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D. HURON, *Sweet Anticipation: Music and the Psychology of Expectation*. Cambridge, MA: The MIT Press (A Bradford Book), 2006. 476 pp, 108 illus. ISBN 0–262–08345–0 (hbk) $40/£25.95.

Having been privileged to see a pre-publication draft of this book, it was with a real sense of pleasurable anticipation that I prepared to read the final version. And my expectations (largely veridical, in terms of the theory that is set out) were more than fulfilled (positively valenced to a higher degree than I had imagined): there seems little doubt that *Sweet Anticipation* will become a landmark text in the burgeoning interdisciplinary domain of empirical musicology. The way that Professor Huron tells his story – the story of the 'ITPRA' theory and its implications for music – is compelling, drawing extensively on formal and informal research (and, frankly, anecdote) with equal panache; and abounding with insights and fascinating digressions into the musical experience, any of which, one senses, could spawn another volume or two. If you want to know what garden paths, cognitive firewalls, Wittgenstein's puzzle and neural Darwinism contribute to the perception of music and the reason why this sentence. Made you think twice, then this is the book for you. Huron writes with humour and humanity, and with an intuitively didactic approach that is never patronizing.

To summarize so extensive a piece of sustained thinking in a paragraph or two is inevitably to do it an injustice, but needs must. At the outset, Huron distinguishes five expectation-related emotion response systems (p. 15). First, the 'imagination response' motivates an organism 'to behave in ways that increase the likelihood of future beneficial outcomes'. Next, the 'tension response' prepares the organism for an impending event 'by tailoring arousal and attention to match the level of uncertainty and importance of an impending outcome'. Once the event has occurred, the 'prediction response' provides 'positive and negative inducements that encourage the formation of accurate expectations'. At the same time, the 'reaction response' addresses a worst-case scenario by acting immediately to protect the organism. Finally, the 'appraisal response' yields 'positive and negative reinforcements related to the biological value of different final states'. The ITPRA model is shown diagrammatically in Figure 1.

The durations of these five responses are in some cases very variable and so they can differ greatly from one another. For example, the act of imagining a future event may occur seconds, minutes, days, months or even years before its onset (p. 16). In contrast, the tension response is linked to the period immediately prior to the anticipated moment of outcome, although composers may intentionally delay the arrival of the predicted event so as to heighten the feeling of anticipation (p. 329). *Following*

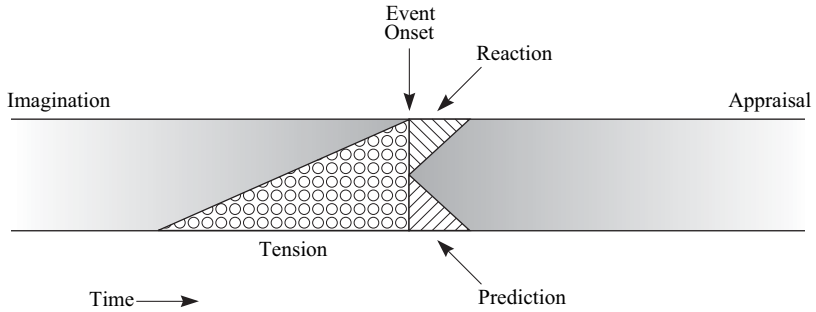

FIGURE 1 *The ITPRA model of expectation (after Huron, Sweet Anticipation, p. 17).*

the event, the reaction response is rapid, beginning less than 150 milliseconds after its onset, although somatic changes may continue for several seconds afterwards (p. 13). Similarly, the prediction response is triggered and takes effect in the period immediately following the stimulus. In contrast, the appraisal response has the potential to last almost indefinitely (p. 16). This, like the imagination response, is consciously mediated, and it is Huron's view that, in many situations, when listeners are not explicitly paying attention to the music, the imagination and appraisal components of ITPRA may not come about or may be attenuated (p. 310). Hence, in the typical 'stream-of-consciousness' state of listening, expectation in music can probably be accounted for by TPR – tension, prediction and reaction responses – alone.

