Energy and Symmetry in Language and Yoga

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Abstract

The structures of syllables and of yoga poses are compared. Syllables are tripartite, with sound segments rising in sonority (acoustic energy) to a peak, then falling. Likewise, *asanas* are tripartite, with symmetrical movements flanking the sustaining, vital energy peak. In both entities, then, symmetric structure flanks energy peaks. This organization is not a physical necessity, but a cognitive preference.

The authors of this paper are a linguist and a student of yoga trained through B.K.S. Iyengar in the tradition of Patanjali, the semi-mythological yogi of the third century CE. Our dialogue and practice have led us to investigate similarities between syllables and yoga poses (*asanas*).

Article Frontispiece. *Tadasana* (Mountain Pose). (Photo © David neal)

We examine *asanas* performed in isolation (leaving sequences, *vinyasas*, for future study). We account for two observations:

1. Approaches and departures for *asanas* are often mirror images of one another.

2. In the string approach-sustaining-departure, the sustaining, according to traditional masters' words and the understanding of yogis, involves the greatest flow of energy.

We compare the structures of syllables in spoken language and of *asanas*, and propose that the principle governing syllable structure has an analog governing *asana* practice. Neither principle is a physical necessity—but, rather, a cognitive preference. This work suggests a tendency for different areas of human activity to develop similar principles, whether unconscious or conscious, that may be governed by unifying cognitive meta-principles.

Syllable Structure

Basics

Syllables around the world vary structurally. The most common structure is (C)V (parentheses indicate C is optional). "C" represents a consonant sound, and "V" represents a vowel sound, regardless of orthography. For example, the syllable that makes up the word "a" in the phrase "a law" consists of a vowel ([ʌ] in the International Phonetic Alphabet); its structure is V. The syllable in "law" consists of a consonant and a vowel ([lɔ] in the IPA); its structure is CV.

Everything within the syllable that precedes V is the onset. Some languages allow onsets to be comprised of only one C. But many allow consonant clusters, as in *flaw* ([flɔ]); its structure is CCV.

Everything other than the onset is the rime. While some languages allow the rime no C's, others allow C or a consonant cluster. C's in the rime are the coda:

VC: "at" ([æt])

VCC: "ask" ([æsk])

Everything not in the onset or coda is the nucleus (Fig. 1)—typically a vowel or diphthong, but sometimes a triphthong (complexities unexemplified here, since nuclei are not our focus). One can view C's as merely ways to begin or end V's.

Sonority Hierarchy

In many languages, syllables can have onset and/or coda clusters:

    CCVC: flap [flæp]

    CVCC: bark [bæɹk]

    CCVCC: bland [blænd]

