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Formative Processes of Durational Projection in "Free Rhythm" World Music

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IN A 1996 survey of the ethnomusicological literature, Martin Clayton identified around seventy musical genres across the world in which rhythm seems to be "free," ranging from those "apparently without pulse of any kind to those with a clear pulse but no higher level periodicity" (Clayton 1996, 324). Many scholars had observed this phenomenon, particularly in a "continuous, loosely related cultural zone" extending from North Africa to East Asia where "free rhythm is an essential, genre-related characteristic" (Frigyesi 1993). Clayton's special concern, however, was why the music had attracted so little analysis. He attributed its neglect to a lack of appropriate theory:

> The absence of adaptable concepts and methods in conventional (Western) musicology, where rhythmic analysis generally presumes the existence of metre, appears to have inhibited the development of ethnomusicological methods. . . . Most non-Western cultures, too, appear to lack theories of free rhythm, and the fact that ethnomusicologists have in general found no such indigenous theories to report has also stood as a barrier to this study. (Clayton 1996, 325–6)

Although theories of meter have been enriched lately by consideration of the timelines and nonisochronous beats that are common in world music (Agawu 2006; Polak and London 2014), such concepts still do not apply to situations in which pulse and pulse hierarchy are too irregular, sporadic, or slow to be entrained, or even absent. For analyzing free sung poetry, theories of prosody suggest grouping durations into poetic feet. For instance, Tsuge (1970) observes in Persian music how singers tend

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to alternate long and short syllables in a loosely iambic pattern (see also Azadehfar 2004 and, for a related repertoire, Qureshi 1969). This kind of description helps explain some of the generative strategies of performers but does not define large-scale form or engage with the specific durations of syllables, phrases, or sections.

Just a year after Clayton's article appeared, however, a promising possibility presented itself. In the book *Meter as Rhythm*, Christopher Hasty posited an elemental process of temporal perception that he called "projection." The top row of Figure 2.1 represents it symbolically as it might manifest in a succession of sounds, represented by thick line segments. The onset of the second sound makes definite a duration, denoted by a solid arc, that began at the onset of the first sound. At this same moment, indicated by the head of the arrow on the arc, Hasty says, listeners mentally "project" this duration into the future. The projection, symbolized by the dashed arc, acts as a measure by which listeners may assess the timing of upcoming events. For instance, if an event appears that same duration after the second onset, the projection is felt to be "realized." The sensation of meter, then, as defined in this theory, does not involve pulse hierarchies or entrainment, but simply an assessment of durational reproduction.

Grounded in process philosophy, the concept of projection is intuitively appealing, because it captures a familiar and compelling aspect of temporal cognition: our ability to direct our attention toward a future moment contingent upon an immediately past duration, and so to discriminate differences between successive durations. Hasty developed it into a rich, hierarchical theory of metrical "particularity" that can express, for example, the complex temporal sensations afforded by modernist Western art music. Considering Clayton's conundrum, however, it is worth investigating how the concept *tout simple* can support analysis of free rhythm.

At first glance it appears promising: listeners may perceive and project durations even in the briefest, most irregular succession of events, and the theory provides a way to characterize the time-sensations that they afford. Some of the nature and variety of these sensations are demonstrated by the rhythms analyzed in Figure 2.1, which are adapted from Hasty's exposition. The realization of a projection, shown in the top row, offers a sense of temporal continuity, specifically, that the realizing event-onset is extending an ongoing process, perhaps a nascent stream of pulse. This continuity may be nuanced if the event-onset is heard to realize the projection slightly early or late, as represented at the top of the second row: acceleration deemphasizes the present moment and directs attention toward the future, while slowing makes the present seem more weighty and terminal. A sense of termination arises more strongly when an event fails to materialize within the scope of a projection, creating metrical "hiatus" and discontinuity. Some event successions foster a change of scope, in which the listener decides to subordinate a second event in order to focus on a longer duration. Other rhythms, shown at the bottom of the second row, may encourage the listener to reorient attention toward the second event-onset, and the shorter or longer duration it begins, as more salient than the first. Lastly, as shown at the bottom of the figure, an event may be heard as subordinate, functioning more to continue an already becoming duration than to initiate a new one; the later it occurs in the duration, the more it heightens, as an anacrusis, the anticipation of the completion of the duration.

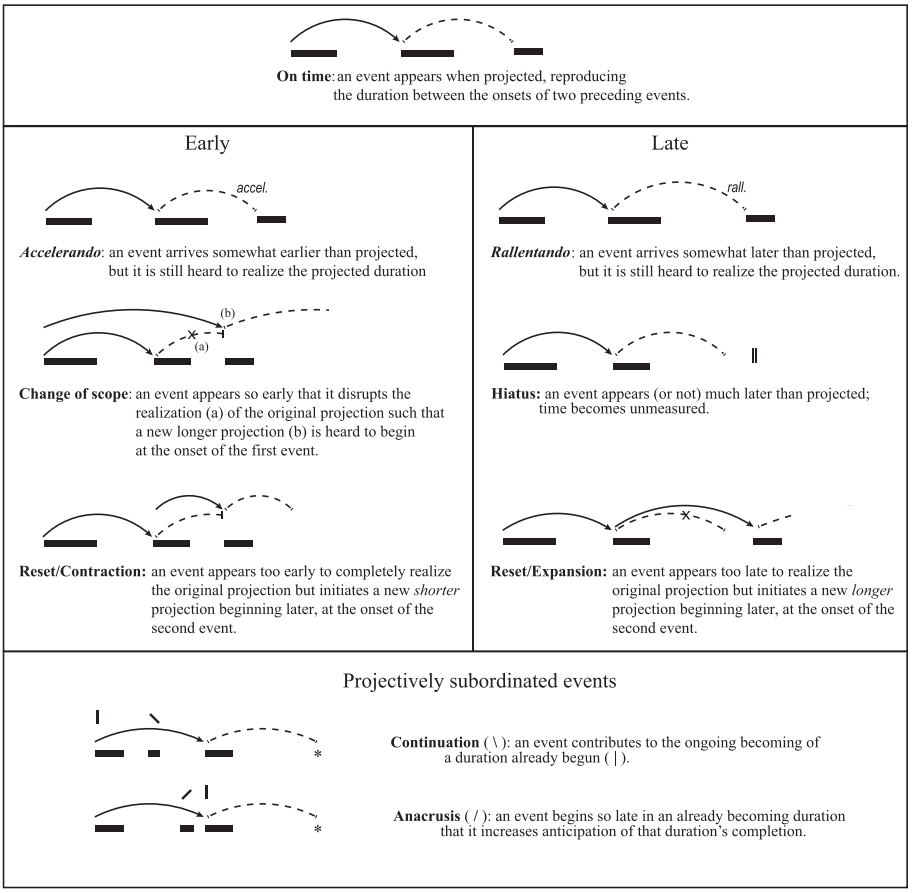

FIGURE 2.1 Some temporal sensations associated with durational projection and realization. Adapted from Hasty, *Meter as Rhythm* (1997, 87–89).