The second main element in Huron's theory concerns the way in which expectations are formulated, a cognitive activity that invariably occurs through the (typically subconscious) extrapolation of trends and tendencies from data gathered through previous experiences. In particular, in the domain of music, Huron is interested in four types of information storage and retrieval, each of which implicates a different kind of memory: episodic, semantic, short-term and working. Semantic memory, he contends, forms the basis of *schematic* expectations, which underlie anticipation based on the intuitive statistical analysis of how events have unfolded in the past. That is, the felt probability of what will occur next depends on the frequency with which things have previously been perceived to happen (acknowledging that this may well vary according to the contexts in which they appeared). Interestingly, it seems that when listeners anticipate events in music, they rely on 'heuristic' knowledge – information that assists cognition, but that only approximates to the stylistic characteristics of groups of pieces that can be measured statistically (p. 91). So, for example, listeners tend to expect that a large interval will be followed by a change in pitch direction, whereas a more faithful account of what occurs is captured by the mathematical principle of 'regression to the mean' (pp. 92 and 93). However, this calculation requires holding a series of events in memory and assessing the potentially numerous relationships between them, representing a greater degree of mental activity than applying the simple algorithm of 'post-skip reversal', which serves listeners perfectly adequately most of the time.

It is the notion of schematic expectation, above all others, that seems to lie at the heart of Huron's thinking in *Sweet Anticipation*, and the other forms are given rather less attention. Nonetheless, they are important. Episodic memory forms the basis of

veridical expectations: 'invariant sequences learnt from frequent exposure to a particular stimulus' (p. 363). Huron uses the term in relation to rehearing familiar pieces of music, when it is possible for listeners to know more or less precisely what is going to happen next based on encodings of extended patterns of sounds in memory (p. 224). Short-term memory is posited as the source of *dynamic* expectations, which arise from 'the immediately preceding experience' (p. 363), as when 'a novel work causes a listener to expect similar passages as the work continues' (p. 413). With sufficient repetition, a pattern held in short-term memory may pass into so-called 'intermediate-term memory' and then potentially into long-term memory (p. 228). Finally, working memory enables *conscious* expectations to occur (p. 363) through the retrieval of explicit knowledge (p. 236).

So, does the theory hold up? For sure, Huron's ideas are supported by his analysis of pieces of music – many thousands of them, which must equate to hundreds of thousands of interrelated sonic events – and further evidence is presented in the form of excerpts that are culled from a range of compositions. Ultimately, though, these seem to function more as grist to Huron's theoretical mill, rather than offering the reader striking new views of how a particular piece or elements of it 'work' structurally or functionally (the brief but insightful accounts of the musical styles of Wagner, Schoenberg and Stravinsky notwithstanding). Hence, methodologically, *Sweet Anticipation* appears to be more music-psychological than music-theoretical in conception, focussing largely on how people *typically* hear pieces, and tending towards generalities and commonalities, rather than seeking to discover what they *may* be able to discern, and pertaining primarily to specific compositions.[1] Yet by the end of the book, this reader, at least, found himself yearning for an extended example, which would show just how the different strands of the theory might actually work together in practice, within the context of a given listener hearing a particular piece.

No doubt formal empirical endeavours will follow to this end but, for now, taking a metaphorical leaf out of Professor Huron's book, I decided to conduct a short informal piece of research myself to try out the ITPRA model and the four types of expectation that he identifies. I used a phenomenological approach, whereby the intuitions that occur in the course of listening are subject to contemporaneous and subsequent metacognitive analysis – in the manner typical of music theory. As Huron makes clear in *Sweet Anticipation*, inductive methods such as this have their limitations. Nonetheless, they can provide useful starting points, not least in raising the questions to which subsequent, more rigorous, experimentation can seek generalizable answers.

It struck me that the best way to start testing the theory was in the context of a piece that I had not heard before (as far as I was aware), so I chose at random a harpsichord sonata from among the 546 known to have been composed by Domenico Scarlatti (1685–1757) – K.18 – and downloaded the appropriate MIDI-file from the Midiworld website (Midiworld, 1995–2008). Much of Scarlatti's music is renowned for being shot-through with a delightful sense of caprice, and K.18 therefore potentially offered an exciting challenge to Huron's theory of musical expectation. My intention was to listen to the first 10 seconds or so of the sonata, without a score, with the ITPRA model in mind, to see how well this accorded with my experience

(accepting that some forms of response occur non-consciously). I would then reflect on what had occurred, using a score for reference. The first four bars of K.18 are reproduced in Figure 2. The tempo was ♩ = 109.

