

VISUALIZING VIBRATO: A LIBRARY OF WIGGLES TO BROADEN TECHNICAL AND CULTURAL HORIZONS

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ABSTRACT

In this paper, we provide a library of 169 vibrato graphics utilizing recent developments in music publishing that make it easier to notate vibrato and with superior clarity. Visualizing vibrato with two variables, speed and presence, helps teachers, students, composers and musicologists to broaden horizons technically and stylistically. In an ocularcentric world, seeing vibrato makes it easier to comprehend cultural differences and practice vibrato. Users may copy, paste, and customize the 169 vibrato graphics. This requires installation of the Open Font ‘Bravura Text’, developed in tandem with the Standard Music Font Layout specification (SMuFL), which together represent a milestone in the history of music notation. Bravura gives access to over 2440 music symbols, 35 of which are tessellating glyphs for building vibrato wiggles. As a result of testing combinatorial options and developing an inventory of graphics relevant to vibrato training, we aim to advance notational intelligence across technical and expressive dimensions of vibrato for instrumentalists and vocalists alike. With SMuFL’s latest version 1.4 released in March 2021, and version 1.5 currently in the drafting stage, we additionally offer suggestions to the developers of this significant notational tool for how it may be further refined.

1. INTRODUCTION

It is unusual to notate vibrato. Indications tend to be vestigial and verbal. This imprecision allows technical habits and cultural biases to shut down the imagination, closing doors to expressive possibilities. In many vocal and instrumental traditions, from Western classical (e.g. soprano, violin) to diverse Asian traditions (e.g. duduk, piri, shakuhachi) cultivating a good vibrato is key to professional success, yet it remains invisible in the scores that mobilize the industry. Conversely, for composers working with music notation software, the lack of variety and precision in vibrato symbols can negatively impact their creativity and usability [1, p. 7]. From both sides of the coin, for example composers from a Western classical background or performers from an Asian tradition, this can foster prejudice, blind spots, musical parochialism, and lack of intercultural understanding about vibrato. Instead of being

able to speak multiple vibrato languages, many musicians overlook less privileged vibrato cultures. By visualizing vibrato, the idea of engaging with the unfamiliar, or mastering the mysterious, becomes less daunting. Involuntary habits can be noticed, the craft of vibrato made more deliberate, and virtuosity, concentration, focus, and expression can be enhanced in both performance and notation [1, p. 13]. Whether the objective is to learn a foreign musical style, or to raise one’s level of virtuosity within a musical style, it is helpful to see vibrato in more detail than ‘vib.’ and ‘senza vib.’. We therefore welcome the inclusion by Daniel Spreadbury within Bravura of a repertoire of glyphs that allow vibrato to be represented on the page with greater precision.¹

The Bravura font family is significant for three reasons. First, it has been released under the SIL Open Font License, which means that it is free to download, use, embed, redistribute with other software (including commercial software) or to create derivative versions. Secondly, its companion, the Standard Music Font Layout (SMuFL, pronounced ‘smooﬂe’), is a revolutionary specification, solving what was becoming a technological nightmare in a manner applauded by music engravers and software developers.² Thirdly, Bravura is a music font of outstandingly high quality. It harvests the collective heritage of the last two hundred years comprehensively, pushing levels of beauty and legibility even higher. Bravura and SMuFL were launched in 2013, establishing Spreadbury and Steinberg Media as global leaders developing the next-generation music notation and composition software, Dorico. Our motivation for creating and sharing a library of customizable vibrato graphics is to liberate the creative imagination of performers and composers and to decolonize vibrato education. SMuFL Version 1.4 allows for seven shades of ‘speed’ and five shades of ‘presence’.³ We use the term presence, rather than width or intensity, to reduce confusion. The width of a wiggle segment conveys speed, not presence, and the adjective intensity is generally used for

¹ Bravura is described at smufl.org/fonts and maintained at github.com/steinbergmedia/bravura.

