4 B3 D4 E4 F#4 D4 E4 D4 B3 B3 B3 B3 B3 A3 A3 B3 D4 C#4 B3 C#4 B3 E4 C#4 C#4 C#4 A3 F#3 A3 B3 D4 E4 B3 C#4 B3 E4 C#4 G#3 B3 C#4 E4 G#4 F#4 E4 C#4 C#3 D#3 E3 E3 G#3 G#3 C#4 D#4 D#4 E4 E3 A3 G#3 G#3 A3 A3 G#3 G#3 A3 A3 E4 D4 C#4 D4 D4 C4 Bb3 A3 A3 A3 A3 A3 A3 C4 D4 C4 G3 D3 A3 F4 E4 D4 C4 A3 G3 E3 G3 C4 B3 B3 A3 E4 B3 A3 G#3 G#3 A3 A3 G#3 G#3 A3 A3 E4 D4 C#4 D4 D4 C4 Bb3 A3 A3 A3 A3 A3 A3 A3 Bb3 G3 Eb4 D4 C4 F4 Bb3 A3 G3 C4 Bb3 Bb3 A3 G3 G3 F3 D4 D4 D4 D4 D4 D4 D3 E3 F3 F3 A3 D4 F4 Ab4 Ab3 Ab3 A3 D3

Raw MIDI Data:

57 56 56 57 57 56 56 57 57 64 62 61 62 62 60 58 57 57 57 57 57 60 62 57 55 50 57 60 57 60 57 60 62 65 64 62 60 57 55 52 59 59 57 57 62 59 62 59 62 59 62 64 66 62 64 62 59 59 59 59 59 57 57 59 62 61 59 61 59 64 61 61 61 57 54 57 59 62 64 59 61 59 64 61 56 59 61 64 68 66 64 61 49 51 52 52 56 56 61 63 63 64 52 57 56 56 57 57 56 56 57 57 64 62 61 62 62 60 58 57 57 57 57 57 57 60 62 60 55 50 57 65 64 62 60 57 55 52 55 60 59 59 57 64 59 57 56 56 57 57 56 56 57 57 64 62 61 62 62 60 58 57 57 57 57 57 57 57 58 55 63 62 60 65 58 57 55 60 58 58 57 55 55 53 62 62 62 62 62 62 50 52 53 53 57 62 65 68 56 56 57 50

"True Tessitura" Data:

-07 -08 -08 -07 -07 -08 -08 -07 -07 00 -02 -03 -02 -02 -04 -06 -07 -07 -07 -07 -07 -04 -02 -07 -09 -14 -07 -04 -07 -04 -07 -04 -02 00 00 -02 -04 -07 -09 -12 -05 -05 -07 -07 -02 -05 -02 -05 -02 -05

-02 00 +01 -02 00 -02 -05 -05 -05 -05 -05 -07 -07 -05 -02 -03 -05 -03 -05 00 -03 -03 -03 -07 -10 -07 -05 -02 00 -05 -03 -05 00 -03 -08 -05 -03 00 +03 +01 00 -03 -15 -13 -12 -12 -08 -08 -03 -01 -01 00 -12 -07 -08 -08 -07 -07 -08 -08 -07 -07 00 -02 -03 -02 -02 -04 -06 -07 -07 -07 -07 -07 -07 -04 -02 -04 -09 -14 -07 00 00 -02 -04 -07 -09 -12 -09 -04 -05 -05 -07 00 -05 -07 -08 -08 -07 -07 -08 -08 -07 -07 00 -02 -03 -02 -02 -04 -06 -07 -07 -07 -07 -07 -07 -07 -06 -09 -01 -02 -04 00 -06 -07 -09 -04 -06 -06 -07 -09 -09 -11 -02 -02 -02 -02 -02 -02 -14 -12 -11 -11 -07 -02 00 +03 -08 -08 -07 -14

"O, Colombina, il tenero fido Arlecchin" - *Pagliacci*, Ruggero Leoncavallo

Note Input:

E4 D4 C4 B3 D4 C4 B3 A3 B3 C4 D4 E4 D4 G4 D4 E4 D4 C4 B3 D4 C4 B3 A3 C4 B3 F#3 G#3 A3 B3 C4 B3 E3 E4 D4 C4 B3 D4 C4 B3 A3 B3 C4 D4 E4 E4 A4 E4 F4 F4 D4 C4 Bb3 Bb3 D4 Bb3 A3 G#3 G#3 E3 F#3 G#3 A3 G#3 A3 B3 C4 D4 E4 F4 E4 G#3 A3 B3 C4 D4 E4 E4 D4 C#4 B3 D4 C#4 B3 A3 B3 C#4 D4 E4 E4 A4 G4 G4 D4 D4 G4 F4 F4 Bb3 D4 Bb3 A3 G#3 E3 E3 G#3 A3 B3 C4 A3 E3 G#3 A3 B3 C4 A3 E4 E4 E4 A3

Raw MIDI Data:

64 62 60 59 62 60 59 57 59 60 62 64 62 67 62 64 62 60 59 62 60 59 57 60 59 54 56 57 59 60 59 52 64 62 60 59 62 60 59 57 59 60 62 64 64 69 64 65 65 62 60 58 58 62 58 57 56 56 52 54 56 57 56 57 59 60 62 64 65 64 56 57 59 60 62 64 64 62 61 59 62 61 59 57 59 61 62 64 64 69 67 67 62 62 67 65 65 58 62 58 57 56 52 52 56 57 59 60 57 52 56 57 59 60 57 64 64 64 57

"True Tessitura" Data:

00 -02 -04 -05 -02 -04 -05 -07 -05 -04 -02 00 -02 +02 -02 00 -02 -04 -05 -02 -04 -05 -07 -04 -05 -10 -08 -07 -05 -04 -05 -12 00 -02 -04 -05 -02 -04 -05 -07 -05 -04 -02 00 00 +04 00 00 00 -02 -

04 -06 -06 -02 -06 -07 -08 -08 -12 -10 -08 -07 -08 -07 -05 -04 -02 00 00 00 -08 -07 -05 -04 -02 00 00 -02 -03 -05 -02 -03 -05 -07 -05 -03 -02 00 00 +04 +02 +02 -02 -02 +02 00 00 -06 -02 -06 -07 -08 -12 -12 -08 -07 -05 -04 -07 -12 -08 -07 -05 -04 -07 00 00 00 -07

"J'enfourche aussi Pégase" - *Manon*, Jules Massenet

Note Input:

B3 B3 B3 B3 D4 F4 F4 B3 B3 D4 G3 G3 G3 G3 G3 G3 G3 G3 B3 B3 B3 B3 B3 B3 E4 E3 E3 E3 E3 E3 G#3 B3 B3 E3 E3 E3 E3 E3 E3 E3 E3 A3 G#3 G#3 G#3 E3 B3 B3 B3 B3 C#4 A3 A3 B3 A3 B3 A3 A3 B3 C#4 B3 C#4 B3 B3 C#4 D4 C#4 D4 C#4 C#4 G#3 G#3 G#3 C#4 A3 A3 A3 D4 F#3 D4 C#4 B3 C#4 B3 A3 A3 A3 A3 A3 A3 A3 A3 A3 A3 A3 A3 A3 G#3 F#3 E3 F#3 G#3 F#3 E3 F#3 E4 D4 C#4 D4 C#4 B3 C#4 F#4 E4 D4 E4 D4 C#4 D4 C#4 B3 A3 A3 A3 A3 A3 A3 A3 A3 A3 A3 A3 A3 C#4 B3 C#4 A3 C#4 E4 A4 B3 E4

Raw MIDI Data:

59 59 59 59 62 65 65 59 59 62 55 55 55 55 55 55 55 55 59 59 59 59 59 59 64 52 52 52 52 52 56 59 59 52 52 52 52 52 52 52 52 57 56 56 56 52 59 59 59 59 61 57 57 59 57 59 57 57 59 61 59 61 59 59 61 62 61 62 61 61 56 56 56 61 57 57 57 62 54 62 61 59 61 59 57 57 57 57 57 57 57 57 57 57 57 57 56 54 52 54 56 54 52 54 64 62 61 62 61 59 61 66 64 62 64 62 61 62 61 59 57 57 57 57 57 57 57 57 57 57 57 61 59 61 57 61 64 69 59 64

"True Tessitura" Data:

-05 -05 -05 -05 -02 00 00 -05 -05 -02 -09 -09 -09 -09 -09 -09 -09 -09 -05 -05 -05 -05 -05 -05 00 -12 -12 -12 -12 -12 -08 -05 -05 -12 -12 -12 -12 -12 -12 -12 -12 -07 -08 -08 -08 -12 -05 -05 -05 -05 -03 -07 -07 -05 -07 -05 -07 -07 -05 -03 -05 -03 -05 -05 -03 -02 -03 -02 -03 -03 -08 -08 -08 -03 -07 -07 -07 -02 -10 -02 -03 -05 -03 -05 -07 -07 -07 -07 -07 -07 -07 -07 -07 -07 -07 -07 -07 -08 -10

-12 -10 -08 -10 -12 -10 00 -02 -03 -02 -03 -05 -03 +01 00 -02 00 -02 -03 -02 -03 -05 -07 -07 -07 -07 -07 -07 -07 -07 -07 -07 -07 -03 -05 -03 -07 -03 00 +04 -05 00

"Als zullendes Kind" [Starling Song] - *Siegfried*, Richard Wagner

Note Input:

C4 C4 Bb3 Ab3 G3 Bb3 Ab3 G3 F3 Gb3 Ab3 Bb3 C4 F3 F3 Gb3 Ab3 Bb3 C4 Db4 C4 Bb3 Ab3 C4 Bb3 Ab3 G3 Bb3 Ab3 G3 F3 F3 G3 Ab3 F3 C4 F3 Gb3 Ab3 Bb3 Ab3 F3 C4 Bb3 Ab3 Ab3 F3 Gb3 Ab3 Bb3 Db4 C4 Cb4 Bb3 A3 Bb3 Db4 Eb3 F3 G3 Ab3 Eb3 Ab3 Bb3 Eb3 C4 C4 Bb3 Ab3 G3 Bb3 Ab3 G3 F#3 F#3 G3 Bb3 Eb4 G3 Ab3 Bb3 C4 Bb3 G3 Ab3 Cb4 Fb4 Ab3 Bb3 Cb4 Db4 Eb4 Db4 Cb4 Bb3 A3 Db4 Cb4 Bb3 A3 F3 Gb3 Ab3 Bb3 Ab3 Bb3 C4 Db4 Eb4 Db4 C4 Bb3 Ab3 Ab3 G3 G3 Bb3 Ab3 G3 C4 C4 Db4 Eb4 F4 E4 C4 F4 Eb4 Db4 C4 Db4 Db4 Db4 Db4 C4 Gb4 Db4 Db4 Db4 Db4 C4 C4 C4 F4 F4 F4 F4 Eb4 Db4 Db4 C4 C4 F3

Raw MIDI Data:

60 60 58 56 55 58 56 55 53 54 56 58 60 53 53 54 56 58 60 61 60 58 56 60 58 56 55 58 56 55 53 53 55 56 53 60 53 54 56 58 56 53 60 58 56 56 53 54 56 58 61 60 59 58 57 58 61 51 53 55 56 51 56 58 51 60 60 58 56 55 58 56 55 54 54 55 58 63 55 56 58 60 58 55 56 59 64 56 58 59 61 63 61 59 58 57 61 59 58 57 53 54 56 58 56 58 60 61 63 61 60 58 56 56 55 55 58 56 55 60 60 61 63 65 64 60 65 63 61 60 61 61 61 61 60 66 61 61 61 61 60 60 60 65 65 65 65 63 61 61 60 60 53

"True Tessitura" Data:

-04 -04 -06 -08 -09 -06 -08 -09 -11 -10 -08 -06 -04 -11 -11 -10 -08 -06 -04 -03 -04 -06 -08 -04 -06 -08 -09 -06 -08 -09 -11 -11 -09 -08 -11 -04 -11 -10 -08 -06 -08 -11 -04 -06 -08 -08 -11 -10 -08 -06 -03 -04 -05 -06 -07 -06 -03 -13 -11 -09 -08 -13 -08 -06 -13 -04 -04 -06 -08 -09 -06 -08 -09 -10 -10 -09 -06 -01 -09 -08 -06 -04 -06 -09 -08 -05 00 -08 -06 -05 -03 -01 -03 -05 -06 -07 -03 -05

-06 -07 -11 -10 -08 -06 -08 -06 -04 -03 -01 -03 -04 -06 -08 -08 -09 -09 -06 -08 -09 -04 -04 -03 -01 00 00 -04 00 -01 -03 -04 -03 -03 -03 -03 -04 +01 -03 -03 -03 -03 -04 -04 -04 00 00 00 00 -01 -03 -03 -04 -04 -11

“Alles fühlt der Liebe Freuden” - *Die Zauberflöte*, Wolfgang Amadeus Mozart

Note Input:

C4 D4 B3 C4 D4 B3 C4 D4 B3 C4 G3 C4 B3 A3 G3 A3 B3 C4C4 D4 B3 C4 D4 B3 C4 D4 B3 C4 G3 C4 B3 A3 A3 D4 D4 B3 C4 B3 A3 A3 D4 D4 G3 G3 A3 B3 B3 C4 A3 G3 G3 D4 D3 D3 D3 E3 F#3 G3 D4 D3 D3 D3 E3 F#3 G3 C4 D4 B3 C4 D4 B3 C4 D4 B3 C4 G3 C4 E4 G3 G3 G3 A3 B3 C4 C4 E4 G3 G3 G3 A3 B3 C4 C4 E4 G3 G3 G3 A3 B3 C4 C4 D4 B3 C4 D4 B3 C4 D4 B3 C4 G3 C4 B3 A3 G3 A3 B3 C4C4 D4 B3 C4 D4 B3 C4 D4 B3 C4 G3 C4 B3 A3 A3 D4 D4 B3 C4 B3 A3 A3 D4 D4 G3 G3 A3 B3 B3 C4 A3 G3 G3 D4 D3 D3 D3 E3 F#3 G3 D4 D3 D3 D3 E3 F#3 G3 C4 D4 B3 C4 D4 B3 C4 D4 B3 C4 G3 C4 E4 G3 G3 G3 A3 B3 C4 C4 E4 G3 G3 G3 A3 B3 C4 C4 E4 G3 G3 G3 A3 B3 C4

