

Tune and rhyme: Translation symmetry at work

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Abstract

This paper outlines some thoughts on translation symmetry as a common denominator underlying our vague sense that music and poetry are similar. Melody and rhyme are both clusters of sound translated in time, and the human mind registers such clusters easily and with pleasure. A working poet considers some aspects of this translation symmetry and asks some questions that mathematics and science may eventually address.

Tracks in time

People often feel that poetry and music are similar. “That line of poetry is so musical” we murmur without being able to specify exactly what we mean. In fact, the underlying loom on which both music and poetry are woven is translation symmetry.

Brains evolved to notice regularities in the world and pull out underlying patterns, especially symmetries, that are useful. Human brains then turn the process around and use these abstracted patterns to create tangible things that please us. However, different modes of perception are biased in how they detect (and subsequently use) symmetry. For instance, our visual systems handle reflection symmetry superbly, especially the ‘bilateral’ type where the left side of a face is reflected in the right. We detect such balanced, vertically reflected patterns immediately and unconsciously. Our visual systems are much less clever at noticing ‘translation’ symmetries – the kind of transformation that picks up a pattern and shifts it in space. When researchers have us peer at configurations of dots and lines, we’re less quick to detect that the same pattern has been repeated (without being flipped into its mirror image) on the other side of our visual field [1].

When it comes to hearing, our detection capacities are reversed [2]. We don’t easily notice that notes have been ‘mirrored’ (i.e. an identical sequence of musical notes has been repeated backwards). Nor do we quickly hear palindromic words like “rats” and “star” as being made up of the same sounds forward and backwards. But our ears do recognize *translation* symmetry – a chunk of sound that has been shifted like a tile on a floor – very well. So art forms based on sound – music and poetry – employ this kind of patterning a great deal.

The most obvious form of translation symmetry in sonic performances is beat, a recurring pulse. However a regular beat, whether it’s a quick-march in music or the ta-TUM of an iambic pentameter poem. has very restricted symmetry. Like one of those patterns crimped around the rim of a pot, it’s a one-track line. (I’m talking here about the way beat is generally used in Western music, not the polyrhythmic patterns of, say, African music.) The more interesting sonic symmetry patterns are melody and rhyme, which operate in several dimensions at once.

Rhyme and melody are both clusters of sounds that recur in the same order and depend critically on recurring patterns of stress. As Daniel Levitin writes, “A melody is an auditory object that maintains its identity in spite of transformations” [3]. We distinguish a melody by its pattern of duration and accentuation; notes that fall on downbeats or other important rhythmic junctures usually become the tune’s most recognizable ones. In fact, the stress pattern is so important to melody that we can identify familiar tunes when their rhythm is tapped out on a single pitch – although we do not do as well when the tune’s rising/falling tones are used but they are all made the same length [4]. Rhyme is just as crucially dependent on matching stress patterns. This is why *entered* and *interred* are not good rhymes, in spite of the fact that they group almost exactly the same sounds in the same order. However, we happily accept Jack and Jill’s pairing of *water* and *after* as a satisfactory duplication.

Central to both the simpler symmetry of beat and the greater complexity of melody/rhyme is expectation – the anticipated recurrence of a symmetrical pattern. These patterns get our attention. Expectation is most obvious with rhythm: a regular beat sets up a train of pulses and the brain continues to anticipate them with remarkable accuracy even when individual pulses disappear into silence. But melody and rhyme create expectation by allowing patterns to slide in more than one dimension. Tunes shift up and down in pitch, and rhyme adds an especially interesting dimension to the (usually) one-way arrow of time.

A rhyme kicks you back to hear again something that you heard before – something you may not even have noticed the first time. It does this by delaying the processes in the brain that strip away auditory information when incoming sound is handed off to the semantic modules that assign it to an abstract category. (I.e., deciding that a particular parcel of sound waves is meant as a *p* rather than the very closely related *b*.) In normal speech, we lose the actual puff or pop quickly from consciousness and focus on assembling meaning. Rhyme delays this process of stripping out the sensory data, allowing us to hold it in a kind of echo chamber, the auditory short-term memory. Reuven Tsur, one of the earliest scholars to apply cognitive theory to literary studies, points out that in some circumstances, rhyme will reverberate more intensely and longer than most other aspects of poetic language. The brain perceives rhyming units as being closely knit together even if they are relatively far apart, so that rhyme spreads “a kind of sensory net over a considerable region of a poem” [5]. It is almost as though the rhyme inhabits a dimension that is space-like as well as time-like.

Rhyme’s combination of duplicated sound AND rhythmic profile makes it register a little differently than the other repetitions of consonants or vowels typical of poetry. Traditions like Anglo-Saxon poetry, which use alliteration in well-defined positions at the beginning of stressed syllables, do create a translation symmetry. But more general repetitions of sound that do not involve matching rhythmic patterns (like the repeated consonants in Keats’ famous line, “season of mists and mellow fruitfulness”) appeal less to our love of translation symmetry than to our highly developed sense of the relative probability of speech sounds. We know how frequently a sound like ‘m’ or ‘l’ or ‘s’ is likely to turn up in a stretch of our language, and notice when that typical frequency is skewed – in other words, we are appreciating a different kind of mathematical relationship.

