Symmetrical scale

Why am I learning this?
Symmetrical scales are very common in different styles of twentieth- and twenty-first-century music, including jazz. They are particularly useful for developing your sense of pitch, because they often require that you use multiple reference points to hear and sing them accurately.

A symmetrical scale is a scale with a repeating step pattern. The most common symmetrical scales are the chromatic, whole-tone, octatonic, and hexatonic scales.

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History
Chromaticism has been around since ancient times, but symmetrical scales have only been theorized and used independently since the late nineteenth century. This is the same period in which keyboards have been tuned in equal temperament (with equal semitones), which allows for precise symmetry. The French composer Olivier Messiaen called symmetrical scales modes of limited transposition and used a few others besides the more common ones.

General properties
Because the diatonic, pentatonic, and acoustic scales have a step pattern that does not repeat within the octave, each scale degree is uniquely situated. Conversely, because symmetrical scales have a repeating step pattern, the scale degrees are not unique, and conventional scale-degree names and numbers, strictly speaking, do not apply. Indeed, even conventional letter names and staff notation are misleading, because they are related to diatonic scales. Symmetrical scales are more easily visualized on the clock face. Nevertheless, scale-degree numbers and solfège syllables can be used heuristically, just like letter names and staff notation.

For the same reasons, the diatonic, pentatonic, and acoustic scales have a different mode for each member, and they have twelve pitch-class collections (i.e., twelve possible positions on the clock face), while symmetrical scales have fewer modes than members and fewer than twelve pitch-class collections.

Specific scales
The most common symmetrical scales are the chromatic, whole-tone, octatonic, and hexatonic scales.

Chromatic scale
The chromatic scale has all half steps. It is easiest to sing as an expanded diatonic scale:

```
1 2 3 4 5 6 7 8
```

```
do  re  me  fa  sol  la  te  ti  do
```
Because all the steps are the same, there is only one chromatic mode. Because the scale includes all twelve pitch classes, there is also only one chromatic collection.

Example: Bartók, “Chromatic Invention,” No. 91 from Mikrokosmos (1926–1939), vol. 3, mm. 1ff. What makes this an example of the chromatic scale and not just chromaticism is that it is impossible to reduce the music to a diatonic or another kind of scale.

Whole-tone scale

The whole-tone scale has all whole steps. It is perhaps easiest to sing as overlapping 1–2–3 patterns, repeating notes to switch patterns. As you gain fluency, drop the syllable for 3 and sing the scale as 1–2–1–2–1–2–1, and finally drop all syllables:
It is also possible to sing the scale as overlapping 1–2–3–#4 patterns, likewise dropping syllables as you gain fluency:

Because all the steps are the same, there is only one whole-tone mode.

Because the whole-tone scale overlaps with itself after being transposed up through two semitones, it has only two collections, named after their distinctive members, starting with C:

Example: Stevie Wonder, "You Are the Sunshine of My Life," from *Talking Book* (1972): The introduction features major thirds ascending through a whole-tone scale. The rising, expansive steps set a buoyant mood for the love song.

Example: Béla Bartók, "Whole-Tone Scale," No. 136 from *Mikrokosmos* (1926–1939), vol. 5, mm. 1ff: The piece actually uses two whole-tone scales, one on C and one on A, the lower of which seems to shadow the first.
Octatonic scale (diminished scale)

The octatonic scale, or diminished scale in jazz theory, has alternating whole steps and half steps. (In jazz theory, the term octatonic just means eight-note.) It might be easiest to sing as overlapping 1–2–b3 patterns:

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>2</th>
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<th>2</th>
<th>2</th>
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</thead>
<tbody>
<tr>
<td>do</td>
<td>re</td>
<td>me=do</td>
<td>re</td>
<td>me=do</td>
<td>re</td>
</tr>
</tbody>
</table>

\[ \text{Andante, } \frac{j}{4} = 108 \]
It is also possible to sing the scale as overlapping 1–2–b3–4–b5 patterns:

\[
\begin{array}{cccccccc}
1 & 2 & b3 & 4 & b5=1 & 2 & b3 & 4 & b5=1 \\
\end{array}
\]

do re me fa se=do re me fa se=do

The term *diminished scale* refers to the scale being like two diminished seventh chords a half step apart:

\[
\begin{array}{cccccccc}
\end{array}
\]

