Zero

By Jerry Leake

This article discusses the profound absence *and* presence of *zero* in how we perceive musical time. On the surface, my thesis may appear obvious—or perhaps not. It is like looking up to the infinite universe of stars and space, thinking "So what?" or "So deep!" Philosophical and theoretical debates help us gain deeper insights into the laws that bind our universe—the laws that inspire a musician to weave sound inside time. That said: By whom, and when, was zero first discovered? Or shall I say, *invented*?

ZERO HISTORY/ZERO THOUGHTS

Mesopotamia

By the middle of the 2nd millennium BCE, Babylonian mathematics had a sophisticated sexagesimal positional numeral system (a numerical system with 60 as its base). The lack of a positional value (or zero) was indicated by a *space* between sexagesimal numerals. By 300 BCE, a punctuation symbol (two slanted wedges) was co-opted as a placeholder in the same Babylonian system. In a tablet unearthed at Kish (dating from about 700 BCE), the scribe Bêl-bân-aplu wrote his zeros with three hooks, rather than two slanted wedges. The concept of zero as a number and not merely a symbol for separation is attributed to India, where, by the 9th century CE, practical calculations were carried out using zero, which was treated like any other number, even in case of division. (Kaplan, Robert. (2000). *The Nothing That Is: A Natural History of Zero*. Oxford: Oxford University Press.)

Zero is the ultimate destroyer: multiply a trillion by zero and you have annihilated an immense number. Because zero was invented after "Year 1" the *calendar of time* is off by one year. The "actual" millennium we celebrated on Y2K "factually" occurred in 2001, and with zero fanfare. "Year 1" should have been called "Year 0." At birth we are a second old, then 10 seconds, 8 weeks; a mother proudly brags, "9 months and 5 days!" After travelling a full year, the annual celebrations begin.

The stroke of midnight at "12" signifies "zero" on the military 24-hour clock: 6 A.M. is *zero six hundred* hours. The movie title "Zero Dark Thirty" translates to "12:30 A.M." and "Zero Hour" signifies the beginning of a military mission. Due to the constant presence of clocks and numbers, it is odd to think of "12" as "0." Young recruits have to rewire neural networks to master a military time perspective and discipline.

The principles of measuring time function the same as when measuring distance. When you start a marathon, you begin at zero; a mile is completed *only* after it has been run. But we do not think about music in terms of distance, except when it relates back to time: How long is the tune? What kind of journey did it take? Time and distance have a uniquely mysterious relationship; study Einstein for a while and you will quickly see how big it gets!

A Clapping Quiz

One of my favorite exercises is to have students clap what I carefully describe as "four evenly executed and completely full beats." An eager student claps four times. "Okay, who else?" Again, a student renders four nice claps. I smile and ask, "Was that correct?" Others comment on the evenness or clarity of the clapper. A discussion ensues with no one realizing my point: It is not about the quality and execution of claps, it is the fact that they clapped only three beats! The correct answer is to clap five times to render "four completely full beats." They ponder the truth, the somewhat obvious, and debate their points.

What is a beat?

Following an open discussion about four vs. five claps, I ask: "So what is a beat?" A general reply: "A unit of measuring time in music." I clap once: "What was that?" Answer: "A clap." I hit a stick once on the table: "That's not a clap, so what is it?" I savor visages of curious confusion. "What I played was an *event*—a singular event with no other meaning concerning its place inside time." I continue: "If that was an event, what defines a beat?" Reply: "A second clap!" We all clap once to mark a beat's origin and a second time (at beat 2) to mark its destination; a pulse is established and the beat goes on.

A beat is defined by two events: a conductor initiates two baton motions—up and down—to glue together a massive orchestra. Phrases like "ready, go" instigate a pulse. As a cue to begin, my African teacher amusingly says: "Go." I joke with all seriousness: "Go where?" He provided a vocal "event" but not a beat reference.