Raw MIDI Data:

60 62 59 60 62 59 60 62 59 60 55 60 59 57 55 57 59 60 60 62 59 60 62 59 60 62 59 60 55 60 59 57 57 62 62 59 60 59 57 57 62 62 55 55 57 59 59 60 57 55 55 62 50 50 50 52 54 55 62 50 50 50 52 54 55 60 62 59 60 62 59 60 62 59 60 55 60 64 55 55 55 57 59 60 60 64 55 55 55 57 59 60 60 64 55 55 55 57 59 60 60 62 59 60 62 59 60 62 59 60 55 60 59 57 55 57 59 60 60 62 59 60 62 59 60 62 59 60 55 60 59 57 57 62 62 59 60 59 57 57 62 62 55 55 57 59 59 60 57 55 55 62 50 50 50 52 54 55 62 50 50 50 52 54 55 60 62 59 60 62 59 60 62 59 60 55 60 64 55 55 55 57 59 60 60 64 55 55 55 57 59 60 60 64 55 55 55 57 59 60

“True Tessitura” Data:

-04 -02 -05 -04 -02 -05 -04 -02 -05 -04 -09 -04 -05 -07 -09 -07 -05 -04 -04 -02 -05 -04 -02 -05 -04 -02 -05 -04 -09 -04 -05 -07 -07 -02 -02 -05 -04 -05 -07 -07 -02 -02 -09 -09 -07 -05 -05 -04 -07 -09 -09 -02 -14 -14 -14 -12 -10 -09 -02 -14 -14 -14 -12 -10 -09 -04 -02 -05 -04 -02 -05 -04 -02 -05 -04 -09 -04 00 -09 -09 -09 -07 -05 -04 -04 00 -09 -09 -09 -07 -05 -04 -04 00 -09 -09 -09 -07 -05 -04 -04 -02 -05 -04 -02 -05 -04 -02 -05 -04 -09 -04 -05 -07 -09 -07 -05 -04 -04 -02 -05 -04 -02 -05 -04 -02 -05 -04 -09 -04 -05 -07 -07 -02 -02 -05 -04 -05 -07 -07 -02 -02 -09 -09 -07 -05 -05 -04 -07 -09 -09 -02 -14 -14 -14 -12 -10 -09 -02 -14 -14 -14 -12 -10 -09 -04 -02 -05 -04 -02 -05 -04 -02 -05 -04 -09 -04 00 -09 -09 -09 -07 -05 -04 -04 00 -09 -09 -09 -07 -05 -04 -04 00 -09 -09 -09 -07 -05 -04

“A te, o cara” - *I Puritani*, Vincenzo Bellini

Note Input:

A3 A3 A3 D4 C#4 E4 A3 A3 D4 C#4 E4 A3 A3 F#4 F#4 F#4 E4 F#4 A4 G4 D4 C#4 D4 E4 D4 G4 F#4 E4 A3 A3 A3 D4 E4 A3 A3 D4 C#4 D4 F#4 E4 C#4 A3 A3 F#4 F#4 F#4 F#4 E4 C#4 D4 E4 F#4 G4 A4 D4 E4 F#4 G4 F#4 E4 B3 C#4 D4 A3 A3 D4 C#4 E4 A3 A3 D4 C#4 D4 F#4 E4 C#4 A3 A3 F#4 F#4 F#4 E4 C#5 B4 A4 G4 F#4 E4 F#4 G4 D4 C#4 D4 E4 D4 G4 E4 A3 A3 A3 D4 C#4 D4 F#4 E4 C#4 A3 A3 B3 C#4 D4 E4 E4 F#4 E4 F#4 E4 F#4 E4 C#4 A3 A3 F#4 F#4 F#4 F#4 E4 B3 D4 E4 F#4 G4 A4 D4 E4 F#4 G4 F#4 E4 B3 C#4 D4 D4 E4 F#4 G4 F#4 F#4 E4 F#4 E4 B3 D4 C#4 F#4 E4 D4 G#4 A4 G4 B3 C#4 F#4 E4 F#4 D4 G#4 A4 G4 F#4

Raw MIDI Data:

57 57 57 62 61 64 57 57 62 61 64 57 57 66 66 66 64 66 69 67 62 61 62 64 62 67 66 64 57 57 57 62 64 57 57 62 61 62 66 64 61 57 57 66 66 66 66 64 61 62 64 66 67 69 62 64 66 67 66 64 59 61 62 57 57 62 61 64 57 57 62 61 62 66 64 61 57 57 66 66 66 64 73 71 69 67 66 64 66 67 62 61 62

64 62 67 64 57 57 57 62 61 62 66 64 61 57 57 59 61 62 64 64 66 64 66 64 66 64 61 57 57 66 66 66 66 64 59 62 64 66 67 69 62 64 66 67 66 64 59 61 62 62 64 66 67 66 66 64 66 64 59 62 61 66 64 62 68 69 67 59 61 66 64 66 62 68 69 67 66

"True Tessitura" Data:

-07 -07 -07 -02 -03 00 -07 -07 -02 -03 00 -07 -07 +01 +01 +01 00 +01 +04 +02 -02 -03 -02 00 -02 +02 +01 00 -07 -07 -07 -02 00 -07 -07 -02 -03 -02 +01 00 -03 -07 -07 +01 +01 +01 +01 00 -03 -02 00 +01 +02 +04 -02 00 +01 +02 +01 00 -05 -03 -02 -07 -07 -02 -03 00 -07 -07 -02 -03 -02 +01 00 -03 -07 -07 +01 +01 +01 00 +08 +06 +04 +02 +01 00 +01 +02 -02 -03 -02 00 -02 +02 00 -07 -07 -07 -02 -03 -02 +01 00 -03 -07 -07 -05 -03 -02 00 00 +01 00 +01 00 +01 00 -03 -07 -07 +01 +01 +01 +01 00 -05 -02 00 +01 +02 +04 -02 00 +01 +02 +01 00 -05 -03 -02 -02 00 +01 +02 +01 +01 00 +01 00 -05 -02 -03 +01 00 -02 +03 +04 +02 -05 -03 +01 00 +01 -02 +03 +04 +02 +01

"Dal labbro il canto estasiato vola" - *Falstaff*, Giuseppe Verdi

Note Input:

F3 G3 Ab3 Bb3 Bb3 Bb3 Bb3 F4 D#4 D#4 D#4 Ab3 Bb3 B3 B3 B3 D#4 D#4 D#4 F4 G4 Bb3 Bb3 C4 Db4 Db4 Db4 Db4 Ab4 G4 F4 Eb4 C4 C4 Eb4 Db4 C4 B3 C4 F4 C4 Bb3 Ab3 Ab3 Ab3 Ab3 F#4 F#4 F#4 Bb3 Db4 F4 Eb4 Gb3 Gb3 Gb3 F4 F4 F4 F4 Ab3 C4 Eb4 Db4 Db4 Db4 E4 E4 E4 Eb4 E4 F#4 Ab4 Ab4 Eb4 F#4 E4 B3 C4 C4 E4 D4 C4 E4 F#4 G4 Ab4 A3 A3 A3 A3 G#3 G#3 F#3 E3 D#3 B3 Bb3 Bb3 Bb3 B3 C#4 Eb4 G#3 Bb3 B3 B3 Bb3 Eb4 Eb4 Eb4 Eb4 G#3 Bb3 B3 F#4 E4 Eb4 C#4 B3 G#3 G#3 G#3 E4 Eb4 C#4 C#4 C4 Eb4 G#3 C4 C#4 Eb4 F4 F#4 F4 Eb4 C#4 C4 Bb4 Ab4

Raw MIDI Data:

53 55 56 58 58 58 58 65 63 63 63 56 58 59 59 59 63 63 63 65 67 58 58 60 61 61 61 61 68 67 65 63 60 60 63 61 60 59 60 65 60 58 56 56 56 56 66 66 66 58 61 65 63 54 54 54 65 65 65 65 56 60 63 61 61 61 64 64 64 63 64 66 68 68 63 66 64 59 60 60 64 62 60 64 66 67 68 57 57 57 57 56 56 54 52 51 59 58 58 58 59 61 63 56 58 59 59 58 63 63 63 63 56 58 59 66 64 63 61 59 56 56 56 64 63 61 61 60 63 56 60 61 63 65 66 65 63 61 60 70 68

"True Tessitura" Data:

-11 -09 -08 -06 -06 -06 -06 00 -01 -01 -01 -08 -06 -05 -05 -05 -01 -01 -01 00 +02 -06 -06 -04 -03 -03 -03 -03 +03 +02 00 -01 -04 -04 -01 -03 -04 -05 -04 00 -04 -06 -08 -08 -08 -08 +01 +01 +01 -06 -03 00 -01 -10 -10 -10 00 00 00 00 -08 -04 -01 -03 -03 -03 00 00 00 -01 00 +01 +03 +03 -01 +01 00 -05 -04 -04 00 -02 -04 00 +01 +02 +03 -07 -07 -07 -07 -08 -08 -10 -12 -13 -05 -06 -06 -06 -05 -03 -01 -08 -06 -05 -05 -06 -01 -01 -01 -01 -08 -06 -05 +01 00 -01 -03 -05 -08 -08 -08 00 -01 -03 -03 -04 -01 -08 -04 -03 -01 00 +01 00 -01 -03 -04 +05 +03

"It is a curious story" [Prologue] - *The Turn of the Screw*, Benjamin Britten

Note Input:

G3 G3 G3 D4 E4 E4 A3 E4 E4 E4 D4 C#4 B3 C#4 D4 G3 G3 D4 G3 G3 F#3 G#3 A3 B3 C#4 D3 F#4 E4 A3 E4 D4 D4 D4 D4 D4 D4 D4 D4 D4 E4 D4 C#4 B3 A3 B3 C#4 D4 G3 G3 B3 G3 C#4 A3 D4 E4 A3 F4 E4 D4 C4 B3 A3 G3 C4 C4 C4 G4 F4 G3 A3 F4 E4 C4 A3 A3 B3 C4 D4 G3 G3 C4 C4 A3 B3 C4 C4 F3 G3 Ab3 Eb3 Eb3 Bb3 F3 F3 G3 Ab3 Bb3 G3 Bb3 Bb3 C4 Db3 Bb3 Bb3 Eb4 Eb4 Eb4 Eb4 Ab3 Bb3 D#4 D#4 D#4 D#4 D#4 C#4 D#4 A#3 A#3 A#3 B3 C#4 D#4 F#3 D#4 A#3 B3 B3 E4 D#4 B3 D#4 D#4 B3 D#4 E4 B3 B3 F#4 F#4 B3 B3 B3 E4 E4 F#3 F#3 F#3 C#4 C#4 C#4 C#4 C#4 C#4 C#4 C#4 C#4 C#4 C#4 C#4 C#4 C#4 C#4 C#4 C#4 C#4 C#4 Db4 Db4 Db4 Db4 Db4 Db4 Db4 Db4 Db4 Db4 Eb4 Eb4 Eb4 F4 Db4 Db4 B3 B3 B3 C4

G3 G3 B3 C4 C4 G3 G3 G3 B3 B3 D4 C4 G3 E4 E4 D4 C#4 E4 B3 A3 E4 G4 F#4 E4 D4 C#4 B3 A3 G3 E4 E4 G3 G3 G3 E4 G3 G3 G3

Raw MIDI Data:

55 55 55 62 64 64 57 64 64 64 62 61 59 61 62 55 55 62 55 55 54 56 57 59 61 50 66 64 57 64 62 62 62 62 62 62 62 62 62 62 64 62 61 59 57 59 61 62 55 55 59 55 61 57 62 64 57 65 64 62 60 59 57 55 60 60 60 67 65 55 57 65 64 60 57 57 59 60 62 55 55 60 60 57 59 60 60 53 55 56 51 51 58 53 53 55 56 58 55 58 58 60 49 58 58 63 63 63 63 56 58 63 63 63 63 63 61 63 58 58 58 59 61 63 54 63 58 59 59 64 63 59 63 63 59 63 64 59 59 66 66 59 59 59 64 64 54 54 54 61 61 61 61 61 61 61 61 61 61 61 61 61 61 61 61 61 61 61 61 61 61 61 61 61 61 61 61 61 61 61 61 63 63 63 65 61 61 59 59 59 60 55 55 59 60 60 55 55 55 59 59 62 60 55 64 64 62 61 64 59 57 64 67 66 64 62 61 59 57 55 64 64 55 55 55 64 55 55 55

“True Tessitura” Data:

