Influence of Linguistic Rhythm on Individual Compositional Style in 19th Century French and German Art Song

Leigh VanHandel,[*1] Tian Song[#2]

[*]*College of Music, Michigan State University, USA*
[#]*College of Education, Michigan State University, USA*
[1]lvh@msu.edu, [2]songtian@msu.edu

ABSTRACT

This study extends prior research on the influence of linguistic rhythm on musical rhythm to 19th-century French and German art songs. Results indicate that the measurement of rhythmic variability used in prior studies, the nPVI, or *normalized Pairwise Variability Index,* may be of use in studying individual compositional style even when a significant correlation with spoken language characteristics is not present in the repertoire. By modifying and focusing the results of the nPVI, it is possible to determine musically meaningful information about individual composer's rhythmic characteristics.

I. INTRODUCTION

Rhythm in spoken language is a perceptual effect involving the *isochrony,* or the regularity of occurrence, of some type of speech item; the item can be a speech unit (such as a syllable) or a linguistic event (such as accent or stress). Languages may be categorized as *syllable-timed* (for example, French and Spanish), in which individual syllables are perceived to be of nearly equal duration, or as *stress-timed* (for example, English and German), in which stressed syllables are perceived as occurring regularly, as a result of the expansion or compression of unstressed syllables.

Recent linguistic studies, most notably Grabe & Low (2002) and Ramus *et al*. (1999), have demonstrated quantitative rhythmic differences between stress- and syllable-timed languages. These studies focused on the role of vowel duration in the two types of languages; they hypothesized that since the length of a syllable is primarily determined by vowel length, an increased variability in vowel length would result in greater variability in syllable length, whereas a language with little variation in vowel length would have little overall variation in syllable length. The model Grabe & Low (2002) developed to measure the amount of durational variability in a language is called the *normalized Pairwise Variability Index,* or nPVI, defined as:

$$nPVI = 100 \times \left[\sum_{k=1}^{m-1} \left| \frac{d_k - d_{k+1}}{(d_k + d_{k+1})/2} \right| / (m-1) \right]$$

where *m* is the number of vowels in an utterance and d_k is the duration of the *k*th item. Grabe and Low's study demonstrated that because stress-timed languages have greater durational variability between successive vowels due to compression and expansion of syllables, stress-timed languages have a higher nPVI measurement than a syllable-timed language with lower variability.

While the nPVI was originally intended to be a measure of the average variation of successive vocalic intervals in spoken language, four studies have used the measure to study the relative durational contrast between successive rhythmic events in music. Patel and Daniele (2003a), Huron and Ollen

(2003), Patel and Daniele (2003b) and Daniele and Patel (2004) all studied rhythm in short instrumental themes to determine whether the rhythmic characteristics of the composer's native language were present. Each study found significant differences between stress- and syllable-timed languages, though Huron and Ollen found a reversal of expected results – the nPVI for the syllable-timed Romance languages (French, Spanish, Italian) was higher than that for the stress-timed Germanic languages (German, Austrian).

A. The database and methodology modifications.

The previous studies focused solely on the rhythmic characteristics of instrumental music. In fact, Patel and Daniele (2003) indicated they were studying instrumental music because they believed vocal music would reflect the rhythms of speech, saying: "[i]f music is based on words, and words have different rhythmic properties in the languages under study, then it would be no surprise if musical rhythm reflected linguistic rhythm."

The current study applies a modified nPVI measure to a large database of solo vocal songs created using David Huron's *Humdrum Toolkit,* an open source software package designed to assist with music research. The database consists of melodic, rhythmic, phrasing, and text information from over one thousand 19th century French and German art songs by 29 composers, as shown in Table 1.

Table 1. Composers and songs in current study database.