A Kind of Conservation

According to Noether’s theorem, every conservation law in physics is directly related to an underlying mathematical symmetry. Notably, the law of conservation of energy arises from a translation symmetry of time. This has a pleasant metaphoric connection with music and poetry because the symmetries of translation used in both art forms represent a kind of “energy conservation.”

Shall I compare thee to a summer’s day...? The ta-TUM, ta-TUM of that iambic meter is the heartbeat of English poetry. Music and poetry share the same tension between a regular, repeated rhythm

plodding away in the background and the phrasing of a real combination of words or musical ideas that floats over top of this it. In music, the ideal pattern is marked off by bars, within which notes must add up to a consistent sum. In poetic meter, the patterns of stress in different types of metrical ‘foot’ have a similar kind of time-keeping function. You’re supposed to get the same number of stresses in each one.

Actually, even more than the exact number of stressed/unstressed syllables, each poetic foot is supposed to have the same amount of *energy*. Musicologist Robert Jourdain notes that we process the tempo of music and of language in similar ways, and that we unconsciously slow the rhythm of speech at the beginning and end of phrases. “It’s not the velocity of movement that’s constant, but rather the level of difficulty of movement. If you were to set a metronome to an average speed and then move to it in lock-step, you’d drag your feet across the centre of rooms but spin out at corners...” [6].

A Few Beats More

A sequence of sounds registers quickly and clearly, even when repeated after a considerable length of time, and we welcome such repetitions back. Our enjoyment comes from identifying the recurrence of a complex structure, from recognizing how it has been translated through time.

Learning to abstract a pattern of translation symmetry from incoming sounds seems to be a fundamental exercise in young human brains, and we make such learning a priority. Getting sounds to match is the essence of acquiring both music and language, and we begin to be able to do so around the same age. The four-year-old memorizing a nursery rhyme is learning a kind of practical translation symmetry in the syllables that construct her language. She’s noticing the subtle variations of sounds within words and how different consonants peg vowels down in different ways – the *a* of *cat* and *pat* is not the same as the *a* of *car* and *far*. Most importantly she’s learning how sound adjusts itself to rhythm. When she recites “Peter, Peter pumpkin eater / had a wife and couldn’t keep her,” she finds that *eater* and *keep her* have something in common that overrules the difference between *-t-* and *-p h-*. That ‘something’ is the abstract translation symmetry underlying the rhythm.

We still don’t completely understand why human beings have so strong an innate ability to detect and enjoy symmetry. Is it simply because it’s easier and more efficient to process similar signals from incoming sources, a kind of mental economy? Or does it offer specific utilitarian advantages that have proved useful throughout evolution?

In the case of our visual system’s preference for reflection symmetry, the ‘why’ may be simpler to explain. We are members of the great family of Bilateria, and all of its members have body plans organized along an axis of reflection. There are big risks and rewards associated with being able to pick such creatures out of the surrounding vegetation.

But why do we like *translation* symmetry in the aural domain? Has there been an evolutionary advantage to noticing how out-of-phase wave patterns present themselves that helps organisms to discriminate the source of sounds? Could such an advantage become a source of our liking for the-same-and-not-the-same? Alternatively, is recognizing translation symmetry in sound patterns simply a function of a more generalized need to distinguish scale-invariant patterns in incoming data? Self-similar patterns tend to be meaningful, and we may have evolved to evaluate such sameness/difference in sonic patterns rather than translation symmetries *per se*. (On the visual side, there are clear advantages to being able to recognize things as ‘the same’ even though they are entering the eye at different scales.) Are there animal analogues – does that dancing cockatoo on YouTube [7] really respond to the translation symmetry of beat or is he picking out something else to make him move?

Regardless of *why* our sensory systems privilege different types of symmetry, we are still far from understanding *how* our brains do the math – in other words, how we manage the task of abstraction that is fundamental to so much neocortical activity. The ability to abstract underlies tasks as apparently diverse as deciding that two different objects are red, establishing that such-and-such a waveform signifies a “p” while that one is a “b”, or choosing whether a given pattern of sound is really TUM-ta-ta vs. TUM-ta-TUM. (Try answering that last question for a combination of syllables like ‘microwave,’ for instance.)

And finally, what a poet would love to know: how idiosyncratic are our perceptions? Do we have a universal sense of what counts towards categorizing sounds as similar? For instance, do matching end consonants rank higher than sameness in vowel sounds? In other words, does elk/belt count as a closer match than elk/ilk? I know what I’d vote for (the matching vowels). But that might be entirely my choice. If you looked at the Fourier transforms of the sound waves, might you see something that could give my assessment a more objective flavor?

Science will continue to probe such questions using mathematical tools. In the meantime, artists will go on using translation symmetries with innate gusto:

*Rhyme’s tiles slide
from line
to line, a not-so-rigid motion –
a knitted, shifting symmetry
that matches ‘tree’
to ‘infinity’, ‘identity’
or ‘melody.’ Rhyme bides
its time
until a tuneful congruence
chimes in –
duplication
with a difference, like forests
that line a river with the glide
of pine
and aspen, an automorphic chorus
of translation.*

References

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