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Tessitura changes in music theatre repertoire for the soprano voice

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Tessitura Changes in Music Theatre Repertoire for the Soprano Voice

Linda Barcan

Abstract

While the term tessitura is often poorly defined and loosely applied, certain statements about its application to singers and their repertoire may be made. For vocal repertoire, tessitura refers to the prevailing note or range of notes in a vocal line. For singers, it refers to the area in which the voice is most comfortably resonant. The definition most frequently used to capture the concept in relation to both singer and repertoire is the range of pitches where a voice or song "sits". While attempts have been made to quantify tessitura, most references to this term remain largely subjective. This study attempts to objectively measure tessitura by redefining it as an average pitch. A protocol was developed based on Rastall's formula for calculating a pitch centre of gravity (PCG), taking into account not just the frequency of pitches, but also their duration. This protocol was used to measure changes in tessitura in soprano music theatre repertoire from the 1920s to the 2000s. Although anecdotally recognised by pedagogues and practitioners, the hypothesis that the tessitura of female music theatre repertoire has lowered over time has never been formally tested, despite the existence of parallel studies on the lowering of speaking fundamental frequency (SFF). The results of our study revealed a statistically significant lowering of tessitura in soprano music theatre repertoire over time. The implications of this, and further possible applications of the methodology, are discussed.

Introduction

It is generally acknowledged that the tessitura for music theatre soprano repertoire sits lower than for the female classical voice. Says Richard Walters: "the preferred vocal sound in women's musical theatre literature is often significantly lower than as defined by classical vocal tradition, especially by operatic standards of tessitura" (Walters, 1986, p. 2). This is, Walters claims, a deliberate aesthetic choice, aimed at clarity of diction, the naturalistic delivery of text and characterisation. The hypothesis of this study is as follows: that not only is the tessitura for music theatre sopranos generally lower than that of their classical cousins, but that this tessitura has lowered over time. Although anecdotally recognised, this hypothesis has never been formally tested, despite the existence of parallel studies on the lowering of the female Speaking Fundamental Frequency[i].

Definitions of Tessitura

"[Tessitura] is just a common term. Everybody uses it. I don't think most people even know what it means" (Elliott, 2004, p. 244).

So claimed one participant in musicologist JanClaire Elliott's study of tessitura in vocal music, summarising the ambiguity that surrounds this term. In her study, Elliott surveyed fifteen voice practitioners, made up of professional singers, coaches, teachers and composers of vocal music, who delivered no less than nineteen definitions of tessitura. These include: a quality of sound, an area of sound, a congregation of pitches, a dominant range of sound, one or more pitches, a collection of pitches, a pitch class, a concentration of pitches, a reasoned abstraction of pitches, the heart of the range, and a middle range of pitches (Elliott, 2004, p. 248). From these descriptors we can ascertain that tessitura is aligned with pitch.

At this point, it is worth remembering that there are two main applications of the term tessitura: it may refer to either a piece of music or to a singer's voice (Titze, 2008, p. 59). This paper borrows the terms "song tessitura" and "singer tessitura" from Ingo Titze to distinguish between these two applications. When examining tessitura's relationship to pitch, it is important not to confuse tessitura with range. Range describes the entire compass of a voice or piece of music from the lowest note to the highest. *The Norton/Grove Concise Encyclopaedia of Music* defines tessitura rather as "the part of the range most used". For Stefen Thurmer, it is "the portion of the vocal or instrumental compass employed most commonly" (Thurmer, 1988, p. 327)[ii]. It starts to become clear that tessitura is bound up with notions of pitch dominance[iii].

Subjective Descriptions of Tessitura

"Teachers, singers, musical directors, and connoisseurs of vocal music all have their own ideas – often subjective – of what the tessitura of a piece is" (Thurmer, 1988, p. 327).

Even in its origins, tessitura plays a figurative role. Etymologically, the term *tessitura* derives from the Italian verb *tessere* (to weave) and is translated literally as "texture"[iv]. The musical implications of this may be that tessitura "weaves" in and out of a piece of music, adding to its texture like a thread through cloth (Elliott, 2004, p. 240 and p. 248).

In writings on vocal music, tessitura is often expressed in equally subjective terms. These include notions of "sitting", "lying" or "fitting" (Elliott, 2004, p. 243). Even reference books commonly use these descriptors. *The Shorter Oxford English Dictionary*, for example, defines tessitura as "the range within which most tones of a voice part or melody lie" (Brown, 2012, p. 3,221) and *The New Grove Dictionary of Opera* refers to "the 'fit' of a role" (cited in Elliott, 2005, p. 240). Musicologist Richard Rastall describes tessitura as "that part of the pitch-range in which the music tends to lie" (Rastall, 1984, p. 181), a definition which he subsequently dismisses as "too loose".

The definitions above were all made with reference to song tessitura. When it comes to singer tessitura, the terms of reference are no less subjective. *The Dictionary of Vocal Terminology: An Analysis* describes singer tessitura as "the natural area in which to sing with the greatest comfort and ease" (cited in Elliott, 2004, p. 240). Titze speaks of the singer's "comfort level with the given distribution of pitches in a song" (Titze, 2008, p. 59). Most attractive perhaps, to the singer and to the voice teacher, is Elliott's conception of singer tessitura as the area in which the voice "blossoms" (Elliott, 2004, pp. 243-248).