In the short period before the music began, I could feel my 'imagination response' kicking into action. Being broadly familiar with half-a-dozen or so of Scarlatti's other sonatas led me to expect a two-part, possibly imitative, harpsichord texture, couched within a major or minor key and consistent metrical framework, and probably comprising rapid figuration. My assumptions proved to be well-founded, and as the sonata got underway, my initial impression was of the sheer speed with which things happen: a continuous stream of seven events per second, implying a gap of only around 140 milliseconds between the onsets of successive notes. As I've noticed before, I experienced quite a jolt in moving from thinking *about* music in an abstract sense, with the luxury of being able to play and replay short passages in my head as often as I wished, to the reality of streams of sounds speeding unstoppably by, offering little or no time for conscious reflection. To pause and think about things in any depth would inevitably have left lacunae in the perceived musical flow as my mind struggled to process what had just been heard while at the same time striving to evaluate incoming information. In any case, the speed of events passing by prompted my first set of questions:

1. How is it envisaged that the ITPRA model works in the context of series of sounds that follow in swift succession? Even assuming that 'I' (the imaginative response) and 'A' (the appraisal response) are not present, and the listener is using only the tension, prediction and reaction responses, does one such cycle overlap with the next? If so, how does this imbrication work in cognitive terms? Is it possible for the 'reaction' response from one event to function at the same time as the 'tension' response pertaining to the next, for example? Or is it thought that TPR cycles are necessarily discrete, and therefore follow each other rapidly? (Given that notes in the sonata were passing by every seventh of a second, this

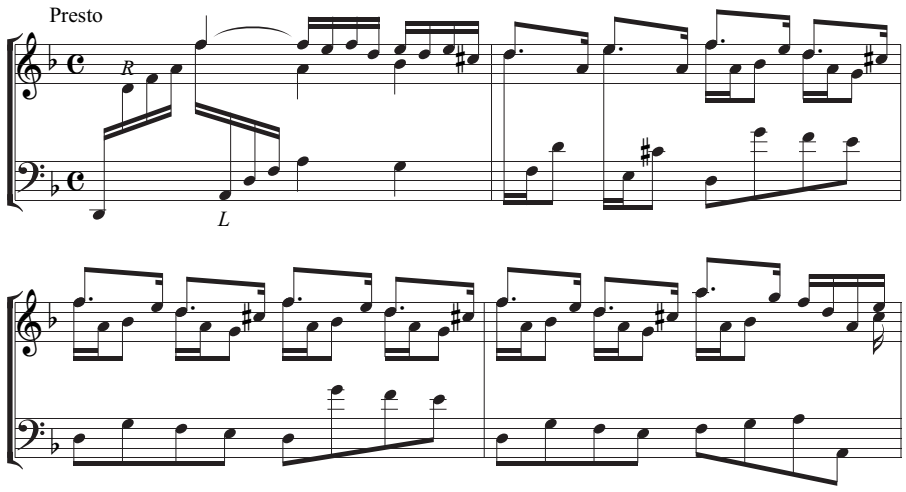

FIGURE 2 *D. Scarlatti, Harpsichord Sonata, K.18, opening bars.*

seems unlikely.) Or, perhaps, the TPR cycle need not function note by note, but can operate cumulatively over series of notes?

Related to these issues was another: from the second bar, one gets the sense of two and then three parts moving independently, with complementary peaks and troughs occurring asynchronously within an integrated texture. So:

2. How does the ITPRA model function in the context of free counterpoint, when each melodic line potentially bears expectancies that wax and wane at different times, or may even potentially work in opposition?