French	#	German	#
Bizet	24	Beethoven	18
Chabrier	9	Brahms	52
Chaminade	19	Franz	61
Chausson	30	Hensel	47
David	33	Lang	26
Debussy	33	Loewe	9
Duparc	14	Mahler	19
Fauré	64	Mendelssohn	57
Gounod	51	Schubert	121
Holmés	16	C. Schumann	7
Lalo	15	R. Schumann	123
Massé	20	Strauss	33
Massenet	39	Wolf	82
Reber	30		
Reyer	8		
Saint–Saëns	7		
Total:	**412**	**Total:**	**655**

Composers were included in the database based upon availability of sufficient repertoire for study, reputation within the genre, gender, and to provide data points distributed across the 1800s. In cases where composers had authored a

large number of songs, a representative sample was selected from different periods of their life. Encoding was done by highly trained musicians; files were checked by other highly trained musicians for accuracy and for agreement with phrasing interpretations.

Unlike the strict selection criteria of the previous studies, the primary selection criteria in this study were only that the songs be secular solo vocal works with piano accompaniment, and be composed before 1900 by French and German composers. To avoid translation issues, both the composer and the poet had to be native speakers of the language, with the text originally written in that language. Stylistic pieces, such as *Chinoise,* were excluded, as were songs that had been excerpted from operas.

1) Phrasing, grace notes and rests. When applying the nPVI to short (3-4 mm.) thematic excerpts, as in the previous studies, phrasing is not a primary consideration. However, as the current study includes full song melodies, phrasing becomes critically important.

According to Fox (2002), there is evidence that the duration of a perceived isochronous unit in spoken language does not remain constant over a long utterance, but rather changes from phrase to phrase. Linguistic isochrony appears to conform to the principles of the *intonational phrase,* which may be defined as "the unit at which the cognition, physics, syntax, phonetics, and phonology of speech converge" (Wennerstrom 2001). As a result, each phrase uses a different unit of isochrony, and rather than calculate the nPVI across boundaries, linguists calculate the nPVI of individual phrases.

Thus, the most accurate representation of rhythmic variability in music results from applying the nPVI measure to the closest musical correlate to the intonation phrase level of speech, which is the musical phrase. Therefore, the nPVI was modified to calculate the phrase-nPVI, or *pnPVI*, which is the amount of rhythmic variability in individual musical phrases. Song and composer averages are calculated from this data.

The four previous studies were inconsistent in their treatment of rhythmic events such as grace notes and rests. Patel and Daniele's studies discarded themes that contained grace notes, and either discarded all themes containing rests (2003a) or ignored rests (2003b); Huron and Ollen's study included themes containing grace notes and rests, converting grace notes to a 64th note duration and adding the duration of a rest to the duration preceding it. The current study discarded grace notes and embellishments and categorized rests as intra- or inter-phrase rests. A complete discussion of these decisions can be found in VanHandel (2005).

II. RESULTS

A. Cross-Language Results

A cross-language comparison reveals no difference in the rhythmic variability present in the songs written by German composers and the songs written by French composers (t=-.28, p=.78); the overall French pnPVI average was 49.44, while the overall German pnPVI average was 48.76. As in Huron and Ollen (2003), the songs from the syllable-timed Romance language have a higher pnPVI value than the stress-timed Germanic language, rather than the expected lower value. Thus, the hypothesis that French and German vocal music would generally reflect the rhythmic variability characteristics of the spoken language does not hold for this data. What is most important about this result is that the hypothesis has failed in a genre and era where the relationship between language and music has traditionally been assumed to be strong.