In some languages three or more C's occur in onsets and/or codas. Before considering such, let's look at occurrences of CC in English. For now, we will ignore CC's containing [s] or [z].
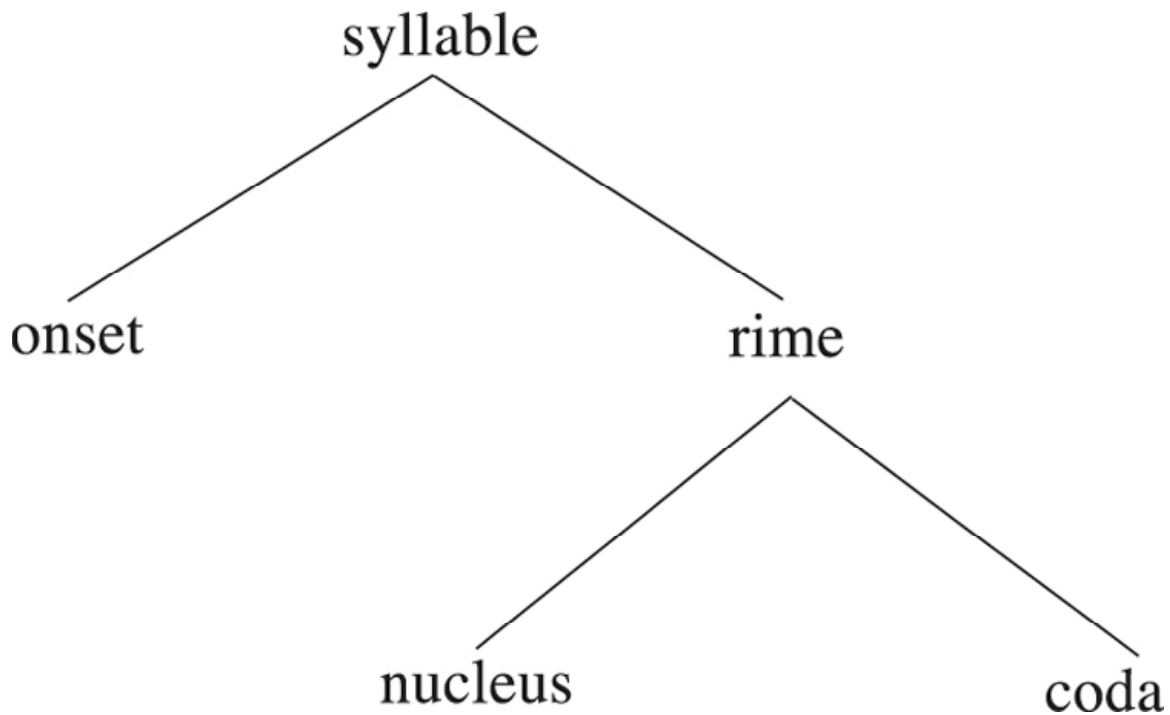

Fig. 1. Syllable structure.

A pattern emerges. The C's [b] and [l], for example, co-occur as [bl] in onsets (*blue*) but [lb] in codas (*bulb*). No English words begin in [lb] or end in [bl]. Likewise [fl] occurs in onsets (*flab*) but [lf] occurs in codas (*elf*). The onsets [pl], [kl], [pɹ], [bɹ], and [fɹ] (*please, claw, proud, brown, frown*) correspond to the codas [lp], [lk], [ɹp], [ɹb], and [ɹf] (*help, elk, carp, barb, barf*). (We have omitted aspiration of voiceless stops to avoid confusion over the number of C's in onsets.)

This is no accident of English. If a cluster contains [b] and [End Page 333] [l] in any language, [bl] appears in onsets and [lb] in codas. To some extent the possible onsets and codas of language are mirror reflections.

The mirroring is not perfect, however. English allows [l] and [v] to co-occur in codas (*twelve*) but not onsets. Russian allows them together in onsets (*Vladimir*), but not codas. Particular languages do not avail themselves of all the possibilities allowed by the brain's language mechanism. But the point is, if C1 and C2 co-occur, they assume one order in onsets and the reverse in codas.

Caveat: There are languages that don't work this way, such as Polish. Furthermore, more than 80% of the world's languages remain undescribed. But for described languages, this symmetry generally holds.

Linguists have proposed an organizing principle to describe this fact [1]. Sounds are sonorous to different degrees, and syllable structure is sensitive to this scale—the Sonority Hierarchy (SH). The principle says that, within a syllable, sounds rise in sonority to a peak, then fall. So syllables exhibit reflexive symmetry around the nucleus with respect to sonority.

Sonority is a measure of the energy of sounds. Many factors contribute to energy. Sounds with unobstructed or less obstructed airflow are more sonorous than sounds with more obstructed airflow. Voicing also contributes. Voiced sounds are made with the vocal cords vibrating strongly (as in the letter [d]). Voiceless sounds have little or no vocal cord vibration ([t]). Voiced sounds are more sonorous than voiceless. A third factor is frequency (pitch). High frequency sounds are more sonorous than low frequency. A fourth factor is intensity (loudness); this factor has been shown to be more important than previously thought [2].