Though fleeting, these sensations may be heard to organize grouping structure and to combine into larger-scale processes. For instance, two different rhythms may be heard as the same if they produce the same series of time-sensations, or one may be described specifically as a variant according to the way that its projections vary those of the other. Realization, acceleration, slowing, and hiatus may be heard to create and articulate a directed temporal flow to which some events contribute but others may come as surprise, forcing retrospective reinterpretations of the importance of beginnings and durations.

Perhaps the reason that the potential of this theory for analyzing free rhythm has not been appreciated is that not enough work has been done to show how such music can direct and organize these elemental sensations that it describes. To foster that appreciation, this chapter examines how the durational successions in three examples of "free rhythm" world music may afford perception of process, pitch structure, and form.

To give concrete examples of the time-sensations represented in Figure 2.1, and of their formal functions, and also to consider some methodological questions, I will refer first to an item of Persian classical music: Afsāne Ziā'i's vocal performance (*āvāz*)

of the melody *Bīdād* from the *dastgāh homāyun*, one of twelve modal systems of the *radif*. The recording belongs to the comprehensive *Les voix du monde* collection, now publicly available online, that was assembled under the aegis of the Centre National de la Recherche Scientifique and the Musée de l'homme in France. As is typical of the genre, this performance consists of a wordless vocalise that proceeds through three episodes, alternating with and sometimes accompanied by an imitating flute (*ney*) (During 1996a). For present purposes I will consider only the introductory episode, called the *darāmad*. (Audio.2.1 ▶). It manifests a clear but irregular series of durations begun by discrete changes of pitch or timbre, some after brief rests, and it establishes the *dastgāh*, in which (at the pitch level of this performance) F#4 functions as the reciting tone and E4 as a phrase-ending tone (Farhat 1989).[1] Scholars characterize the rhythm of *āvāz* as "unmeasured rubato" (Tsuge 1970, 205). However, Owen Wright's study of this genre speculates that regularity may arise in the "surface rhythmic morphology of individual phrases or in their interrelationships" (Wright 2009, 36). Hasty's theory offers a way to engage specifically with that morphology: each definite duration initiates a projection that measures the becoming duration of the next event, and imparts certain temporal qualities to it.

Examples of those qualities are identified by the annotations on the transcription of the *darāmad* in Figure 2.2. It employs Western durational notation, as is common in transcriptions of this genre, but each event is placed horizontally proportionate to

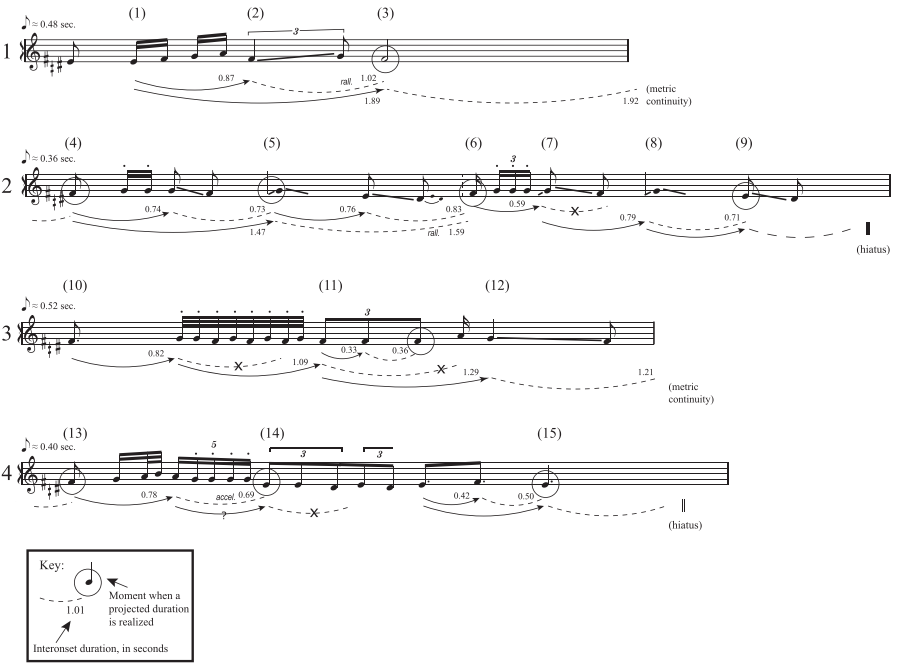

FIGURE 2.2 Projective analysis of the introduction (*darāmad*) to the classical Persian chant (*āvāz*) of an extract from *Bīdād* from *dastgāh homāyun*, sung by Afsāne Ziā'i with Hoseyn Omumi, *ney*. Transcribed by John Roeder.

its onset time, with a notehead that approximates its duration with reference to the tempo mark at the beginning of its respective staff, so that the durations of identically notated events may differ. The arrows and arcs indicate durations that may be heard to participate in projections. To clarify certain comparisons, numbers on the arcs label these durations quantitatively to the nearest hundredth of a second but, as I shall discuss, it is only the comparisons, not the chronometric timings, that are relevant to the analysis. The grouping of the events into four systems reflects my hearing that the projective processes form the *darāmad* hierarchically into two pairs of phrases.

Before proceeding, however, let us take the opportunity this music provides to consider the appropriateness of the analytical method. Within many of the durations asserted by the transcription, timbre, loudness, and pitch vary continuously. How valid is it, then, to quantify and compare them? Judit Frigyesi trenchantly demurs:

> The idea that one can scientifically measure the duration of a note is pure illusion: in reality, most sounds present a complex schema of internal life with subtle variations in loudness, timbre, vibrato, and pitch. Ornamentation and the coordinated action of multiple instruments make the image more confused, just like the presence of breath, vibrato, and text pronunciation in vocal music. At a very subtle level, the act of deciding when a note begins and ends is already influenced by our preconceived perception of the internal periodicity of a particular style. (Frigyesi 1999, 61; par. 23 in online version)[2]

If she is right that "scientific" measurement is unjustifiable, then one must find other ways of describing free rhythm, for example as contours of stress, as Frigyesi herself has done with her characterization of "flowing rhythm" in Jewish *nusah*, or as patterns of "intonations" (Asafiev 1947; Chashchina 2013).