² The goal of SMuFL is to establish a new standard glyph mapping for musical symbols that is optimized for modern font formats and that can be adopted by a variety of software vendors and font designers, for the benefit of all users of music notation software. Launched in 2013, Version 1.4 was released on 16 March 2021 and is the latest version: w3c.github.io/smufl/releases/1.4. As of this time of writing on 17 July 2025, Version 1.5 is in the drafting stage: <https://w3c.github.io/smufl/latest/>

³ The present repertoire of vibrato glyphs was added by Daniel Spreadbury to SMuFL in Version 0.5 (2013-07-08) and to Bravura in Version 0.2 (2013-07-05); smufl.org/versionhistory and raw.githubusercontent.com/steinbergmedia/bravura/master/redis/FONTLOG.txt.

timbre, a variable that is independent of vibrato.⁴ In notation, vibrato speed and presence are represented by the wiggle’s wavelength and amplitude. Acoustically, presence collapses three parameters into one: variance in pitch (known as ‘extent’), loudness (or amplitude), and timbre. In order to give vibrato wiggles the same level of beauty and elegance that SMuFL accommodates for trills, we recommend for Version 1.5 of SMuFL that the number of gradations of presence be increased from five to eight (introducing straight segments). Our library presents 169 multi-segment wiggles in five tables (Figures 1-5), with an analysis of the composition of each graphic to facilitate customization. Working with these wiggles requires installation of a SMuFL-compliant font. This document uses ‘Bravura Text’ version 1.393, released in February 2021. Bravura is a family of two fonts, one intended for use in scoring applications, the other for use in text-based applications. We only use the font for scoring applications, ‘Bravura’, to illustrate correct tessellation under Recommendation 1 below, otherwise all the graphics use ‘Bravura Text’.⁵

2. A LIBRARY OF 169 VIBRATO WIGGLES

This library is intended to serve anyone working with a vibrato-capable instrument who wishes to expand their technical horizons or escape their cultural paradigm. These visualizations are intended as a means to help cultivate vibrato skills that are less mechanical, less limited by cultural conditioning, more supple, more in control, wider in expressive palette, and better able to adapt to context.

Figure 1 presents the full repertoire of component glyphs with their names, Hex codes, and a run of identical glyphs to copy and paste. The glyphs are named ‘wiggleVibrato-[Presence][Speed]’, with five gradations of presence from ‘Smallest’ to ‘Largest’, and seven gradations of speed from ‘Slowest’ to ‘Fastest’. Figures 2–5 combine the segments in systematic ways, capturing a few of the vibrato idioms and training exercises practised around the world. The range, scope, and subtleties in real life are vastly greater, limited only by human imagination and schooling. The graphics may be regarded as signs intended to mobilize complex actions rather than as phonographic documents with a mechanical correspondence to reality[2]. Figures 3 and 4 present tessellations that reveal how the glyphs were designed. Figures 2 and 5 push beyond their designer’s intentions in order to capture real-world vibrato practices more precisely, leading us to make Recommendations 2 and 3. The numbers in brackets reveal the composition of each tessellation. For example, (2,2,2,2) means that there are two instances of each segment.

The vibrancy, or emotional life in a musical tone involves oscillations that are an interaction of three acoustic com-

⁴ The concepts of a wide vibrato (generally slow) and an intense vibrato (generally fast) fail to decouple the two variables with neutrality. The term ‘width’ may relate to the physical action of producing vibrato on Western string instruments, or the extent of the pitch bend. Width also fails to describe the relevant action, for example, of woodwind players who use finger vibrato.

⁵ The latest versions of the Open Type Font (OTF) files are available at github.com/steinbergmedia/bravura/tree/master/redist/otf. In most cases, a double click on the downloaded OTF file will install it on your system.

ponents. The main component may be pitch, loudness, or timbre: they vary in proportion between instruments, between performers, between notes, and during notes. A vibrato’s presence may therefore be increased by a wider pitch range (the ‘extent’), a wider dynamic range, or a wider timbral range. Jeffrey Lependorf, the composer and shakuhachi master, stresses that on the shakuhachi “various [vibrato] widths as well as various speeds are possible and all can be a sustained note” and gives the example of *yuri* which “tend either to begin fast and erratic, slowing down to a controlled vibrato, or vice versa”[3, pg. 238-239].⁶ The Armenian duduk teacher, Vick Gevorgyan, likens the rhythm of a good vibrato to the sound of a ball bouncing, with the bounce height and period of oscillation decaying naturally [4]; this decaying oscillation is also heard on the Korean piri [5]. On instruments with fewer notes, vibrato is more in the limelight and often a focus of artistry, with performers exercising greater control than their Western counterparts.

