TIMBRE AND MUSICAL INSTRUMENTS

TIMBRE

*Timbre* (pronounced TAM-ber) is a French word that means "tone color"—that is, the quality of an instrument's sound that distinguishes an oboe from a flute or a voice or a trumpet. Musicians have a fuzzy vocabulary for describing the differences between timbres, using such general metaphors as "bright" or "dark." Instead, musicians typically describe the timbre of one instrument by comparing it to the timbre of another. Care should be taken in making comparisons this way, however, because it may reinforce an attitude that the instruments of a particular culture form the standard to which all other music is compared.

In most music, timbre is controlled through instrumentation and orchestration. *Instrumentation* refers to the choice of instruments that play a certain piece. *Orchestration* is the art of combining the instruments in different ways for musical effect. The term *orchestration*, by the way, does not necessarily apply only to the orchestra; it can just as well refer to any combination of instruments. A good orchestrator knows, for example, that certain instruments make a good musical "foreground" for solos when combined with certain other instruments that serve as "background."

Ensembles may have *heterogeneous* (all different) or *homogeneous* (all similar) instrumentation. The *gagaku* orchestra of Japan, for example, has a well-balanced heterogeneous instrumentation consisting of plucked strings, flutes, reed instruments, a metal gong, and drums. The *sho* mouth organs form a constant background against which the solo double reeds and flutes are easily heard. The plucked string and percussion timbres fill in the slow melody with occasional punctuations.

The Western string quartet is an example of a homogeneous ensemble (Figure 1). It is made up of two violins, a viola, and a cello, all string instruments of the violin family. This choice of instruments enables them to achieve great variety of sound and yet blend beautifully when necessary.
FIGURE 1
The European string quartet consists of four instruments of the violin family including, from left to right, violin, another violin, cello, and viola. Although these instruments differ in range, they are all of very similar construction, and so this group is classified as a homogeneous ensemble.

MUSICAL INSTRUMENTS
Musical instruments are important not just for the sounds that they make but often for the ways in which they reflect a musician's personality, expression, and culture. They can be rudimentary or extremely expensive, simple or technologically sophisticated, mass-produced to a standard or unique. The fact that some musicians give names to their instruments reflects the bond they feel with them, for an instrument can become a direct extension of a musician's expressive thought. In some cultures, musicians may personify their instruments in other ways or consider them spiritually charged. The respect that they give them goes far beyond their monetary value.

RESONANCE
Instrument makers can change an instrument's tone quality and loudness by building in hollow chambers or solid pieces called resonators, which work by filtering and amplifying the sound waves in specific ways. A resonator may be a solid board, such as the soundboard of a piano, an open box, or some other open or closed cavity. Some instruments have a resonator for each pitch, such as the marimba or the Indonesian gender (Figure 2).
Not only are sound waves caused by moving objects but also sound waves can cause other objects to move. For example, plucking a string on a sitar, an Indian string instrument, can cause another nearby string tuned to the same pitch to vibrate softly even though the second string was untouched. If you put your ear next to this string, you hear its "ghost" sound, as if it were played very softly, because of a phenomenon called sympathetic vibration. The air is being pushed and pulled by the first string, and the air slightly pushes and pulls the second string. However, only the string tuned to the same note vibrates; the others are silent because they are not designed to move at that frequency. Each string has its own vibrating frequency, which depends on the string's length and tension. This frequency is called the resonant frequency of that string. All physical objects have at least one resonant frequency and sometimes a range of frequencies. When a wave in the air around them matches this frequency, the object vibrates in sympathy, making the original sound seem louder. For example, a violin maker constructs the body of the instrument to have roughly equal resonant frequencies throughout the violin's range. However, certain frequencies resonate better than others, and the precise loudness of these frequencies is largely responsible for the violin's distinctive sound.
CLASSIFICATION

Musical instruments around the world come in an astounding variety, and there are equally various ways of classifying them. Instruments are classified by their musical function, their range, their construction, their method of producing a sound, and so on.

One common method of classification organizes instruments into three categories: string instruments (instruments whose strings are the sounding body), wind instruments (instruments that are blown through), and percussion instruments (instruments that are struck). Like any classification scheme, there are problems with this one. Strings and winds are classified by what makes the sound, whereas percussion instruments are classified by how a sound is made. The piano, for example, is an instrument whose strings are struck. Is it a string instrument or a percussion instrument? (It has been classified both ways.) Although this classification works well for Western orchestras, for which it was developed, it is not as useful for other types of ensembles. In Korea, instruments are classified by the principal material of their construction—wood, metal, stone, skin, and so on—but, again, this scheme is less useful outside a Korean orchestra.