-09 -09 -09 -02 00 00 -07 00 00 00 -02 -03 -05 -03 -02 -09 -09 -02 -09 -09 -10 -08 -07 -05 -03 -14 +01 00 -07 00 -02 -02 -02 -02 -02 -02 -02 -02 -02 00 -02 -03 -05 -07 -05 -03 -02 -09 -09 -05 -09 -03 -07 -02 00 -07 00 00 -02 -04 -05 -07 -09 -04 -04 -04 +02 00 -09 -07 00 00 -04 -07 -07 -05 -04 -02 -09 -09 -04 -04 -07 -05 -04 -04 -11 -09 -08 -13 -13 -06 -11 -11 -09 -08 -06 -09 -06 -06 -04 -15 -06 -06 -01 -01 -01 -01 -08 -06 -01 -01 -01 -01 -01 -03 -01 -06 -06 -06 -05 -03 -01 -10 -01 -06 -05 -05 00 -01 -05 -01 -01 -05 -01 00 -05 -05 +01 +01 -05 -05 -05 00 00 -10 -10 -10 -03 -03 -03 -03 -03 -03 -03 -03 -03 -03 -03 -03 -03 -03 -03 -03 -03 -03 -03 -03 -03 -03 -03 -03 -03 -03 -03 -03 -03 -03 -03 -03 -03 -01 -01 -01 00 -03 -03 -05 -05 -05 -04 -09 -09 -05 -04 -04 -09 -09 -09 -05 -05 -02 -04 -09 00 00 -02 -03 00 -05 -07 00 +02 +01 00 -02 -03 -05 -07 -09 00 00 -09 -09 -09 00 -09 -09 -09

“Dies Bildnis ist bezaubernd schön” - *Die Zauberflöte*, Wolfgang Amadeus Mozart

Note Input:

Bb3 G4 F4 Eb4 D4 C4 Bb3 Ab3 Ab3 F4 Eb4 D4 C4 Bb3 Ab3 G3 B3 C4 Eb4 A3 Bb3 Bb3 Bb3 Ab4 F4 D4 Bb3 Eb4 F4 Eb4 D4 C4 Bb3 Bb3 C4 D4 Eb4 Bb3 G4 F4 Ab4 F4 Eb4 Eb4 Eb4 G4 F4 Eb4 F4 F4 Eb4 D4 C4 C4 D4 Eb4 Db4 D4 Eb4 G4 F4 Eb4 D4 C4 D4 Eb4 Db4 D4 Bb3 Bb3 Bb3 Bb3 D4 D4 F4 F4 E4 E4 G4 Bb3 Bb3 Bb3 C4 Bb3 A3 Bb3 D4 C4 C4 C4 F4 G4 G4 Bb3 Bb3 Bb3 C4 Bb3 Bb3 F4 Eb4 Bb3 F4 Eb4 Bb3 Eb4 F4 G4 F3 G3 A3 Bb3 Bb3 C4 D4 Eb4 F4 G4 Ab4 F4 D4 Bb3 Bb3 C4 D4 Eb4 F4 G4 F4 D4 C4 C4 F4 F4 Bb3 Eb4 Eb4 Gb4 Eb4 D4 C4 F4 Ab3 Ab3 C4 D4 F4 Eb4 Bb3 C4 D4 F4 Eb4 Eb4 Bb3 C4 D4 Eb4 Bb3 G4 Ab4 F4 Eb4 D4 Eb4 Db4 Db4 Db4 C4 D4 E4 F4 G4 Ab4 D4 Bb3 F4 Eb4 D4 C4 Bb3 Bb3 Bb3 C4 D4 Eb4 Bb3 G4 F4 Ab4 F4 Eb4 Eb4 D4 G4 Eb4 Eb4 C4 Bb3 Eb4 G3 Bb3 Bb3 Ab3 G3 F3 G4 Eb4 F4 Eb4 Bb3 Eb4 G4 G4 F4 Eb4 D4 Eb4

Raw MIDI Data:

58 67 65 63 62 60 58 56 56 65 63 62 60 58 56 55 59 60 63 57 58 58 58 68 65 62 58 63 65 63 62 60 58 58 60 62 63 58 67 65 68 65 63 63 63 67 65 63 65 65 63 62 60 60 62 63 61 62 63 67 65 63 62 60 62 63 61 62 58 58 58 58 62 62 65 65 64 64 67 58 58 58 60 58 57 58 62 60 60 60 65 67 67 58 58 58 60 58 58 65 63 58 65 63 58 63 65 67 53 55 57 58 58 60 62 63 65 67 68 65 62 58 58 60 62 63 65 67 65 62 60 60 65 65 58 63 63 66 63 62 60 65 56 56 60 62 65 63 58 60 62 65 63 63 58 60 62 63 58 67 68 65 63 62 63 61 61 61 60 62 64 65 67 68 62 58 65 63 62 60 58 58 58 60 62 63 58 67 65 68 65 63 63 62 67 63 63 60 58 63 55 58 58 56 55 53 67 63 65 63 58 63 67 67 65 63 62 63

“True Tessitura” Data:

-06 +02 00 -01 -02 -04 -06 -08 -08 00 -01 -02 -04 -06 -08 -09 -05 -04 -01 -07 -06 -06 -06 +03 00 -02 -06 -01 00 -01 -02 -04 -06 -06 -04 -02 -01 -06 +02 00 +03 00 -01 -01 -01 +02 00 -01 00 00 -01 -02 -04 -04 -02 -01 -03 -02 -01 +02 00 -01 -02 -04 -02 -01 -03 -02 -06 -06 -06 -06 -02 -02 00 00 00 00 +02 -06 -06 -06 -04 -06 -07 -06 -02 -04 -04 -04 00 +02 +02 -06 -06 -06 -04 -06 -06 00 -01 -06 00 -01 -06 -01 00 +02 -11 -09 -07 -06 -06 -04 -02 -01 00 +02 +03 00 -02 -06 -06 -04 -02 -01 00 +02 00 -02 -04 -04 00 00 -06 -01 -01 +01 -01 -02 -04 00 -08 -08 -04 -02 00 -01 -06 -04 -02 00 -01 -01 -06 -04 -02 -01 -06 +02 +03 00 -01 -02 -01 -03 -03 -03 -04 -02 00 00 +02 +03 -02 -06 00 -01 -02 -04 -06 -06 -06 -04 -02 -01 -06 +02 00 +03 00 -01 -01 -02 +02 -01 -01 -04 -06 -01 -09 -06 -06 -08 -09 -11 +02 -01 00 -01 -06 -01 +02 +02 00 -01 -02 -01

“Ah, mes amis/Pour mon âme" - *La fille du régiment*, Gaetano Donizetti

Note Input:

Bb3 C4 D4 Eb4 F4 D4 Eb4 F4 D4 Eb4 Bb3 G3 Ab3 A3 Bb3 C4 Eb4 F4 Bb3 D4 Eb4 F4 G4 E4 F4 G4 E4 F4 Bb3 A3 Bb3 C4 Eb4 F4 Gb4 G4 G3 Eb4 Eb4 D4 C4 D4 Eb4 C4 G3 Eb4 C4 F4 F4 G4 A3 Eb4 C4 F4 Bb3 C4 D4 C4 Bb3 C4 D4 C4 Bb3 D4 D4 C4 Eb4 F4 Eb4 D4 F4 G4 F4 Eb4 G4 Ab4 G4 F4 Bb3 Eb4 Eb4 Eb4 Eb4 Eb4 Gb4 Db4 Eb4 Db4 B3 B3 B3 B3 B3 Eb4 Bb3 Eb4 Eb4 Eb4 Eb4 Eb4 Eb4 Gb4 Gb4 E4 Eb4 Db4 B3 A3 A3 Bb3 Bb4 Bb3 D4 Eb4 F4 D4 Eb4 F4 D4 Eb4 Bb3 G3 Ab3 A3 Bb3 C4 D4 Eb4 Bb3 D4 Eb4 F4 G4 E4 F4 G4 E4 F4 Bb3 A3 Bb3 C4 D4 Eb4 Gb4 G4 F4 G4 Ab4 Eb4 Eb4 F4 D4 G4 F4 G4 Ab4 Bb3 Bb3 D4 Bb3 D4 F4 Eb4 D4 Bb3 D4 F4 Ab4 Bb3 G4 F4 Eb4 G4 F4 E4 F4 D4 F4 Eb4 D4 C4 Bb3 G4 F4 E4 F4 F4 D4 F4 A4 G4 F4 Eb4 D4 C4 C4 D4 C4 D4 D4 Eb4 G4 F4 F4 Eb4 D4 F4 C4 Db4 C4 Db4 D4 Eb4 Eb4 F4 Gb4 F4 F4 Eb4 Db4 C4 C4 C4 D4 D4 Eb4 E4 G4 F4 E4 F4 F4 D4 F4 Ab4 G4 F4 F4 A4 G4 F4 Eb4 G4 F4 Eb4 D4 F4 Eb4 D4 C4 Bb3 A3 F4 E4 C4 C5 C5 A4 F4 E4 D4 C4 Bb3 G3 D4 C4 C4

C5 C5 A4 E4 D4 C4 Bb3 G3 C4 A3 F4 G4 Ab4 C4 F4 Eb4 Bb3 C4 Ab3 F4 C4 C4 E4 F4 G4 D4 E4 F4 C4 C5 C5 A4 F4 E4 D4 Bb3 G3 D4 C4 C4 C5 C5 A4 F4 E4 D4 C4 Bb3 G3 C4 F4 E4 D4 E4 D4 C4 B3 C4 E4 Eb4 E4 F4 F4 E4 D4 E4 D4 C4 B3 C4 E4 Eb4 E4 F4 C4 C4 C5 F4

Raw MIDI Data:

58 60 62 63 65 62 63 65 62 63 58 55 56 57 58 60 63 65 58 62 63 65 67 64 65 67 64 65 58 57 58 60 63 65 66 67 55 63 63 62 60 62 63 60 55 63 60 65 65 67 57 63 60 65 58 60 62 60 58 60 62 60 58 62 62 60 63 65 63 62 65 67 65 63 67 68 67 65 58 63 63 63 63 63 66 61 63 61 59 59 59 59 59 63 58 63 63 63 63 63 63 66 66 64 63 61 59 57 57 58 70 58 62 63 65 62 63 65 62 63 58 55 56 57 58 60 62 63 58 62 63 65 67 64 65 67 64 65 58 57 58 60 62 63 66 67 65 67 68 63 63 65 62 67 65 67 68 58 58 62 58 62 65 63 62 58 62 65 68 58 67 65 63 67 65 64 65 62 65 63 62 60 58 67 65 64 65 65 62 65 69 67 65 63 62 60 60 62 60 62 62 63 67 65 65 63 62 65 60 61 60 61 62 63 63 65 66 65 65 63 61 60 60 60 62 62 63 64 67 65 64 65 65 62 65 68 67 65 65 69 67 65 63 67 65 63 62 65 63 62 60 58 57 65 64 60 72 72 69 65 64 62 60 58 55 62 60 60 72 72 69 64 62 60 58 55 60 57 65 67 68 60 65 63 58 60 56 65 60 60 64 65 67 62 64 65 60 72 72 69 65 64 62 58 55 62 60 60 72 72 69 65 64 62 60 58 55 60 65 64 62 64 62 60 59 60 64 63 64 65 65 64 62 64 62 60 59 60 64 63 64 65 60 60 72 65

“True Tessitura” Data:

-06 -04 -02 -01 00 -02 -01 00 -02 -01 -06 -09 -08 -07 -06 -04 -01 00 -06 -02 -01 00 +02 00 00 +02 00 00 -06 -07 -06 -04 -01 00 +01 +02 -09 -01 -01 -02 -04 -02 -01 -04 -09 -01 -04 00 00 +02 -07 -01 -04 00 -06 -04 -02 -04 -06 -04 -02 -04 -06 -02 -02 -04 -01 00 -01 -02 00 +02 00 -01 +02 +03 +02 00 -06 -01 -01 -01 -01 -01 +01 -03 -01 -03 -05 -05 -05 -05 -05 -01 -06 -01 -01 -01 -01 -01 -01 +01 +01 00 -01 -03 -05 -07 -07 -06 +05 -06 -02 -01 00 -02 -01 00 -02 -01 -06 -09 -08 -07 -06 -04 -02 -01 -06 -02 -01 00 +02 00 00 +02 00 00 -06 -07 -06 -04 -02 -01 +01 +02 00 +02 +03

-01 -01 00 -02 +02 00 +02 +03 -06 -06 -02 -06 -02 00 -01 -02 -06 -02 00 +03 -06 +02 00 -01 +02 00 00 00 -02 00 -01 -02 -04 -06 +02 00 00 00 00 -02 00 +04 +02 00 -01 -02 -04 -04 -02 -04 -02 -02 -01 +02 00 00 -01 -02 00 -04 -03 -04 -03 -02 -01 -01 00 +01 00 00 -01 -03 -04 -04 -04 -02 -02 -01 00 +02 00 00 00 00 -02 00 +03 +02 00 00 +04 +02 00 -01 +02 00 -01 -02 00 -01 -02 -04 -06 -07 00 00 -04 +07 +07 +04 00 00 -02 -04 -06 -09 -02 -04 -04 +07 +07 +04 00 -02 -04 -06 -09 -04 -07 00 +02 +03 -04 00 -01 -06 -04 -08 00 -04 -04 00 00 +02 -02 00 00 -04 +07 +07 +04 00 00 -02 -06 -09 -02 -04 -04 +07 +07 +04 00 00 -02 -04 -06 -09 -04 00 00 -02 00 -02 -04 -05 -04 00 -01 00 00 00 00 -02 00 -02 -04 -05 -04 00 -01 00 00 -04 -04 +07 00

"En ferment les yeux" - *Manon*, Jules Massenet

Note Input:

B3 A3 A3 B3 B3 D4 D4 C#4 D4 E4 F#4 E4 D4 C#4 C#4 B3 D4 C#4 B3 A3 G#3 G#3 F#3 G#3 A3 B3 C#4 D4 G#4 F#4 A3 B3 C#4 C#4 A3 E4 E4 C#4 A3 A3 A3 A3 A3 A3 A3 A3 A3 A3 A3 A3 A3 A3 A3 A3 A3 A3 A3 A3 A3 A3 C#4 C#4 E4 A3 A3 A3 A3 A3 C#4 B3 B3 A3 A3 A3 B3 D4 A3 F#3 A3 E3 A3 A3 B3 C#4 F#4 E4 D4 A3 A3 B3 D4 A3 F#3 A3 E3 A3 F#3 A3 A3 D4 B3 D4 C#4 F#4 E4 B3 E4 D4 C#4 B3 A3 B3 D4 C#4 F#4 E4 B3 E4 B3 E4 C#4 E4 G4 B3 C#4 D4 E4 F#4 B3 E4 D4 A3 B3 D4 A3 G4 F#4 F#4 E4 D4 A3 Bb3 G3 D4 A3 D4 D4 C#4 D4 C#4 C#4 B3 C#4 D4 A4 G4 A3 A3 A3 D4 A3 B3 D4 A3 A3 A3 A3 B3 D4 F#4 E4 D4 D4

Raw MIDI Data:

59 57 57 59 59 62 62 61 62 64 66 64 62 61 61 59 62 61 59 57 56 56 54 56 57 59 61 62 68 66 57 59 61 61 57 64 64 61 57 57 57 57 57 57 57 57 57 57 57 57 57 57 57 57 57 57 57 61 61 64 57 57 57 57 57 61 59 59 57 57 57 59 62 57 54 57 52 57 57 59 61 66 64 62 57 57 59 62 57 54 57 52 57 54 57 57 62 59 62 61 66 64 59 64 62 61 59 57 59 62 61 66 64 59 64 59 64 61 64 67 59 61 62 64 66

59 64 62 57 59 62 57 67 66 66 64 62 57 58 55 62 57 62 62 61 62 61 61 59 61 62 69 67 57 57 57 62 57 59 62 57 57 57 57 59 62 66 64 62 62

"True Tessitura" Data:

-05 -07 -07 -05 -05 -02 -02 -03 -02 00 +01 00 -02 -03 -03 -05 -02 -03 -05 -07 -08 -08 -10 -08 -07 -05 -03 -02 +03 +01 -07 -05 -03 -03 -07 00 00 -03 -07 -07 -07 -07 -07 -07 -07 -07 -07 -07 -07 -07 -07 -07 -07 -07 -07 -07 -07 -07 -07 -07 -03 -03 00 -07 -07 -07 -07 -07 -03 -05 -05 -07 -07 -07 -05 -02 -07 -10 -07 52 -07 -07 -05 -03 +01 00 -02 -07 -07 -05 -02 -07 -10 -07 52 -07 -10 -07 -07 -02 -05 -02 -03 +01 00 -05 00 -02 -03 -05 -07 -05 -02 -03 +01 00 -05 00 -05 00 -03 00 +02 -05 -03 -02 00 +01 -05 00 -02 -07 -05 -02 -07 +02 +01 +01 00 -02 -07 -06 -09 -02 -07 -02 -02 -03 -02 -03 -03 -05 -03 -02 +04 +02 -07 -07 -07 -02 -07 -05 -02 -07 -07 -07 -07 -05 -02 +01 00 -02 -02

"Kuda, kuda vï udalilis" - *Eugene Onegin*, Pyotr Il'yich Tchaikovsky

Note Input:

B3 C4 E4 B3 B3 A3 B3 C4 E4 B3 B3 B3 B3 A#3 A#3 A#3 F#4 F#4 G4 F#4 E4 D4 C4 B3 A#3 C4 B3 B3 F#4 E4 D#4 E4 B3 D4 C4 A3 G#3 A3 B3 C4 C4 F#3 F#3 A3 B3 C4 D4 E4 C#4 D#4 B3 G4 F#4 E4 D4 C4 B3 A#3 C4 B3 B3 F#4 E4 A#3 E4 D4 C4 A3 D4 E3 B3 A#3 G3 A#3 B3 B3 D4 C4 B3 B3 F#4 F#4 E4 E4 F#4 G4 F#4 E4 D4 C4 B3 A3 B3 C4 B3 E3 F#3 E3 D4 E4 B3 D4 D4 E4 A3 D4 D4 D4 E4 B3 D4 D4 A3 D4 B3 B3 D4 B3 B3 A3 A3 G3 G3 G3 G3 G3 E3 E3 B3 F#3 F#3 F#3 G#3 G#3 C#4 A#3 F#3 F#3 B3 B3 B3 B3 B3 B3 D#4 B3 B3 F#4 D4 C4 B3 B3 B3 C4 A3 G3 F#3 B3 D#4 F#4 F#4 E4 D4 C4 B3 A#3 C4 B3 B3 F#4 E4 D#4 E4 A#3 B3 D4 A3 A3 A3 G#3 A3 B3 C4 C4 F#3 A3 A3 A3 B3 C4 D4 E4 C#4 C#4 C#4 D#4 D#4 E4 A3 B3 B3 B3 G4 F#4 E4 D4 C4 B3 C4 B3 B3 G#4 F#4 F4 D4 C#4 G3 G#3 B3 A3 A3 B3 C4 F#3 A3 C4 F#3 F#3 F#3 C4 A3 A3 A3 B3 C4 D#3 F#3 C4 B3 F#3 E4 D4 A3 D4 G4 F#4 C#4 D#4 G#4

G#4 G4 G4 F#4 D#4 B3 D#4 F#4 F4 E4 C#4 A#3 C#4 E4 E4 E4 B3 E4 E4 A#3 E4 F#4 G4 E4 D4 C4 B3 A3 B3 C4 B3 E3 G3 F#3 E3 E3 F3 F3 F#3 G3 F#3 E3 G3 B3 B3 B3 C4 A3 B3 B3 E4 C4 A3 C4 E4 B3

Raw MIDI Data:

59 60 64 59 59 57 59 60 64 59 59 59 59 58 58 58 66 66 67 66 64 62 60 59 58 60 59 59 66 64 63 64 59 62 60 57 56 57 59 60 60 54 54 57 59 60 62 64 61 63 59 67 66 64 62 60 59 58 60 59 59 66 64 58 64 62 60 57 62 52 59 58 55 58 59 59 62 60 59 59 66 66 64 64 66 67 66 64 62 60 59 57 59 60 59 52 54 52 62 64 59 62 62 64 57 62 62 62 64 59 62 62 57 62 59 59 62 59 59 57 57 55 55 55 55 55 52 52 59 54 54 54 56 56 61 58 54 54 59 59 59 59 59 59 63 59 59 66 62 60 59 59 59 60 57 55 54 59 63 66 66 64 62 60 59 58 60 59 59 66 64 63 64 58 59 62 57 57 57 56 57 59 60 60 54 57 57 57 59 60 62 64 61 61 61 63 63 64 57 59 59 59 67 66 64 62 60 59 60 59 59 68 66 65 62 61 55 56 59 57 57 59 60 54 57 60 54 54 54 60 57 57 57 59 60 51 54 60 59 54 64 62 57 62 67 66 61 63 68 68 67 67 66 63 59 63 66 65 64 61 58 61 64 64 64 59 64 64 58 64 66 67 64 62 60 59 57 59 60 59 52 55 54 52 52 53 53 54 55 54 52 55 59 59 59 60 57 59 59 64 60 57 60 64 59

“True Tessitura” Data:

-05 -04 00 -05 -05 -07 -05 -04 00 -05 -05 -05 -05 -06 -06 -06 +01 +01 +02 +01 00 -02 -04 -05 -06 -04 -05 -05 +01 00 -01 00 -05 -02 -04 -07 -08 -07 -05 -04 -04 -10 -10 -07 -05 -04 -02 00 -03 -01 -05 +02 +01 00 -02 -04 -05 -06 -04 -05 -05 +01 00 -06 00 -02 -04 -07 -02 -12 -05 -06 -09 -06 -05 -05 -02 -04 -05 -05 +01 +01 00 00 +01 +02 +01 00 -02 -04 -05 -07 -05 -04 -05 -12 -10 -12 -02 00 -05 -02 -02 00 -07 -02 -02 -02 00 -05 -02 -02 -07 -02 -05 -05 -02 -05 -05 -07 -07 -09 -09 -09 -09 -09 -12 -12 -05 -10 -10 -10 -08 -08 -03 -06 -10 -10 -05 -05 -05 -05 -05 -05 -01 -05 -05 +01 -02 -04 -05 -05 -05 -04 -07 -09 -10 -05 -01 +01 +01 00 -02 -04 -05 -06 -04 -05 -05 +01 00 -01 00 -06 -05 -02 -07 -07 -07 -08 -07 -05 -04 -04 -10 -07 -07 -07 -05 -04 -02 00 -03 -03 -03 -01 -

01 00 -07 -05 -05 -05 +02 +01 00 -02 -04 -05 -04 -05 -05 +03 +01 00 -02 -03 -09 -08 -05 -07 -07 -05 -04 -10 -07 -04 -10 -10 -10 -04 -07 -07 -07 -05 -04 -15 -10 -04 -05 -10 00 -02 -07 -02 +02 +01 -03 -01 +03 +03 +02 +02 +01 -01 -05 -01 +01 00 00 -03 -06 -03 00 00 00 -05 00 00 -06 00 +01 +02 00 -02 -04 -05 -07 -05 -04 -05 -12 -09 -10 -12 -12 -11 -11 -10 -09 -10 -12 -09 -05 -05 -05 -04 -07 -05 -05 00 -04 -07 -04 00 -05

"Ach, so Fromm"/"M'apparì tutt'amor" - *Martha*, Friedrich Flotow

Note Input:

A3 C4 D4 C4 A3 C4 F4 G4 F4 F4 E4 G4 D4 C4 E4 Bb3 D4 C4 C4 A3 C4 D4 C4 A3 C4 F4 G4 F4 E4 A3 A3 E4 E4 D4 D4 C4 Bb3 Bb3 C4 D4 D4 E4 F4 C4 A3 D4 C4 D4 Bb3 Bb3 C4 D4 D4 E4 F4 C4 A3 D4 C4 F4 E4 F4 F4 F4 Eb4 E4 F4 C4 Db4 Bb3 Ab3 Eb4 E4 F4 F4 F4 G4 G4 F4 E4 G4 F4 A3 C4 E4 D4 G3 G#3 A3 C4 D4 C4 A3 C4 F4 G4 F4 E4 G4 D4 C4 E4 Bb3 A3 D4 C4 C4 A3 C4 D4 C4 A3 F4 G4 F4 E4 D4 C4 B3 Bb3 G3 F3 F4 G4 F4 E4 D4 G3 C4 B3 Bb3 F4 F4 A3 C4 Bb3 A3 F4 A4 G4 F4 E4 D4 F4 D4 C4 F4 F4 F4 F4 F4 F4 A4 G4 F4 E4 D4 C4 Bb4 E4 F4

Raw MIDI Data:

57 60 62 60 57 60 65 67 65 65 64 67 62 60 64 58 62 60 60 57 60 62 60 57 60 65 67 65 64 57 57 64 64 62 62 60 58 58 60 62 62 64 65 60 57 62 60 62 58 58 60 62 62 64 65 60 57 62 60 65 64 65 65 65 63 64 65 60 61 58 56 63 64 65 65 65 67 67 65 64 67 65 57 60 64 62 55 56 57 60 62 60 57 60 65 67 65 64 67 62 60 64 58 57 62 60 60 57 60 62 60 57 65 67 65 64 62 60 59 58 55 53 65 67 65 64 62 55 60 59 58 65 65 57 60 58 57 65 69 67 65 64 62 65 62 60 65 65 65 65 65 65 69 67 65 64 62 60 70 64 65

"True Tessitura" Data:

-07 -04 -02 -04 -07 -04 00 +02 00 00 00 +02 -02 -04 00 -06 -02 -04 -04 -07 -04 -02 -04 -07 -04 00 +02 00 00 -07 -07 00 00 -02 -02 -04 -06 -06 -04 -02 -02 00 00 -04 -07 -02 -04 -02 -06 -06 -04 -02 -02 00 00 -04 -07 -02 -04 00 00 00 00 00 -01 00 00 -04 -03 -06 -08 -01 00 00 00 00 +02 +02 00 00 +02 00 -07 -04 00 -02 -09 -08 -07 -04 -02 -04 -07 -04 00 +02 00 00 +02 -02 -04 00 -06 -07 -02 -04 -04 -07 -04 -02 -04 -07 00 +02 00 00 -02 -04 -05 -06 -09 -11 00 +02 00 00 -02 -09 -04 -05 -06 00 00 -07 -04 -06 -07 00 +04 +02 00 00 -02 00 -02 -04 00 00 00 00 00 00 +04 +02 00 00 -02 -04 +05 00 00

"Che gelida manina" - *La Bohème*, Giacomo Puccini

Note Input:

Ab3 Ab3 Ab3 Ab3 Ab3 Ab3 Ab3 Ab3 Ab3 Eb4 Eb4 Db4 C4 Bb3 Ab4 F4 F#4 F#4 Ab3 Eb4 Eb4 Db4 C4 Bb3 Bb3 Db4 Eb4 F4 Eb4 Eb4 Eb4 Eb4 C4 Bb3 Eb4 Eb4 F4 G4 Ab4 Ab4 G4 F4 Eb4 Eb4 Bb3 Db4 C4 Bb3 Ab3 Ab3 Ab3 Ab3 Ab3 Ab3 Ab3 Ab3 Ab3 Eb4 Eb4 Db4 C4 Bb3 Bb3 Ab4 Db4 Bb4 Ab4 Eb4 Ab4 F4 Eb4 Db4 C4 Db4 F4 Bb3 Eb4 Ab3 Ab3 Ab3 F4 G3 A3 Bb3 C4 C4 C4 C4 C4 D4 A3 C4 C4 C4 C4 F4 C4 Eb4 Eb4 Eb4 Db4 Db4 Db4 Ab3 C4 C4 Bb3 Bb3 D4 F4 Bb3 Ab3 Ab3 Ab3 C4 Eb4 C4 Ab3 G3 G3 G3 G3 G3 F3 F3 G3 C4 Eb4 G4 Eb4 D4 C4 Eb4 C4 C4 D4 Eb4 G4 F4 Bb3 Eb4 Eb4 Ab4 F4 Ab4 G4 F4 Eb4 Bb3 Bb3 Bb3 C4 D4 Db4 C4 Bb3 Ab3 G3 F3 Ab3 C4 Bb3 Eb3 Eb4 Eb4 C4 Bb3 Ab3 Db4 Db4 C4 C4 C4 Ab3 F3 Bb3 Eb4 G4 G4 F4 G4 G4 C4 C4 Eb4 Eb4 F4 D4 Eb4 C4 C4 Eb4 Eb4 C4 Ab3 Ab3 F4 Eb4 Bb3 Bb3 Bb3 C4 Db4 C4 C4 F4 G4 C5 Bb4 Eb4 Eb4 Eb4 Eb4 Db4 C4 Eb4 Eb4 Eb4 Eb4 C4 Eb4 Eb4 Eb4 Eb4 Db4 C4 Eb4 F3 Eb4 Eb4 Db4 C4 Eb4

Raw MIDI Data:

56 56 56 56 56 56 56 56 56 63 63 61 60 58 68 65 66 66 56 63 63 61 60 58 58 61 63 65 63 63 63 63 60 58 63 63 65 67 68 68 67 65 63 63 58 61 60 58 56 56 56 56 56 56 56 56 56 63 63 61 60 58 58 68 61 70 68 63 68 65 63 61 60 61 65 58 63 56 56 56 65 55 57 58 60 60 60 60 60 62 57 60 60 60 60 65 60 63 63 63 61 61 61 56 60 60 58 58 62 65 58 56 56 56 60 63 60 56 55 55 55 55 55 53 53 55 60 63 67 63 62 60 63 60 60 62 63 67 65 58 63 63 68 65 68 67 65 63 58 58 58 60 62 61 60 58 56 55 53 56 60 58 51 63 63 60 58 56 61 61 60 60 60 56 53 58 63 67 67 65 67 67 60 60 63 63 65 62 63 60 60 63 63 60 56 56 65 63 58 58 58 60 61 60 60 65 67 72 70 63 63 63 63 61 60 63 63 63 63 60 63 63 63 63 61 60 63 53 63 63 61 60 63

"True Tessitura" Data:

-08 -08 -08 -08 -08 -08 -08 -08 -08 -01 -01 -03 -04 -06 +03 00 +01 +01 -08 -01 -01 -03 -04 -06 -06 -03 -01 00 -01 -01 -01 -01 -04 -06 -01 -01 00 +02 +03 +03 +02 00 -01 -01 -06 -03 -04 -06 -08 -08 -08 -08 -08 -08 -08 -08 -08 -01 -01 -03 -04 -06 -06 +03 -03 +05 +03 -01 +03 00 -01 -03 -04 -03 00 -06 -01 -08 -08 -08 00 -09 -07 -06 -04 -04 -04 -04 -04 -02 -07 -04 -04 -04 -04 00 -04 -01 -01 -01 -03 -03 -03 -08 -04 -04 -06 -06 -02 00 -06 -08 -08 -08 -04 -01 -04 -08 -09 -09 -09 -09 -09 -11 -11 -09 -04 -01 +02 -01 -02 -04 -01 -04 -04 -02 -01 +02 00 -06 -01 -01 +03 00 +03 +02 00 -01 -06 -06 -06 -04 -02 -03 -04 -06 -08 -09 -11 -08 -04 -06 -13 -01 -01 -04 -06 -08 -03 -03 -04 -04 -04 -08 -11 -06 -01 +02 +02 00 +02 +02 -04 -04 -01 -01 00 -02 -01 -04 -04 -01 -01 -04 -08 -08 00 -01 -06 -06 -06 -04 -03 -04 -04 00 +02 +07 +05 -01 -01 -01 -01 -03 -04 -01 -01 -01 -01 -04 -01 -01 -01 -01 -03 -04 -01 -11 -01 -01 -03 -04 -01

"Here I stand/Since it is not by merit" - *The Rake's Progress*, Igor Stravinsky

Note Input:

B3 C4 C4 C4 C4 C4 C4 E4 A3 A3 B3 G3 D4 B3 B3 B3 C4 C4 D4 G4 F4 E4 D4 C4 B3 C4 A3 G4 G3 G3 G3 A3 A3 A3 C4 C4 C4 C4 B3 B3 B3 G4 G3 A3 A3 A3 B3 B3 G4 G3 G3 G3 A3 A3 C4 C4 E4 D4 D4 D4 D4 D4 D4 D4 D4 D4 B3 G3 G3 G4 B3 B3 B3 B3 B3 B3 B3 B3 B3 B3 B3 B3 B3 C#4 C#4 C#4 C#4 A3 B3 B3 B3 B3 E4 C#4 Eb4 Eb4 Eb4 Eb4 Eb4 Eb4 F#4 A3 A3 A3 G#3 G#3 C4 F4 G3 G3 D4 D4 E3 A3 G3 F3 A3 Bb3 C4 A3 F3 C4 D4 Bb3 G3 C4 F4 Bb3 G3 C4 C4 B3 A3 G3 G3 A3 A3 F4 D4 B3 G3 E4 G4 A3 D4 E4 D4 C4 C4 D4 Eb4 C4 D4 C4 Bb3 D4 E4 F4 D4 G3 C4 Bb3 C4 E4 C4 F4 C4 A3 F4 E4 D4 G4 E4 C4 D4 C4 Bb3 C4 Bb3 Bb3 F4 F#3 F#4 Eb4 C4 A3 F3 A3 C4 Bb3 D4 Bb3 E4 A3 G3 E4 A3 F3 F#3 Eb4 C4 A3 D4 Bb3 A3 Bb3 A3 Bb3 A3 F3 C4 D4 Bb3 G3 A3 Bb3 C4 F4 Bb3 D4 G3 C4 C4 B3 G3 G3 A3 F4 E4 B3 G3 E4 G4 A3 F4 D4 E4 D4 C4 E4 G4 E4 E4 D4 C4 Bb3 A3 A3 C#4 E4 A3 F4 F4 Bb3 A3 G3 A3 G3 F3 D4 Bb3 G3 C4 A4 D4 D4 Bb3 G3 C4 F4

Raw MIDI Data:

59 60 60 60 60 60 60 64 57 57 59 55 62 59 59 59 60 60 62 67 65 64 62 60 59 60 57 67 55 55 55 57 57 57 60 60 60 60 59 59 59 67 55 57 57 57 59 59 67 55 55 55 57 57 60 60 64 62 62 62 62 62 62 62 62 62 62 59 55 55 67 59 59 59 59 59 59 59 59 59 59 59 59 61 61 61 61 57 59 59 59 59 64 61 63 63 63 63 63 63 66 57 57 57 56 56 60 65 55 55 62 62 52 57 55 53 57 58 60 57 53 60 62 58 55 60 65 58 55 60 60 59 57 55 55 57 57 65 62 59 55 64 67 57 62 64 62 60 60 62 63 60 62 60 58 62 64 65 62 55 60 58 60 64 60 65 60 57 65 64 62 67 64 60 62 60 58 60 58 58 65 54 66 63 60 57 53 57 60 58 62 58 64 57 55 64 57 53 54 63 60 57 62 58 57 58 57 58 57 53 60 62 58 55 57 58 60 65 58 62 55 60 60 59 55 55 57 65 64 59 55 64 67 57 65 62 64 62 60 64 67 64 64 62 60 58 57 57 61 64 57 65 65 58 57 55 57 55 53 62 58 55 60 69 62 62 58 55 60 65

“True Tessitura” Data:

-05 -04 -04 -04 -04 -04 -04 00 -07 -07 -05 -09 -02 -05 -05 -05 -04 -04 -02 +02 00 00 -02 -04 -05 -04 -07 +02 -09 -09 -09 -07 -07 -07 -04 -04 -04 -04 -05 -05 -05 +02 -09 -07 -07 -07 -05 -05 +02 -09 -09 -09 -07 -07 -04 -04 00 -02 -02 -02 -02 -02 -02 -02 -02 -02 -05 -09 -09 +02 -05 -05 -05 -05 -05 -05 -05 -05 -05 -05 -05 -05 -05 -03 -03 -03 -03 -07 -05 -05 -05 -05 00 -03 -01 -01 -01 -01 -01 -01 +01 -07 -07 -07 -08 -08 -04 00 -09 -09 -02 -02 -12 -07 -09 -11 -07 -06 -04 -07 -11 -04 -02 -06 -09 -04 00 -06 -09 -04 -04 -05 -07 -09 -09 -07 -07 00 -02 -05 -09 00 +02 -07 -02 00 -02 -04 -04 -02 -01 -04 -02 -04 -06 -02 00 00 -02 -09 -04 -06 -04 00 -04 00 -04 -07 00 00 -02 +02 00 -04 -02 -04 -06 -04 -06 -06 00 -10 +01 -01 -04 -07 -11 -07 -04 -06 -02 -06 00 -07 -09 00 -07 -11 -10 -01 -04 -07 -02 -06 -07 -06 -07 -06 -07 -11 -04 -02 -06 -09 -07 -06 -04 00 -06 -02 -09 -04 -04 -05 -09 -09 -07 00 00 -05 -09 00 +02 -07 00 -02 00 -02 -04 00 +02 00 00 -02 -04 -06 -07 -07 -03 00 -07 00 00 -06 -07 -09 -07 -09 -11 -02 -06 -09 -04 +04 -02 -02 -06 -09 -04 00

“E lucevan le stelle/Oh! dolci baci” - *Tosca*, Giacomo Puccini

Note Input:

F#3 F#3 F#3 F#3 F#3 F#3 F#3 B3 B3 B3 B3 B3 B3 B3 B3 B3 B3 B3 B3 C#4 C#4 B3 B3 B3 B3 B3 B3 B3 B3 B3 B3 B3 G3 G3 G3 G3 G3 G3 F#3 F#3 F#3 F#3 F#3 F#3 F#3 F#3 C#4 D4 E4 F#4 D4 C#4 F#3 B3 B3 B3 C#4 D4 G3 G3 G3 A3 B3 C#4 D4 E4 G4 A4 G4 E4 F#4 F#4 F#3 C#4 D4 E4 F#4 E4 D4 C#4 F#3 B3 B3 C#4 D4 G4 G4 G4 G4 G4 E4 C#4 F#4 F#4 E4 E4 E4 C#4 D4 D4 A3 E4 F4 G4 A4 G4 F4 E4 A3 D4 D4 C#4 C#4 F#3 B3

Raw MIDI Data:

54 54 54 54 54 54 54 59 59 59 59 59 59 59 59 59 59 59 59 61 61 59 59 59 59 59 59 59 59 59 55 55 55 55 55 55 55 54 54 54 54 54 54 54 54 61 62 64 66 62 61 54 59 59 59 61 62 55 55 55 57 59 61

62 64 67 69 67 64 66 66 54 61 62 64 66 64 62 61 54 59 59 61 62 67 67 67 67 67 64 61 66 66 64 64 64 61 62 62 57 64 65 67 69 67 65 64 57 62 62 61 61 54 59

"True Tessitura" Data:

-10 -10 -10 -10 -10 -10 -10 -05 -05 -05 -05 -05 -05 -05 -05 -05 -05 -05 -05 -03 -03 -05 -05 -05 -05 -05 -05 -05 -05 -05 -09 -09 -09 -09 -09 -09 -10 -10 -10 -10 -10 -10 -10 -10 -03 -02 00 +01 -02 -03 -10 -05 -05 -05 -03 -02 -09 -09 -09 -07 -05 -03 -02 00 +02 +04 +02 00 +01 +01 -10 -03 -02 00 +01 00 -02 -03 -10 -05 -05 -03 -02 +02 +02 +02 +02 +02 00 -03 +01 +01 00 00 00 -03 -02 -02 -07 00 00 +02 +04 +02 00 00 -07 -02 -02 -03 -03 -10 -05

"Fontainebleau! Forêt immense et solitaire/Je l'ai vue" - *Don Carlos*, Giuseppe Verdi

Note Input:

D4 D4 D4 D4 D4 D4 D4 F#4 D4 B3 Bb3 G#3 G3 D4 D4 Eb4 Bb3 Eb4 F4 G4 D4 Eb4 A3 C4 Bb3 A3 Bb3 Eb4 D4 C4 G#3 G#3 G#3 G#3 Bb3 B3 B3 B3 B3 B3 B3 Bb3 Bb3 Bb3 D4 F4 D4 Bb3 Bb3 Bb3 Bb3 Bb3 Bb3 Bb3 Bb3 Bb3 Bb3 B3 B3 B3 B3 B3 B3 B3 B3 B3 B3 B3 C4 C4 C4 C4 C4 C4 C4 C4 C4 C4 C4 C4 C#4 C#4 D4 Eb4 F#4 E4 D4 G3 E4 D4 C#4 C4 C4 B3 Bb3 B3 C4 B3 E4 E4 E4 D4 D4 C4 B3 D4 C4 A3 G#3 A3 E4 F4 F4 F4 F4 G4 F4 E4 C4 G3 C4 F4 E4 Eb4 E4 F4 B3 D4 C4 G4 F#4 F4 E4 E4 D4 D4 C4 B3 A3 B3 A3 G3 G3 C4 F4 E4 Eb4 E4 F4 E4 D4 E4 B3 A4 G4 F4 D4 D4 B3 A3 F#3 G3 A3 G3 D4 G3 C4 C4 E4 D4 C4 Bb3 A3 G#3 C4 B3 A3 F3 D4 F#4 E4 D4 C4 B3 Bb3 B3 D4 C4 B3 G3 F4 E4 Eb4 E4 F4 E4 D4 E4 B3 A4 G4 F4 D4 D4 C4 B3 F#3 G3 A3 G3 D4 G3 D4 C4 E4 D4 C4 F4 E4 E4 C#4 D4 E4 D4 C4 G3 G4 G#4 A4 G4 F4 E4 C#4 D4 F4 A3 B3 C4 D4 E4 A4 G4 F#4 F4 E4 D4 A3 B3 Bb3 B3 E4 D4 C4