The clean slate offered by the aulos revival [6, pg. 24-40], the instrument of Greek tragedy, and the global equality and diversity agenda prompt us to consider how to decolonize the attitudes to vibrato perpetuated by Western notation and Western conservatoire training.⁷ How could we give oppressed vibrato practices equal consideration and respect on the pages of globally-connected devices, updating Western notation to reflect contemporary values? And how might these vibrato traditions be contextualized within intercultural frameworks; for example, migrating elements of one vibrato tradition into another context (e.g. a Greek tragedy-inspired Western opera) or vice versa, expanding a vibrato tradition with new possibilities [7, pg. 9-11]? Writing new music for doublepipes – exercises and rehearsals for recording and performance of Austin Oting Har’s Greek tragedy-inspired opera *The Ghost* [6, pg. 24-40][8] – we decided to differentiate five broad categories:

- 1) d-vib. diaphragm vibrato (abdomen, rib-cage, throat)
- 2) m-vib. mouth vibrato (lip, chin, jaw, neck)
- 3) a-vib. arm vibrato (elbow, wrist, hand)
- 4) f-vib. finger vibrato (slight leak, slightly covering the highest open hole, fully covering lower holes)⁸
- 5) i-vib. interference-beat vibrato (unison pitches slightly detuned)

All of these techniques would have been possible in the elite piping cultures of ancient Mesopotamia, Egypt, Persia, Greece, and Rome; all have subtypes that are porous (except i-vib.) and promiscuous [9].⁹ Vibrato is a surprisingly rich ecosystem characterised by hybridity and strong opinions. The conventional stance of Western singing teachers, who widely view non-Western and non-Classical vi-

⁶ See Lependorf’s paper also for a graphic notation of a slow and wide vibrato becoming fast and narrow on shakuhachi.

⁷ The crux of a debate over how to notate music for ancient Greek aulos is explained in Barnaby Brown, Babylonian tunings for the 9-string *sammū* (c. 1800–600 BCE) and a hypothetical tablature for Panhellenic aulos (c. 500 BCE), Figshare, 2020, doi.org/10.6084/m9.figshare.13064126.

⁸ Historical names in Western music for types of finger vibrato include *flattement* and *bisbigliando*.

⁹ For demonstrations on a Pydna aulos with double reeds, and a Rustic aulos with single reeds, see Barnaby Brown, Five Types of Vibrato: exploring the possibilities on doublepipes, YouTube, 2020, youtu.be/FFQrtazhX1A.

wobbleVibratoStart U+EACC		Smallest U+EAD0	Fastest
		Small U+EAD7	
		Medium U+EAD6	
		Large U+EAE5	
		Largest U+EAE4	
Slowest	Smallest U+EAD3	Faster	Smallest U+EACF
	Small U+EAD1		Small U+EADG
	Medium U+EAE1		Medium U+EAD0
	Large U+EAE8		Large U+EAE4
	Largest U+EAEF		Largest U+EAE3
Slower	Smallest U+EAD2	Faster Still	Smallest U+EACE
	Small U+EAD9		Small U+EAD5
	Medium U+EAE0		Medium U+EADC
	Large U+EAE7		Large U+EAE3
	Largest U+EAE6		Largest U+EAE2
Slow	Smallest U+EAD1	Fastest	Smallest U+EACD
	Small U+EAD8		Small U+EADA
	Medium U+EADF		Medium U+EADB
	Large U+EAE6		Large U+EAE2
	Largest U+EAE9		Largest U+EAE9

Figure 1. The thirty-six ‘wobbleVibrato’ glyphs in SMuFL 1.4 and Bravura 1.393.