Notions of comfort, ease and blossoming are perfectly comprehensible to a singer, more so, perhaps, than are objective measurements of pitch dominance. One could argue that it is a different matter for those responsible for guiding singers: their teachers, coaches, musical directors and composers.

Objective Descriptions of Tessitura

Objective descriptions of tessitura are available in the literature, and make the prospect of quantifying tessitura more feasible. For Titze and Thurmer, "song tessitura" describes the distribution of pitches, measured by calculating frequency of occurrence (Titze, 2008, p. 59;

Thurmer, 1988, p. 327). It seems that even “singer tessitura”, often expressed in the most subjective of terms, may also be measured. Titze defines it as the area of the voice that displays the greatest dynamic range (Titze, 2008, p. 60), based on a singer’s ability to easily crescendo and decrescendo on a sustained note in a given part of their voice.

Rationale for Measuring Tessitura

Before we look at the quantification of tessitura in more detail, it is important to address the rationale for doing so. One of the most pedagogically driven reasons for measuring tessitura must surely be to help the voice teacher and the singer make informed repertoire choices.
Many scholars (Nix, 2002; Ralston, 1999; Titze, 2008) have remarked on the importance of repertoire choice for vocal pedagogues and their students:

> Even singers who perform at a world-class level find miscalculations in repertoire selection to be vocally hazardous or sometimes even career-threatening... It is the teacher's task to carefully choose repertoire that ensures success and progress while it challenges but does not defeat the student (Nix, 2002, p. 217).

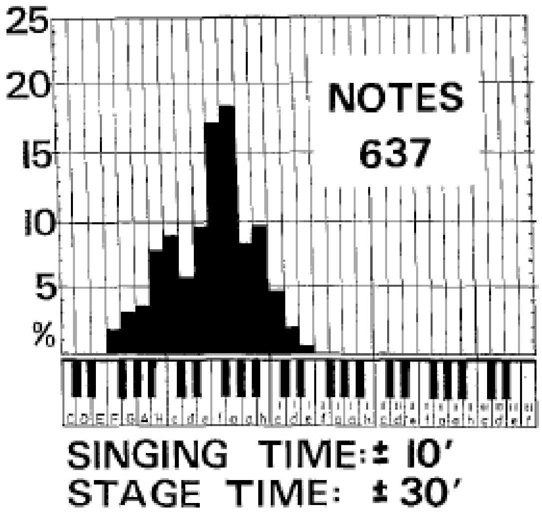
Says Janette Ralston: “inappropriate musical selections can, at best, diminish the efficiency of students’ learning and, at worst, damage students’ psychological abilities to perform music” (Ralston, 1999, p. 163). Ralston reminds us that until now voice teachers have had little help in selecting appropriate literature for their students and calls for “a consistent grading instrument with which to measure the difficulty of vocal repertoire” (Ralston, 1999, p. 165). Tessitura is one of the seven variables in her Ralston Repertoire Difficulty Index (Ralston, 1999, p. 167).
Specific knowledge of the tessitura of a piece of vocal literature may help singing teachers and their students match “singer tessitura” with ”song tessitura” (Titze, 2008, p. 60). In this way, students of singing might be allowed to develop their voices without the discomfort of sustaining an uncomfortably high tessitura, or a tessitura that sits in the passaggio zone, an area of the voice bounded by points of register transition that require advanced technical skills to negotiate with ease.

Whilst nothing can replace the singing teacher’s ear and eye, nor their knowledge and experience of vocal repertoire, it is possible that technology may help in determining the degree of difficulty of a piece. “A logical step [to determine vocal difficulty]”, says Stefan Thurmer, “is to develop a statistical method of the objective and reproducible definition of ‘tessitura’” (Thurmer, 1988, p. 327).

Measuring Tessitura

In 1984, Richard Rastall claimed that there was “no means of quantifying a composer’s distribution of the available pitches in vocal music” (Rastall, 1984, p. 181). Since then, methods have been proposed for quantifying tessitura, most notably by Rastall himself (1984), Thurmer (1988) and Titze (2008). These methods have all involved the use of the tessiturogram as a tool for providing objective measurements of tessitura.

The tessiturogram analyses, and represents in graphic form, frequencies of pitch occurrence in a piece of vocal music or an operatic role. Stefan Thurmer produced tessiturograms for the seven principal roles in Mozart’s *The Magic Flute*. There are, however, some problems inherent in Thurmer’s calculations. For example, duration is not included as a variable, repeated notes within the same measure are counted as one (Thurmer, 1988, p. 327), and the value of each note is not taken into account. The actual measurement of pitch occurrence is also problematic, since sharps and flats were removed from the calculation.[v] The effect of this methodology is to produce a result with limited practical relevance to the singer.