There may be other factors, as well. And factors interact; in some languages a voiced sound with completely obstructed airflow might behave as though it is more sonorous than a voiceless sound with partially obstructed airflow. That is, different languages rank the factors in different orders. So, while the SH is called upon to account for universal reflexive symmetry within syllables, languages differ on the assignment of relative sonority to sounds close in sonority. Our interest is the reflexive symmetry of onsets and codas, so our findings are not affected by different assignments of sonority values across languages. Accordingly, we look only at English without detriment to our argument.

Stops, i.e. the sounds [p], [b], [t], [d], [k] and [g] (initial in *pooh, boo, to, do, coo,* and *goo*), are occlusive (airflow stops, then is released): stops occur at syllable peripheries. **Fricatives**, i.e. the sounds [θ], [ð], [f], [v], [s], [z] (initial *in thy, thigh, fie, vie, sue, zoo*) and [ʃ], [ʒ] (medial in *Aleutian, allusion*), involve partial closure in the oral cavity, which leads to a hissy quality; fricatives occur closer to the nucleus. In **nasals**, i.e. [m], [n], [ŋ] (final in *beam, bean* and *bing*), the air is occluded in the oral cavity, but flows freely through the nasal cavity; nasals occur even closer to the nucleus. And in **liquids**, i.e. [l] and [ɹ] (initial in *low, row*), air flows freely around the

tongue sides in the first and down the tongue groove in the second; liquids occur closest to the nucleus. Table 1 lists the logically possible combinations of types of clusters, given the groups S (stops), F (fricatives), N (nasals), L (liquids).

When two C's from one group co-occur, the more sonorous is closer to the nucleus. For example, [ɹ] and [l] are both liquids, and [ɹ] appears closer to the nucleus (*pearl*).

Empty cells in Table 1 reveal gaps in the lexicon. We fill some in the section below where we discuss [s]/[z] clusters. (We omit science-fiction examples that could fill others, e.g. *fnord*.)

Given the many onset gaps in Table 1, we note another complexity: Sonority in onsets can rise sharply, whereas in codas it declines gradually [3]. So we don't see two C's of the same group in onsets, only codas. Likewise, we don't see two C's of adjacent groups in onsets (although we say more about F + N in the section below discussing [s]/[z] clusters), only codas. This preference is so strong in English that we don't have onsets of the form S + N, where other languages do (although, even in other languages that is less common than S + L).

Extensions

Thus far we have omitted **affricates**—stops with delayed release (initial in *chin* [ʧ], *gin* [ʤ]). These do not appear in onset clusters in English except when resulting from phonological rules (as in *train*; /t/ affricates to [ʧ] before [ɹ]). They occur more freely in coda clusters. In both locations, they position between stops and fricatives:

    affricate + stop [ʤd] *fudged*

    nasal + affricate [nʤ] *fringe*

    liquid + affricate [ɹʧ] *church*

We have also omitted sounds open to analysis as either **nonsyllabic** V's (the part of a diphthong or triphthong that doesn't carry the beat) or as C's (called **glides**). For example, is the onset of *fume* CC ([f] plus the glide [j]), or is it C, preceding a diphthong in the nucleus? Likewise, is the coda of *newt* CC (the glide [w] plus [t]), or is it C after a falling diphthong in the nucleus? The determination is immaterial here. The important point is that if the relevant sounds are analyzed as consonants (glides being the most sonorant), onsets and codas display reflexive symmetry.

[s]/[z], and CCC Clusters

[s], a fricative, can precede a stop in onsets and follow one in codas (spay, stop, ski, and lapse, cuts, ax), and [z], a fricative, can follow a stop in codas (cubs, pads, dogs), in violation of the SH. This violation is no surprise. Cross-linguistically, voiceless fricatives (like [s]) show exceptional behavior with respect to the SH [4]. And the behavior of [s]/[z] in English is a historical peculiarity of Indo-European languages.

Considering clusters with [s]/[z], we now fill a gap in Table 1: F + N in onsets (*snow*).