Growing (2,2,2,2)	Growing (3,3,3,3)	Growing (4,4,4,4)	Growing (5,5,5,5)
Decaying (2,2,2,2)	Decaying (3,3,3,3)	Decaying (4,4,4,4)	Decaying (5,5,5,5)
<i>Component glyphs</i>	<i>8 glyphs</i>	<i>16 glyphs</i>	<i>32 glyphs</i>
wobbleVibratoSmallSlowest U+EADA	.....	.....	.....
wobbleVibratoMediumSlow U+EADF	.....	.....	.....
wobbleVibratoLargeFaster U+EAE4	.....	.....	.....
wobbleVibratoLargestFastest U+EAE9	.....	.....	.....

Figure 2. Variable-presence, fixed-speed tessellations

brato cultures as ‘unhealthy’, ‘artificial’, or ‘incorrect’, may be linked to vibrato’s invisibility.¹⁰ Composers or educators working with other instruments could adapt this culture-neutral taxonomy for situations where it was desirable to notate multiple vibrato types in a single score, without suggesting that one type or aesthetic is superior to others.

3. METAPHORS FOR VIBRATO TRAINING

Five levels of speed and five levels of presence are probably optimal for educational purposes. Meaningful extramusical associations make it easier to differentiate the levels conceptually and sets of words like the following may be useful in teaching and learning.

Anything repetitive is a potential health hazard and discovering the easiest way, loosening up, is important in every vibrato idiom. These metaphorical associations on a simple 1–5 scale may be more memorable and manageable in the context of technical training, but for typographic elegance, the finer gradations provided by Bravura are invaluable. There is no need for educational categories and graphic increments to coincide. They satisfy different cri-

¹⁰ Karyn O’Connor, singwise.com/articles/vibrato-what-it-is-and-how-to-develop-it. The belief that vibrato ‘occurs naturally in order to protect the vocal folds’ is cultural, correct from one perspective; it fails to explain Indian, Arabic, Balkan, and other vocal styles that possess far greater agility in vibrato than is customary in Western Classical singing; for example, Pratibha Sarathy, ‘How to sing Gamakas?’, VoxGuru, YouTube, 2018, youtu.be/AIPraIlSmIk.

Accel. (1,1,1,1,1,1)	Accel. (2,2,2,2,2,2)	Accel. (3,3,3,3,3,3)
Accel. (1,1,1,2,2,3,4)	Accel. (1,1,2,2,3,5,7)	Accel. (1,2,3,4,5,6,7)
Rall. (1,1,1,1,1,1)	Rall. (2,2,2,2,2,2)	Rall. (3,3,3,3,3,3)
Rall. (4,3,2,2,1,1)	Rall. (7,5,3,2,1,1)	Rall. (7,6,5,4,3,2,1)

Figure 3. Fixed-presence, variable-speed tessellations

Growing (2,1,1,1)	Growing (3,2,2,2)	Growing (5,3,3,3)
Growing (5,4,3,2,1)	Growing (6,5,4,3,2)	Growing (7,6,5,4,3)
Decaying (1,1,1,1,2)	Decaying (2,2,2,2,3)	Decaying (3,3,3,3,5)
Decaying (1,2,3,4,5)	Decaying (2,3,4,5,6)	Decaying (3,4,5,6,7)

Figure 4. Variable-presence, linear-speed-change tessellations

teria: the metaphors meet needs of pedagogy and practising, developing competency, whereas the graphic distinctions satisfy demands of music publishing, producing scores.

4. SHARPENING THIS NOTATIONAL TOOL

We began developing this library for personal use, producing scores for aulos, practicing unfamiliar vibrato techniques destined for the recording and performance of Har’s Greek tragedy-inspired opera[10][8][6, pg. 24-40], and developing materials for aulos students that would be good allies for marginalized vibrato cultures. This creative process brought some minor issues into focus, leading us to suggest three refinements. Although primarily addressed to font designers contributing to the evolution of the Bravura font family, and to the W3C Music Notation Community Group responsible for the evolution of SMuFL, they are shared here to invite a broader spectrum of potential users to add their wisdom on how to make this tool even more satisfying and future-proof.