Two early researchers of musical instruments from around the world, Erich von Hornbostel and Curt Sachs, drew up a similar but more consistent classification scheme that ethnomusicologists commonly adopt today. At the highest level, they arrange the instruments by precisely what makes the sound:

1. **Chordophones** (string instruments). A vibrating string, whether plucked, bowed, or struck, makes the sound.
2. **Aerophones** (wind instruments). A column of air within the instrument makes the sound.
3. **Membranophones** (drums). A membrane (skin) stretched over a resonator or frame makes the sound.
4. **Idiophones**. The entire instrument vibrates to make the sound.
5. **Electrophones**. The instrument makes sound through a loudspeaker.

Note that this classification scheme is very similar to the strings/winds/percussion organization scheme, except that it divides conventional percussion instruments into two groups. Not only does this division make the method more consistent, it is also less ethnocentric because in many cultures, percussion instruments are the majority, not the minority. Because of this consistency, the piano is now more clearly classified as a chordophone. There are still gray areas and hybrids, of course, although not as many.
CHORDOPHONES
Chordophones share many general characteristics. First, the strings have to be stretched somehow. They must be secured at both ends but allowed to move freely in between. Usually a construction known as a bridge is used to lift the string up over the body of the instrument so that it vibrates freely (Figure 3). A string instrument often has two bridges, one at each end, although one may be higher than the other. In instruments such as the violin and guitar, the higher piece is usually called the bridge. A single bridge may serve for several strings, or each string may have its own bridges. The Hungarian cimbalom and Iranian santur often have a bridge in the middle of each string, so that it is possible to play different pitches on each side of a center bridge.

FIGURE 3
A string instrument bridge lifts the string above the instrument and forms an edge for the vibration of the string. This bridge on a dilruba from India has a main set of strings that cross over its top and another set of strings that are threaded through holes in the middle.
There are several methods for obtaining different pitches on a string instrument. First, one may have a different string for each pitch, as in a piano. On other chordophones, the pitch of a string may be varied by pressing the string down at a certain point and therefore shortening its vibrating length. In this case, the finger can determine the vibrating length, or the finger can push the string down so that it is stopped by an intermediate bridge, called a \textbf{fret} (Figure 4). Guitars and mandolins are examples of string instruments with frets, whereas violins and \textit{sarods} are examples of instruments without frets.

There are several reasons to use frets: they make the task of finding the pitch easier and thus make it more practical to finger several strings simultaneously, as is common on the guitar. Because the fret creates a sharp, hard point, the string vibrates longer and more loudly than it does when stopped by the flesh of the finger. But frets lock the player into a certain tuning and generally make it impossible to change pitch by sliding the finger along the string.
However, 1930s blues guitarists in the United States began to use the tops of soft-drink bottles to obtain **glissando** (sliding pitch) effects. This technique evolved into the slide guitar, an example of a movable bridge.

Adjusting the tension of the string can also vary its pitch, and in this way, players of fretted instruments can create small changes in pitch, such as a **vibrato**, a continuous wavering of pitch often used on the classical guitar or the Indian **sitar**. On zithers such as the Chinese **zheng** or Japanese **koto**, the player may press down on the string behind a tall bridge to create pitch slides or vibrato (Figure 5). The **whammy bar** is a modern innovation used on electric guitars to slide the pitch up and down by varying string tension.

**FIGURE 5**

When playing the Korean **kayagum** curved-board zither, the player plucks with the right hand and then presses down behind the bridge with the left hand to bend the pitch.
Some kinds of chordophones may have more than one string tuned to a certain pitch. For example, some guitars have two adjacent strings per pitch, in the configuration known as a twelve-string guitar. The collection of adjacent strings associated with a particular pitch is called a course; when there are two strings in a course, it is a double course; three strings, a triple course; and so on (Figure 6). There may be several reasons for having multiple courses, but the most common is that they provide extra volume. When describing a chordophone, it is common to refer to it as a "six-course" rather than a "six-string" instrument, for example. Let's look at some ways in which chordophones are divided even further.

**FIGURE 6**
The Iranian santur uses multiple courses for each pitch to increase volume. This santur uses quadruple courses (four strings for each pitch).

**ZITHERS**
Chordophones in which the strings are parallel to a resonator that extends their entire length.

**Stick zithers.** Those in which the sounding board is relatively narrow and round, like a stick. The similar bar zither has a string attached to a curved stick.

**Tube and curved zithers.** Strings attached around the outside of a tube that serves as a resonator (Figure 7). When a part of the tube is cut away to form a surface for the instrument, it is known as a half-tube or curved-board zither (Figure 5).
Raft zithers. Those with a flat sounding board parallel to the strings.