Additionally, we now note that English syllables allow [s]CC in onsets: *straw* ([stɹ ɔ]), *spray* ([spɹej]), *screw* ([skɹuw]), *spla*t ([splæt]). The second C is always a voiceless stop and the third a liquid (or glide), so initial [s] is the only SH violation.

Types of C's	**Onset**	**Types of C's**	**Coda**
S + S		S + S	[pt] *kept*
S + F		F + S	[ft] *heft*
S + N		N + S	[nt] *tent*
S + L	[kl] *clue*	L + S	[lk] *milk*
F + F		F + F	[fθ] *fifth*
F + N		N + F	[nθ] *tenth*
F + L	[fɹ] *free*	L + F	[ɹf] *barf*
N + N		N + N	
N + L		L + N	[lm] *palm*
L + L		L + L	[ɹl] *pearl*

Table 1. English CC-clusters, excluding [s]/[z]

Turning to codas, we again find CCC. If we include glides, some of these CCC's [End Page 334] obey the SH (*thank* ([θejŋk]). Others do not, and, generally, final [s]/[z] is the offending segment (*parks* [paɹks]). In rare codas a nasal precedes an inserted stop made at the same location in the mouth, which precedes a fricative (as in southern U.S. pronunciation of *strength*—[stɹeŋkθ]), in violation of the SH.

If we count glides, English allows even CCCC codas (*oinks, paints*).

Importantly, even including [s]/[z], reflexive symmetry generally holds between onsets and codas since exceptions to the SH occur in onsets and codas in their reflexive counterposition.

Alternatives

Exceptions to the SH have led to alternative principles for syllable organization. Cairns and Feinstein propose a theory based on universal tendencies, in contrast to language-specific characteristics [5]. Others propose theories based on metrics (rhythm/prosody) [6]. Alternative theories cite complex interactions of acoustic factors [7].

No alternative accounts for all aberrant behavior [8]. Accordingly, the SH remains the most accepted account of onset-coda reflexive symmetry.

Nature of the Principle

With strong regularity across the world's documented languages, sequences of sounds in onsets mirror those in codas. With few exceptions, the syllable moves progressively toward the strongest flow of energy (and the freest airflow), then wanes away from it.

The SH as a guide for syllable structure is not an articulatory or acoustic necessity. We have no trouble pronouncing sequences such as [fta] or [akl], though they never occur in natural language.

Additionally, consider anatomical facts. Regarding production, the jaw opens more slowly than it closes (the **asymmetric jaw cycle**). So a syllable in isolation begins more slowly than it ends [9]. (This accounts for syllabification strategies [10]. We suggest it also accounts for the markedness of codas across languages.) As for perception, the auditory system has variable sensitivity. It is most sensitive to the beginning of a stimulus, then sensitivity declines as the stimulus continues [11]. So the listener is more sensitive to onsets than codas. Given that the onset is produced more slowly and is attended to with more sensitivity, we might expect the syllable to be asymmetrical if only anatomical characteristics were relevant.

We conclude that symmetry does not follow from physical properties of the world (and is surprising in light of those properties). Rather, the SH is a cognitive principle for organizing sound information.

Asana Structure Compared to Syllable Structure

Basics

We posit that yogic processes develop the "cultured and matured mind" and consider *asanas* as dynamic, not static, although they manifest the crucial elements of stability, firmness and serenity [12]. We view them as sites for a stimulating rhythmic flow of energy.

The accomplishing of an *asana* depends on the pose and its surroundings, the movements that precede and follow it, which help enunciate it. These include the mental/emotional climate as well as the physical.

A pose consists of a tripartite action: the approach (getting into a pose), sustaining (the pose itself) and departure (getting out). This division is inspired by the Hindu Trinity, Brahma the Creator, Vishnu the Preserver, and Shiva the Destroyer: formation, persistence, disappearance. Together they symbolize the universal sound A/U/M, the sacred syllable whose vibration is "the subtlest form of [God's] creation" [13]. This grouping promotes continuity of concentration: the stages are

interdependent, with success of the whole resulting from a proper triangular articulation.

