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A Pedagogy of Beauty: Teaching Plato's *Republic* through Mathematics and Music

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The teaching of political philosophy often begins with Plato's *Republic*. Its protagonist Socrates is said to have brought philosophy down from the heavens and introduced it into politics. By identifying a standard beyond the existing laws and conventions of the city, he implicitly challenged its political order—and explicitly troubled the Athenian old guard. He brought particular controversy by denouncing the existing poetry and music of Athens as failing to conform to the true standard of beauty. His consequent revolutionary call to censor some types of music—among other provocations—led the Athenian assembly to charge him with preaching false gods and corrupting the youth.

Today the charges of teaching false standards are just as likely to come from the youth themselves. How dare anyone suggest that musical beauty is not in the eye of the beholder? Most students consider music a matter of individual taste, and they jealously guard their prerogative to choose it. Largely gone are the days in which young people learned music in participatory fashion: by singing or playing in social gatherings led by community leaders. The advent of recording technology has largely turned music into a passive encounter, and headphones have individualized the experience. Moreover, applications like Spotify and Pandora offer an incredibly wide palette from which to choose one's personal collection. If we define our identities today as individual choosers, music offers one of the earliest opportunities to express one's personhood. Hence, when students today hear the voice of Socrates suggesting that true musical beauty is not in their own eyes as beholders, but instead is grounded in a preexistent and unchanging order of nature, they are inclined to

change the (Pandora) station.

The attitude of defining beauty for oneself is often worn as a fashionable and current look. Yet the philosophic roots of this position predate even Socrates in the works of Heraclitus. Heraclitus sought to explore the foundations of ultimate reality. To do so, he asked the question of nature: What is fundamentally constant in the cosmos? His answer sounds remarkably familiar: the only constant is change itself. As Heraclitus explains, one cannot step into the same river twice. By the time one takes the second step, the river appears to have physically changed (Heraclitus DK22 B12, 17).[1] This position seems so plausible to those who follow the dizzying fluctuations of politics that Heraclitus' answer has become a contemporary cliché. But the implications of his position are not trite. The river does not simply change its physical shape, like a singer changing costumes during a Super Bowl halftime set. Rather, the very essence of the river changes, as if Katy Perry were to become an actual shark thrashing about in search of water. Because there is no essential commonality between pretransformation Katy and posttransformation shark, a concertgoer cannot use the same name (e.g., "human being") to describe both. What is more, Heraclitus asserts that the very person who steps into the "river" (if we can still call it such) for the second time has *himself* also changed since the first step. Concertgoer "John" who called her "Katy" may now be concertgoer "Megatron" who describes her as "shark." To extend the analogy, a second concertgoer might name posttransformation Katy "dolphin"—and a third might apply the name "unicorn" to her (him? it?). Each appearance is utterly unique for each person; it is an apparition in the eye of the beholder. Heraclitus's connection to the musical preferences of students now becomes apparent. If each student can define musical beauty for himself, there is no necessary common thread connecting each individual's definition of beauty.

In the *Republic,* Socrates addresses this Heraclitean conundrum with his concept of the forms. Socrates does not deny the fact of change in the physical world. However, he identifies an additional world—one more truly real—that is known by the mind rather than the senses. This higher world contains perfect, unchanging forms of each of the names (e.g., "human being") by which we group (or define) a multitude of individual physical appearances (e.g., individual human beings at different times). Hence, a costume change does not change Katy Perry's substance as a "human being," because both before and after the change she participates (however imperfectly) in the same human essence. Likewise, all individual concertgoers can employ the common name "human being" because each one's individual perception (however imperfect) grasps a common essence. In other words, each of Katy's individual physical appearances is a different shadow of the stable, unchanging category "human being."

According to Socrates, the same applies to the particulars that we group into the category named "beauty." Each eye (or, more accurately, each mind's eye) grasps something of the ideal form of beauty in an individually beautiful instance of music. Hence, beauty does not simply exist in the eye (or ear) of the beholder. Rather, it exists (and exists most fully) in a higher realm. However, these transcendent ideals also imply exclusion, as some individual instances fail to participate in the form of beauty. Likewise, not all human actions participate in the ideal of goodness, nor do

all uses of reason participate in the ideal of wisdom.