In fact, neither of these questions was relevant to my initial impression of K.18, where, for the first second or so, I seemed to have no specific expectations at all. I felt that I was principally caught up with the business of taking in what was to me a novel arrangement of notes, and the effort of grounding my ongoing perceptions within the metrical and tonal frameworks that they implied (in order to make sense of what was going on) took up all of my conscious attention.[2] If anything, the mode of listening I intuitively adopted appeared to me to be slightly retrospective, catching up with what had just occurred – registering events that were still within the ambit of the 'perceived present' – and trying to understand their significance in the light of what had happened immediately before. I can recall being struck (retrospectively) by the force of the fifth octave F that occurs on the second beat of bar 1 without, I believe, having had any particular sense of anticipation as to what might occur at that point. In the 140 milliseconds between this note and the preceding fourth octave A, there would not in any case have been time for a 'tension response' to register. The point is (it struck me afterwards), things can seem surprising *after the event*, without the need for cognitive preparation. (To take an example in everyday life: I have been writing this paragraph in my study at home, which overlooks our driveway, and I have just been pleasantly surprised to see a friend unexpectedly turn in from the street and walk towards the front door. I can relive the moment and the emotion now, just thinking about it. However, neither 'imagination' nor 'tension' responses figured in my original reaction to the event.) Hence my next questions are:

3. Is it believed that the ITPRA (or, in its reduced from, TPR) model is active all the time in hearing music, or is this thought to vary according to the listening style of the person concerned, and the attention that he or she is giving to the stream of incoming sounds at any given moment? Is either of the pre-outcome responses (imagination and tension) necessary to perceive 'surprise in retrospect' – to have an emotionally valenced response to an event according to the perceived probability of its occurrence? And, on a related tack, how is it envisaged that ITPRA relates to other forms of music processing – particularly memory (noting that three of the ITPRA elements are in any case retrospective)?

In listening to K.18, the first regularity that became apparent was the uniform succession of onsets, and there is no doubt that, shortly after the beginning of the piece, I could safely have predicted when the next event was going to occur. I remain unconvinced that such prediction was part of my listening experience in these early stages, though – or if it was, it was entirely non-conscious. Trying to relive those moments

now, I sense that the problem was trying to enauralize the *when* of a note without knowing *what* it was going to sound like. For sure, I knew that the next event would have a harpsichord timbre and that the dynamic level would be very similar to that of the notes that preceded it. However, as Huron's statistical tables show (for example, pp. 158 and 159), the best that schematically based prediction in the domain of pitch can offer listeners in terms of first-order scale-degree probabilities is a general sense of what is coming next. And reflecting on it now, it seems that this 'general sense' was insufficient to kick my expectation mechanism into gear.

To take a simple example, consider the position as I heard the last semiquaver of the third beat of bar 1: a semiquaver D in the fifth octave. Thinking about it subsequently – with the music frozen in time – it is relatively easy to imagine coherent continuations that use any of the scale degrees of D minor located within the fourth or fifth octaves. And, if requested, I could (no doubt) informally assign them approximate probabilities of occurrence based on my schematic awareness of western pitch structures of the late Baroque. But it is a leap of music-psychological faith to say that because I *can* do this in an artificial situation, where there is time to contemplate, evaluate different options and even change my mind, that I *do* do such calculations (or some non-conscious equivalent) as part of the usual listening process. And bear in mind that, when listening for real, projections would have to be made within the 140 milliseconds that was available before the next event. So my next questions are:

4. What part do schematic projections in the domain of pitch play in listening to a piece of music for the first time beyond giving a *general sense* of what is to come next? And if parallel processing is continually in play (in terms of evaluating multiple future options), how does this tie in with the aesthetic experience?

The first time I recall having a more or less palpable sense of what was coming next was upon hearing the fifth octave C♯ at the end of bar 1, when movement to the D a semitone higher seemed to be implied. Why should this have been the case? Perhaps, after all, schematic expectations were a significant factor: here, the perceived likelihood of the leading note (C♯) rising to the tonic (D) seeming to be strengthened by being situated within the context of the quasi-cadential harmonic progression (Ic–IIb–Vd^9–Ib) – and the melodic and harmonic implications set up by tonic chord in second inversion followed by the supertonic and dominant were indeed realized during the first beat of the second bar. However, the fact that the outcome of even so stereotypical an underlying pattern as this is far from certain was shown at the end of the next bar, when a C♯ functioning atop a very similar harmonic progression failed to resolve to the usual D.