Most yoga manuals present photos of poses with discussion of the sustaining, and how to frame it. But the initial and final points are also *asanas*. For individual standing poses or any sequence of standing poses, this is *Tadasana* (Mountain Pose), the foundation of standing poses (Article Frontispiece).

Tadasana is analogous to the origin on a Cartesian graph. It is comparable to a flow of air through the speech tract that produces a single, pure vowel.

When going into and out of an *asana*, breath and movement are coordinated. Typically, one exhales on the approach and inhales on the departure, though one could do the opposite, as for instance in backward bends.

Symmetry

Tadasana and *Utkatasana* (Fierce Pose) (Fig. 2) are symmetrical poses (the body is divided along the midsagittal plane).

The initial pose (*Tadasana*) prepares the focal pose (*Utkatasana*), which is followed by a closing pose (*Tadasana*). The movements from *Tadasana* into *Utkatasana* and from *Utkatasana* into *Tadasana* are mirror images of each other—even as different muscle groups work in accordance with the demands of gravity. Symmetry of the limbs in relation to the spine is maintained throughout. As we move from *Tadasana* into *Utkatasana*, the knees bend while the arms reach up and the spine extends, counteracting gravity. To return, the heels press down firmly. Throughout, the various muscles function synergistically to assure smooth, balanced execution.

What happens, though, when the sustained *asana* is asymmetrical?

Utthita Trikonasana (Extended Triangle Pose) (Fig. 3) is a dynamic organization of body, breath and mind. A scattered approach or departure will prevent the *asana* from yielding full benefits. If one loses concentration when moving from an initial to a central pose, proper alignment of body parts may not be maintained. Have the kneecaps fallen, is the pelvis collapsed onto the femur head? Adjustments made after the fact may take more energy than if one had approached the *asana* with steady concentration. These are typically problems besetting the beginner.

One of the possible approaches to *Trikonasana* is from *Tadasana*. The legs jump apart, the left foot turns inward, the right leg revolves 90° in the hip socket. The torso tilts, increasing spinal extension until the right fingers touch the floor. The head turns to look up at the left hand. Weight distributes across both feet and from lower to upper fingertips, enabling length horizontally (coccyx to the first cervical vertebra) and vertically (hand to hand). *Trikonasana* is a chest-opener; it encourages fuller breathing, facilitates circulation, relieves backaches and invigorates pelvic organs.

Breathing is observed, not controlled. If the jaw is clenched and the breath held or let in and out with short or hard spurts, the pose needs adjusting. To relieve this type of constriction at the start, the breath should coordinate easily with the movements of approach and departure.

The departure from *Trikonasana* reverses, thus mirroring, the motions made in the approach. Even, steady breathing helps concentrate the *asana* toward meditation. As the pose is refined, "the intelligence is made to penetrate towards the core of being" [14].

But the departure may be affected by one's behavior during the sustaining. If one had lost awareness in the back leg, then on returning, one would awake sensation there to "charge" it. This facilitates the departure, differentiating it from the [End Page 335] approach, and is instantly experienced by the practitioner.

Fig. 2. *Utkatasana* (Fierce Pose). (Photo © David Neal)

The approach begins the moment the yogi leaves *Tadasana* and continues until s/he is fully in *Trikonasana*. Jumping and turning the feet are as much a part of the approach as extension of limbs and spine. The departure begins the moment the yogi leaves *Trikonasana* and continues until s/he is fully reestablished in *Tadasana*.

Acknowledging that there may be differences due to ancillary or optional actions, one can say nonetheless that approach and departure are reflexively symmetrical.

Extensions of Symmetry

Symmetry plays a larger role in the practice of *asanas* than it does in syllables.

With respect to internal work, when individual poses require variant actions in the approach and departure due to gravity, these actions may themselves mirror each other. For example, when moving into *Trikonasana* on the right, one may consciously connect the right sit bone with the left inner heel. When returning, one connects the right heel with the left sit bone: drawing down, drawing up. Within this symmetry of effort/attention, the reverse formulation holds equally and the effects will be balanced as the instructions travel from feet and legs through pelvis and torso.