Growing (2,2,2,2,2) 	Growing (3,3,3,3,3) 	Growing (4,4,4,4,4)
Growing (5,4,3,2,1) 	Growing (6,5,4,3,2) 	Growing (7,6,5,4,3)
Decaying (2,2,2,2,2) 	Decaying (3,3,3,3,3) 	Decaying (4,4,4,4,4)
Decaying (1,2,3,4,5) 	Decaying (2,3,4,5,6) 	Decaying (3,4,5,6,7)

Figure 5. Variable-presence, exponential-speed-change tessellations

Presence	1 absent frozen	2 subtle melting	3 normal warm	4 prominent heated	5 extravagant ecstatic
Speed	1 still peace	2 swaying throbbing	3 laughing sobbing	4 chuckling crying	5 sparkling terrified

Figure 6. Five levels of speed and five levels of presence

4.1 Recommendation 1: Negative side bearings in Bravura Text

The wiggles tessellate beautifully in applications designed to support SMuFL. At the present time, these include Dorico, MuseScore, Capella 8, Soundslice, Verovio, neoScores, MusicXML, Logic Pro X, and MaxScore, with support for Finale coming soon. There is an issue, however, with Microsoft Office 365. When pasted into Word or Powerpoint, the ‘wiggleTrill’ segments in version 1.393 of Bravura Text appear with normal character spacing at font size 72 as seen in Figure 7.

Note that there are nine speeds of trill. Switching kerning on has no effect and sharp corners appear with Word’s export to PDF function. There is a user workaround. With character spacing condensed by 4.5 points, the segments overlap as seen in Figure 8.

Slightly smoother junctions may be achieved by adjusting the spacing manually (between 3.2 and 5.1 points) as seen in Figure 9.

More efficient is to build the wiggles in an application like Dorico or MuseScore and do a screen capture. Ideally, however, the glyphs would tessellate correctly automatically in the applications available as standard in ed-



Figure 7. Recommendation 1.1: ‘wiggleTrill’ segments with character spacing at font size 72



Figure 8. Recommendation 1.2: ‘wiggleTrill’ segments overlapping with character spacing condensed by 4.5 points

ucational institutions, without administrators having to do anything other than install Bravura Text. The SMuFL guidelines for fonts designed for scoring applications state: “Tessellating glyphs (such as wavy lines, or the component parts of complex trills and mordents) should have negative side bearings, in order to achieve correct tessellation when set in a single run [1].”

In the version of the font designed for scoring applications, ‘Bravura’, the glyphs tessellate beautifully, but the large white space above and below is unwieldy in text-based applications. The glyph is shown in Figure 10 (the excessive white space appears when used in text-based applications).

For tessellating glyphs, we recommend that the existing guidelines for fonts designed for scoring applications be extended to fonts designed for text-based applications. We also offer font designers and application developers a set of wiggles for testing purposes (Figure 11). Ideally, non-technical users would be able to build wavy lines with variable-speed and variable-presence, with the tessellation happening automatically as the typographer intended.

4.2 Recommendation 2: Invariable glyph width per speed

Training the muscles that produce vibrato involves learning how to relax, reduce tension, and cultivate an effortless oscillation that beautifies the sound with freedom and agility, without risk of fatigue or injury. One of the exercises that promotes flexibility and enriches the expressive palette is to maintain a constant vibrato speed while turning up or down the presence. Another is to maintain a constant vibrato presence while turning up or down the speed. Decoupling the two parameters is the antidote to an involuntary or mindless vibrato: the result of tension and bias curbing an artist’s capacity to be deliberate.

Figure 2 reveals that the vibrato glyphs were not designed with independence of speed and presence in mind. Only four gradations of presence are available for notating a fixed-speed vibrato because the seven speeds are not absolute, but relative (proportionally scaled with the presence). As a result, the ‘SlowestSmallest’ wiggle has a shorter wavelength than the ‘FastestLargest’ wiggle:

This is counterintuitive. The difference in glyph width between ‘SlowestLargest’ and ‘FastestSmallest’ is also un-



Figure 9. Recommendation 1.3: ‘wobbleTrill’ segments with smoother junctions by manually adjusting character spacing between 3.2 and 5.1 points



Figure 10. Recommendation 1.4: ‘wobbleTrill’ segments with good tessellation using Bravura font, but excessive white space above and below the symbol when used in text-based applications

realistically large:

Pavarotti’s vibrato speed ranges between 5.6 and 6.6 Hertz, with significant emotional nuance lying within this 1.0 Hertz bandwidth [12]. Instrumentalists often have a wider range of speed than singers, and more control, but it is in Asian cultures that the widest range of speed is found. Where many Western instrumentalists demonstrate virtuosity through fingering techniques, “the shakuhachi demonstrates true virtuosity in the areas of vibrato and pitch inflection” [3, pg. 238]. The result of making vibrato speed relative to presence, rather than absolute, is that vibrato nuances which are compelling and eminently practical can only be notated crudely (Figure 2), yet speed changes that are impractical, far beyond what Asian virtuosos do, can be notated beautifully.