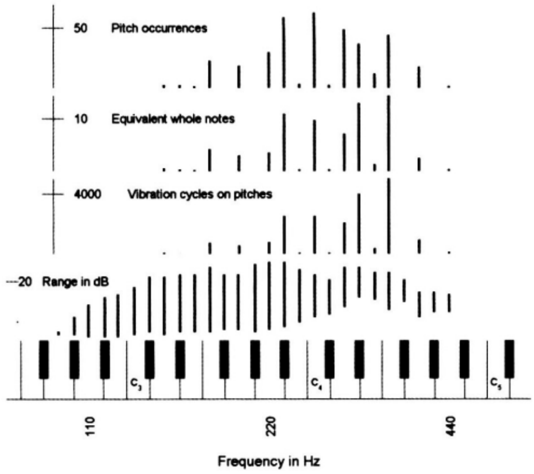


Tessiturogram: Sarastro, The Magic Flute, W. A. Mozart. Sarastro's part has a well-balanced tessitura. Most of the 637 notes to be sung represent between 5 and 10% of the total, with the exception of the notes F and G (German notation, see keyboard in diagram) with 17 and 18%, respectively. Sarastro's singing time is 10 min and his stage time is 30 min.

Figure I. Thurmer's Tessiturogram (Thurmer, 1988, p. 327).

Titze's tessiturogram of Mozart's "Il mio tesoro intanto" delivers an image of a dominant pitch range of a single aria. Twenty years on from Thurmer's study, Titze's analysis is, as one might expect, more complex than Thurmer's, although this has more to do with methodology than with technology. Sharps and flats are included in the calculation, and pitch is expressed in terms of fundamental frequency (in Hertz), rather than on the cruder basis of note names. A simple tessitura analysis of "Il mio tesoro intanto" produces a dominant pitch of C4, however once duration is taken into account, a quite different result emerges, as the dominant pitch shifts from C4 to F4 - although C4 has the greatest number of occurrences, F4 has the greatest accumulated duration. The change is significant since, for many tenors, F4 falls in the *secondo passaggio*, a part of the range where the voice does NOT necessarily blossom.

A rigorous measurement of tessitura should therefore take into account the duration of each note as well as its pitch. The combined effect of sustain, repetition of notes and the precise pitch of a note (whether G, G# or Gb) surely contributes to a singer's sense of comfort ("singer tessitura" matches "song tessitura") or discomfort ("singer tessitura" does not match "song tessitura"). A similar conclusion as to the importance of duration in measuring tessitura was reached by Rastall nearly thirty years ago.



Tessituragram for the aria "Il mio tesoro intanto" from Mozart's opera *Don Giovanni*.

Figure II. Titze's Tessiturogram (Titze, 2008, p. 60).

In 1984, Richard Rastall's tessitura analysis of the incidental vocal music in Play Number 45, "The Assumption of the Virgin", from the York cycle of mystery plays, prompted him to develop a formula calculated to produce a durational average or dominant pitch. Rastall called this the "Pitch Centre of Gravity", or PCG, a nod to the formula for calculating the centre of gravity in mechanics (Rastall, 1984, p. 190)[vi]. Rastall's PCG was reached by numbering each semitone of the scale in sequence, and by counting up the duration for which each pitch was sounded[vii].

'Surge' A: Calculation of 'centres of gravity'.

		I		II	
Note	Value	No. of ♩ beats	Product	No. of ♩ beats	Product
c''	14	5	70	5.5	77
b♮'	13	2.5	32.5	0.5	6.5
b♭'	12	4	48	2	24
a'	11	20.25	222.75	9	99
g#'	10	0	0	0	0
g'	9	17.25	155.25	17	153
f#'	8	0	0	0	0
f'	7	14.5	101.5	23.25	162.75
e'	6	3.5	21	7.5	45
d#'	5	0	0	0	0
d'	4	2.5	10	5	20
c#'	3	0	0	0	0
c'	2	4.5	9	4.25	8.5
b	1	0	0	0	0
rests	0	1	0	1	0
TOTALS	in piece	75		75	
	sounding	74	670.0	74	595.75
	PCG		9.054		8.051

Figure III. Rastall's Tessiturogram (Rastall, 1984, p. 190).

Although presented in tabular form, Rastall's analysis of "Surge", one of the pieces of music in "The Assumption of the Virgin", also constitutes a "tessiturogram".

The study which follows is an analysis of changes in tessitura in music theatre repertoire for the soprano female voice from the 1920s through to the 2000s. This study adopted the Rastall model for measuring tessitura on the basis that a single value, a Pitch Centre of Gravity, is a more efficient and consistent measure, and that such a measure befits a longitudinal approach[viii].

Constructing a Music Theatre Canon

Although the genre of the musical has only existed for around one hundred years, there is no doubt that a canon of musicals has developed, agreed upon by a community of theatre-goers, musicologists, historian and critics (Block, 1993, p. 529).

For this study, a music theatre canon was constructed based on pre-existing lists produced by four music theatre historians: Engel (1975), Kingman (1990), Swain (1990) and Block (1993). In addition to these, four criteria for canon inclusion, extrapolated from a literature review of canonicity, were applied (Tompkins, 1986; Block, 1993; Citron, 1993; Green, 1996). These criteria are: 1) popularity, represented by the initial reception of a work, and measured in the number of performances of the original production; 2) durability, represented by the test-of-time paradigm and measured in revivals; 3) quality or merit, represented by critical approval and musicological evaluation, and measured in awards and 4) representation in the literature, indicated by inclusion in *The Singer's Musical Theatre Anthology* series.

The final result was a list of 39 of the longest-running musicals, with length of run addressing the popularity criterion. 92% of these musicals had received either a revival or an award or both, addressing durability and quality. One song per musical was chosen, using the *Singer's Musical Theatre Anthology* soprano volumes as the repertoire source. The 39 songs were then subjected to a tessitura analysis.