Enlarging our view, we find more symmetries. Normally, one would do an asymmetrical pose to one side, then the other—the action to the second side is a mirror of the first. For *Trikonasana*, the sequence might be *Tadasana, Trikonasana* to the right then to the left, returning from there to *Tadasana.* But one could return to *Tadasana* between right and left, thus performing two separate poses, each with its own approach/sustaining/departure. Symmetry is preserved throughout. In either strategy, there is a passage through the centerline, since the pose must be completed on both sides. While the elements of the comings and goings are interchangeable, the execution and benefits of the pose are altered, depending on the sequence chosen [15].

To deepen the experience of the principle of symmetry, we could approach with concentration, sustain in contentment, and depart with concentration, maintaining throughout a firmness and steadiness of body-mind that link the progression seamlessly [16].

Asanas and Syllables

With respect to symmetry, this analysis of *asanas*—approach/ sustaining/ departure—finds an analogue in syllables—onset/nucleus/coda. In syllables, possible onset and coda clusters are mirror images of one another, as are

approaches and departures in *asanas*, while the *asana* sustaining is comparable to the syllable nucleus.

Of course, there are differences between syllables and *asanas*. The presence of a syllable onset is independent from the presence of a coda, whereas *asanas* require both an approach and departure. The particular syllable onset is independent of the particular coda (cf. [bl] in the onset but [k] in the coda in blank). However, the approach and departure of any given isolated *asana* reflect one another. This difference is consistent with the fact noted earlier: symmetry is a compelling characteristic throughout asana practice. It is expressed in the unfolding of the three-part sequence and in the performance of asymmetric poses as they are executed equally from side to side. It is visible spatially and temporally, as the distance covered going and coming is the same. The actions are even rhythmically symmetrical.

Nevertheless, by mining the analogy between syllables and *asanas*, we can understand *asana* structure better. The SH is based on a notion of energy level, the most salient part of which is airflow. If we are to propose an analogous guiding principle for the structure of *asanas*, we must examine energy and airflow during an asana.

In theory, a conscious execution of *asana* approach/sustaining/departure would maintain a consistent mental and physical energy, understood now as steady concentration. When the practitioner is "immature," actuality does not match theory: physical and mental energy drop off during the asana. Over time, "maturity would practically mean an ability to perform *Trikonasana* with complete efficacy in all conditions" [17]. The drop-off of mental energy corresponds (whether causing or reflecting) to the drop-off of physical energy.

Physical and mental energy in *asana* is influenced by other factors, too. There seems to be more of it if one practices in a group; like yogurt culture, its growth [End Page 336] accelerates as you feed it; and more is required for new *asanas.* However, even with the familiar *Trikonasana*, a new frame can effect a major reformulation. Then, steady practice clears the path: "Where the inner energy can flow, there the intelligence can enter" [18].

Fig. 3. *Utthita Trikonasana* (Triangle Pose). (Photo © David Neal)

We have been investigating the physical and mental activity involved in producing a particular shape, but we must not ignore finer layers of poses. In Patanjali's system, *asana* is the third of eight branches of practice, immediately following rules for ethical behavior *(yama, niyama*), and preceding breath restraint (*pranayama*), sense withdrawal (*pratyahara*), concentration, meditation and bliss (*dharana, dhyana*, *samadhi)*. However, according to Iyengar, *samadh*i can be attained at any moment: "Perfection in an asana is achieved when the effort to perform it becomes effortless and the infinite being within is reached" [19].

Subtler forms of energy in an *asana* manifest with airflow. For the beginner, *asana* requires free airflow: breath is not controlled. Indeed, airflow—at this point,

prana—is the prime mover in an *asana*. *Prana* is defined as breath, life force, vital energy. It informs all we do. In the accomplished yogi, body, mind and breath are brought, as part of deepening practice, to interact with each other. One can place/localize the breath in an asana, or move it from one part of the body to another during the sustaining. One can use inhalation, exhalation and breath retention as components of asana exploration: Prashant Iyengar teaches breath as any of the following, "pelvicilium (hypogastric), naval (epigastric), diaphragmatised, pulmonary, vocal, nasal"; the breath teaches the pose to the body and the mind, the mind teaches the pose to the body and the breath [20].