The present wavelength ratio of 11:1 between the ‘Fastest’ and ‘Slowest’ glyphs exaggerates reality unhelpfully. We recommend simplifying reality by fixing the seven vibrato speeds to the widths of the existing ‘Large’ glyphs. A ratio of 3:1 between the longest and shortest wavelengths is sufficient to mobilize musically-intelligent results, bringing this vibrato notation tool into alignment with the practices of musicians.

Vibrato training on many instruments involves starting slow (1 Hertz) and spreading looseness and freedom of movement to progressively faster rates, without locking up or freezing [13].¹¹ Fixing the gradations of speed to notional practice tempi would be a performer-friendly approach, making this vibrato notation tool more useful in education.

Figure 6 shows how the glyphs for each degree of presence have frequencies that vary comparably with the wavelengths of the seven colors of the rainbow.

The existing names of the seven speeds are confusing because ‘SlowerStill’ is missing and there is no increment between ‘Slow’ and ‘Fast’. When building variable-speed vibrato graphics, it is opaque which glyphs are adjacent in the series. SMuFL’s ‘About’ page states: “Room for future expansion has generally been left in each group, so code points are not contiguous. The code point of each glyph

¹¹ For example, see String Technique, Developing Vibrato for Cello, YouTube, 2018, youtu.be/Ki0miM7wQbw.

Note: Microsoft Word does not currently support the correct tessellation of multi-segment wavy lines. The painstaking labours of font designers, setting the negative side bearings of each glyph, are therefore not displayed in this table, which uses a crude workaround: the wiggles are at a font size of 22 pt with character spacing condensed by 1.0 pt. They must be pasted into an application that does support negative side bearings for the quality of Spreadbury’s work to be appreciated and refined.

<p>Nine trill speeds</p> <p>1 2 3 4 5 6 7 8 9 8 7 6 5 4 3 2 1</p>	<p>Five vibrato presences</p> <p>1 2 3 4 5 4 3 2 1</p>
<p>Seven vibrato speeds</p> <p>1 2 3 4 5 6 7 6 5 4 3 2 1</p>	

Figure 11. Paradigm of adjacent shades for testing negative side bearings

wobbleVibratoSlowestSmallest 9 glyphs
 wobbleVibratoFastestLargest 9 glyphs

Figure 12. Recommendation 2.1: ‘SlowestSmallest’ wiggle has a shorter wavelength than the ‘FastestLargest’ wiggle

in SMuFL 1.0 and later is intended to be immutable, and likewise every glyph has a canonical name, also intended to be immutable” [14].¹²

We recommend that an exception be made, renaming the seven wavelengths for each amplitude ‘Speed1’ to ‘Speed7’.

In summary, Figure 3 and 4 represent how the glyphs were designed. In Figure 3, it is clear that only the speed is changing. In Figure 4, both variables are changing: the speed is relative to the presence. We recommend that the glyphs in each speed category have a fixed width, so that Figure 2 becomes as rich as Figure 4, and Figure 4 and 5 can be merged, jettisoning the distinction between linear and exponential speed change. The tessellations in each cell of Figure 4 would become the same length and this would replace Figure 2. This harmonises the notation with musical practice, achieving a typographic granularity consistent with acoustic reality.

4.3 Recommendation 3: Finer gradations of presence

Our third recommendation is to add another three shades of presence, including absent. This would smooth the step changes in amplitude visible on the title page of the present document and make the notation of Asian vibrato idioms more intuitive for readers by incorporating sections of straight, vibrato-less tone within the graphic.