Because the pattern repeats after two steps, the octatonic scale has only two modes: the diminished scale proper, also known as the *whole-half diminished scale*:

\[
\begin{array}{cccccccc}
1 & 2 & b3=1 & 2 & b3=1 & 2 & b3=1 & 2 & b3 \\
\end{array}
\]

do re me=do re me=do re me=do re me=do re me

and the *half-whole diminished scale*, which has six scale degrees in common with the *acoustic scale*:

\[
\begin{array}{cccccccc}
1 & b2 & b3 & 3 & b4 & 5 & 6 & b7 & 8 \\
\end{array}
\]

do ra me mi fi sol la te do

It is entirely possible that a piece of music might use an octatonic scale (or rather *collection*) without a particular *mode* being evident—that is to say, without any *pitch class* or *pitch classes* standing out as starting points.
Because the octatonic scale overlaps with itself after being transposed through three semitones, it has only three collections, named after their distinctive members, starting with C:

![Octatonic Scale Diagram](image)

Example: Björk, "Pluto," from *Homogenic* (1997): The song uses a whole-half diminished scale. The climax has a melodic pattern that is sequenced up by minor third through the scale. The abandonment of the tonic as the sequence proceeds illustrates the desire to "explode this body."

Example: Béla Bartók, "From the Island of Bali," No. 109 from *Mikrokosmos* (1926–1939), vol. 4, mm. 1ff: The piece uses OCT(D,Eb). The focus on half steps without tonal definition gives the piece a sultry, misty feeling.

### Hexatonic scale (augmented scale)

The hexatonic scale, or augmented scale in jazz theory, has alternating minor thirds and half steps, or—properly speaking—intervals 3 and 1. (In jazz theory, the term *hexatonic* just means six-note.) It might be easiest to sing as follows:

![Hexatonic Scale Example](image)
It is also possible to sing the scale with overlapping 1–b3–3 patterns:

The term augmented scale refers to the scale being like two augmented triads a half step apart:

Because the pattern repeats after two steps, the hexatonic scale has only two modes: the augmented scale proper:

and an augmented scale beginning with a half step, which is both uncommon and difficult to sing:

As with the octatonic scale, it is entirely possible that a piece of music might use a hexatonic scale without a particular mode being evident.

Because the hexatonic scale overlaps with itself after being transposed through four semitones, it has only four collections, named after their distinctive members, starting with C:
Example: John Coltrane, "Giant Steps," from Giant Steps (1960): The melody uses HEX(D, Eb) except in mm. 4, 8, and 10, and the tonic triads BM, GM, and EbM also use HEX(D, Eb). Assuming that the scale starts from any of these tonics, the piece uses the first mode. The title refers to the giant steps between the remotely related keys.

Example: Hugo Wolf, "Das verlassene Mägdlein," no. 7 from Mörike Lieder (1888), mm. 19–34; scroll to 1:04: The song uses alternating augmented triads from hexatonic scales, portraying the girl's daydreaming.

Other scales
There are sixteen types of pitch-class collections that have the kind of symmetry discussed here. Some of them stretch the definition of scale:

1. zero notes
2. chromatic scale
3. tritone
4. every pitch class except a tritone
5. augmented triad
6. every pitch class except an augmented triad
7. C, C#, F#, G, for example
The first twelve listed here are in complementary pairs, meaning whatever pitch classes are missing from one set can make up the other one. The last four can complement themselves; for example, HEX(D,Eb) fills in the gaps of HEX(C,C#).

Note: the kind of symmetry discussed here (a repeating step pattern, hence a scale mapping onto itself through transposition) usually but not always involves inversional symmetry as well (mapping onto itself through inversion). But the latter kind of symmetry is not significant here, as it is also found in the diatonic, pentatonic, and acoustic scales.

Further reading

- Joseph Straus, *Introduction to Post-Tonal Theory*, Chapter 4

External links

The Wikipedia article on symmetrical scales is not extensive. There are separate, more detailed articles on the chromatic scale, the whole-tone scale, and the octatonic scale.