Methodology

The vocal lines for each song were entered into music notation program Sibelius version 6. A customised plug-in designed to calculate a durational average, and based on Rastall's formula for a Pitch Centre of Gravity, was applied. Four variables were produced:

a) the highest note of the range, expressed as MIDI values;
b) the lowest note of the range, expressed as MIDI values;
c) the overall range, measured in semitones and calculated from the previous two values;
d) the Pitch Centre of Gravity, expressed as MIDI values.

The results were collated in Excel 2007, and graphs were generated for each of the four data sets, plotted against time (See Figures IV-VII). A trend line was inserted using the Excel Trend Line function (line of best fit) to reveal patterns over time[ix]. To determine whether the results were statistically significant ($p < .05$), all data were subjected to a Regression Analysis, using a commercially available Excel plug-in.

Results

Two of the four variables revealed statistically significant results. It would seem that whilst the bottom end of the range of soprano music theatre repertoire has lowered significantly over time, the top end of the range has remained more or less stable. The Pitch Centre of Gravity, or measure of tessitura, has lowered significantly.

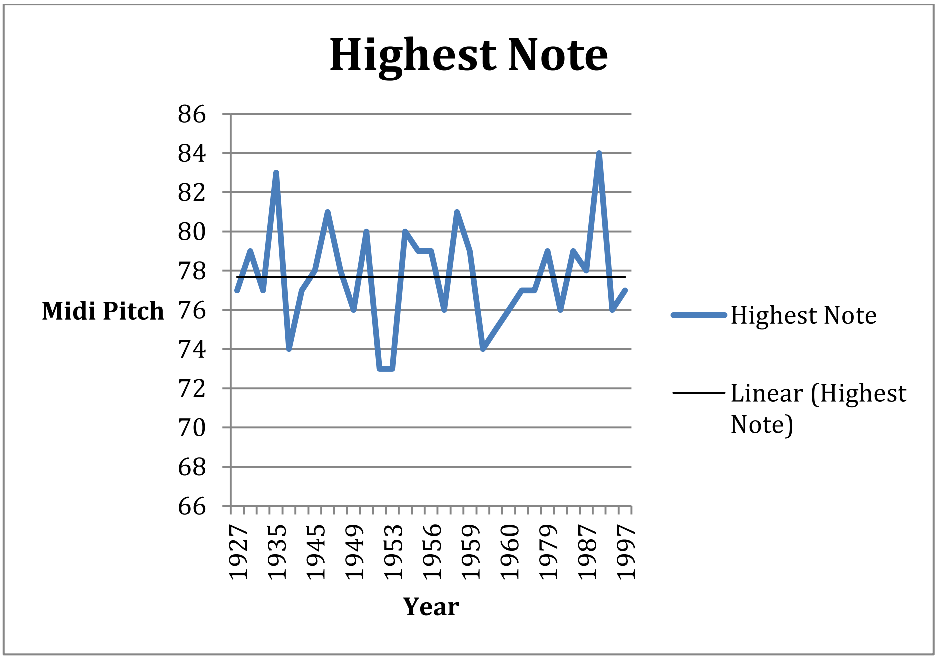


Figure IV. Results of the Tessitura Analysis for the Highest Note of the Range

Figure IV represents the variation in the highest note of the range for each song over time. Whilst the raw data show a great deal of variation, the trend line shows no significant raising or lowering.

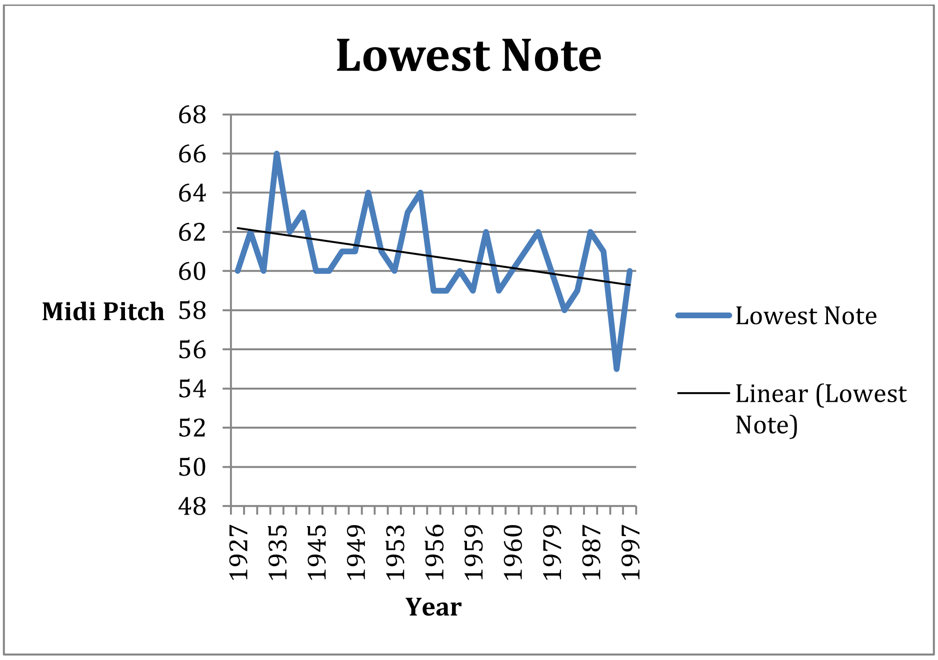


Figure V. Results of the Tessitura Analysis for the Lowest Note of the Range

Figure V represents the variation in the lowest note of the range for each song over time. The trend line shows a marked downward movement, indicating that the bottom end of the range has dropped. This was a statistically significant result.