However, the fact that sounds are complexly varying ensembles of qualities does not preclude hearing and comparing the durations begun at their onsets. Indeed, Frigyesi's description affirms the essentially processive nature of durational perception that Hasty's theory advocates. For instance, the moment (2) is clearly articulated by the sudden change in pitch, and although the pitch and vocal timbre vary continuously immediately afterward, the moment (3) is also clearly articulated by a discontinuity in those same features. Thus the duration from (2) to (3) can be perceived as a whole, complete process, whose "subtle variations" are what make its becoming so compelling. Moreover, a listener need not quantitatively measure it to perceive whether it replicates the equally perceptible duration from (1) to (2). What I take from Frigyesi, then, is not a renunciation of duration per se but an exhortation to consider the "internal life" of projections and how they color the durations' functions. Some examples will be considered in the analyses that follow.

Furthermore, projective analysis can address some of the well-known problems of transcribing free rhythm that are implicit in Frigyesi's critique (see also Clayton 1996, 326 and Frigyesi 1993, 60–62). For instance, the indication of gliding pitches and ornaments of *āvāz* using Western-style note heads, which imply the beginnings of discrete events of fixed pitch, suggests durations that are not really present. Figure 2.2

compensates for this weakness by using projective arcs to group together symbols that appear to represent two or more distinct events—such as the G4-to-F#4 just before (5), the E4-to-embellished-D#4 just before (6), the G4-to-F#4 at (12), and the accelerating pitch ascent at (13)—into a single longer duration of varying pitch. The arcs show that it is the longer durations that have metrical function in the analysis, not the briefer processes that combine into them.

It is harder to counter Frigyesi's objection that beginnings and ending of sounds are not objectively measurable but are perceived with reference to a stylistic context. But she seems to be referring to styles in which there is some explicit or implicit conception of periodicity. There are many genres that insiders claim to be aperiodic, and so her assertion may simply be taken as a mandate to focus on them.

Having addressed these methodological questions, let us listen in the *darāmad* for the various projective time-sensations of Figure 2.1, and consider their formative functions. On several occasions, the song affords hearing the most elemental process in Hasty's theory, a realized projection. Consider the moment labeled (15) on the last staff of Figure 2.2. The E beginning then sounds on time if we hear the duration that it completes from the onset of the preceding F#, shown by the dashed arc, to reproduce the duration from the earlier E to that F#, shown by the solid arrow.

When successive durations differ somewhat, we may still hear a realized projection but understand the realizing event to be slightly rushed or delayed. For example, consider moment (2) on the first staff. At the attack of F# then, the duration beginning at (1) is made definite and is projected forward. The singer holds the F# slightly (150 ms) longer than the duration she projected (870 ms), bending it upward in pitch to G4 before stabilizing again on a sustained F#4 starting at (3). Her return to F# realizes the projection, but slightly late, giving a temporal sensation of *rallentando* that is indicated on the dashed arc. This process gives the F# at (3) a metrical priority, enhanced by the delay, beyond the stress it accrues through its duration alone. It also makes the duration (1.89s) from (1) to (3) available, as indicated by the long dashed arc, to measure the duration of the long F#. Attending to projections, then, we may discern a rhythmic strategy in this opening. Although singer employs a variety of durations, the effect is not arbitrary. She concisely realizes projections of increasing length, culminating in a long F# that is thereby affirmed both as a modally significant pitch and as a promise of continuation and connection to the following music.

She fulfills that promise by beginning her next event, at (4), on time (within 3 ms) as measured by the projection she set up at (3). However, her succeeding utterances come more quickly than at first, making it impossible to perceive a constant pulse carrying on from the first system. The new projective processes mark the moment (4) as an important beginning, and (5) and (6) as moments of realized projection, forming a durational hierarchy that recalls the time sensations she introduced from (1) to (4). Yet she also develops them: right away she introduces a distinctive glottal tremolo (*tahrir*) on G, indicated by the staccato articulation marks, as part of the becoming of the first projective duration; and she begins to associate sounds with similar "internal life" with particular projective functions by placing descending semitone glissandi (G4 to F#4 and E4 to D#4) as the realizations of the short projections at (4) and (5).

At (6) she starts to repeat the events of (4),[3] but she changes her timing in a way that introduces new projective sensations. At (7), the projection of the duration from (6) is nearly 200 ms shorter than the preceding projections, breaking the metrical continuity. As the *tahrir* tremolo now recurs more intensely, it seems to cause this disruption. The next event (8) comes too late to realize it, even as a *rallentando*. The following chain of events affords the "reset/expansion" sensation cataloged in Figure 2.1: we reorient our reference to a later beginning, and the duration we project is longer than the previous one. Specifically, if we change our reference to consider (7) as a beginning, we can hear a realized projection when the 790 ms duration from it to (8) is closely reproduced by the 710 ms duration from (8) to (9). In this way the singer gives the onset of the realizing E, circled at (9), an emphasis that it did not have the first time around, before (6). Since the E functions in this *dastgāh* as a phrase-ending pitch, this emphasis is appropriate, but then she glides away from it, denying it stability. With the projections that she has set up at (9), she has the option to make the next onset sound on time, and thus to create the kind of durational continuity that she did at (4). But her next entrance, at (10), is far too late to reproduce the duration from (8) to (9). This dissolution of projection offers the sensation of "hiatus" described in Figure 2.1, and it allows her next phrase to begin relatively uncontingent upon past durations.

Capitalizing upon that distinctive quality, she sings a contrasting series of events that thwart any attempt to hear durational reproduction but still appeal to listeners' memories and experience of what she has just sung. Her *tahrirs*, whose disruptive powers were foreshadowed at (6), now recur and continue beyond what we could project, thus initiating a succession of reset/expansions at (11) and (12) that might be heard as development of the earlier one at (7).[4] At (13), which realizes the projection at (12), she offers us a sense of longer durational predictability, but then accelerates into another ambiguous passage with *tahrir*. In this context, her last and clearest reproduction of duration at (15) restores temporal order, makes the phrase-ending pitch E4 sound "on time," and sets up another hiatus into which the flute can enter uncontingent upon her timing.

My narrative of this *darāmad* shows how the theory of projection distinguishes and precisely characterizes several types of "freedom" in its rhythm, each affording a distinctive temporal sensation.[5] In one type, definite durations are not immediately reproduced, such as following (6). In another, there are successive realized projections, but the reproduced duration is different, such as is shown by the lower arrow-arc pairs between (1) and (6). Also, there are moments of hiatus when no projections are active, such as just before (10). Projections may have qualities of *rallentando* or *accelerando* such that events sound late or early, such as at (3) and (14) respectively. Or events may simply seem too long or too short, and so disrupt projection or encourage the listener to reorient to other moments and durations, as at (8) and (11).

The varying qualities and presence of realized projections form the *darāmad* into two pairs of phrases, the second of each pair beginning with the succession F# to G after a long duration. Consistency of projective processes, such as from (1) to (4) and (4) to (6), binds events together into groups, and those groups are separate by change of projective duration, such as at (4) and (13), and contrast of process, such as at (10).