Raw MIDI Data:

62 62 62 62 62 62 62 66 62 59 58 56 55 62 62 63 58 63 65 67 62 63 57 60 58 57 58 63 62 60 56 56 56 56 58 59 59 59 59 59 59 58 58 58 62 65 62 58 58 58 58 58 58 58 58 58 58 59 59 59 59 59 59 59 59 59 59 59 59 59 59 60 60 60 60 60 60 60 60 60 60 60 60 60 61 61 62 63 66 64 62 55 64 62 61 60 60 59 58 59 60 59 64 64 64 62 62 60 59 62 60 57 56 57 64 65 65 65 65 67 65 64 60 55 60 65 64 63 64 65 59 62 60 67 66 65 64 64 62 62 60 59 57 59 57 55 55 60 65 64 63 64 65 64 62 64 59 69 67 65 62 62 59 57 54 55 57 55 62 55 60 60 64 62 60 58 57 56 60 59 57 53 62 66 64 62 60 59 58 59 62 60 59 55 65 64 63 64 65 64 62 64 59 69 67 65 62 62 60 59 54 55 57 55 62 55 62 60 64 62 60 65 64 64 61 62 64 62 60 55 67 68 69 67 65 64 61 62 65 57 59 60 62 64 69 67 66 65 64 62 57 59 58 59 64 62 60

"True Tessitura Data":

-02 -02 -02 -02 -02 -02 -02 +01 -02 -05 -06 -08 -09 -02 -02 -01 -06 -01 00 +02 -02 -01 -07 -04 -06 -07 -06 -01 -02 -04 -08 -08 -08 -08 -06 -05 -05 -05 -05 -05 -05 -06 -06 -06 -02 00 -02 -06 -06 -06 -06 -06 -06 -06 -06 -06 -06 -05 -05 -05 -05 -05 -05 -05 -05 -05 -05 -05 -05 -04 -04 -04 -04 -04 -04 -04 -04 -04 -04 -04 -04 -04 -03 -03 -02 -01 +01 00 -02 -09 00 -02 -03 -04 -04 -05 -06 -05 -04 -05 00 00 00 -02 -02 -04 -05 -02 -04 -07 -08 -07 00 00 00 00 00 +02 00 00 -04 -09 -04 00 00 -01 00 00 -05 -02 -04 +02 +01 00 00 00 -02 -02 -04 -05 -07 -05 -07 -09 -09 -04 00 00 -01 00 00 00 -02 00 -05 +04 +02 00 -02 -02 -05 -07 -10 -09 -07 -09 -02 -09 -04 -04 00 -02 -04 -06 -07 -08 -04 -05 -07 -11 -02 +01 00 -02 -04 -05 -06 -05 -02 -04 -05 -09 00 00 -01 00 00 00 -02 00 -05 +04 +02 00 -02 -02 -04 -05 -10 -09 -07 -09 -02 -09 -02 -04 00 -02 -04 00 00 00 -03 -02 00 -02 -04 -09 +02 +03 +04 +02 00 00 -03 -02 00 -07 -05 -04 -02 00 +04 +02 +01 00 00 -02 -07 -05 -06 -05 00 -02 -04

"I know that you all hate me" - *The Saint of Bleecker Street*, Gian Carlo Menotti

Note Input:

Bb3 Bb3 A3 Ab3 G3 Eb4 D4 G3 Bb3 G4 F4 Eb4 C4 Ab3 G3 F3 C4 G3 G3 G3 Bb3 Bb3 A3 A3 Ab3 G3 Eb3 D3 Eb4 D4 D4 G3 G4 F4 Eb4 D4 C4 C4 C4 D4 D4 Eb4 C4 C4 D4 C4 D4 C4 G3 G3 C4 Bb3 C4 G3 G3 C4 D4 Eb4 D4 C4 Eb4 Bb3 Ab3 C4 G3 G3 F3 G3 Ab3 Bb3 C4 D4 C4 Ab3 Eb4 D4 D4 D4 C4 Bb3 D4 Eb4 F4 Eb4 D4 C4 D4 Eb4 Ab3 G3 C4 B3 C4 Eb4 C4 B3 C4 C4 C4 B3 C4 B3 C4 Eb4 C4 B3 C4 C4 F3 Db4 Db4 Db4 Eb4 E3 Db4 Db4 Db4 D4 Eb4 F#3 E4 E4 E4 E4 E4 Eb4 D4 Db4 F4 E4 C4 Ab3 F3 E4 E4 Eb4 D4 Db4 C4 F4 E4 C4 Ab3 F3 Ab3 B3 Ab3 B3 Bb3 Bb3 Ab3 Db4 Eb4 E4 Eb4 Eb4 Db4 E4 B3 A3 E4 Ab3 Ab3 F#3 Ab3 A3 B3 Db4 Eb4 Db4 A3 Eb4 D4 Db4 Ab3 Bb3 Db4 Eb4 E4 Eb4 Db4 F#4 E4 E4 Db4 Eb4 E4 F#4 G#4 A4 F#4 A3 Ab3 G3 G3 C4 D4 Eb4 D4 C4 Eb4 Bb3 Ab3 C4 Eb4 G3 G3 F3 Ab3 Bb3 C4 D4 C4 Ab3 Eb4 D4 D4 C4 D4 Eb4 F4 G#4 C5 G4 G4

Raw MIDI Data:

58 58 57 56 55 63 62 55 58 67 65 63 60 56 55 53 60 55 55 55 58 58 57 57 56 55 51 50 63 62 62 55 67 65 63 62 60 60 60 62 62 63 60 60 62 60 62 60 55 55 60 58 60 55 55 60 62 63 62 60 63 58 56 60 55 55 53 55 56 58 60 62 60 56 63 62 62 62 60 58 62 63 65 63 62 60 62 63 56 55 60 59 60 63 60 59 60 60 60 59 60 59 60 63 60 59 60 60 53 61 61 61 63 52 61 61 61 62 63 54 64 64 64 64 64 63 62 61 65 64 60 56 53 64 64 63 62 61 60 65 64 60 56 53 56 59 56 59 58 58 56 61 63 64 63 63 61 64 59 57 64 56 56 54 56 57 59 61 63 61 57 63 62 61 56 58 61 63 64 63 61 66 64 64 61 63 64 66 68 69 66 57 56 55 55 60 62 63 62 60 63 58 56 60 63 55 55 53 56 58 60 62 60 56 63 62 62 60 62 63 65 68 72 67 67

“True Tessitura” Data:

-06 -06 -07 -08 -09 -01 -02 -09 -06 +02 00 -01 -04 -08 -09 -11 -04 -09 -09 -09 -06 -06 -07 -07 -08 -09 -13 -14 -01 -02 -02 -09 +02 00 -01 -02 -04 -04 -04 -02 -02 -01 -04 -04 -02 -04 -02 -04 -09

-09 -04 -06 -04 -09 -09 -04 -02 -01 -02 -04 -01 -06 -08 -04 -09 -09 -11 -09 -08 -06 -04 -02 -04 -08 -01 -02 -02 -02 -04 -06 -02 -01 00 -01 -02 -04 -02 -01 -08 -09 -04 -05 -04 -01 -04 -05 -04 -04 -04 -05 -04 -05 -04 -01 -04 -05 -04 -04 -11 -03 -03 -03 -01 -12 -03 -03 -03 -02 -01 -10 00 00 00 00 00 -01 -02 -03 00 00 -04 -08 -11 00 00 -01 -02 -03 -04 00 00 -04 -08 -11 -08 -05 -08 -05 -06 -06 -08 -03 -01 00 -01 -01 -03 00 -05 -07 00 -08 -08 -10 -08 -07 -05 -03 -01 -03 -07 -01 -02 -03 -08 -06 -03 -01 00 -01 -03 +01 00 00 -03 -01 00 +01 +03 +04 +01 -07 -08 -09 -09 -04 -02 -01 -02 -04 -01 -06 -08 -04 -01 -09 -09 -11 -08 -06 -04 -02 -04 -08 -01 -02 -02 -04 -02 -01 00 +03 +07 +02 +02

"Amore o grillo" - *Madama Butterfly*, Giacomo Puccini

Note Input:

F3 Bb3 D4 F4 Eb4 D4 C4 Bb3 A3 G3 G3 A3 Bb3 C4 A3 A3 Bb3 C4 A3 G3 F3 G3 C4 C4 C4 F3 Bb3 D4 D4 F4 Eb4 D4 Bb3 A3 G3 G3 Bb3 Bb3 Bb3 Bb3 Bb3 Bb3 Bb3 Bb3 Bb3 Bb3 Bb3 Bb3 Bb3 Bb3 Bb3 Bb3 Bb3 Bb3 Bb3 Bb3 Db4 Db4 Db4 Db4 Db4 Db4 Db4 Db4 Db4 Db4 Db4 C4 Db4 C4 Bb3 C4 Bb3 C4 Db4 Eb4 Eb4 Ab3 Db4 F4 Ab4 F4 Eb4 Db4 C4 Bb3 Bb3 Bb3 D4 D4 F4 Eb4 D4 C4 Bb3 A3 G3 G4 F4 Eb4 F4 C4 F4 G4 Bb4 A4 F4 F4 F3 F4 Eb4 D4 Bb3 A3 G3 D4 C4 Bb3

Raw MIDI Data:

53 58 62 65 63 62 60 58 57 55 55 57 58 60 57 57 58 60 57 55 53 55 60 60 60 53 58 62 62 65 63 62 58 57 55 55 58 58 58 58 58 58 58 58 58 58 58 58 58 58 58 58 58 58 58 58 61 61 61 61 61 61 61 61 61 61 61 60 61 60 58 60 58 60 61 63 63 56 61 65 68 65 63 61 60 58 58 58 62 62 65 63 62 60 58 57 55 67 65 63 65 60 65 67 70 69 65 65 53 65 63 62 58 57 55 62 60 58

"True Tessitura" Data:

-11 -06 -02 00 -01 -02 -04 -06 -07 -09 -09 -07 -06 -04 -07 -07 -06 -04 -07 -09 -11 -09 -04 -04 -04 -11 -06 -02 -02 00 -01 -02 -06 -07 -09 -09 -06 -06 -06 -06 -06 -06 -06 -06 -06 -06 -06 -06 -06 -06 -06 -06 -06 -06 -06 -06 -06 -06 -03 -03 -03 -03 -03 -03 -03 -03 -03 -03 -03 -04 -03 -04 -06 -04 -06 -04 -03 -01 -01 -08 -03 00 +03 00 -01 -03 -04 -06 -06 -06 -02 -02 00 -01 -02 -04 -06 -07 -09 +02 00 -01 00 -04 00 +02 +05 +04 00 00 -11 00 -01 -02 -06 -07 -09 -02 -04 -06

"Morgenlich leuchtend in rosigem Schein" - *Die Meistersinger von Nürnberg*, Richard Wagner

Note Input:

E4 B3 C4 E4 D4 C4 B3 D4 C4 B3 A3 G3 A3 B3 C4 F3 A3 B3 E3 A3 C4 E4 G4 A4 E4 G4 G4 D4 F4 E4 D4 E4 D4 C4 B3 A3 A3 G3 B3 C4 D4 E4 E4 F4 D4 B3 C4 E4 E4 C4 B3 B3 A3 A3 A3 G3 B3 C4 D4 E4 E4 F4 D4 B3 E4 G4 F#4 F4 E4 E4 A3 D4 D4 G3 A3 B3 C4 D4 E4 E4 D4 G4 E4 C4 D4 E4 D4 C4 E4 B3 C4 E4 D4 C4 B3 D4 B3 A3 G3 A3 B3 C4 F3 G3 A3 B3 E3 A3 C4 E4 G4 F#4 E4 E4 B3 D4 E4 D4 A3 C4 B3 A3 B3 Eb3 F#3 B3 C#4 Eb4 E4 C#4 Bb3 B3 Eb4 F#4 Eb4 B3 Bb3 Bb3 G#3 A3 B3 F#3 G#3 Bb3 C#4 D4 E4 F#4 D4 C4 E4 A4 G4 F#4 E4 E4 A3 D4 D4 G3 B3 C4 D4 E4 E4 E4 D4 G4 E4 E4 D4 E4 F#4 G4 G4 C4 G3 A3 B3 C4 E4 G4 F#4 F4 A3 C4 B3 C4 D4 E4 A3 B3 D4 G3 G#3 A3 B3 D4 C4 C#4 D4 E4 G4 F4 A4 F4 E4 D4 B3 E4 D4 C4 B3 C4 B3 C4 F4 E4 D4 C#4 D4 E4 F4 G4 F4 E4 D4 G4 F#4 F4 E4 D4 C4 E4 G4 F#4 F4 B3 C4 E4 F#4 F4 A3 C4 E4 A4 A3 B3 C#4 D4 Eb4 E4 D4 C4 B3 A3 D4 E4 F4 B3 C4 E4 G4 C4 D4 E4 F4 B3 C4 E4 G4 C4 C4 C4 E4 D4 C4

Raw MIDI Data:

64 59 60 64 62 60 59 62 60 59 57 55 57 59 60 53 57 59 52 57 60 64 67 69 64 67 67 62 65 64 62 64 62 60 59 57 57 55 59 60 62 64 64 65 62 59 60 64 64 60 59 59 57 57 57 55 59 60 62 64 64 65