This unexpected result is interesting on its own merits; however, it is not musically meaningful. In fact, even if the cross-language comparison *was* significantly different, it still would not provide much musically relevant information about musical style, whether overall or that of individual composers. One way to come closer to a musically relevant discussion of rhythmic variability in music is to look deeper than this surface-level result to determine whether the lack of an overall cross-language difference is masking some deeper relationships that may prove musically relevant.
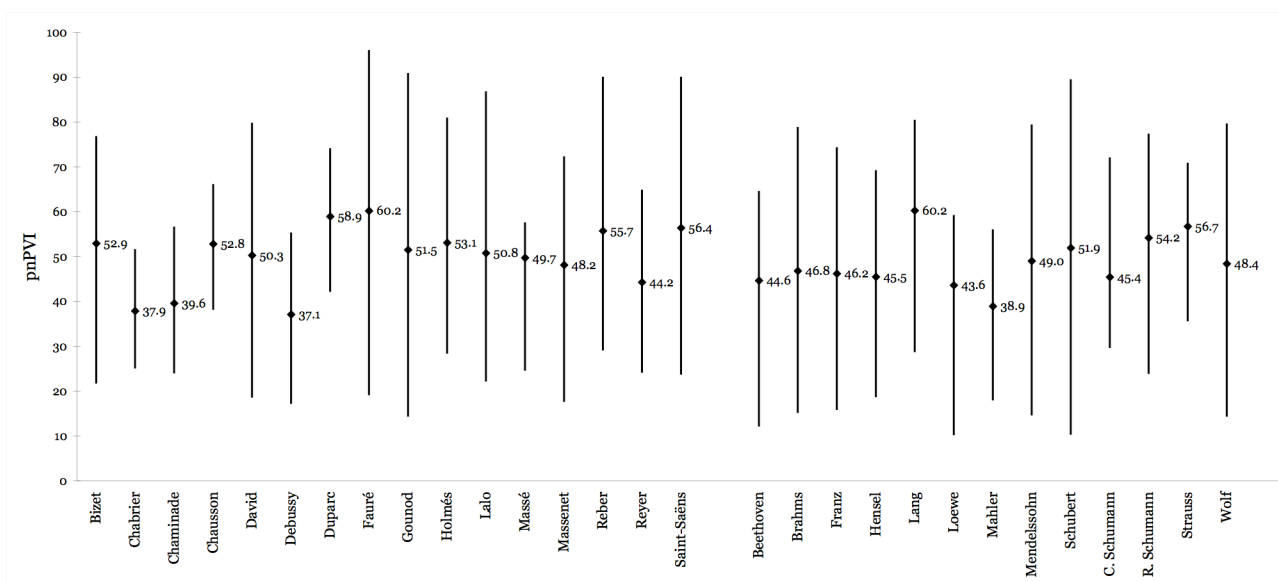

Figure 1. Individual composer average pnPVI and range for full songs (calculated by averaging phrases)

B. Individual Composer Rhythmic Variability.

Figure 1 illustrates the overall pnPVI average and the range of pnPVI averages for songs for individual composers. (Both the overall pnPVI and the song averages are calculated by averaging individual phrase pnPVI values.) For example, the pnPVI value for Bizet songs ranges from a minimum of 21.6 to a maximum of 76.8, with an overall average of 52.9.

Clearly notable on this graph are the low average pnPVI and small range for the Chabrier, Chaminade, and Debussy songs, indicating that the compositional style of these composers regularly included a low amount of rhythmic variability; this can be visually contrasted with the narrow distribution range and relatively high average pnPVI for Duparc, indicating that Duparc's compositional style regularly included a *high* amount of rhythmic variability.

An ANOVA F-test showed that there are significant differences in pnPVI across French composers (F=31.82, DF=15, and p<0.0001). Newman-Keuls multiple comparison tests were then used to compare all pairs of means. The results, as shown graphically in Figure 2, indicate Chabrier, Chaminade, and Debussy are significantly different than every other French composer except Reber. The connecting lines in Figure 2 indicate that the rhythmic variability characteristics of that composer pair are *not* significantly different; in other words, the fewer connecting lines a composer has, the less similar they are to their compatriots.

Similarly, the ANOVA F-test showed that there are significant differences in pnPVI across German composers (F=25, DF=12, and p<0.0001). Newman-Keuls multiple comparison tests, represented graphically in Figure 3, indicated that Josephine Lang's average pnPVI value of 60.2 is significantly different than all other German composers with the exception of Strauss, who himself is different from every other composer except Robert Schumann.

C. Influence of Meter on Rhythmic Variability.

Patel and Daniele (2003) briefly considered whether meter may have an effect on rhythmic variability. They investigated whether there were differences between what they termed "binary and ternary meters (i.e., meters which divide beats into two vs. three subdivisions, such as 2/4 vs. 6/8)". Their results indicated there was no difference across languages in the percentage of use of the metrical types across the French and English themes; both used "binary" meters approximately 75% of the time (English: 75.9%, French 79.0%). In addition, they determined that there was no significant difference across language in the nPVI value of "binary" meters vs. "ternary" meters (42.98 vs. 45.25, respectively). Thus they excluded metrical type as having a role in the signficant differences they found in their study.