INDIAN MUSIC

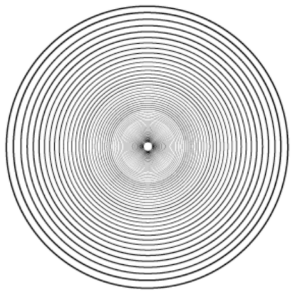
The subject of "zero" arises when I discuss North Indian classical music; how the rhythm system is conceptualized using cycles of time as opposed to linear bars. That is not to suggest that time cycles do not exist in African bell patterns, for example. Indian music takes cyclic awareness to a profoundly deeper, more philosophical level. Geometric images clarify this point.

Shown below, a consistent wave moving from left point A to Z represents the continuous flow of Ewe music from Ghana (for example), each wave marking one bell phrase. North Indian classical music is best visualized using circles of time that gradually shrink as cycles accelerate from very slow to very fast, within a single raga performance lasting an hour or more.

African cycle (wave)



Indian cycle (circle)



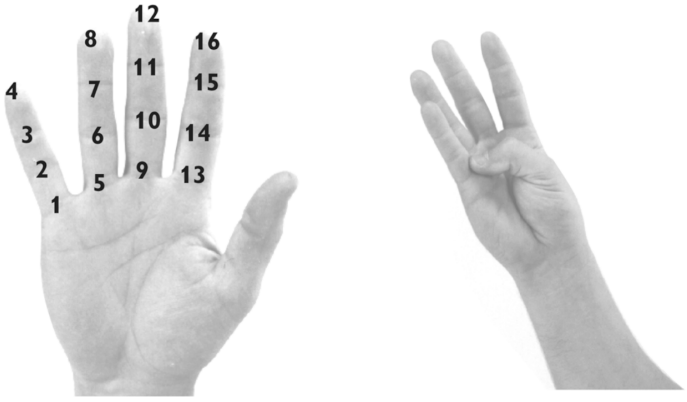
Magic Number 11

The following statement brings zero to the forefront: "Eleven is the magic number for tihai in 16-beat tintal that start on *sam* (pronounced "sum," beat 1) and end on *sam*." A *tihai* (tee-hi) is a rhythm cadence played three times with the final stroke landing on beat 1 of a given cycle (for example). The student ponders how a tihai built with 11 beats relates to 16-

beat tintal; the math does not seem to work. "Okay," I continue, "how long is two cycles of tintal?" Answer: "32." I then introduce the "Keeping Tal" method of counting beats.

Keeping Tal

Using the open right hand to count *matras* (beats), the thumb is placed at the bottom of the pinkie to mark *sam*: beat 1 (right photo below). The knuckle line above marks beat two, then three, with beat four at the top of the pinkie (left photo). This is repeated for the ring, middle, and index fingers, with the tip of the index finger marking the 16th beat. The cycle is repeated by counting 17, 18, 19, until you reach the top of the index finger again, counted as beat 32. To reach *sam* of the next cycle simply count to 33. Our formula therefore is 3 (tihai) x 11 (magic number) = 33 (two tintal cycles *plus* 1).



Other issues arise when visualizing time on the hand: how to count and calculate unique subdivisions, fractional (3.5) beats, long phrase origins, and destinations. In essence, students needs to rewire their neural network to accept the "zero" truth. We discuss if this alters (or not) how we perceive the "beat"—whether drastic changes occur in the musical reality.

12-beat Ektal

When examining the very slow 12-beat rhythm cycle called "Ektal" I discovered that a compass best represents how the player navigates through vast oceans of time. As mentioned, 12 o'clock midnight (zero) does not easily register as a point of origin; it is too engrained as a schedule-keeping device. However, a compass works well for navigating through a slow cycle that requires well over a minute to complete. In this unique context, each "beat" can be divided into eight smaller subunits, creating the illusion of a 96-beat rhythm cycle. To get inside this idea we will first examine the basic tabla strokes of 12-beat ektal.

Shown below are ektal tabla bols (syllables) set to a medium speed: dhin / dhin / dha ge / tirakita / tun / na / kat / ta / dha ge / tira kita / dhin / na, etc…

Medium speed ektal:

dhin	dhin
dha ge	tira kita
tun	na
kat	ta
dha ge	tira kita
dhin	na
dhin…	

Shown below is the ektal cycle set to a very slow speed, with each initial syllable now moving down the page, with the four subdivisions (filled with drum ornaments) of each beat moving across the page, numbered 1–4. This pulse would establish a 48-beat cycle, lasting about 50 seconds per cycle.