62 59 64 67 66 65 64 64 57 62 62 55 57 59 60 62 64 64 62 67 64 60 62 64 62 60 64 59 60 64 62 60 59 62 59 57 55 57 59 60 53 55 57 59 52 57 60 64 67 66 64 64 59 62 64 62 57 60 59 57 59 51 54 59 61 63 64 61 58 59 63 66 63 59 58 58 56 57 59 54 56 58 61 62 64 66 62 60 64 69 67 66 64 64 57 62 62 55 59 60 62 64 64 64 62 67 64 64 62 64 66 67 67 60 55 57 59 60 64 67 66 65 57 60 59 60 62 64 57 59 62 55 56 57 59 62 60 61 62 64 67 65 69 65 64 62 59 64 62 60 59 60 59 60 65 64 62 61 62 64 65 67 65 64 62 67 66 65 64 62 60 64 67 66 65 59 60 64 66 65 57 60 64 69 57 59 61 62 63 64 62 60 59 57 62 64 65 59 60 64 67 60 62 64 65 59 60 64 67 60 60 60 64 62 60

"True Tessitura" Data:

00 -05 -04 00 -02 -04 -05 -02 -04 -05 -07 -09 -07 -05 -04 -11 -07 -05 -12 -07 -04 00 +02 +04 00 +02 +02 -02 00 00 -02 00 -02 -04 -05 -07 -07 -09 -05 -04 -02 00 00 00 -02 -05 -04 00 00 -04 -05 -05 -07 -07 -07 -09 -05 -04 -02 00 00 00 -02 -05 00 +02 +01 00 00 00 -07 -02 -02 -09 -07 -05 -04 -02 00 00 -02 +02 00 -04 -02 00 -02 -04 00 -05 -04 00 -02 -04 -05 -02 -05 -07 -09 -07 -05 -04 -11 -09 -07 -05 -12 -07 -04 00 +02 +01 00 00 -05 -02 00 -02 -07 -04 -05 -07 -05 -13 -10 -05 -03 -01 00 -03 -06 -05 -01 +01 -01 -05 -06 -06 -08 -07 -05 -10 -08 -06 -03 -02 00 +01 -02 -04 00 +04 +02 +01 00 00 -07 -02 -02 -09 -05 -04 -02 00 00 00 -02 +02 00 00 -02 00 +01 +02 +02 -04 -09 -07 -05 -04 00 +02 +01 00 -07 -04 -05 -04 -02 00 -07 -05 -02 -09 -08 -07 -05 -02 -04 -03 -02 00 +02 00 +04 00 00 -02 -05 00 -02 -04 -05 -04 -05 -04 00 00 -02 -03 -02 00 00 +02 00 00 -02 +02 +01 00 00 -02 -04 00 +02 +01 00 -05 -04 00 +01 00 -07 -04 00 +04 -07 -05 -03 -02 -01 00 -02 -04 -05 -07 -02 00 00 -05 -04 00 +02 -04 -02 00 00 -05 -04 00 +02 -04 -04 -04 00 -02 -04

"Outside this house" - *Vanessa*, Samuel Barber

Note Input:

E4 Db4 B3 E4 A3 F#3 Db4 E3 F#3 A3 Ab3 E3 F#3 Db4 B3 B3 B3 D4 A3 Ab3 A3 Db4 Ab3 Ab3 Ab3 Ab3 B3 B3 Eb4 F#4 F#4 F4 Ab3 C4 Eb4 B3 Db4 D4 D4 B3 A3 Db4 E3 F#3 A3 Ab3 F#3 Db4 B3 E4 B3 D4 A3 Db4 Ab3 Db4 D4 Db4 B3 Db4 D4 F#4 E4 B3 G3 G3 G4 F#4 F#4 E4 Db4 D4 F#4 E4 F4 Eb4 Bb3 Bb3 Bb3 Db4 Db4 C4 C4 Bb3 Bb3 F3 F3 Ab3 G3 C4 Ab3 A3 G3 C4 C4 F3 A3 G3 G3 Bb3 Bb3 A3 E3 G3 D3 D3 G3 A3 Bb3 C4 C4 D4 D4 C4 G3 A3 Bb3 Db4 F4 Eb4 D4 Db4 B3 Ab4 G4 E4 Db4 B3 F#3 Db4 B3 B3 D4 F4 C4 B3 B3 B3 D4 D4 Eb4 D4 C4 D4 G4 F4 C4 Eb4 Ab4 Ab4 F#3 A3 Ab3 F#3 Db4 E4

Raw MIDI Data:

64 61 59 64 57 54 61 52 54 57 56 52 54 61 59 59 59 62 57 56 57 61 56 56 56 56 59 59 63 66 66 65 56 60 63 59 61 62 62 59 57 61 52 54 57 56 54 61 59 64 59 62 57 61 56 61 62 61 59 61 62 66 64 59 55 55 67 66 66 64 61 62 66 64 65 63 58 58 58 61 61 60 60 58 58 53 53 56 55 60 56 57 55 60 60 53 57 55 55 58 58 57 52 55 50 50 55 57 58 60 60 62 62 60 55 57 58 61 65 63 62 61 59 68 67 64 61 59 54 61 59 59 62 65 60 59 59 59 62 62 63 62 60 62 67 65 60 63 68 68 54 57 56 54 61 64

“True Tessitura” Data:

00 -03 -05 00 -07 -10 -03 -12 -10 -07 -08 -12 -10 -03 -05 -05 -05 -02 -07 -08 -07 -03 -08 -08 -08 -08 -05 -05 -01 +01 +01 00 -08 -04 -01 -05 -03 -02 -02 -05 -07 -03 -12 -10 -07 -08 -10 -03 -05 00 -05 -02 -07 -03 -08 -03 -02 -03 -05 -03 -02 +01 00 -05 -09 -09 +02 +01 +01 00 -03 -02 +01 00 00 -01 -06 -06 -06 -03 -03 -04 -04 -06 -06 -11 -11 -08 -09 -04 -08 -07 -09 -04 -04 -11 -07 -09 -09 -06 -06 -07 -12 -09 -14 -14 -09 -07 -06 -04 -04 -02 -02 -04 -09 -07 -06 -03 00 -01 -02 -03 -05 +03 +02 00 -03 -05 -10 -03 -05 -05 -02 00 -04 -05 -05 -05 -02 -02 -01 -02 -04 -02 +02 00 -04 -01 +03 +03 -10 -07 -08 -10 -03 00

“La fleur que tu m'avais jetée” - *Carmen*, Georges Bizet

Note Input:

F4 Db4 Ab3 F3 E3 F3 C4 Bb3 Ab3 Ab3 Db4 Db4 Db4 F4 Eb4 Bb3 Db4 C4 A3 Bb3 Eb4 C4 Bb3 Ab3 Ab3 C4 Bb3 Ab3 Ab3 C4 Bb3 Ab3 Ab3 A3 A3 Ab3 A3 B3 A3 D4 D4 Db4 E4 B3 B3 Db4 D4 Db4 Db4 C4 Eb4 D4 Db4 C4 Db4 Ab4 F3 Gb3 Ab3 C4 Bb3 Ab3 Bb3 Ab3 Ab3 A3 A3 A3 A3 Db4 C4 C4 Bb3 Db4 C4 Bb3 Db4 F4 F4 Eb4 C4 Bb3 Bb3 Bb3 Ab3 Ab3 G3 Ab3 Bb3 Eb4 E4 Db4 Ab3 E3 Ab3 Bb3 Bb3 C4 C4 C4 C4 C4 C4 C4 C4 D4 D4 D4 D4 D4 D4 D4 Eb4 Eb4 Eb4 Eb4 E4 E4 E4 E4 F4 Eb4 Db4 Eb4 F4 Eb4 Db4 Eb4 Ab4 Gb4 F4 Db4 Bb3 Ab3 Db4 C4 Db4 Db4 Ab4 Gb4 F4 F4 Eb4 F4 Bb3 B3 Bb3 Gb4 F4 Eb4 Eb4 Db4 Eb4 F4 Ab3 A3 Ab3 F4 Eb4 Db4 C4 Db4 Eb4 Ab3 Ab3 Db4 Eb4 F4 Ab3 Bb3 C4 Db4 Eb4 F4 Gb4 Ab4 Bb4 Gb3 Ab3 Bb3 C4 Db4

Raw MIDI Data:

65 61 56 53 52 53 60 58 56 56 61 61 61 65 63 58 61 60 57 58 63 60 58 56 56 60 58 56 56 60 58 56 56 57 57 56 57 59 57 62 62 61 64 59 59 61 62 61 61 60 63 62 61 60 61 68 53 54 56 60 58 56 58 56 56 57 57 57 57 61 60 60 58 61 60 58 61 65 65 63 60 58 58 58 56 56 55 56 58 63 64 61 56 52 56 58 58 60 60 60 60 60 60 60 60 62 62 62 62 62 62 62 63 63 63 63 64 64 64 64 65 63 61 63 65 63 61 63 68 66 65 61 58 56 61 60 61 61 68 66 65 65 63 65 58 59 58 66 65 63 63 61 63 65 56 57 56 65 63 61 60 61 63 56 56 61 63 65 56 58 60 61 63 65 66 68 70 54 56 58 60 61

“True Tessitura” Data:

00 -03 -08 -11 -12 -11 -04 -06 -08 -08 -03 -03 -03 00 -01 -06 -03 -04 -07 -06 -01 -04 -06 -08 -08 -04 -06 -08 -08 -04 -06 -08 -08 -07 -07 -08 -07 -05 -07 -02 -02 -03 00 -05 -05 -03 -02 -03 -03 -04 -01 -02 -03 -04 -03 +03 -11 -10 -08 -04 -06 -08 -06 -08 -08 -07 -07 -07 -07 -03 -04 -04 -06 -03 -

04 -06 -03 00 00 -01 -04 -06 -06 -06 -08 -08 -09 -08 -06 -01 00 -03 -08 -12 -08 -06 -06 -04 -04 -04 -04 -04 -04 -04 -04 -02 -02 -02 -02 -02 -02 -02 -01 -01 -01 -01 00 00 00 00 00 -01 -03 -01 00 -01 -03 -01 +03 +01 00 -03 -06 -08 -03 -04 -03 -03 +03 +01 00 00 -01 00 -06 -05 -06 +01 00 -01 -01 -03 -01 00 -08 -07 -08 00 -01 -03 -04 -03 -01 -08 -08 -03 -01 00 -08 -06 -04 -03 -01 00 +01 +03 +05 -10 -08 -06 -04 -03

"Celeste Aïda" - *Aïda*, Giuseppe Verdi

Note Input:

D4 C#4 D4 E4 D4 E4 D4 B3 B3 C4 B3 A3 B3 A3 G3 Bb3 Bb3 Bb3 C4 D4 Eb4 Eb4 Eb4 F4 G4 F4 F4 D4 D4 D4 D4 D3 B3 B3 C#4 D4 E4 F#4 D4 F#4 E4 D4 C#4 B3 Bb3 Bb3 Bb3 G#3 Bb3 G#3 G#3 F#3 Bb3 Bb3 Bb3 C4 D4 F4 Eb4 Eb4 F4 F#4 G#4 G#3 G3 A3 Bb3 C4 F4 F3 G3 A3 Bb3 C4 F4 G3 A3 Bb3 C4 D4 A3 A3 B3 C#4 D4 F3 G3 A3 Bb3 D4 F4 G4 F4 Eb4 D4 A3 Bb3 E3 F3 D4 D4 D4 C4 Bb3 F4 F4 C#4 Bb3 C#4 Bb3 C4 C#4 C#4 Bb3 F4 F4 F#4 F4 Eb4 C#4 Eb4 C#4 C4 C#4 C#4 C4 Bb3 C#4 F4 Eb4 C#4 F4 C4 F4 G4 A4 Bb4 A4 G4 D4 E4 F4 F4 F3 A3 Bb3 C4 F4 F3 G3 A3 Bb3 C4 F4 G3 A3 Bb3 C4 D4 F#4 A3 B3 C#4 D4 F3 G3 A3 Bb3 D4 F4 G4 F4 Eb4 D4 A3 C4 E3 F3 D4 D4 D4 C4 Bb3 F3 F3 F3 F3 F3 F3 F3 F3 F3 F3 F3 F3 F3 F3 F3 F3 F3 F3 F#4 F4 Eb4 F4 C4 Eb4 C#4 C4 Bb3 Bb4 A4 G4 F4 D4 F4 Eb4 C4 Bb3 Bb3 D4 D4 D4 D4 F4 D4 F4 F4 F4 F4 F4 Bb4

Raw MIDI Data:

62 61 62 64 62 64 62 59 59 60 59 57 59 57 55 58 58 58 60 62 63 63 63 65 67 65 65 62 62 62 62 50 59 59 61 62 64 66 62 66 64 62 61 59 58 58 58 56 58 56 56 54 58 58 58 60 62 65 63 63 65 66 68 56 55 57 58 60 65 53 55 57 58 60 65 55 57 58 60 62 57 57 59 61 62 53 55 57 58 62 65 67 65 63 62 57 58 52 53 62 62 62 60 58 65 65 61 58 61 58 60 61 61 58 65 65 66 65 63 61 63 61 60 61

61 60 58 61 65 63 61 65 60 65 67 69 70 69 67 62 64 65 65 53 57 58 60 65 53 55 57 58 60 65 55 57 58 60 62 66 57 59 61 62 53 55 57 58 62 65 67 65 63 62 57 60 52 53 62 62 62 60 58 53 53 53 53 53 53 53 53 53 53 53 53 53 53 53 53 53 53 53 53 66 65 63 65 60 63 61 60 58 70 69 67 65 62 65 63 60 58 58 62 62 62 62 65 62 65 65 65 65 65 70