Flat box zithers. Those with a hollow box resonator (Figure 8).

Trough zithers. Zithers with a trough carved in their sounding boards for resonance.

![valiha from Madagascar](image)

**FIGURE 7**
The *valiha* from Madagascar is an example of a tube zither.

**LUTES**
Chordophones in which the strings are parallel to the body that holds them, with a resonator at one end.

Spike lute. Mostly bowed and hence also known as a "spike fiddle." The neck is a round stick that extends through the resonator and forms the spike (Figure 9).

Fingerboard lute. The neck is a flat surface that the fingers press the strings down to. A fingerboard may have frets (Figure 11) or be fretless (Figure 10).
FIGURE 8
The *kecapi* from West Java, Indonesia, is a zither with a box resonator.

FIGURE 9
The *masingo* is a spike lute chordophone from Ethiopia. Also known as a spike fiddle, the string is supported on a single stick that extends through a resonator at the bottom end.
The Iranian sehtar, an example of a fretted lute chordophone.

The European cello or violoncello is a lute instrument with a flat neck but no frets.
LYRES
Sometimes considered a form of lute, but in these chordophones, the strings are attached to a crossbar held up by two posts with a resonator at the bottom (Figure 12).

![Figure 12](image)

The seron is a lyre from Uganda.

HARPS
Chordophones in which the strings are roughly perpendicular to a resonator.

Angle harps. The strings are stretched between two pieces of wood joined at an angle (Figure 13).

Bow harps. The strings are stretched between the sides of a single piece of wood shaped like a curved bow.
A harp, like this one from Jalisco, Mexico, has strings attached more or less perpendicularly to the resonator rather than parallel to it. In this photograph, the resonator is on the bottom, although in performance, it would lean against the player's shoulder. In an angle harp, like this one, the other end of the string is attached to a bar (on the right in this picture) attached at an angle to the resonator.

**AEROPHONES**

In aerophones, it is not the physical instrument or string that vibrates but the air itself, inside a vessel such as a tube. This air is called an **air column**, even though the tube it is in may be wrapped around many times, as in a trumpet. Just as a string vibrates only at certain frequencies when stopped at a certain length and tension, air inside a tube vibrates only at certain frequencies.

These frequencies correspond to the **harmonic series**. The player can make the instrument vibrate in different frequencies in this series by increasing the air pressure, a technique called **overblowing**. For the pitches in between the notes of the harmonic series, the player varies the length of the tubing through the use of **valves** (European trumpets), holes (**zurna**, clarinet), or **slides** (trombone).

The aerophone player may set the air into motion in a number of different ways. In flutes, the player blows over a sharp opening or notch. When the angle is just right, the stream of air
oscillates over and under the opening, causing the air inside to vibrate. In double reed instruments, the player ties two flat pieces of wood, plant, or plastic (the reed, often actually made of reed) tightly together and fixes them in the end of the tube (Figure 14).

![Figure 14]

A double reed like this one from an Iranian zurna consists of two flat pieces of cane or other material tied tightly together and inserted into the end of a tube. This instrument has a small metal disc at the bottom of the reed for the lips to rest on.

When under air pressure, the reeds quickly open and close, creating the vibration of the air column. In single reed instruments, the reed is attached tightly to the end of the instrument itself (Figure 15).

![Figure 15]

A single reed, like this one attached to the mouthpiece of a saxophone from the United States, is a flat piece of wood or some similar material that vibrates on top of the end of the tube.

The aerophone player may also buzz her lips into the end of the tube. In the West, such instruments are called brass instruments because of the material of their construction, but buzzed-lip aerophones elsewhere are frequently made of wood or other materials. The tone may be varied also by the shape of the tubing, called the bore. For example, the European trumpet's tubing varies very little in diameter over the vast majority of its length. Only the bell at the end is flared. Thus we say that overall it has a cylindrical bore. However,
the bore of the French horn gets gradually larger over its length; thus we say that it has a **conical bore**.

The ways in which the air column is set into motion have been briefly categorized, but let’s break it down even further.

**FLUTES**

Aerophones in which a stream of air is focused on a sharp edge.

**End-blown notch flute.** The player holds the tube straight away from the mouth but blows over the rim of the hole of the tube (Figure 16).

![Figure 16](image)

*Panpipes, such as this *zampona* from Bolivia, are collections of end-blown flutes. The player blows over the edge of each pipe to create the vibration.*

**Transverse or side-blown flute.** The player holds the tube perpendicular to his head and blows over an open hole (Figure 17).
**FIGURE 5.17**
A transverse flute, like this *bansi* transverse flute from Sulawesi, Indonesia, is held out perpendicular to the player's head. The player focuses a stream of air over the hole on the left.