We suggest names for the additional symbols in Figure 6, renaming the existing glyphs so that, as for speed, it is transparent which glyphs are neighbouring increments.

¹² There are 118 groups of glyphs, proceeding roughly in order of usage, from general to particular instruments, types of music, or historical periods; smufl.org/about. The vibrato wiggles are in the group ‘Multi-segment lines’, which is found just below the thirteen ‘Medieval and Renaissance’ groups.

wiggleVibratoSlowestLargest 2 glyphs
 wiggleVibratoFastestSmallest 22 glyphs

Figure 13. Recommendation 2.2: ‘SlowestLargest’ and ‘FastestSmallest’ glyph width is unrealistically large

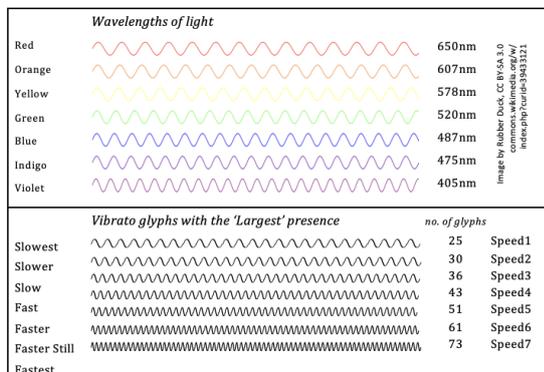


Figure 14. Nomenclature for seven gradations of wavelength

Having seven shades of presence for each shade of speed, plus three straight glyphs (‘Presence0Speed1’, ‘Presence0Speed4’, and ‘Presence0Speed7’), would increase the number of tessellating vibrato glyphs from 35 to 52, allowing for significantly smoother representations of growth and decay. Giving each parameter seven degrees (plus straight), and revising the canonical names to a numerical series, would also make the tool more intuitive.

An alternative and simpler solution is to keep the existing number of gradations but make the steps in amplitude less pronounced, linear rather than exponential. Largest could be overwritten with Large and a new set of glyphs, halfway between Large and Largest, could overwrite Large. The question is, does having nine trill speeds, seven vibrato speeds, and five levels of vibrato presence meet most users’ needs? Probably. But does this reflect Western musical beliefs and practices, or will it meet the needs of others whose musical craft was relatively invisible before YouTube?

5. CONCLUSIONS

Vibrato has had a long invisible period. We celebrate the development of a visionary notation tool that allows the emotional life of tones to be seen in a graphically nuanced and globally accessible way. This has potential relevance for anyone interested in the art of vibrato, be they educators, performers, composers, or musicologists.

When launching Bravura and SMuFL in 2013, Daniel Spreadbury defined three of the problems he set out to solve as follows: “to allow for easy extensibility in the event that new symbols are dreamed up or there are omissions; to provide a framework for the development of new music fonts; and to develop a community around the standard, so that the wisdom of experts in different fields of music can be brought to bear” [15]. Bravura represents thousands of hours of human labor – it is a stunning achieve-

Existing glyphs	Proposal 1	Proposal 2
Smallest	Straight	Presence0
Small	Smallest	Presence1
Medium	SmallerStill	Presence2
Large	Smaller	Presence3
Largest	Small	Presence4
	Medium	Presence5
	Large	Presence6
	Larger	Presence7
	LargerStill	Presence8
	Largest	Presence9

Figure 15. Proposed nomenclature for seven gradations of wavelength

ment, collating centuries of loving endeavor by music engravers. The vibrato glyphs barely scratch the surface of what this font offers, but their significance may be far greater than Spreadbury and his team at Steinberg anticipated. Possessing the technology to look at vibrato more closely makes it easier for performers to address technical limitations and to handle bias, waking us up to possibilities that lie beyond the habits, clichés, and beliefs of the culture we happen to be bred in. These glyphs help a dominant group become more aware and respectful of vibrato cultures in outgroups that do not share the privilege or self-confidence of the Western musical culture that derives its success, in no small part, to intimidatingly beautiful notation. For better or worse, notation reifies. A tool that allows everyone to visualize other vibrato cultures with beauty and nuance helps to level the playing field. That would be revolutionary.

6. REFERENCES

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