What Patel and Daniele call "binary" and "ternary" meters are more frequently referred to by musicians as *simple* and *compound* meters, respectively. Table 2 illustrates that for the current study's 19th century art song database, the overall proportion of use for simple and compound meters found by Patel and Daniele (2003) holds; simple meters are used in 73.2% of the phrases in the database, whereas compound meters are used for 24.9% of the phrases. There is no significant deviation from these proportions within either language individually (p=.11, Fisher's Exact p). The percentages do not sum to 100% because they do not include phrases in complex meters or phrases that contain multiple meter signatures.

Table 2. Percentage of use of simple and compound meters

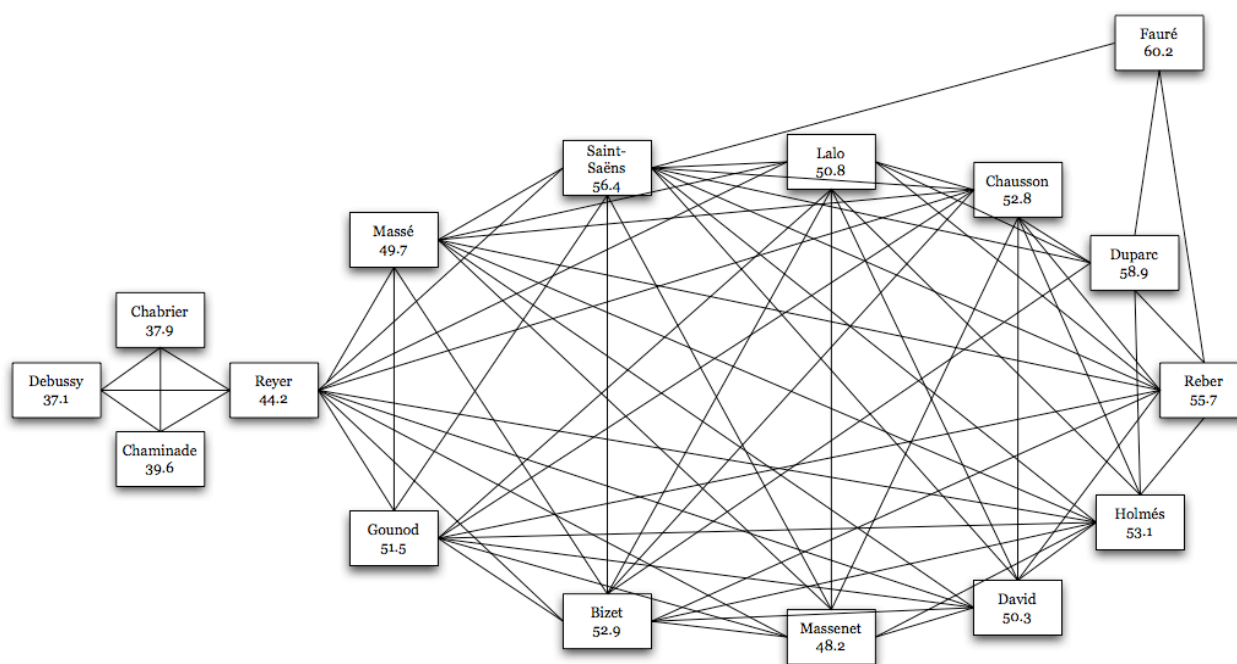|	simple	compound
French and German phrases combined:	73.2%	24.9%
French phrases alone:	74.6%	22.9%
German phrases alone:	72.2%	26.4%