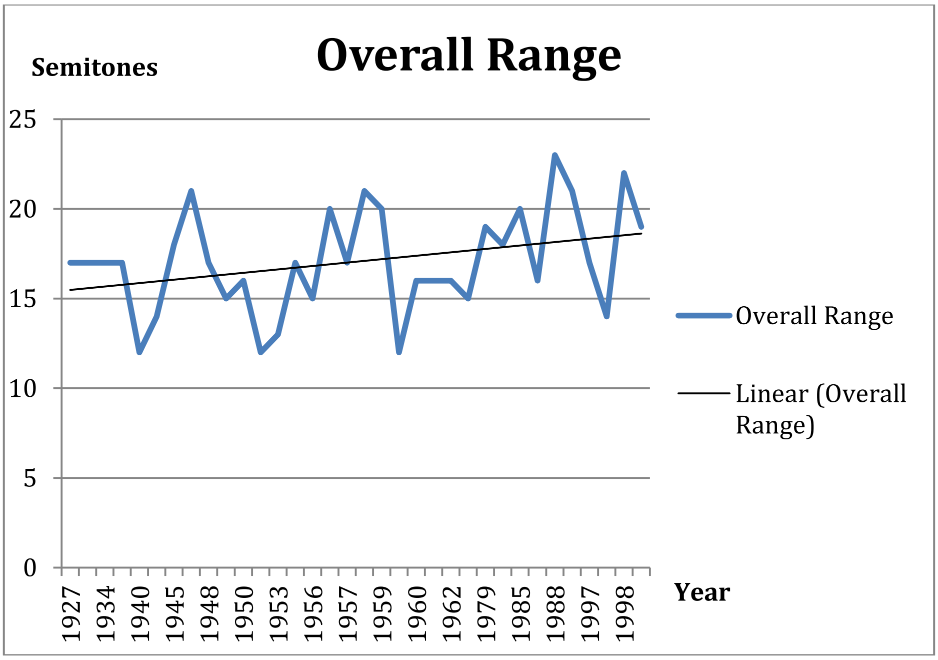


Figure VI. Results of the Tessitura Analysis for the Overall Range

Figure VI represents the variation in the overall range for each song over time. The graph shows an upward trend, suggesting at first glance that the average range has increased. This would seem logical, since the lowest note of the range has dropped significantly. However, the highest note has not risen significantly, which explains the lack of statistical significance for overall range (a significance factor of 0.109321306, well above 0.05).

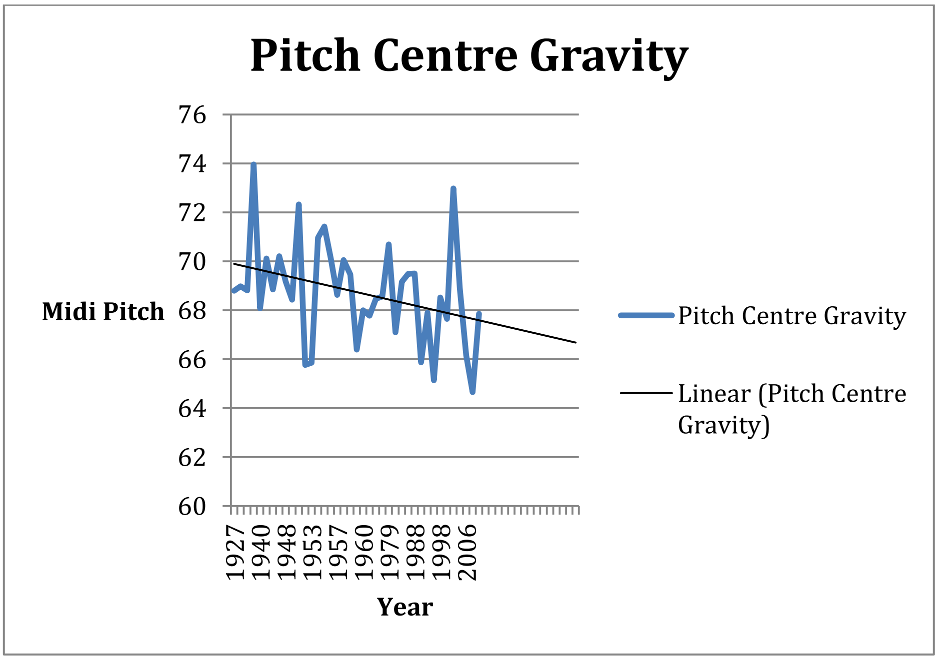


Figure VII. Results of the Tessitura Analysis for the Pitch Centre of Gravity (PCG)

Figure VII reveals a consistent and significant downward trend in the Pitch Centre of Gravity, indicating that the tessitura of soprano music theatre repertoire has lowered over time. This was a statistically significant result[x].