Retrospective analysis shows that there were other forms of anticipation in play at the end of the first bar, though, brought about through what Huron terms 'dynamic' expectation – that is, derived from 'intraopus' structures. Huron uses the term in the context of expectations that arise between groups of notes (p. 227), although in fact within-group patterning can give rise to intraopus expectations too. To understand how, I will delve briefly into my 'zygonic' theory, which seeks to model the cognition of musical structure (and, elsewhere, I use it to interrogate implication and expectation in music in some detail; see Ockelford, 2006).

Zygonic theory, like the ITPRA theory, resides somewhere in epistemological space between music theory and music psychology. It relies on fusing the intuitions that constitute the conceptual currency of the former with the empirical findings that are properly the stuff of the latter, to consider both how music makes sense in general terms as well as how specific musical experiences can be interpreted. The theory holds that, in the absence of attendant extramusical material such as verbal language, and with due regard to human cognitive processing requirements and limitations (Lerdahl, 1988; Huron, 2001; Ockelford, 2002), the apprehension of musical structure must, in the final analysis, stem purely from the perceived auditory landscape of music itself. It is hypothesized that this is achieved through the (typically non-conscious) sense of derivation engendered when one sound or group of sounds or attribute thereof is deemed to exist in imitation of another: that is, through repetition. The imagined mental construct through which this occurs is termed a 'zygonic relationship'[3] – a special type of 'interperspective relationship' through which perceived aspects of musical sounds are compared. Such relationships can be represented graphically and parsimoniously as shown in Figure 3.[4]

Here, the listener is assumed just to have heard the C♯. Hence, the notes of K.18 up to that point are now a recent memory, and the first beat of bar 2 is still in the future. The figure shows the hypothesized result of *within*-group anticipation at one hierarchical level removed from the musical surface. In the domain of pitch, the first interperspective relationship of scale degree ('A'), linking $\hat{3}$ and $\hat{2}$ is predicted to be imitated through a zygonic relationship ('B'), producing a second interperspective relationship ('C'), which, kicking off from where the first ends on $\hat{2}$, implies a future appearance of $\hat{1}$. *When* this is likely to occur is indicated (it is hypothesized) by parallel relationships operating in the domain of perceived time, such that the difference in the 'relative metrical location' of the first two notes of the group (+1 beat – see relationship 'D') is predicted (through zygonic relationship 'E') to be replicated (relationship 'F'), yielding an onset for $\hat{1}$ of the first beat of the second bar.

However, as was shown to be the case with schematic prediction, there are other intraopus continuations that are just as feasible and musically satisfactory as that shown in Figure 3 (see Figure 4). Hence, once more, the listener is potentially faced with multiple choices, and it is difficult to see how expectation of this type can offer anything more than a *general* sense of what is coming next.

This is only part of the story of intraopus expectation, however. Expectations arising from the relationships between whole groups of sounds offer other, distinct routes to the prediction of future events. Consider again the passage in question. There are a number of ways in which the musical mind, engaged, we may surmise, in the continuous, intuitive search for regularity, could parse this melodic segment. Two interpretations that could facilitate between-group prognostication are shown in Figure 5.

In the first, the melody is heard structurally as pairs of notes, each of which ascends one scale degree. The fourth pair in the series starts with the C♯ that the listener has just heard. By my reckoning, at least, there is a strong sense in which the ear expects the two-note pattern to be repeated again, both in terms both of relative pitch and rhythm. In the second scenario, the melody is parsed structurally as two groups with four notes in each. Following the appearance of the initial two melodic