The sustaining is steady and flowing. It is the time of greatest energy, and affords unobstructed movement of energy along the spine and throughout the human system. *Prana* percolates. Indeed, Iyengar speaks of aligning the energy, understood as vibration in the front and back legs. The sustaining emancipates both energy and airflow—very much like the syllable nucleus.

Further study teaches that within Patanjali's system, movement results from the circulation of *prana,* not only as air and energy, but as spirit (*purusha*), in opposition to matter (*prakrti*). So when Iyengar speaks of aligning the s/Self in *Trikonasana*, he refers to both the subjective, intellectual self that is disturbed by fluctuating thoughts and the spiritual entity *(purusha)* distinguished from it as Self. When performing an *asana,* he asserts, "Each and every fiber, each and every cell, each and every capillary has to be connected to the s/Self, that is the alignment of the *asana*, of the s/Self with the body, the body with the s/Self" [21]. An expansive sustaining yields insight. It is the moment of greatest flow of air and pranic energy.

The requirement that approach and departure be symmetrically reflexive is not a physical necessity, just as reflexivity is not a physical necessity in syllables. For any number of asymmetrical poses, several approaches and departures are routinely taught. But the point is, in the absence of a reason to do otherwise, they mirror each other. In short, reflexive symmetry is not simply good form, it is internally coherent and an aspect of the practice of concentration/awareness in *asana*.

The principle at play here organizes movement so that it forms a mirror of cellular awareness around the sustaining, thus surrounding a center of greatest flow of air and vital energy, analogous to the SH in the syllable. We call this organizing principle the *Prana* Hierarchy (PH).

Conclusions

The Sonority Hierarchy, a governing principle for syllable organization, finds [End Page 337] an analogue in *asana* practice in the *Prana* Hierarchy. The syllable's point of highest sonority and the *asana*'s point of greatest *prana* are flanked by symmetrical structure.

These symmetries cannot follow from physical facts about the world. The asymmetric jaw cycle leads us to expect onsets and codas to be asymmetrical; the

effects of gravity lead us to expect asana approaches and departures to be asymmetrical. That physical forces go against symmetry shows symmetry is not the null case; it is not what happens in the absence of rules. Rather, symmetry is an organizational principle that the human mind adopts for cognitive reasons.

That similar principles should apply here may seem surprising, especially since language principles apply unconsciously, whereas yoga *asanas* are consciously organized. But, importantly, *asanas* move the practitioner into a special mental realm—a "freedom in consciousness" [22]. Hence conscious practice discloses unconscious principles. Human activities that persist through generations might even be expected to reflect unconscious principles. For example, all metrical units in poetry are also found in ordinary language prosody, though non-linguists are rarely aware of that. Yoga has been practiced for over 2,000 years. Furthermore, while *asanas* range in difficulty, the activity is participatory; young and old, weak and strong are welcome. These facts help to ensure that *asana*s conform to deeper principles, in the way we have defined.

It is possible, then, that the SH and PH have a single font—a meta-principle dubbed the Energy Hierarchy, which calls for symmetric structure flanking energy peaks in whatever sense of energy is relevant to the specific human activity it governs. For syllable production, it is sonority, for *asanas* it is *prana*, in other cases it might be light, heat, or speed, for example. We hope our study suggests avenues of research into unconscious and conscious principles in human endeavors.

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18. B.K.S. Iyengar, Iyengar Intensive at Estes Park (Yoga Journal (5-DVD set), 2005) Disc II.

19. Iyengar [12] p. 159.

20. Iyengar [15] pp. 53, 22–27, 68–74.

21. Iyengar [18].

22. Iyengar [12] p. 160. [End Page 338]