Discussion and Conclusions

The tessitura analysis conducted by this study revealed a significant lowering of "song tessitura" in soprano music theatre repertoire over time. One can hypothesise that there has been a parallel lowering in "singer tessitura", concentrating the soprano music theatre voice in "an expressive and strong" middle register (Walters, 1993, p. 2), and bringing the singing range closer to the normal speech range.

It is possible that this lowering effect is associated with the contemporary desire in music theatre to connect to more speechlike qualities and resonances, enhancing clarity of diction. This tendency has been enabled by the development of amplification in the theatre since the 1960s and 1970s. This technology removes the need for higher frequencies which in pre-amplification days were necessary to allow the voice to project over an orchestra[xi].

Whatever the explanation, teachers of music theatre should be aware of this effect when assigning repertoire to their voice students. As Titze notes, when singer and song tessitura do not match, the singing teacher's solution may be to change the key. However, if accumulated pitch duration, or tessitura, is not taken into account, "singer-song adaptation still may not be complete" (Titze, 2008, p. 60). Whilst "singer-song adaptation" may be effected by vocal technique and efficient practice, careful attention should be paid to repertoire choice in the first place, in order to avoid the pedagogical puzzle of trying to fit a square peg in a round hole. This is a dilemma which often confronts singing teachers and their students, particularly those who work in an institutional setting where the curriculum or performance requirements may place repertoire constraints on a student body without allowing for dissimilar soprano voice categories. To borrow the words of the late Richard Miller, this is "a matter of concern for both the singer and the teacher of singing" (Miller, 2000, p. 5).

Notes

i Longitudinal studies conducted in Australia, Sweden, America and Canada have demonstrated that modern-day women possess deeper speaking voices than women from previous generations. In a 1993 Australian study, a lowering of pitch by an average of 48 Hertz was found across two generations from 1943 to 1993 (Pemberton *et al*., 1993). This was not attributable to factors known to influence SFF (age, menopause, smoking, the oral contraceptive pill and inhaled steroids). Pemberton et al. hypothesised that the lowering effect was due to psychosocial and cultural issues related to the more prominent status of women in the media and other public spheres.

ii Although Thurmer clearly thinks of tessitura as an average pitch, even he confuses range and tessitura when he states that the "classical" definition of tessitura is "the general *compass* of a vocal part" (Thurmer, 1988, p. 327). The Shorter Oxford English Dictionary defines compass rather as "the *range* of tones of a voice or musical instrument" (Brown, 2002, p. 466). Occasionally this confusion is found in reference sources. For example the *Dizionario della Lingua Italiana Nuovamente* defines tessitura as "the entire extension of the voice", which is clearly not supported by other dictionary definitions.

iii In Elliott's survey, opinions as to the number of pitches comprising a tessitura varied according to the respondent, though Elliott found that they tended to fall into one of two groups. The first (and largest) group considered tessitura to be a collection of pitches outlined by a melodic interval. The second group viewed tessitura as a predominant pitch, from which other pitches within the melodic phrase "hang" (Elliott, 2004, p. 244).

iv Standard Italian-English dictionaries also define the noun form as "weaving". See for example Bacchelli, 2012, p. 1540.

v The difference between Gb4 and G4 is obvious to a musician, but becomes immediately apparent to anybody once a numerical value, such as a MIDI value, is assigned to the pitches.
vi In his comparative analysis of tessitura differences between an operatic soprano role (Clara in *Porgy & Bess*) and a pre-1960s musical theatre soprano role (Magnolia in *Show Boat*), Banfield recommends Ralston's Pitch Centre of Gravity (PCG) formula as an efficient means of calculating tessitura (Banfield 2000, p.74).
vii This operation yielded the following formula:

$$p = \frac{1d_1 + 2d_2 + 3d_3 + ... + nd_n}{d_1 + d_2 + d_3 + ... + d_n}$$

where p is the number of the pitch to be found and d_n is the sounding duration of the highest pitch, numbered n on the scale of values. ($d_1 + d_2 + d_3 + ... + d_n$) is the total sounding duration of the voice part i.e. the total duration of the piece minus the duration of the rests in that voice part (Rastall, 1984, p.190).
viii Contemporary music notation software such as Sibelius, and music analysis software such as MelodicMatch do have tessitura analysis functions. The function within Sibelius does not account for duration, and the MelodicMatch function produces a middle pitch range rather than a durational average. Neither of these analyses suited the purposes of this study, hence the adoption of Rastall's formula.
ix This Excel function includes a standard deviation test.
x There is an interesting comparison to be made between the Pemberton et al. (1993) study of Speaking Fundamental Frequency and this study. The lowering of the Pitch Centre of Gravity in music theatre repertoire over time is expressed in MIDI values. If these are converted into Hertz (or cycles per second), the difference between the average PCG for the 1940s and the average PCG for the 1990s comes to around 46 Hertz (or two semitones), almost exactly the same lowering as that found in Speaking Fundamental Frequency over the same period. This is worthy of further investigation.
xi The common practice of using amplification on Broadway stages began with the arrival of the "rock musical" in the 1960s and 70s. These musicals, such as *Hair* and *Jesus Christ Superstar*, had scores that were heavily influenced by the popular music of the day, and featured orchestras containing electrically amplified instruments which would overpower the performers unless they too were amplified by onstage microphones (Wollman, 2006, p.54). In the 1960s and 1970s, hand-held or stand microphones were used, and from the 1980s onwards, radio microphones took over (Wollman, 2006, pp. 124-128). As Wollman notes, this had an effect on vocal production since performers no longer needed to "belt from the diaphragm" (Wollman, 2006, p.125).