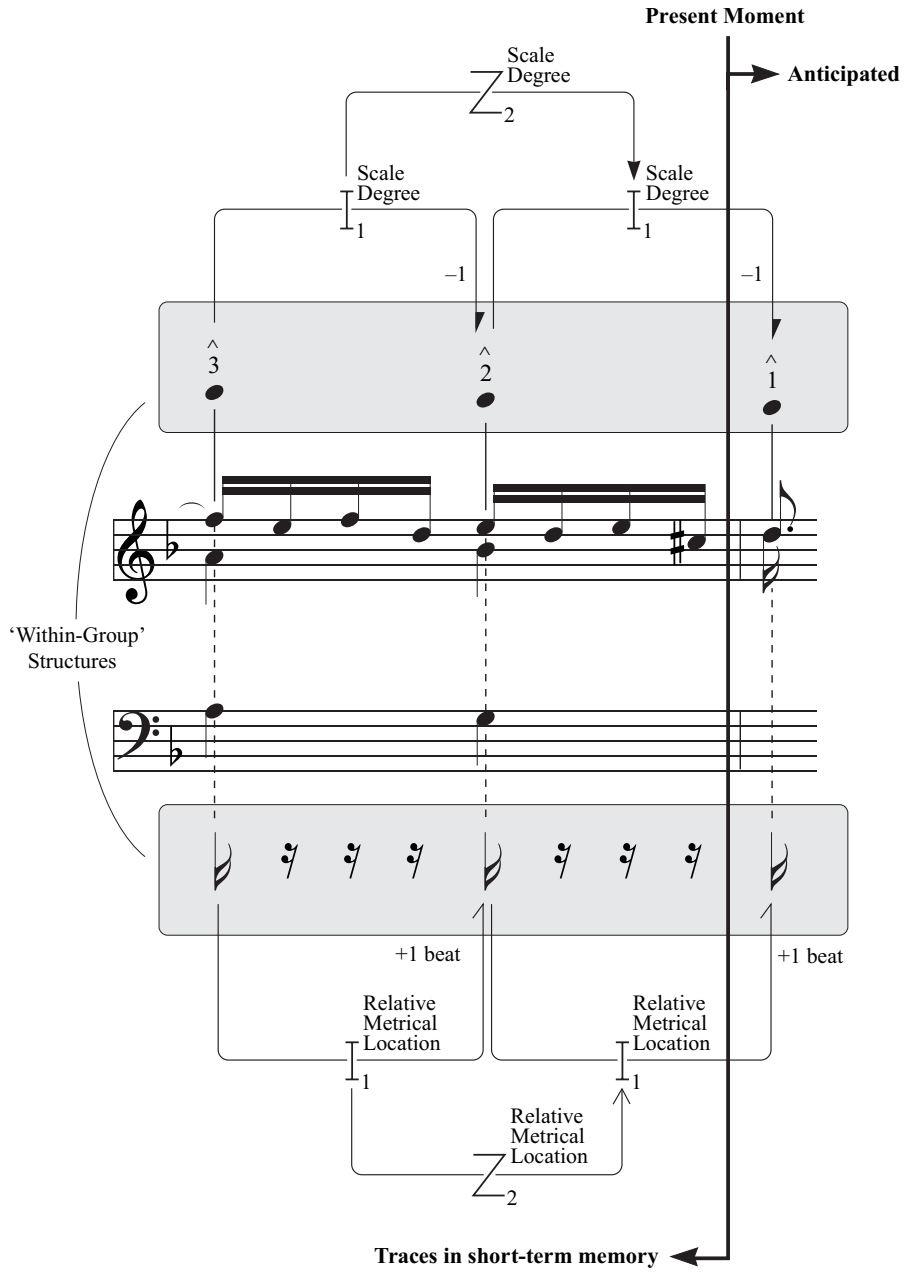

FIGURE 3 *Within-group zygonic relationships hypothesized to inform expectation at the end of the first bar of K.18.*