The single hiatus during the vocalise creates the strongest discontinuity, and the hiatus after it sets up the entrance of the flute solo. Lastly, pitches that are highlighted at moments of durational reproduction in this otherwise unpredictably timed music form a meaningful process. Realized projections introduce and reinforce F#4 as reciting tone, establish G4 as an important upper neighbor (and as an agent of metrical disruption, because it is the site of the glottal tremolos) and, except for a brief preview at (9), hold off emphasizing the modally referential tone E4 until the end.

This account shows how it is possible to coordinate the observations about durational projection in an analysis that attributes purpose to every event in its time. The theory's orientation toward process is especially apt for evoking the vivid presence of this *darāmad*, in which each moment is charged with possibilities of realization and denial that the performer creates by her timing.

To see whether durational projection is analytically productive for other sorts of free rhythm, let us consider an item with no known connection to the highly developed world of classical Persian music. On a recording made in 1976, Zinzir, a member of the Gizra people in Waidoro, southwestern Papua New Guinea, performs a solo on bamboo flute (*tatarore*) (Audio.2.2 ▶). While it is said that this item was traditionally "played only during the rainy season to announce the coming of the southeast winds" (Laade 1979), I have not found any account of emic conceptions of periodicity, if there are any in this tiny isolated community. *Pace* Frigyesi, then, the "scientific measurement" of duration is the only access we have into its rhythmic processes.

Fortunately the durations in this solo are simpler in organization and kind than those of the constantly varying sounds in the *darāmad*. They simply cycle repeatedly through a fixed series of five long pitches in a variable nonisochronous rhythm. Each pitch is sustained between 1.8 and 2.4 seconds, and is preceded by what I will call a "grace-note group" of two or more fleeting pitches. Figure 2.3 shows the first seven iterations of the cycle, transcribing the long pitches with open note heads and the grace-note groups with smaller solid note heads beamed to suggest their relative durations, and it labels each grace-note-to-long-note gesture alphabetically. The cycle is articulated by breaths, notated as rests, that performer usually takes after long notes W, X, and Z, and by the distinctive, consistent content and timing of the first grace-note group. The transcription is time-proportional, such that the positions of the long pitches and of the incipits of the grace-note groups correspond to their onset time relative to their respective cycle-incipits, which are aligned vertically at the left. Dashed vertical lines connect corresponding pitches in successive cycles. The way that they diverge and converge shows how the durations between the onsets of the grace-note groups and the long notes vary as grace notes are added, omitted, or modified in duration, and makes evident why it is hard to hear a persistent beat.

Nevertheless, a listener may sense some regularity. The total duration of each cycle remains remarkably consistent for its first five iterations, varying no more than 1.4% (200 ms) from 14.45 seconds. Perhaps the performer maintains a silent internal pulse or perhaps, after much practice, he has settled into a physical routine, but neither seems likely since he varies the contents of the cycle.[6] Moreover, these variations

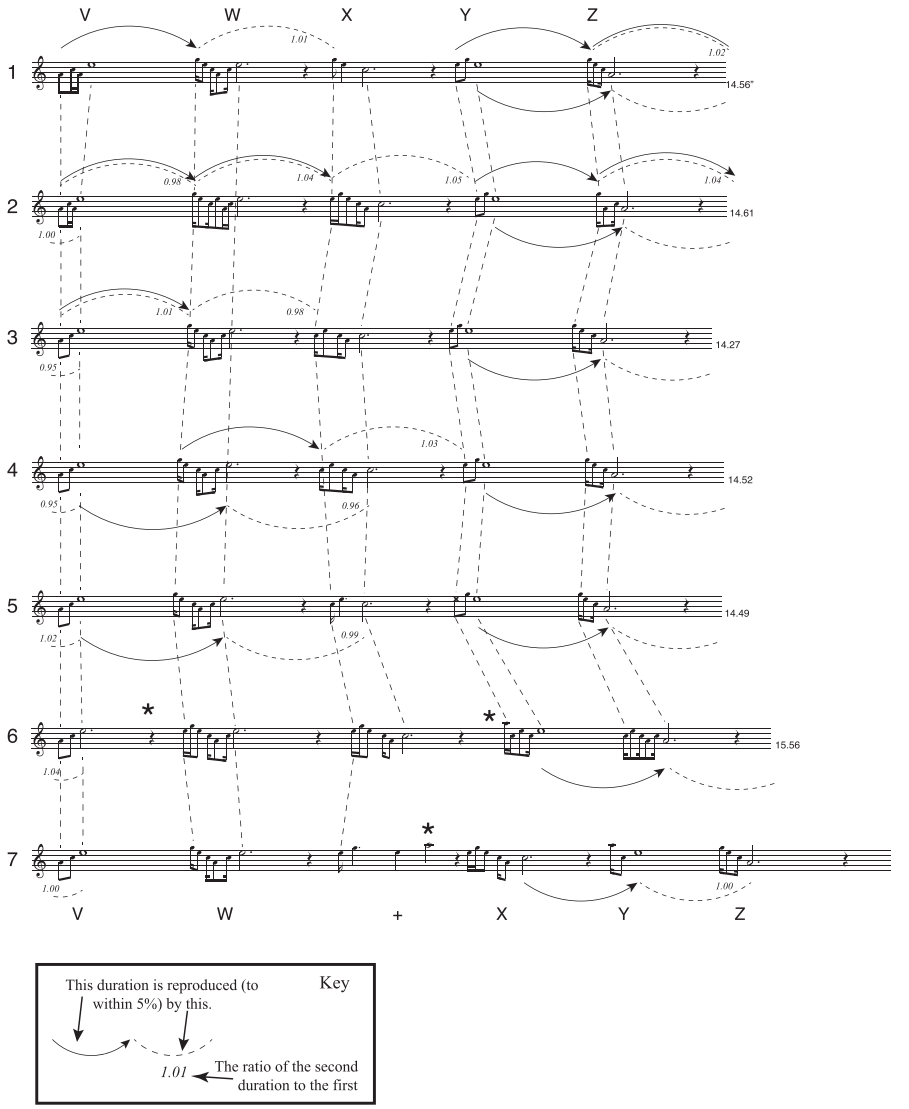

FIGURE 2.3 Projective analysis of the first seven cycles of "Flute," performed by Zinzir, *tatarore*. Transcribed by John Roeder.

produce trends of timing, inconsistent with a pulse stream, that are apparent in the specific way that the lines diverge and converge. For example, across the first five iterations the duration of long note V diminishes and the onset of grace-note group W appears successively earlier; across iterations 3–6 the onset of grace-note group X appears successively later.