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APPENDIX I – List of Songs and their Musicals

DATE	SONG	MUSICAL	PERF*	REV**	AWD#
1927	"Make Believe"	*Show Boat*	572	6	4
1928	"Lover, Come Back To Me"	*The New Moon*	509	2	0
1934	"All Through the Night"	*Anything Goes*	420	3	4
1935	"Summertime"	*Porgy and Bess*	124	7	1
1940	"Bewitched"	*Pal Joey*	374	4	0
1943	"Out of My Dreams"	*Oklahoma*	2212	4	0
1945	"If I Loved You"	*Carousel*	890	4	1
1947	"Waitin' For My Dearie"	*Brigadoon*	581	5	0
1948	"So in Love"	*Kiss Me Kate*	1077	2	5
1949	"The Woman in his Room"	*Where's Charley*	792	1	0
1950	"I'll Know"	*Guys & Dolls*	1200	5	3
1951	"Getting to Know You"	*The King And I*	1246	3	3
1953	"Baubles, Bangles and Beads"	*Kismet*	583	0	1
1953	"A Little Bit in Love"	*Wonderful Town*	559	1	1
1956	"I Could Have Danced All Nig	*My Fair Lady*	2717	3	1
1956	"Somebody Somewhere"	*The Most Happy Fella*	676	3	0
1957	"Goodnight, My Someone"	*The Music Man*	1375	2	1
1957	"I Feel Pretty"	*West Side Story*	732	4	0
1959	"When Did I Fall in Love"	*Fiorello*	795	0	2
1959	"The Sound of Music"	*The Sound Of Music*	1443	1	1
1960	"The Simple Joys of Maidenho	*Camelot*	873	4	0
1960	"Far From the Home I Love"	*Fiddler on the Roof*	3242	4	3
1962	"Lovely"	*A Funny Thing Happened...*	964	2	2
1965	"What Does He Want of Me?"	*Man of la Mancha*	2328	4	2
1979	"Green Finch and Linnet Bird"	*Sweeney Todd*	557	2	7
1982	"Unusual Way"	*Nine*	729	1	6
1985	"Moonfall"	*The Mystery Of Edwin Drood*	608	0	6
1987	"In My Life"	*Les Miserables*	6680	1	5
1988	"Think of Me"	*The Phantom Of The Opera*	9587	0	2
1994	"Home"	*Beauty and the Beast*	5461	0	0
1997	"Once Upon a Dream"	*Jekyll & Hyde*	1543	0	0
1997	"I'm Leaving You"	*The Life*	466	0	2
1998	"Your Daddy's Son"	*Ragtime*	834	1	5
2001	"Follow Your Heart"	*Urinetown*	965	0	2
2003	"Let Us Be Glad"	*Wicked*	3022	0	2
2005	"The Light in the Piazza"	*The Light in the Piazza*	504	0	2
2006	"Practically Perfect"	*Mary Poppins*	1773	0	0
2006	"Whispering"	*Spring Awakening*	859	0	5
2006	"Bride's Lament"	*The Drowsy Chaperone*	674	0	5

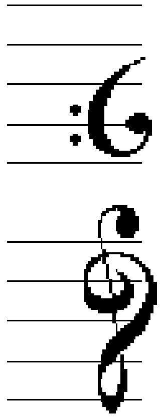
* Number of original performances ** Number of revivals # Number of awards

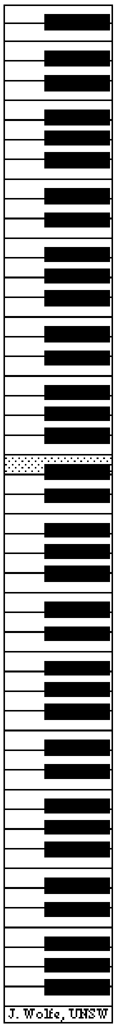
APPENDIX II – Table of Results

DATE	SONG	HIGHEST NOTE (Midi values)	LOWEST NOTE (Midi values)	RANGE (Semi -tones)	PCG (Midi Values)
1927	“Make Believe”	77	60	17	68.7884
1928	“Lover, Come Back To Me”	79	62	17	68.9785
1934	“All Through the Night”	77	60	17	68.8035
1935	“Summertime”	83	66	17	73.9563
1940	“Bewitched”	74	62	12	68.071
1943	“Out of My Dreams”	77	63	14	70.1107
1945	“If I Loved You”	78	60	18	68.846
1947	“Waitin' For My Dearie”	81	60	21	70.2125
1948	“So in Love”	78	61	17	69.18
1949	“The Woman in his Room”	76	61	15	68.4343
1950	“I'll Know”	80	64	16	72.3179
1951	“Getting to Know You”	73	61	12	65.7692
1953	“Baubles, Bangles and Beads”	80	63	17	70.964
1953	“A Little Bit in Love”	73	60	13	65.8512
1956	“I Could Have Danced All Night”	79	59	20	70.1171
1956	“Somebody Somewhere”	79	64	15	71.426
1957	“Goodnight, My Someone”	76	59	17	68.6275
1957	“I Feel Pretty”	81	60	21	70.0431
1959	“When Did I Fall in Love”	79	59	20	69.4608
1959	“The Sound of Music”	74	62	12	66.3889
1960	“The Simple Joys of Maidenhood”	75	59	16	67.992
1960	“Far From the Home I Love”	76	60	16	67.774
1962	“Lovely”	77	61	16	68.4695
1965	“What Does He Want of Me?”	77	62	15	68.5635
1979	“Green Finch and Linnet Bird”	79	60	19	70.6879
1982	“Unusual Way”	76	58	18	67.0929
1985	“Moonfall”	79	59	20	69.1647
1987	“In My Life”	78	62	16	69.493
1988	“Think of Me”	84	61	23	69.5047
1994	“Home”	76	55	21	65.8631
1997	“Once Upon a Dream”	73	59	14	65.1348
1997	“I'm Leaving You”	77	60	17	67.8909
1998	“Your Daddy's Son”	78	56	22	68.5239
2001	“Follow Your Heart”	77	58	19	67.6441
2003	“Let Us Be Glad”	81	64	17	72.9812
2005	“The Light in the Piazza”	78	57	21	68.8989
2006	“Practically Perfect”	79	57	22	67.8521
2006	“Whispering”	69	59	10	64.6525
2006	“Bride's Lament”	76	60	16	66.1574