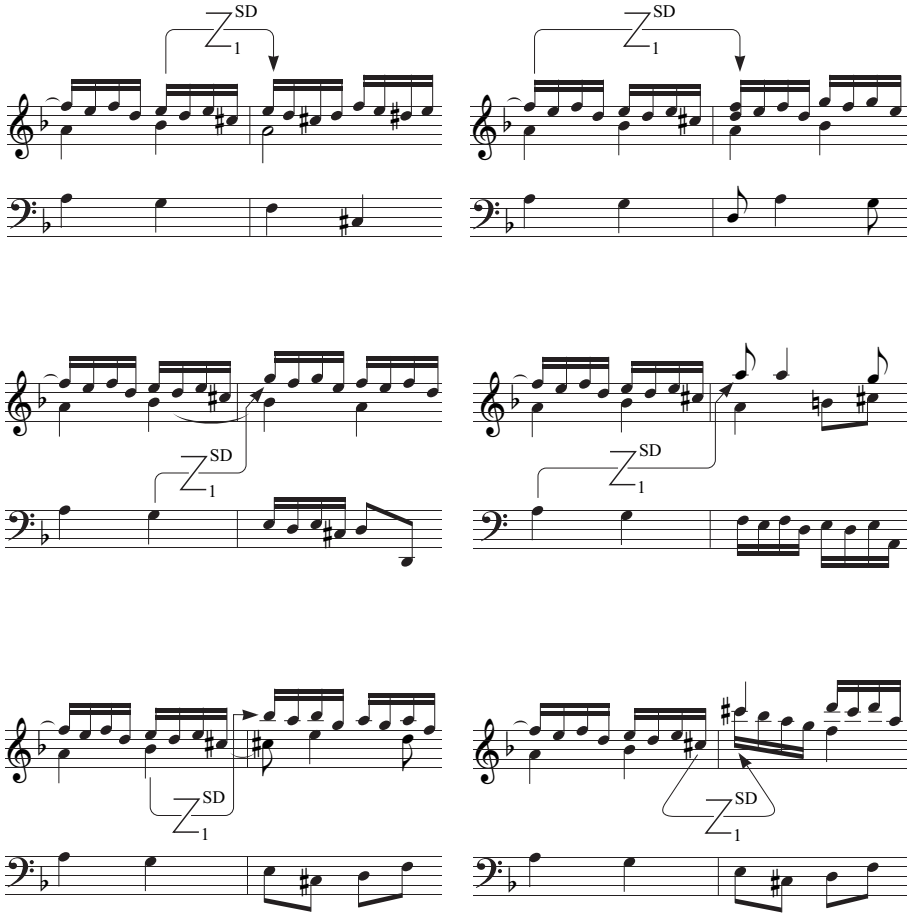

FIGURE 4 *Coherent continuations from the end of bar 1 using different scale degrees (SDs) in D minor, with indicative zygonic connections.*

intervals in the second group, which imitate those in the first, again there appears to be a tendency for the ear to expect this imitation to continue, and that the second group will be completed using the same intervallic pattern as the first. Neither of these modes of prediction excludes the other and, metacognition suggests, both can operate in parallel with schematic expectations, suggesting a particular outcome within the range of possibilities that the latter indicate.

Why should these between-group expectations be more specific than schematically-sourced anticipation? Because they are not based on the cognition of statistically-derived probabilities, but of one series of percepts (or the relationships between them) sequentially imitating another. Of course, nothing is certain, and a set of notes may begin by echoing another, only to head off in a different direction. But the key thing is that recognizing a succession of repeated relationships between groups makes precise prediction – in terms of the what and the when of the future – at least a realistic possibility. Indeed, one can hypothesize that the longer one group