**Duct flute.** The player blows directly into a hole (the duct) that directs the air stream to another hole with a sharp ramp, called a *fipple* (Figure 18).

**FIGURE 18**
A duct flute, like this *suling* from Indonesia, directs an air stream over a sharp notch in an opening. In this case, there is a small opening between the ring around the top of the instrument and the stopped end of the tube. When the player blows into this opening, the air stream is automatically directed over the notch in the opening below.
**Globular flute.** The sound body is a roughly spherical chamber rather than a tube (Figure 19).

![Globular flute](image1)

**FIGURE 19**
An ocarina globular flute from Mexico.

**DOUBLE REEDS**
Aerophones in which two pieces of reed or other material are tied tightly together at the end of a tube, and when put under enough air pressure, begin to vibrate against each other. The tube may have a cylindrical bore or a conical bore (Figure 20).

![Double reeds](image2)

**FIGURE 20**
Here are three slightly different sizes of *shahnai*, a double-reed instrument from India.
SINGLE REEDS
Aerophones in which a flat piece of wood is tied to the mouthpiece of a tube and blown over, causing it to vibrate. The tube may have a cylindrical bore or a conical bore (Figure 21).

BUZZED-LIP INSTRUMENTS
Aerophones, also known as brass, in which the player buzzes his lips into the end of a tube. The tube may have a cylindrical bore or a conical bore (Figure 22).
MEMBRANOPHONES

Membranophones, or drums, have some kind of skin or thin plastic stretched tightly over a frame or resonator. The side with the skin is called the **head** and may be played with the hands or with sticks. There are several methods for stretching the head tightly over the resonator. It may be attached with rivets (Figure 23); with strings threaded through its edges and tied to the drum (Figure 24); with a hoop tightly pressed on top of the head and over the drum resonator (Figure 25); or with glue or other methods.

**FIGURE 23**
The skin of the *bedug* drum from Java, Indonesia, is attached with rivets around the edges of each head.

**FIGURE 24**
In this *donno* drum from West Africa, the head is kept at tension with string threaded through the edges of the drum head.
Resonators come in a variety of shapes for a variety of different types of sound. They form the basis for the most basic classification of most membrano-phones:

- **bowl** (Figure 26)
- **cylindrical** (Figure 27)
- **barrel or waisted** (Figure 28)
- **hourglass** (Figure 29)
- **conical** (Figure 30)
- **goblet** (Figure 31)
- **frame drum** (Figure 32)

Drums are sometimes provided with rattles or other secondary sources that vibrate sympathetically with the drum. The tambourine, for example, has small cymbals inserted in its frame, and the snare drum is named for small wires that rattle inside the drum. Such instruments are actually combination membrano-phones and idiophones.
Old European-style kettle drums, commonly known as *timpani*.

Turkish *davul* or *tupan* – the ancestor of the modern bass drum.
These Ghanian barrel-shaped drums are called kagan, kidi, and petia.

The Korean changgo has an hourglass-shape resonating body.
FIGURE 30
The *mpuunyi* drum from Uganda has a conical resonator.

FIGURE 31
The Iranian *zarb* is a goblet-shaped drum.
Frame drums are simply skins stretched over hoops or frames so shallow that there is effectively no resonator. Frame drums are common in the Middle East as well as among indigenous Americans, such as these Iñupiaqs in Alaska who are playing a qilaun.

**IDIOPHONES**

Idiophones are instruments in which the entire body of the instrument vibrates when struck or (more rarely) rubbed or otherwise set in motion. They include all sorts of bells, cymbals, wood blocks, gongs, and so on. Almost anything can be made an idiophone if you hit it. Because of this variety, idiophones classification can be difficult. For the purposes of this book, we will classify idiophones not by their construction but by the identifiability of their pitch, even though that characteristic can be a spectrum more than definite categories:

- **instruments of definite pitch** (Figure 33)
- **instruments of semi-definite pitch** (Figure 34)
- **instruments of no definite pitch** (Figure 35)
FIGURE 33
Idiophones of definite pitch are often collected into sets and played with mallets, such as this *marimba* from Guatemala.

FIGURE 34
Gongs, such as these *kempuls* from Indonesia, often have a semi-definite pitch.
MUSICAL STYLE

The choices a culture makes in its construction and selection of musical instruments contribute to that culture’s expression of **musical style**—the complex and fluid combinations of all the elements we’ve discussed in this section that help us generalize about related musical compositions and performances. However, we should never lose sight of the fact that musical style cannot exist independently of the culture and society that produce it. As we progress through this course, we will focus on paths toward understanding musical style within its social context and enriching the listening experience.