Starting in the sixth iteration, as the listener may begin to feel lulled by the languid repetition, the variants become more overt; the most noticeable changes are indicated by asterisks on the transcription. For the first time, the performer breathes after the

first long event. Thereafter every grace-note group has more events than any of its earlier versions had. Also, a striking new pitch, A5, initiates grace-note group Y, an octave above the cycle's beginning and ending pitches.[7] These additions increase the cycle length by one second and prepare for more significant changes. In the seventh iteration, after group W, the first three notes of the grace-note group X are greatly elongated, and then change to a long A5, the pitch that was just introduced in the previous cycle. After that novelty, the cycle picks up where it was interrupted, and completes its last three long pitches, so this new pitch functions as an internal expansion of the cycle.[8] The interpolation is indicated in Figure 2.3 with a +.

It is possible to hear a purpose in these trends of timing in the first six cycles, supporting the item's large-scale process, if we attend to very local sensations of durational reproduction. Rather than try to entrain to a constant pulse stream, we may consider for each event: can its timing be projected from the timing of the events that precede it? That is, in terms of Hasty's theory, can we hear realized durational projections?

Figure 2.4 illustrates two ways in which an immediate repetition of duration in this item can be perceived easily because it spans the onsets of events of the same type. In the first way, indicated by symbols above the note heads, we hear the durations beginning (|) at the onsets of each grace-note group. The onsets of the long notes are not as important; we hear the durations they begin simply as continuing (\) the duration begun at the grace-note onset. At each grace-note-group onset, we are aware of a duration just completed (symbolized by the solid arrow pointing to that moment) and of its projective potential to be reproduced (the dashed arc following that moment). If the timing of the next grace-note-group onset (at the end of the dashed arc) is right, the projection is realized: the onset feels like it is on time, and we sense durational continuity, similar to what we could hear at moments of realized projection in the *darāmad*. The other way to listen projectively to the same series of events is indicated by symbols below the note heads in Figure 2.4. We may hear the durations beginning at the onsets of each long note, and each grace-note group simply as an anacrusis (/) to a long-note onset. For each long-to-long duration, the right timing of the next long onset will afford the same feeling of realized projection. Of course other durations can be heard, say, from the onsets of grace-note-groups to the onsets of long durations, and vice versa, but it is obvious from the spacing of the vertical lines on Figure 2.3 that

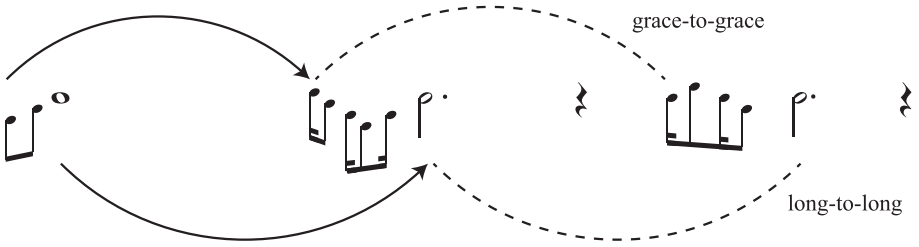

FIGURE 2.4 Two possible kinds of realized durational projections in "Flute" (under the assumption of parallelism).

successive durations of this type are not equal; others are harder to hear because they are so long and involve different types of events.

Although both these ways of listening are concerned simply with the immediate reproduction of duration, they attribute quite different sensations to any given event. In the flute performance, because of the varying timing, one of these readings is usually preferable to the other, because the durational reproduction is more exact. Accordingly, depending on how the timing changes from cycle to cycle, an event that sounds like an important beginning in one cycle may sound in another cycle like a continuation or anacrusis, and an event that sounds on time in one cycle may sound early or late in another. I hear these variations in metrical function and specificity to enliven the cyclic process that might otherwise be depreciated as mere rote repetition.

The annotations on Figure 2.3 document the basis for such a hearing. Each pair of solid and dashed arcs indicates a durational projection that is realized by three successive events of the same type. Arc-pairs *above* the staff indicate projections realized by the onsets of *grace-note* groups, and arc-pairs *below* the staff indicate projections realized by the onsets of *long* notes. Different solid arcs generally correspond to different durations—they range from 2.4 to over 4 seconds—so a succession of them does not indicate a steady pulse stream. The figure shows only those projections in which the second duration is within 5% of the first duration. This is a fairly stringent standard, but also selective: with only a few exceptions, no other pairs of successive durations are nearly that equal. For readers interested in a fuller justification, the appendix to this chapter describes the results of statistical tests that give some confidence that the distributions of durations are not a matter of chance, and cites psychoacoustic research about subjects' ability to discriminate differences in successive durations.

The arcs on the figure help us to identify which durations are immediately reproduced, and to correlate the varying presence of projection with the overall form. Several correlations seem especially salient:

- Below the end of *every* cycle is a dashed arc that continues into the next cycle. This means that in *every* cycle, the attack of the first long E5 realizes the projection created by the attacks of the last two long notes of the previous cycle. That is, if we measure time after the onset of long note Z with reference to the duration to it from the onset of the previous long note Y, the next long note V at the beginning of the next cycle sounds exactly on time. Realized projection forges continuity across every cycle's grouping boundary, thus binding the separate iterations into a larger-scale process.
- In *no* cycle does a solid arc ever span the rest after long note X. This means that durations from the events of group X to the corresponding events of group Y are *never* reproduced, so that the timings of the onsets of the grace-note group and long note of Z always feel unpredictable. However, as observed earlier, every long note Y initiates a span of time that can be felt as measured, lasting until at least the beginning of the next cycle. The consistent lack of measurement just before long notes Y may help the listener feel the ensuing realizations more keenly. In any event, the time sense coming into Y differs

from every other moment, making the temporality during each cycle more variegated than a simple succession of five short groups.

- During the first three iterations, starting from the first long note Y, *every* duration that is reproduced is between the onsets of the *grace-note* groups (above the staff), aside from the special boundary-spanning projections mentioned earlier. At the beginning of the solo, then, it is rewarding to focus on these onsets, because we can hear the projections (the dotted arcs) of the durations they initiate (the solid arcs) to be realized. In this way of listening, the long notes during this passage function to continue those projective durations, not to initiate new ones.
- In contrast, during iterations 4 and 5, as the performer adjusts the timings and contents of the events, it is the durations between the *long* notes that are reproduced (as shown by arcs *below* the staff). Their onsets become the more important beginnings, and the grace-note groups now sound like anacruses to them. Thus the relative metrical importance of grace-note-group onsets and long-note onsets reverses as the cycle repeats. In particular, the first and third long E5s take on a more metrically definite character, and all the grace-note groups sound anacrustic.
- As the changes continue into the sixth and seventh iterations of the cycle, *no* duration (except the boundary-spanning one) is reproduced as exactly as the earlier durations were.[9] We enter a time of metrical uncertainty that may function to help the listener accept, after group W in iteration 7, the interpolation (+) of the greatly slowed grace-note group and the unprecedented high long note. Thereafter, duration begins to repeat again.