What, then, is this ideal form? How can we define real beauty, or goodness, or wisdom? This is precisely the question Socrates faces in the *Republic*. Paradoxically, however, Socrates never offers his interlocutors a rational definition of these forms. Why not? Partly because of the subject matter. The forms are not first principles deducible—and thus definable—through logic. Rather, they are higher realities grasped by intuition. Hence, the best that Socrates can do is to point toward them. But Socrates also demurs because such subject matter calls for a unique pedagogy. The ideal form of reason—wisdom—is not a possession or a stock of knowledge. Hence, Plato's approach to education cannot ultimately be a didactic transmission of knowledge from an active giver to a passive receiver. Instead, education requires a dialectic process. The soul of the learner must open toward a participation in the good, the true, and the beautiful.

It is fitting that Socrates presents his ideals of beauty most clearly in the most notorious element of his pedagogy: musical education. Naturally, Socrates is concerned with the content of the stories to be told: the characters must demonstrate the higher ideals of goodness and virtue. However, he is equally concerned with the musical form in which they are delivered: the "words, harmonic mode, and rhythm" (Plato 398c, 75).[2] Some modes of musical harmony are suitable for lamentation. Socrates dismisses these as inimical to the virtue of courage. Others create a relaxed setting that promotes softness, idleness, and drunkenness (398e, 75). He also rejects these, later comparing drunkenness to tyranny (573c, 243). However, he endorses a mode "of someone engaged in a peaceful, unforced, voluntary action, persuading someone . . . or of someone submitting to the supplications of another who is teaching him" (399b, 75). Evidently music is capable of leading the soul toward vice—but also toward virtue.

What is it about these latter modes that fosters goodness and virtue? Socrates concludes as follows: "Harmony, grace, and rhythm follow simplicity of character—and I do not mean this in the sense in which we use 'simplicity' as a euphemism for 'simple-mindedness'—but I mean the sort of fine and good character that has developed in accordance with an intelligent plan" (400d–e, 77). In other words, he suggests that simplicity is a sign of order in the cosmos. By definition, music must necessarily use a plurality of different notes. The function of musical modes is to relate these notes to each other in more or less harmonious ways. Musical harmony requires simplicity. This is fitting, because Socrates' theory of the ideal forms shows how a multitude of individual appearances can be related to each other through a simple overarching descriptor. This distinguishes his position from the chaos of a Heraclitean position that sees no regularity among individual instances.

The preceding arguments attempt to explain the content of Socrates' ideal forms. But do they captivate the souls of first-year students who have barely awoken in time for class, let alone prepared themselves for a challenge to the validity of their musical preferences? Strangely enough, the very morning hour provides an opening. When queried, students will universally indicate their distaste for waking up to the din of a jackhammer outside their dorm window—effective though it might be. But why should they? After all, if music is in the ear of the beholder, why can't one person's

Stihl be another's Stradivarius? Aren't they both instruments? While students are apt to reject natural standards by which to judge music, they nonetheless rush to distinguish between the pitch of a musical instrument and the noise of an instrument of destruction.

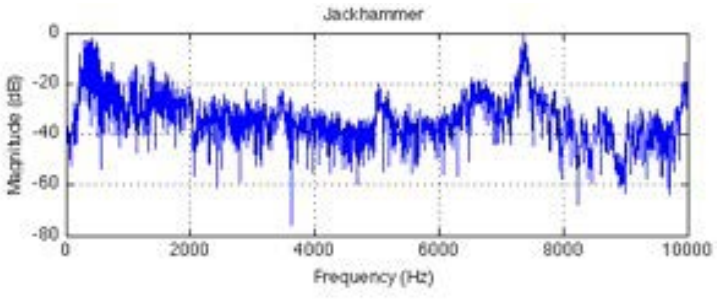
There is a good reason for this. Happily, it comes from the physical sciences—the one area in which students will generally accept the authority of nature. To use the language of physics, sound is a mechanical waveform that displaces air particles. More specifically, every sound—an earthquake, a voice, a power tool—creates a multitude of such waveforms.[3] (For instance, consider how a jackhammer manages to be simultaneously earsplitting *and* earthshaking.) Moreover, each of these many waveforms oscillates at a different speed: the higher-pitched earsplitting ones oscillate more frequently per second than the lower-pitched earthshaking ones. The relative loudness of the high-pitched and low-pitched waves imparts to each sound its distinct and recognizable tone.