APPENDIX III– Conversion of Midi Values to Herz and Notes

MIDI number		Note name	Frequency Hz		Period ms	
21	22	A0	27.500	29.135	36.36	34.32
23		B0	30.868		32.40	
24	25	C1	32.703	34.648	30.58	28.86
26	27	D1	36.708	38.891	27.24	25.71
28		E1	41.203		24.27	
29	30	F1	43.654	46.249	22.91	21.62
31	32	G1	48.999	51.913	20.41	19.26
33	34	A1	55.000	58.270	18.18	17.16
35		B1	61.735		16.20	
36	37	C2	65.406	69.296	15.29	14.29
38	39	D2	73.416	77.782	13.62	12.86
40		E2	82.407		12.13	
41	42	F2	87.307	92.499	11.45	10.81
43	44	G2	97.999	103.83	10.20	9.631
45	46	A2	110.00	116.54	9.091	8.581
47		B2	123.47		8.099	
48	49	C3	130.81	138.59	7.645	7.216
50	51	D3	146.83	155.56	6.811	6.428
52		E3	164.81		6.068	
53	54	F3	174.61	185.00	5.727	5.405
55	56	G3	196.00	207.65	5.102	4.816
57	58	A3	220.00	233.08	4.545	4.290
59		B3	246.94		4.050	
60	61	**C4**	**261.63**	277.18	**3.822**	3.608
62	63	D4	293.67	311.13	3.405	3.214
64		E4	329.63		3.034	
65	66	F4	349.23	369.99	2.863	2.703
67	68	G4	392.00	415.30	2.551	2.408
69	70	**A4**	**440.00**	466.16	**2.273**	2.145
71		B4	493.88		2.025	
72	73	C5	523.25	554.37	1.910	1.804
74	75	D5	587.33	622.25	1.703	1.607
76		E5	659.26		1.517	
77	78	F5	698.46	739.99	1.432	1.351
79	80	G5	783.99	830.61	1.276	1.204
81	82	A5	880.00	932.33	1.136	1.073
83		B5	987.77		1.012	
84	85	C6	1046.5	1108.7	0.9556	0.9020
86	87	D6	1174.7	1244.5	0.8513	0.8034
88		E6	1318.5		0.7584	
89	90	F6	1396.9	1480.0	0.7159	0.6757
91	92	G6	1568.0	1661.2	0.6378	0.6020
93	94	A6	1760.0	1864.7	0.5682	0.5363
95		B6	1975.5		0.5062	
96	97	C7	2093.0	2217.5	0.4778	0.4510
98	99	D7	2349.3	2489.0	0.4257	0.4018
100		E7	2637.0		0.3792	
101	102	F7	2793.0	2960.0	0.3580	0.3378
103	104	G7	3136.0	3322.4	0.3189	0.3010
105	106	A7	3520.0	3729.3	0.2841	0.2681
107		B7	3951.1		0.2531	
108		C8	4186.0		0.2389	





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Linda Barcan holds degrees in Vocal Pedagogy from the Sydney Conservatorium of Music and the National Institute of Dramatic Art (NIDA). Linda has taught voice at NIDA, Toi Whakaari New Zealand National Drama School, the Sydney Conservatorium of Music Open Academy, University of New South Wales, the Australian Institute of Music (AIM), the Actor's College of Theatre and Television (ACTT) and Wesley Institute for Ministry and the Performing Arts. She is currently Lecturer in Voice at the Western Australian Academy of Performing Arts (WAAPA), in both the Classical Voice and Music Theatre departments.

Linda has given vocal workshops for the Australian National Association of Teachers of Singing (ANATS), the Victorian College of the Arts (VCA), the Conservatorium of Wollongong, the Australian Theatre for Young People (ATYP) and the Western Australian Symphony Orchestra (WASO). A classically-trained mezzo-soprano, Linda has performed for Opéra de Lyon, Opera Australia and various chamber companies. She has appeared in concert in Australia, Asia and Europe, and has featured on recordings and in broadcasts for Virgin, Decca, Warner, ABC TV and Radio, Radio France and Radio France Outre-Mer.