Just by attending to the realization of projections in "Flute," then, without even contemplating the more complex time sensations of Figure 2.1, we may observe consistencies and systematic variation in this performance that help us to hear formative processes over a time scale that transcends that of the individual cycle iterations. Just as in the second phrase of the *darāmad*, event-series are repeated but with different timings that affect the larger continuity of the item. The *darāmad* also demonstrated how grouping structure can be created in the absence of repetition through local projective effects, especially hiatus. It is also possible, however, for grouping structure to be perceived if the music reiterates or varies a distinctive pattern of projective time-sensations.

A fine example of such sophisticated control of temporality is the beginning of an *ālāp* on *rāga* Pūriyā-Kalyān performed by Budhaditya Mukherjee (Audio.2.3 ▶). Richard Widdess's intensive analysis (2011) of this studio recording focuses on the strategies by which the sitarist, playing with listeners' conscious and unconscious expectations of pitch, exposes contrasting aspects of the *rāga* and structures the musical discourse both locally and across longer passages. Although Widdess finds no "regular pulse" and therefore says little about rhythm, he makes the intriguing suggestion that "most listeners will compare each duration only with preceding durations, not with any perceived constant unit of duration." Hasty's theory is concerned

precisely with such comparisons. By considering how each event seems to come on time, or earlier, or later than could be expected from the durations immediately preceding it, I will identify some consistent rhythmic strategies by which the artist seems to play with listeners' projections of durational repetition to structure the musical discourse.

My hearing is presented on Figure 2.5. It adapts Widdess's meticulous transcription of the passage (his Figure 5.3, 197), retaining its symbols and time-proportional layout but adding analytical symbols associated with Hasty's theory as well as alphabetical labels of certain points in the passage to which I will refer. (I have added symbols for two events—both chords near moment (m)—that he seems to have inadvertently omitted.) As in the "Flute" transcription just discussed, each solid arc represents a definite duration, completed at the head of the arrow, that has a projective potential to be reproduced, represented by a dashed arc following that moment. With a few exceptions that I shall explain, the figure shows only those projections that are realized to within 5%, in other words, where the first duration is immediately reproduced by another perceptibly identical duration, as was the case in the analysis of "Flute." Again, the number under each dotted arc specifies the ratio of that duration to the duration indicated by the preceding solid arc, calculated from onset timings determined from the recording.

At the beginning of the performance, durational projections can be heard to be created and realized by *cikārī* (drone-string) chords. Starting at moment (a), the attack of each new chord completes, to within 5%, a duration that replicates the duration spanning the preceding two chords. Although the durations are long and varied, precluding a strict pulse, this consistent realization of projections nevertheless gives each chord a sense of appearing on time. As soon as this process is evident, Mukherjee complicates the rhythm by arpeggiating the *tarab* (resonating) strings *downward*. His attacks are quite regular, creating a clear repetition of the medium-length duration shown by the arrows below the staff. Complementarily, at (b), after the onset of the following chord, he arpeggiates the *cikārī* strings *upward*, creating a shorter but also definite and projective duration. Again we may sense a potential for the replication of shorter durations within the becoming of a longer measured duration. However, as shown by the two vertical strokes, nothing occurs to realize the projection. Instead there is a sense of hiatus at the shorter time scale, even as the longer duration is about to be reproduced.

The regular pattern of durational reproduction breaks at (c) when the sixth chord comes much earlier than the projection of the previous long duration. Directly thereafter the melody enters, as shown in solid notes on the score. The faltering metrical continuity of the chords heightens its salience. A seventh drone-string chord follows much sooner than could be expected, as the cutoff dotted arc indicates, but the shorter duration set up by the reset/contraction is not reproduced either. Through this demeasured time the soloist leads his melody to a long-held tonic, attacked simultaneously with another chord at (d). This strong coincidence is also too soon compared to the most recently completed duration from (c) and, although it suggests that the duration from (c) to it might be heard as projective, no event occurs at that duration after

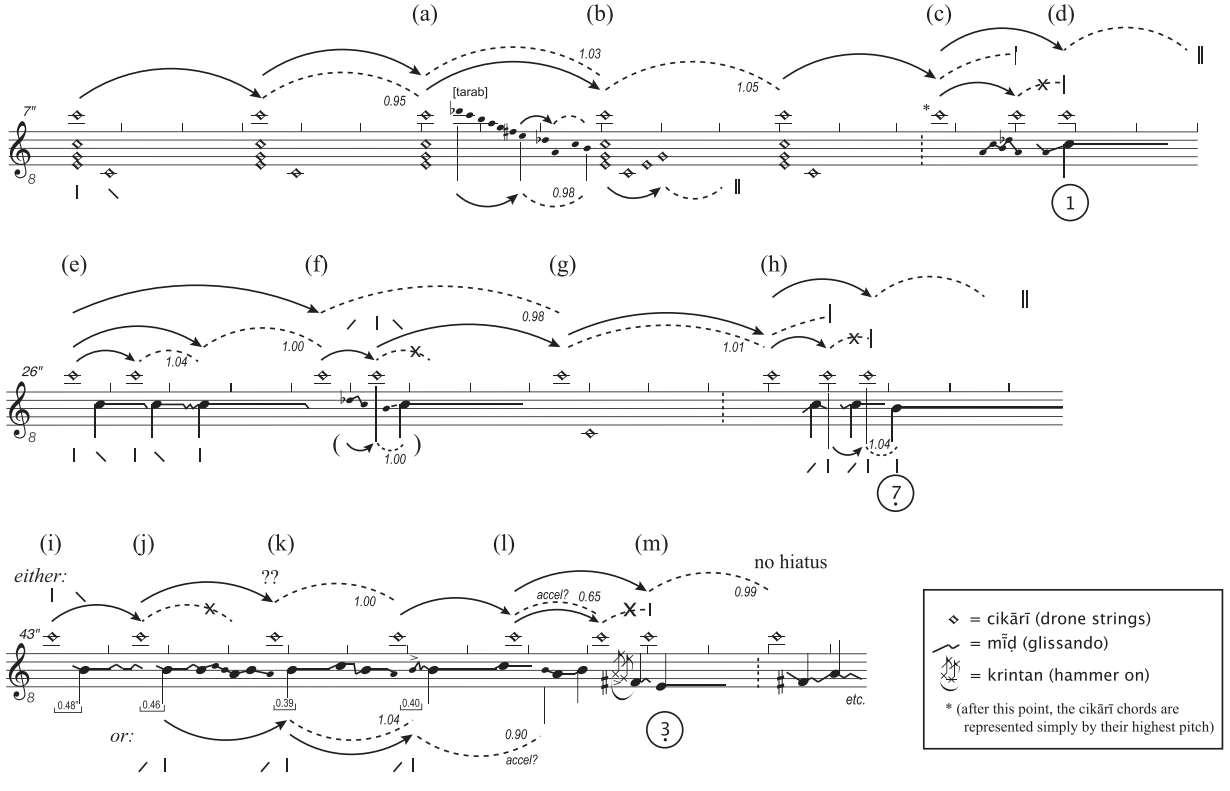

FIGURE 2.5 Projective analysis of the opening (0:07–0:55) of the *ālāp* on *rāga* Pūriyā-Kalyān performed by Budhaditya Mukherjee, *sitar*. Transcribed by Richard Widdess, adapted and annotated by John Roeder.