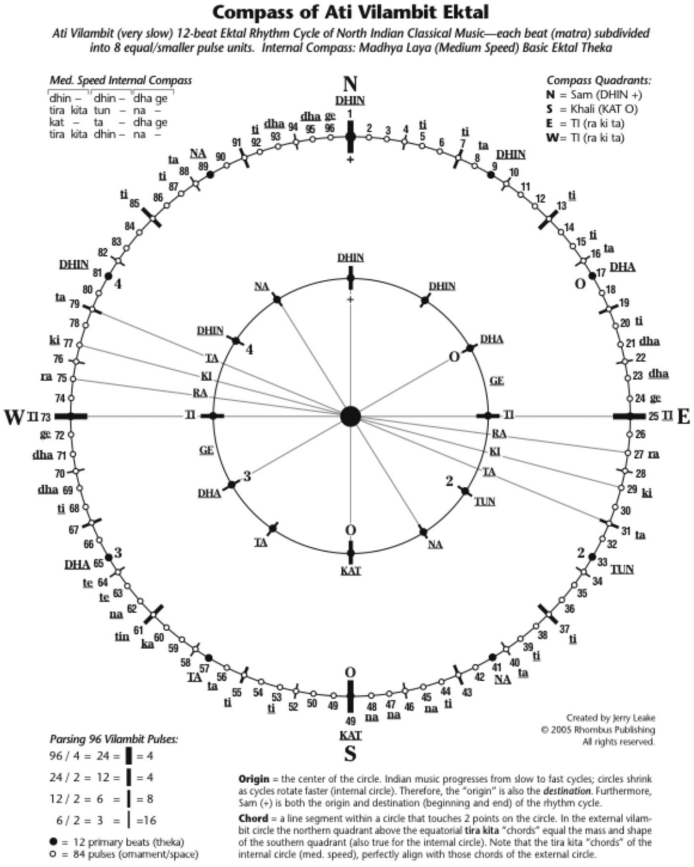
Very slow ektal:

1.			2.		3.		4.	
dhin	–	–	–	ti	–	ti	ta
dhin	–	–	–	ti	–	ti	ta
dha	–	–	ti	dha	–	dha	ge
ti	–	ra	–	ki	–	ta	–
tun	–	–	–	–	–	ti	ta
na	–	–	ti	na	–	na	na
ka	–	–	–	–	–	ti	ta
ta	–	–	ka	tin	na	te	te
dha	–	–	ti	dha	–	dha	ge
ti	–	ri	–	ki	–	ta	–
dhin	–	–	–	–	–	ti	ta
dha	–	–	ti	dha	–	dha	na
dhin …								

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The Compass of Time

The ektal compass that follows applies the same syllables and ornaments from the very slow cycle but with eight subdivisions per beat for a much longer 96-pulse cycle. The compass quadrants—N, S, E, W—reveal interesting relationships in compositional unity and elegance of the cycle. Also shown inside the compass is the medium-speed cycle we first examined. In this highly expanded and somewhat abstract awareness of time the player will feel a strong sensation of "leaving home" (N) and travelling through the remaining E, S, W quadrants before finally returning home. In the context of walking a long distance, you begin at "zero," travel in a large circle around many blocks, hitting each compass quadrant before finally reaching the "home stretch"—your destination and origin. In very, very slow ektal both time and distance are partners, each with "zero origins."



Flamenco Alegrias

The previous ektal compass described a new model for navigating through long rhythm cycles with "north" functioning as "zero." We can also reference the clock image to discuss the 12-beat cycle (*Compás*) of Spanish flamenco music known as *Alegrias*. The word "Compás" is Spanish for meter/time signature in classical flamenco theory. It translates in English to "compass" for also navigating through musical time, much like the ektal image.

Historically, Alegrias is related to other ancient folkloric forms that are in a prominent three feel; sections of songs are often built with an *om pah pah* waltz-like structure. Over time, musicians began experimenting with 3/4, changing the feel by shifting accents to create the 7, 8, and 10 dynamism (discussed below), while also enlarging a 3/4 "bar" to a 12-beat "cycle."