Indeed, every sound in fact emits waveforms that oscillate at both high and low frequencies, as well as all frequencies in between. Hence, it is easy to represent the unique profile of each sound on a graph. The *x*-axis represents the frequency of each of the many waveforms, from low to high (measured in oscillations per second, or hertz). The *y*-axis represents the relative loudness (in decibels) of the particular waveform that oscillates at each rate. When we graph the harsh and unpleasant noise of a jackhammer on such a chart, we discover a line that is utterly random, displaying no regularity or order among its multitude of individual frequencies.[5]

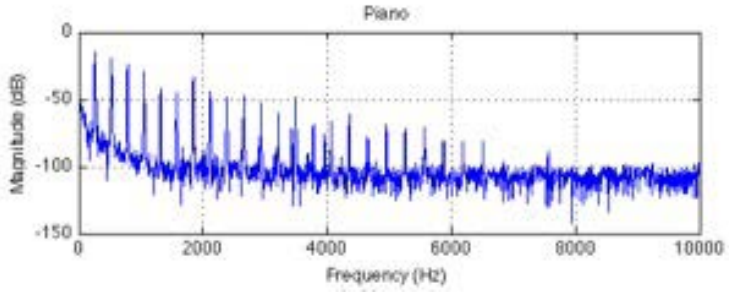
In contrast, when we graph the pitch of a musical instrument such as a piano, we see a remarkable orderliness. If the first peak comes at frequency x, the next will come at the mathematically simple frequency of $2x$. Another will come at $3x$, then $4x$, and on and on, as the chart below indicates.

Although each distinct key on the piano will have a different value for x, each key will produce an identical overall shape. Hence, there is a natural physical basis for the perceived distinction between noise and musical pitch.[5] The operators of the Stihl jackhammer produce a qualitatively distinct sound from the musicians of Steely Dan.

Students are often happy to discover a scientific foundation on which to base



their aversion to noisy morning awakenings. This natural basis enables them to reject industrial cacophony without threatening their casual agnosticism about music. However, their souls tend to become more troubled at the next implication. Just as the waveforms of a particular sound must be mathematically organized in order

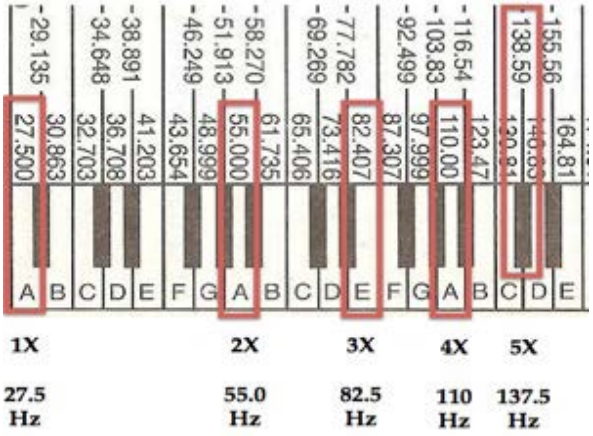


to qualify as a musical pitch, the pitches themselves must be combined with other pitches in order to qualify as music. There are a potentially infinite number of pitches (frequencies) that could be chosen for combination, of which the Western twelve-tone scale is but one. Yet when we examine the *x* values of each note in that scale, we quickly discover the mathematically simple series of *x*, 2*x*, 3*x*, etc., that matches the mathematical overtone series above. If *x* is our first note, 2*x* is an exact octave above. This most perfect and mathematically simple interval of 2:1 thus corresponds to the octave (or unison interval) that is present in all musical systems around the world. Furthermore, 3*x* produces a note an octave and a half above the original. This means that the 3:2 interval produces a "perfect fifth": the interval that is present in virtually every Western musical chord, no matter how basic.[6] Adding 4*x* produces another octave above, and 5*x* adds a major third to complete the major chord—the most common and basic chord. In other words, as the chart below indicates, the five notes representing the frequency interval of 1:2:3:4:5 form the most basic building block of music.