it. So any sense of durational reproduction falls into hiatus, and so the next attack at (e) stands out as a fresh beginning.

The following passage, shown on the second system, enacts the same general temporal process—establishing a pattern of durational reproduction, disrupting it as a new sustained pitch appears, then sinking into hiatus—with some intriguing variations. First the artist recalls the idea of a quickly reiterated chord. However, rather than using it to *disrupt* meter as he did at (d), he now reestablishes a large-scale *continuity* by playing the chord-pairs regularly enough for us to perceive durational replication, as at first. The duration from (e) to (f) repeats immediately from (f) to (g), and the duration from (g) to (h) replicates the immediately preceding chord-to-chord duration.

Mukherjee also enriches this medium-scale process with his placement of the melodic pitches. Whereas on the first system they seemed out-of-time, now they *interact* with the chords to produce and replicate shorter durations. Notably, from (e) to (f) appear two nested levels of shorter realized projections between the attacks of chord and melody pitches, making a quadruple meter. At (f) the timings of chords and melody also afford two sensations of durational replication, although not in such a hierarchy. These processes parallel the smaller-scale projections after (a) and (b), but involve the melody instead of the drone and *tarab* strings.

The subsequent projective processes strengthen the parallelism with the opening music, as is evident in the similar arrangements of solid and dotted arcs at the ends of the first and second systems. After (h), as after (c), the pattern of durational reproduction breaks down as events come much sooner than could be expected. Through the de-measured time, the artist again leads the melody to a long-sustained pitch—now, the important seventh scale-degree of the *rāga*—and holds it long enough to dissolve any expectations of durational reproduction, just as he did when he introduced the tonic.

Starting at the next *cikārī* chord (i), the same medium-scale metrical process is reprised and condensed: a passage of durational reproduction gives way to a series of unpredictably shorter durations that create a passage without pulse, into which a new sustained pitch is injected (now the third scale degree). The broad similarity of the series of projective symbols to those on the first and second systems indicates the reprise.

However, the specifics of this process are varied again, in a way that suggests a larger-scale strategy in the artist's development of durational successions. Rather than creating projective durations solely between chords, as at first, or between the chords and the melodic notes, as on the second system, Mukherjee now alternates chords and melody in a way that affords a figure-ground-like shift in metrical perspective akin to the one that I attributed to the flute solo. At first it is possible to hear the *cikārī* attacks as initiating and realizing durational projections that the melodic notes continue, just as they did at first. The symbols *above* the system at (j) express that hearing. Then, however, the onsets of the scale degree 7s become more important, initiating projective durations within which the *chord* attacks may be heard to function as *anacruses*.

This reading is expressed by the symbols *below* the system. Several factors incline me toward it. The duration projected by the chord at (j) is not realized, as indicated by the X through the dashed arc. Rather, the lengthening and decoration of 7 after (j) draws attention to its onset, and to the duration from it to the onset of the next post-chord 7 at (k). That attention is rewarded when the latter duration is immediately reproduced. Meanwhile the duration from each chord to the subsequent attack of 7 shortens, becoming more anacrustic to the lengthening 7s. Thus, just as the long scale degree 7 marks the first departure of the melody from the tonic, the timing of its onsets in this particular rhythmic context seems to invest the melody with energy to wrest the metric initiative away from the *cikārī* strums.

The artist has carefully prepared this shift of metrical initiative. At the beginning of the improvisation, he followed each *cikārī* chord quickly by an attack of the lowest, tonic, drone string, whose duration simply continued (\) the longer one initiated by the chord; so the chordal strums seemed to be the most important beginning. During the second system he clearly developed this idea by substituting a melodic tonic for the low drone event after each chord. He also suggested twice that the melodic tonic, as the realization of a projection, could itself be an important beginning. The possibility is renewed at the first appearance of 7 at the end of the system, which, unlike the tonic at the end of the first system, follows a chord and realizes a local projection. It is fully accomplished on the third system, when the chords become anacrustic to the melodic 7s.

That an inflection point has been reached is evident from the projective processes after (l). As we might now expect, they strongly resemble those around the introduction of tonic: three chords appear too quickly to hear as realized projections, the last two too rapidly to comprehend as an acceleration. It is therefore difficult again to attribute metrical function to the new scale degree that is sustained. However, this time around Mukherjee does not dally: the duration completed from (l) to (m) is reproduced from (m) to the next *cikārī* chord, and so the music is now able to maintain its continuity past the held melodic pitches, without hiatus. Now the *ālāp* is convincingly underway.

This sort of analysis has the potential to account for many aspects of this music in addition to the important processes of unveiling the *rāga*. For example, it gives an active role to the attacks of the *cikārī*, which otherwise might seem to be a featureless background. More generally, the three systems of Figure 2.5 show how the artist structures rhythm in three similar but progressively developing stages. Interestingly, these correspond well with Widdess's segmentation of the passage into three phrases, indicated by the dashed bar lines, which he derived "heuristically" by considering "distinctly perceptible changes" of pitch (Widdess 2011, 193). The correlation suggests that durational and pitch discourses are closely linked at the outset of this improvisation, perhaps showing how "the performed rhythm is felt to optimize the reception of melodic information and cognition of melodic structure" (Clayton 1996, 330–31).

My detailed analysis of these three items begins to answer Clayton's call to provide models for understanding "free rhythm" in world music. However, I do not claim that the patterns I observe in these examples are characteristic of their respective genres.[10] That would be generalizing Hastily. I have simply demonstrated that the concept of projection, and its attendant sensations, can be used to construct a coherent narrative of extended passages of music that distinguishes and attributes purpose to the specific free rhythms it features. In the R1 sense advocated by Hasty in chapter 1, and true to the vivid improvisatory presence of the items, the analyses I presented focus on "the online activity of making rhythm." To the extent that they seem cogent, we may say that in these various examples we hear the performers regulating their free rhythm to create musical form.