Figure 2. French composers graph: connection lines indicate that the two composers are not significantly different from one another.
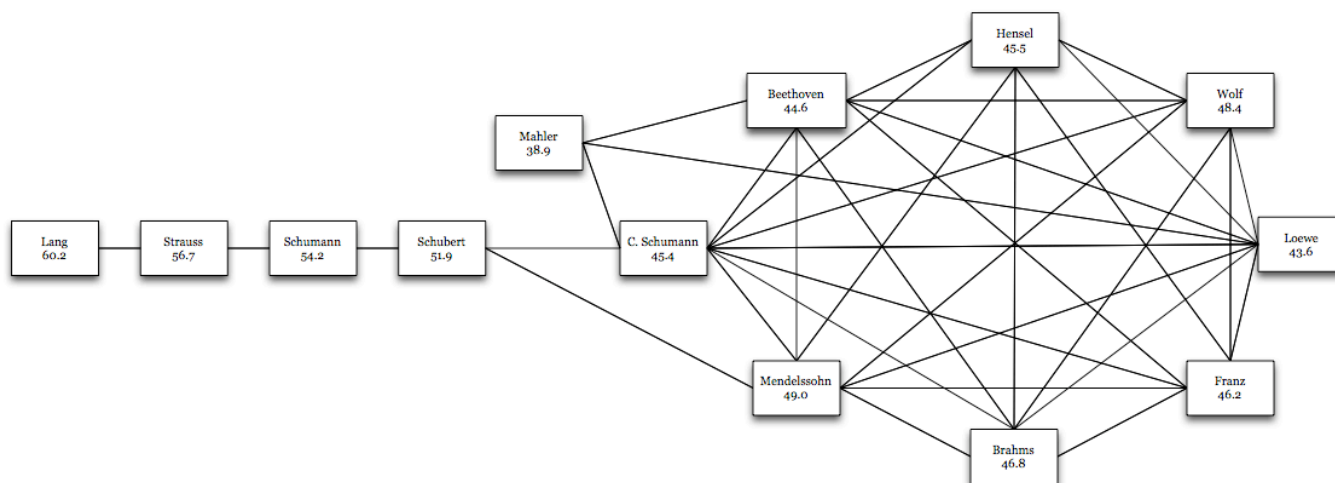
Figure 3. German composers graph: connection lines indicate that the two composers are not significantly different from one another.

Table 3 illustrates the pnPVI value for all phrases in simple and compound meters. The pnPVI average for all phrases in compound meters is significantly higher than the pnPVI average for all phrases in simple meters, indicating an increased amount of rhythmic variability in compound meters compared to simple meters. This result holds for individual languages as well; for both French and German, the compound meter phrases in the database have a significantly higher amount of rhythmic variability than do the simple meter phrases. Table 3 also illustrates that there is no difference across languages for rhythmic variability within simple or compound meters; French phrases in simple meters and German phrases in simple meters tend to have similar amounts of rhythmic variability overall, as do French phrases in compound meters and German phrases in compound meters.

Table 3. pnPVI values for simple and compound meter phrases across and within languages.

	simple	compound	p=
French and German combined:	48.51	55.70	*<.0001*

	simple	compound	p=
French:	49.06	54.98	*.03*
German:	48.11	56.15	*<.0001*
p=	*.31*	*.45*	

Unlike Patel and Daniele (2003), who found an overall cross-language difference in rhythmic variability but did not find a difference across metrical types, in this genre and repertoire there is no cross-language difference overall, but there *is* a significant difference between simple and compound meters, both within-language and with the two languages combined. Compound meters contain a higher amount of rhythmic variability than simple meters for both French composers and German composers.

III. DISCUSSION

The logical next question is whether the percentage of use and the pnPVI trends holds for individual composers, or whether there is variability in the percentage of use and pnPVI value for individual composers that might illuminate something about individual compositional style. Table 4 lists the pnPVI average, number of phrases, and percentage of use for simple and compound meters for each French and German composer.

It is clear that even though both languages have a similar overall distribution of simple and compound meters, the percentage of use of the two metrical types varys greatly for individual composers. For example, Chabrier uses compound meter only 8.25% of the time, and Holmés only 9.93% of the time. In contrast, Lalo uses compound meters 44.59% of the time. A similar range of percentages is present for the German composers as well: Mahler uses compound meters only 8.90% of the time, and Lang only 9.67, whereas Clara Schumann uses compound meters 49.4% of the time.