"True Tessitura" Data:

-02 -03 -02 00 -02 00 -02 -05 -05 -04 -05 -07 -05 -07 -09 -06 -06 -06 -04 -02 -01 -01 -01 00 +02 00 00 -02 -02 -02 -02 -14 -05 -05 -03 -02 00 +01 -02 +01 00 -02 -03 -05 -06 -06 -06 -08 -06 -08 -08 -10 -06 -06 -06 -04 -02 00 -01 -01 00 +01 +03 -08 -09 -07 -06 -04 00 -11 -09 -07 -06 -04 00 -09 -07 -06 -04 -02 -07 -07 -05 -03 -02 -11 -09 -07 -06 -02 00 +02 00 -01 -02 -07 -06 -12 -11 -02 -02 -02 -04 -06 00 00 -03 -06 -03 -06 -04 -03 -03 -06 00 00 +01 00 -01 -03 -01 -03 -04 -03 -03 -04 -06 -03 00 -01 -03 00 -04 00 +02 +04 +05 +04 +02 -02 00 00 00 -11 -07 -06 -04 00 -11 -09 -07 -06 -04 00 -09 -07 -06 -04 -02 +01 -07 -05 -03 -02 -11 -09 -07 -06 -02 00 +02 00 -01 -02 -07 -04 -12 -11 -02 -02 -02 -04 -06 -11 -11 -11 -11 -11 -11 -11 -11 -11 -11 -11 -11 -11 -11 -11 -11 -11 -11 -11 +01 00 -01 00 -04 -01 -03 -04 -06 +05 +04 +02 00 -02 00 -01 -04 -06 -06 -02 -02 -02 -02 00 -02 00 00 00 00 00 +05

"In fernem Land" [Narration] - *Lohengrin*, Richard Wagner

Note Input:

E3 E3 E3 A3 A3 C#4 C#4 B3 C#4 B3 A3 A3 A3 A3 C#4 C#4 C#4 C#4 B3 A3 E4 E4 E4 E4 A3 G#3 A3 C#4 A3 F#3 E3 E3 A3 A3 A3 C#4 C#4 C#4 B3 A3 A3 A3 A3 C#4 C#4 C#4 C#4 C#4 F#4 E4 B3 D4 D4 D4 C#4 B3 E4 E4 E4 C#4 A3 A3 A3 A3 B3 D4 D4 C#4 B3 A3 C#4 B3 B3 B3 B3 C#4 C#4 E4 D4 D4 B3 A3 E3 A3 A3 A3 C#4 C#4 C#4 C#4 C#4 C#4 E4 B3 G#3 G#3 B3 C#4 Eb4 E4 F#4 Eb4 E4 E4 E4 E4 A4 A3 A3 C#4 C#4 F#4 E4 E4 E4 C#4 A3 A3 B3 C#4

D4 G#3 A3 C#4 C#4 F#4 F#4 Bb3 C#4 C#4 Eb4 Eb4 Eb4 C#4 Eb4 Eb4 Eb4 C#4 G#3 B3 B3 B3 Bb3 G#3 Eb4 Eb4 C#4 G#3 B3 B3 Bb3 Bb3 Bb3 G#3 F#3 A3 G#3 Eb4 Eb4 C#4 C#4 B3 B3 Bb3 Bb3 Bb3 G#3 F#3 C#4 C#4 C#4 C#4 C#4 C#4 C#4 D4 C#4 C#4 B3 B3 F#4 F#4 D4 B3 E4 A3 D4 E4 C#4 A3 B3 C#4 C#4 G#4 F#4 E4 Eb4 Eb4 C#4 C#4 C#4 Eb4 E4 C#4 C#4 C#4 C#4 C4 Eb4 E4 G#3 B3 B3 C#4 Eb4 E4 Eb4 Eb4 C#4 C#4 D4 D4 C#4 B3 B3 B3 Bb3 C#4 C#4 E4 E4 Eb4 Eb4 F#4 F#4 F#4 F#4 F#4 F4 F4 F4 D4 D4 C#4 B3 E4 G#3 A3 A3 C#4 C#4 C#4 C#4 C#4 C#4 C#4 Eb4 Eb4 E4 A4 A4 C#4 C#4 C#4 E4 C#4 B3 C#4 A3 C#4 F#4 F#4 C#4 C#4 C#4 Eb4 F4 G#4 F#4 E4 A4 C#4 E4 E4 F#4 E4 D4 B3

Raw MIDI Data:

52 52 52 57 57 61 61 59 61 59 57 57 57 57 61 61 61 61 59 57 64 64 64 64 57 56 57 61 57 54 52 52 57 57 57 61 61 61 59 57 57 57 57 61 61 61 61 61 66 64 59 62 62 62 61 59 64 64 64 61 57 57 57 57 59 62 62 61 59 57 61 59 59 59 59 61 61 64 62 62 59 57 52 57 57 57 61 61 61 61 61 61 64 59 56 56 59 61 63 64 66 63 64 64 64 64 69 57 57 61 61 66 64 64 64 61 57 57 59 61 62 56 57 61 61 66 66 58 61 61 63 63 63 61 63 63 63 61 56 59 59 59 58 56 63 63 61 56 59 59 58 58 58 56 54 57 56 63 63 61 61 59 59 58 58 58 56 54 61 61 61 61 61 61 61 62 61 61 59 59 66 66 62 59 64 57 62 64 61 57 59 61 61 68 66 64 63 63 61 61 61 63 64 61 61 61 61 60 63 64 56 59 59 61 63 64 63 63 61 61 62 62 61 59 59 59 58 61 61 64 64 63 63 66 66 66 66 66 65 65 65 62 62 61 59 64 56 57 57 61 61 61 61 61 61 61 63 63 64 69 69 61 61 61 64 61 59 61 57 61 66 66 61 61 61 63 65 68 66 64 69 61 64 64 66 64 62 59

“True Tessitura” Data:

-12 -12 -12 -07 -07 -03 -03 -05 -03 -05 -07 -07 -07 -07 -03 -03 -03 -03 -05 -07 00 00 00 00 -07 -08 -07 -03 -07 -10 -12 -12 -07 -07 -07 -03 -03 -03 -05 -07 -07 -07 -07 -03 -03 -03 -03 -03 +01 00 -05 -02 -02 -02 -03 -05 00 00 00 -03 -07 -07 -07 -07 -05 -02 -02 -03 -05 -07 -03 -05 -05 -05 -05 -

03 -03 00 -02 -02 -05 -07 -12 -07 -07 -07 -03 -03 -03 -03 -03 -03 00 -05 -08 -08 -05 -03 -01 00 +01 -01 00 00 00 00 +04 -07 -07 -03 -03 +01 00 00 00 -03 -07 -07 -05 -03 -02 -08 -07 -03 -03 +01 +01 -06 -03 -03 -01 -01 -01 -03 -01 -01 -01 -03 -08 -05 -05 -05 -06 -08 -01 -01 -03 -08 -05 -05 -06 -06 -06 -08 -10 -07 -08 -01 -01 -03 -03 -05 -05 -06 -06 -06 -08 -10 -03 -03 -03 -03 -03 -03 -03 -02 -03 -03 -05 -05 +01 +01 -02 -05 00 -07 -02 00 -03 -07 -05 -03 -03 +03 +01 00 -01 -01 -03 -03 -03 -01 00 -03 -03 -03 -03 -04 -01 00 -08 -05 -05 -03 -01 00 -01 -01 -03 -03 -02 -02 -03 -05 -05 -05 -06 -03 -03 00 00 -01 -01 +01 +01 +01 +01 +01 00 00 00 -02 -02 -03 -05 00 -08 -07 -07 -03 -03 -03 -03 -03 -03 -03 -01 -01 00 +04 +04 -03 -03 -03 00 -03 -05 -03 -07 -03 +01 +01 -03 -03 -03 -01 00 +03 +01 00 +04 -03 00 00 +01 00 -02 -05

“Vidino divná” - *Rusalka*, Antonín Dvořák

Note Input:

A3 F#3 G3 A3 A3 A3 A3 B3 E4 A3 A3 F#3 G3 A3 B3 C#4 D4 F#4 E4 D4 B3 B3 A3 G3 D4 C#4 B3 A3 G3 E3 B3 A3 E4 D4 C#4 A3 G3 G3 A3 F#3 G3 A3 A3 B3 A3 C#4 B3 A3 C#4 E4 E4 E4 C#4 D4 E4 E4 E4 G4 D4 C#4 E4 C#4 D4 E4 E4 E4 G4 C4 C4 A3 F#3 G3 A3 A3 B3 E4 A3 A3 F#3 G3 A3 B3 C#4 D4 F#4 C#4 Bb3 B3 G#3 C#4 C#4 C#4 Eb4 C#4 C#4 Bb3 C#4 C#4 C#4 C#4 Eb4 E4 C#4 D4 E4 D4 A3 A3 C#4 D4 E4 F#4 A3 A3 F#3 G3 A3 A3 A3 Bb3 A3 G3 G3 Bb3 Eb4 Bb3 Bb3 Bb3 Bb3 B3 F#3 F#3 G#3 G#3 Bb3 B3 C#4 Eb4 D4 Eb4 Eb4 B3 C#4 Eb4 Bb3 B3 C#4 Eb4 Eb4 Eb4 E4 F4 F4 Bb3 G#3 G#3 E4 F4 G#4 G#3 C#4 C#4 D4 C#4 D4 F4 F#4 A4 G4 F#4 E4 D4 C#4 C4 B3 Bb3 C#4 D4 F#4 D4 A4 C#4 D4 C4 C4 C4 F4 Eb4 C4 G#3 G#3 C4 C4 F4 F4 Eb4 Eb4 C4 Bb3 G#3 C#4 Eb4 Eb4 Eb4 Eb4 G#4 G#4 F#4 Eb4 C#4 Eb4 E4 E4 E4 E4 E4 Eb4 C#4 B3 Bb3 Bb3 C#4 C#4 C4 Eb4 Eb4 C#4 C#4 F4 F4 Eb4 D4 Eb4 G4 G#4

G#3 Bb3 C4 Bb3 Eb3 C4 C4 Bb3 Bb3 C#4 C#4 C4 Eb4 E4 E4 E4 E4 E4 A4 E4 E4 A4 G#4 F#4 Eb4 Eb4 G#4 F#4 Eb4 Eb4 G#4 F#4 Eb4 Eb4 Eb4 Eb4 Eb4

Raw MIDI Data:

57 54 55 57 57 57 57 59 64 57 57 54 55 57 59 61 62 66 64 62 59 59 57 55 62 61 59 57 55 52 59 57 64 62 61 57 55 55 57 54 55 57 57 59 57 61 59 57 61 64 64 64 61 62 64 64 64 67 62 61 64 61 62 64 64 64 67 60 60 57 54 55 57 57 59 64 57 57 54 55 57 59 61 62 66 61 58 59 56 61 61 61 63 61 61 58 61 61 61 61 63 64 61 62 64 62 57 57 61 62 64 66 57 57 54 55 57 57 57 58 57 55 55 58 63 58 58 58 58 59 54 54 56 56 58 59 61 63 62 63 63 59 61 63 58 59 61 63 63 63 64 65 65 58 56 56 64 65 68 56 61 61 62 61 62 65 66 69 67 66 64 62 61 60 59 58 61 62 66 62 69 61 62 60 60 60 65 63 60 56 56 60 60 65 65 63 63 60 58 56 61 63 63 63 63 68 68 66 63 61 63 64 64 64 64 64 63 61 59 58 58 61 61 60 63 63 61 61 65 65 63 62 63 67 68 56 58 60 58 51 60 60 58 58 61 61 60 63 64 64 64 64 64 69 64 64 69 68 66 63 63 68 66 63 63 68 66 63 63 63 63 63

“True Tessitura” Data:

-07 -10 -09 -07 -07 -07 -07 -05 00 -07 -07 -10 -09 -07 -05 -03 -02 +01 00 -02 -05 -05 -07 -09 -02 -03 -05 -07 -09 -12 -05 -07 00 -02 -03 -07 -09 -09 -07 -10 -09 -07 -07 -05 -07 -03 -05 -07 -03 00 00 00 -03 -02 00 00 00 +02 -02 -03 00 -03 -02 00 00 00 +02 -04 -04 -07 -10 -09 -07 -07 -05 00 -07 -07 -10 -09 -07 -05 -03 -02 +01 -03 -06 -05 -08 -03 -03 -03 -01 -03 -03 -06 -03 -03 -03 -03 -01 00 -03 -02 00 -02 -07 -07 -03 -02 00 +01 -07 -07 -10 -09 -07 -07 -07 -06 -07 -09 -09 -06 -01 -06 -06 -06 -06 -05 -10 -10 -08 -08 -06 -05 -03 -01 -02 -01 -01 -05 -03 -01 -06 -05 -03 -01 -01 -01 00 00 00 -06 -08 -08 00 00 +03 -08 -03 -03 -02 -03 -02 00 +01 +04 +02 +01 00 -02 -03 -04 -05 -06 -03 -02 +01 -02 +04 -03 -02 -04 -04 -04 00 -01 -04 -08 -08 -04 -04 00 00 -01 -01 -04 -06 -08 -03 -01 -01 -01 -01 +03 +03 +01 -01 -03 -01 00 00 00 00 00 -01 -03 -05 -06 -06 -03 -03 -04 -01 -

01 -03 -03 00 00 -01 -02 -01 +02 +03 -08 -06 -04 -06 -13 -04 -04 -06 -06 -03 -03 -04 -01 00 00

00 00 00 +04 00 00 +04 +03 +01 -01 -01 +03 +01 -01 -01 +03 +01 -01 -01 -01 -01 -01