APPENDIX

A premise of the analysis of "Flute" is that the immediate reproduction of duration to within 5% has a special significance in the ongoing process of this item. This appendix provides a rationale for that assertion with reference both to statistical properties of the timings and to psychoacoustic research into the perception of difference in successive durations.

First let us consider the durations from the onset of each grace-note group to the onset of the following grace-note group. These are the durations shown above each staff in Figure 2.3. Table 2.1 shows how the ratios of successive durations of this type are distributed.

Table 2.2 is concerned with the durations from the onset of each long note to the onset of the following note. These are the durations shown below each staff in Figure 2.3. The table shows how the ratios of successive durations of this type are distributed.

Both tables show that many ratios fall within a narrow band around exact equality (1.0). The half-widths of the central bands, 3.5% and 4.5% respectively, are consistent with the results of a finding (Fraisse 1952, 44) that listeners judge durations of two successive events to be equal that differ by up to 125 ms, which corresponds to a 4.3% difference in the average 2.9 second flute duration.

On either side of those bands, there is a gap of about the same width (7%) where very few ratios fall, but past that gap, there are again many ratios. In other words, it

TABLE 2.1

Distribution of ratios of successive durations marked by grace-note-group onsets

Ratio	(76%)	91%	98%	105%	112%	(154%)
# of pairs with ratios in that range	11	2	11	0	1	

TABLE 2.2

Distribution of ratios of successive durations marked by long-note onsets

Ratio of second to first duration	(52%)	88%	95%	104%	113%	(150%)
# of pairs with ratios in that range	10	2	11	2	12	

appears from these histograms of the ratio distribution that successive durations of the same type either are very nearly equal, or else are clearly not equal, with very few ambiguous cases.

To gain confidence that this distribution is not the result of a natural random variation, we need to establish that the dataset is different than could be expected if the player were replicating each duration with a degree of accuracy that follows a normal (random) distribution, with most attempts close to success. This can be achieved with a standard statistical method. Under the null hypothesis that short-to-short duration-ratios constitute a sample from a normal distribution, the value of the Shapiro-Wilk test statistic W is 0.9410 with corresponding p-value 0.04105. At a 95% confidence level, then, we reject the null hypothesis, in other words, the short-to-short duration-ratios are highly unlikely to be a sample from a normal distribution.

There is no such clear evidence that the long-to-long duration-ratios are not: under the null hypothesis that long-to-long duration-ratios constitute a sample from a normal distribution, the Shapiro-Wilk test statistic W is 0.98104 with p-value 0.7412. However, a time-series analysis shows that every fifth durational ratio is significantly correlated, in other words, that the durational ratio at a given position in one cycle is correlated with the duration in the same position in the previous cycle.[11] One aspect of this periodicity is evident in the consistent reproduction of duration that Figure 2.3 shows from the end of one cycle to the next.

Much of the research into listeners' ability to discriminate difference between successive durations has focused on longer series of empty durations articulated by short beeps. Summarizing the studies to date, Madison and Merker (2002) cite a range from 3.5% to 8%, which is consistent with Fraisse's results cited earlier. Under certain conditions studied mainly for short intervals associated with speech (200 ms), listeners underestimate or overestimate the second of two durations, and the error is not simply due to perceiving durations categorically (Nakajima et al. 2014). Prior expectations and knowledge of its possible range can influence how a duration is perceived then reproduced (Jazayeri and Shadlen 2010). I would hedge, however, that the stimuli used in this psychological research are much simpler than the kinds of musical situations analyzed in this chapter.

NOTES

1. The scale is sung a minor third lower in the recording than Farhat writes it, so the transcription in Figure 2.2 renders it accordingly.

2. My translation of the French original: "L'idée que l'on puisse mesurer scientifiquement la durée d'une note est une pure illusion; en réalité, la plupart des sons montrent un schéma complexe de vie interne avec des variations subtiles de leur dynamique, de leur timbre, de leur vibrato et de leur hauteur. L'ornementation et l'action coordonnée de plusieurs instruments rendent l'image encore plus confuse, exactement comme la présence de la respiration, du vibrato et de la prononciation du texte dans la musique vocale. À un niveau très subtil, le fait de décider quand commence et quand finit la note est déjà influencé par notre perception préconçue de la périodicité à l'intérieur d'un style particulier."

3. The sense that she is repeating a distinctive and fairly fixed succession of events is strengthened by the flute's flexible doubling from (6) until (10).

4. In texted *āvāz*, in contrast to the situation here, *tahrir* usually ends the phrases, but it seems also to have an effect on temporal continuity for, according to Tsuge (1970, 222), "the whole energy which has sustained the melody is actually discharged in the *tahrir*."

5. Bruno Nettl (1987, 33) offers some more general distinctions of free rhythm in Persian music.

6. The question of whether Indian performers maintain a pulse in *ālāp* is a complex one. Both Widdess 1994 and Wolf 2010 have demonstrated that a regular pulse can in some cases be heard, but performers themselves do not acknowledge it. In a personal communication, Richard Wolf wrote me, "I would venture to say that any competent performance of raga alapana in Karnatak music maintains a steady pulse, and that many of the obvious deviations of attacks from the 'on beats' as it were can be accounted for by the same concepts as are used in music regulated by tala. That is, emphasizing a beat by hitting an offbeat (before or after) is a recognized and theorized part of tala based music" (p.c., October 26, 2016).

7. Since the A5 is produced by overblowing, we may hear its appearance at this moment as the culmination of a process in which the performer has blown progressively harder, resulting in a series of ghosted notes that progressively approach a full-bodied A5.

8. The recording contains three further cycle iterations not transcribed in Figure 2.3. They act as a reinforcing reprise: the eighth cycle is like the first six; the ninth contains the additional long pitch, like the seventh; and the tenth cycle returns again to the original series. The overall process of the complete performance—establishing a cycle, gradually introducing variants that led to significant alterations, returning to the original form, then briefly reprising the departure and return—exemplifies one effective way to shape cyclically organized time.

9. The performer sets up the surprise of the added group in another way: after the incipit of W has been growing successively closer and closer to the long note of V in each preceding cycle, in this seventh cycle its timing reverts to exactly what it was in the first cycle. We might expect, on that basis, that the grace-to-grace duration from V to W would be reproduced, as it was in the first cycle, but it is not—the incipit E5 of the inserted new group appears too late.

10. Nevertheless, my accounts of *āvāz* and *ālāp* do support, for these two specific examples, Frigyesi's assertion (1993, 64) that "the[ir] rhythmic styles . . . would strike even the uninitiated listener as fundamentally different."

11. Thanks to Geoffrey Roeder for running and interpreting the Shapiro-Wilks test and the autocorrelation function on the datasets.

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