As Figures 1-3 showed, there are definite differences in the overall average amount of rhythmic variability present in individual composers. Table 4 illustrates that when the overall average for individual composers is separated into phrases in simple versus compound meter, there are differences within the way individual composers treat the two different metrical types. For example, while most of the French composers have a lower pnPVI value for phrases in simple meters, as expected based on the results shown in Table 3, Chausson, Gounod, Holmés, Lalo, and Reber all have *lower* average pnPVI values for their compound meter phrases than for their simple meter phrases. None of the German composers exhibit this characteristic; the compound meter phrase pnPVI average is higher for each German composer than the pnPVI average for the simple meter phrases.

There are some notable aspects of the simple versus compound comparison. For example, Chabrier's overall pnPVI average was a comparatively low 37.9; only Debussy's overall average of 37.1 was lower. However, Chabrier's average pnPVI values for simple and compound are markedly different – 35.69 for simple meters, and 62.55 for compound,

indicating that when he did use compound meter, he used much more rhythmic variability. In comparison, Debussy's average pnPVI for phrases in simple meters is 36.78 and for phrases in compound meters is 39.16, indicating that there was very little difference in Debussy's rhythmic variability, regardless of meter. Among the German composers, Mahler and Loewe have relatively low pnPVI averages for phrases in simple meters and relatively high averages for phrases in compound meters, while Lang remains relatively consistent across the metrical types.

IV. CONCLUSION

The nPVI measurement, or its refinement (pnPVI) used here, has been used to demonstrate differences in the amount of rhythmic variability used in music. These differences may be attributable to characteristics of the spoken language, as hypothesized in a series of articles by Patel and Daniele and Huron and Ollen.

In an unexpected result, the current study does not demonstrate the cross-language difference found in the earlier studies. However, the results of this study illustrate the use of the pnPVI measurement of rhythmic variability as an important music analysis tool that may be able to bring us closer to understanding the role of rhythmic variability in compositional style. The measurement provides a quantitative measurement of an aspect of compositional style that has received little attention. The differences highlighted in this paper are worthy of further study to determine if and how a composer's approach to metrical types and rhythm may provide a key to understanding individual compositional style.

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Table 4. Individual composer pnPVI average, number of phrases, and percentage of use for simple and compound meters. (Percentages do not add to 100% because some meters were classified as *complex* or *multiple.*)

	French simple			French compound				German simple			German compound		
	pnPVI	**#**	**%**	**pnPVI**	**#**	**%**		**pnPVI**	**#**	**%**	**pnPVI**	**#**	**%**
Bizet	51.72	399	81.10	58.21	93	18.90	Beethoven	42.42	117	66.10	49.76	55	31.07
Chabrier	35.69	260	89.35	62.55	24	8.25	Brahms	44.25	477	67.37	52.44	221	31.21
Chaminade	36.66	182	65.23	46.56	88	31.54	Franz	41.87	469	67.97	55.73	218	31.59
Chausson	52.92	325	77.57	52.62	58	13.84	Hensel	39.22	425	64.01	57.21	232	34.94
David	48.55	195	75.29	55.04	62	23.94	Lang	59.70	271	90.33	65.31	29	9.67
Debussy	36.78	553	83.03	39.16	86	12.91	Loewe	39.92	130	59.63	56.97	61	27.98
Duparc	54.23	185	59.49	66.60	120	38.59	Mahler	36.96	254	86.99	55.89	26	8.90
Fauré	56.87	611	71.13	67.97	227	26.43	Mendelssohn	47.74	354	55.75	50.67	279	43.94
Gounod	52.39	805	76.38	48.71	247	23.43	Schubert	50.32	1615	72.26	56.02	613	27.43
Holmés	53.98	235	80.48	43.28	29	9.93	C. Schumann	42.32	42	50.60	48.56	41	49.40
Lalo	55.58	87	55.41	44.77	70	44.59	R. Schumann	52.80	1419	82.93	61.42	288	16.83
Massé	48.63	209	70.13	53.30	86	28.86	Strauss	54.46	364	71.79	65.09	110	21.70
Massenet	45.56	416	71.85	55.51	152	26.25	Wolf	45.21	749	72.30	56.60	275	26.54
Reber	57.00	253	69.89	52.69	105	29.01							
Reyer	40.29	66	74.16	56.21	20	22.47							
Saint-Saëns	53.03	78	75.73	66.92	25	24.27							