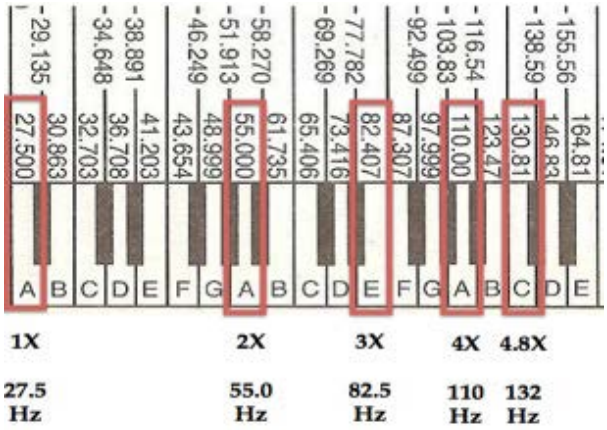
At this point, an uncomfortable realization begins to dawn on students: natural science is revealing a standard that might judge their choice of music.

This (numeric) harmony is also evident in a minor chord—the second most common chord in music. As we see below, here the musical interval is 1:2:3:4:4.8. In other words, the final 4:4.8 interval is actually a ratio of 5:6—the next most numerically simple interval in that continuing sequence.

Out of the almost infinite number of musical pitches that could be combined, Western music has converged on those that match the most numerically simple frequencies. Indeed, even the seemingly arbitrary division of the octave into twelve tones in the West quickly reveals the most numerically elegant relationship possible



between each of the intervals. Hence, the beauty of music is a manifestation of the mathematical nature of the universe, or what Socrates earlier intimated as an "intelligent plan." Thus, by using the standards of physical nature to distinguish pitch from mere noise, and then music from mere pitch, students are opened to the idea of an independent philosophic distinction between beauty and ugliness. They can now begin to grasp why Socrates might endorse some kinds of music as more natural (and



thus ideal) than the others to be avoided.

Happily, this investigation of physical nature that grounds Plato's philosophical argument *about* music can also be taught *using* music. I teach Plato's *Republic* as part of a team-taught Art and Politics course: the gateway course for the Fortin and Gonthier Foundations of Western Civilization Program at Assumption College. The course moves chronologically through great political texts and works of art from the ancient world to the twentieth century. Its deeper purpose, however, is to enable students to recognize the unity of knowledge by drawing connections between two different fields. To this end, I illustrate Plato's unity of truth, goodness, and beauty in one of the great musical works of Western civilization: Chopin's *Fantaisie-Impromptu in C-sharp minor.* The movement among the five notes of the minor scale outlined above forms exactly the first four measures of this piece. As the second-most numerically consonant interval (1:2:3:4:4.8), this establishes a solid foundation for the piece's first minute of bold energy. One can imagine this section meeting Socrates' criteria for inspiring the virtues of courage and self-control. This first movement finally resolves into a C-sharp major chord with the even more elegant 1:2:3:4:5 interval ratio. This major chord then establishes the mode for the following section—an even more orderly form appropriate for cultivating the even higher virtue of wisdom. The beauty of one of Chopin's master works is itself a testament to the physical regularity and mathematical elegance of music.

And this is fully appropriate. After all, to demonstrate natural standards of beauty using the graphs and charts of physical science is a rather didactic way to approach Plato. But the *Republic* is not a scientific treatise aiming to fill the reader's head with laws of nature. Its content is subordinate to its form as a dramatic dialogue. Like beautiful music, this dramatic approach seeks to captivate the reader's soul and open him to participate in the higher ideals that ground all knowledge of nature. Just as students choose the orderly beauty of music to open their eyes and awake from slum-

ber each morning, so can music be used to open their souls and ease their awakening toward Plato's *Republic*.

Acknowledgment

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Notes

1. The Heraclius citation includes the Diels-Kranz numbering system consistent across editions.
2. The Plato citations include the Stephanus numbers consistent across editions.
3. A very small number of digital sounds are exceptions to this rule, such as a pure sine wave.
4. I thank Joel Geddert for producing these graphs, and—more broadly—for the conversations about the physics of sound that inspired and made this paper possible.
5. This is not to say that music cannot include sounds lacking musical pitch; drums are one obvious example. However, without musical pitch, melody and harmony are impossible; only rhythm remains.
6. The diminished chord is an exception, as is the little-used augmented chord. However, both of these display mathematical regularities in the equal tonal distance of each of the intervals. The half-diminished chord is another exception, but its three highest notes form a mathematically elegant minor chord.

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