It is the *palmas* (clapping) pattern that firmly establishes a framework of accented and unaccented strokes as a foundation to the music. One fascinating aspect of the cycle is that the counting begins from beat 12, not beat 1. Shown below in bold/underline are accented numbers (12, 3, 7, 8, 10) that establish the 12-beat phrase. As an exercise, clap hands while speaking all of the numbers, accenting the clap and voice as shown. (Note: there are numerous variations on this basic structure.)

<u>12</u> 1 2 **<u>3</u>** 4 5 6 **<u>7</u>** **<u>8</u>** 9 **<u>10</u>** 11

12 = 1 = 0

While I was exploring this unique counting system, one colleague mentioned that the 12-beat compás has a direct reference to the numbers on the clock. He visualizes time moving clockwise from 12, experiencing a sense of "leaving home" before returning back several seconds later. (The following educational web link uses the moving hands of a clock to describe Alegrias: vimeo.com/10227010. Also note that the "Bulerias" cycle in fast six can be configured to 12; both compás have strong resolution points to beat 10.)

For me, an obvious question quickly arose: "Can I think of 12 as beat 1?" Of course; it is how listeners (and most players) naturally perceive the music. The "theory" that comprises a musician's training is part of the "behind the scenes" training that listeners need not consider to enjoy and appreciate the music.

We can now apply a fundamental principle to conclude our observations: if A = B and B = C, then by law A = C. In other words, if "12" functions like "1," and beat "1" (theoretically) functions like "0," then "12" must also function as "0." In my imagination this is more than just a possibility.

CONCLUSION

For years I have pondered zero in music: how the clock of musical time relates to the clock of universal time, how time and distance interact, and how to navigate time cycles using geographic maps like Keeping Tal on the hand, the Compass of Ektal, and flamenco alegrias counted from beat 12.

The higher aesthetics of music learning and playing, teaching, and philosophy extend beyond oft-treaded questions and answers. Learning music comprises thousands of revelations that bring musicians closer to their true selves, to their highest art. The revelation of "Zero Time" adds to our understanding of how we organize sound within rhythm structures, grooves, and cycles. An authentic artist cannot achieve mature creativity—cannot write a 5-star novel or a music masterpiece—until the internal philosopher from within takes over some of the process and invention.

Zero may not impact your creative life, just as pondering the universe will not alter how the Earth rotates in space. However, if an awareness of "zero" resides somewhere in your toolbox of resources, it could find a concrete place in your process. It might take time but, after all: time was invented so we don't have to do everything all at once.

Jerry Leake is an Associate Professor of Percussion at Berklee College of Music and the New England Conservatory of Music. He is leader of the world-rock-fusion octet Cubist, which has released an acclaimed studio and live CD. He is also co-founder of the world-music ensemble Natraj and the dub/trance groove collective Club d'Elf . Jerry performs regularly with R.A.R.E, C-Jammers, Another Realm, and the Agbekor Drum and Dance Society. On tabla, he has accompanied Ali Akbar Khan, Steve Gorn, Sharafat Ali Khan, Nandkishor Muley, Kumkum Sanyal, Chitravena Ravikiran, Purnima Sen, and Shyamdas. Jerry graduated from Berklee College where he studied jazz vibraphone with Gary Burton and hand percussion with Pablo Landrum. He studied tabla in Pune, India with Rajiv Devasthali and Carnatic rhythm theory and mridangam with T. K. Ramakrishnan. He has learned African music for 20 years with Dolsi-Naa Abubakari Luna of the Dagomba tradition, Ewe music with Godwin Agbeli and David Locke, and balafon/djembe with the Coulibaly family in Burkina Faso. Jerry has written eight widely used texts on North Indian, West African, Latin American percussion, and rhythm theory; manuals for playing world rhythms on drumset; and articles published in *Percussive Notes*. Jerry is former president of the Massachusetts PAS Chapter and has been a composer and member of the Portland Symphony Kinder Koncert percussion ensemble since 1984. **PN**