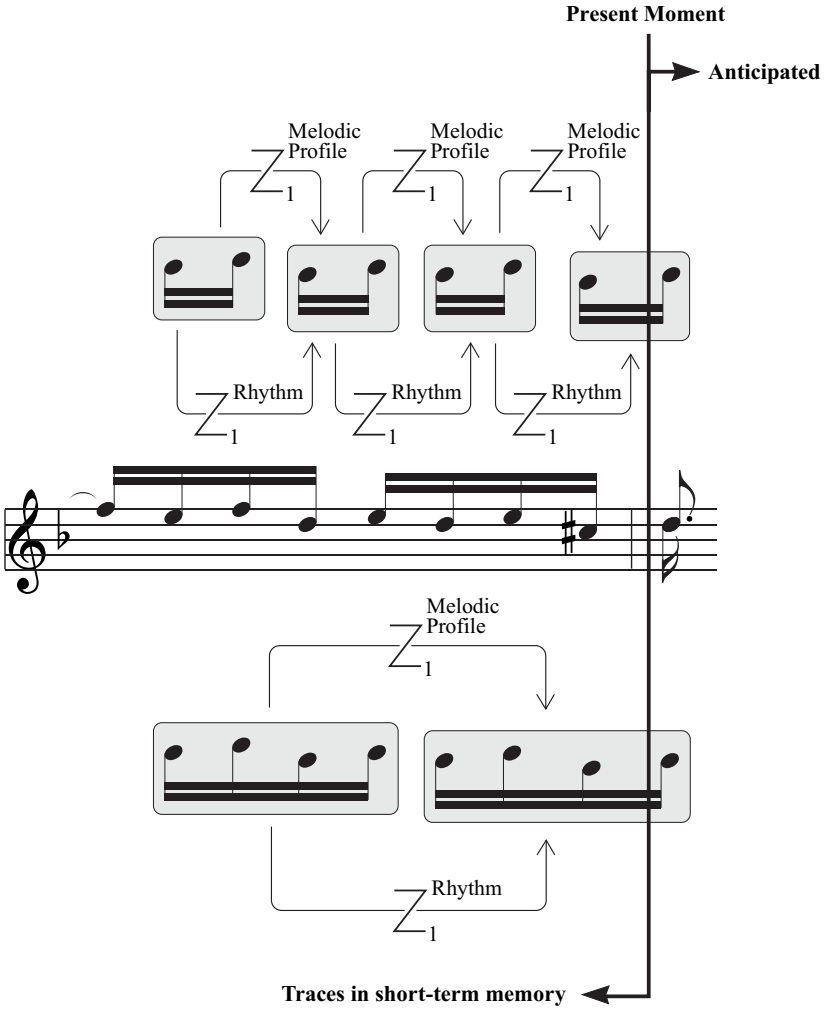

FIGURE 5 *Expectation arising from* between-*group zygonic relationships.*

mirrors another, the more surely will a listener expect, *ceteris paribus*, the imitation to continue in the same way. Hence, what sounds to a listener like a sectional repeat getting underway is likely to induce an extended series of expectations, for example – a process that will be even more protracted upon hearing the beginning of a familiar piece.[5]

It is not clear what the cognitive processing differences may be between a theme that is heard to be repeated immediately, and one that is recognized after a period of other music (as in the chorus of a song, for example, or the recapitulation of the first subject in a sonata form movement), or in the immediate rehearing of piece, or in listening to a piece on a second occasion some time after the first. In any event, the logic is the same in each case, and, contrary to Huron's more constrained definition, whereby 'veridical' expectations are held to be those arising from episodic memories

that operate between (rather than within) hearings of pieces, Bharucha's original, implicitly wider concept seems preferable, whereby veridical expectations can be 'generated either by the activation of memory traces for specific pieces or by explicit prior knowledge of what is to come' (1987, p. 4) – that is, between groups, whatever the context in which they occur.

Notwithstanding the example illustrated in Figure 5, it is with the repeated two-beat motive first heard in the second half of bar 2 that I really became aware of the power of veridical expectations on my first hearing of K.18. The material played in the right hand is heard four times in succession while the bass line (in the left) is structured through a pattern of repetition that is similar, though coloured by changes in register. As a listener, new to the piece, the net result was that just before the last semiquaver of the second beat of bar 4, I was confident that a fifth octave C♯ was going to follow the D. Zygonic theory suggests that the force of this anticipation can be explained by the cumulative effect of implicative relationships connecting this moment with equivalent points in the preceding groups (see Figure 6).[6]

So much for my impressions upon first hearing the opening bars of K.18. However, as Huron points out (p. 241), encountering a piece of music once is not the norm, and I listened to the first four bars a further half dozen times or so, until I felt I knew them quite well. Then I reflected again on my perception of the passage in terms of expectation. How did familiarity affect things? Clearly, since I knew what was going to happen, my expectations always seemed to be fulfilled. On an aesthetic level, I found myself taking pleasure in anticipating certain features, such as the initial fifth octave F, for example, and the very repetition of the descending motive shown in Figure 6. It was as though by priming myself through internal audition to hear the notes a fraction of a second before they occurred I could enjoy the perceptual sensations they offered more.

With all this in mind, we move on to my final series of questions and issues. The opening chapters of *Sweet Anticipation* meticulously demonstrate how the ITPRA theory is derived from a series of hypotheses concerning the broader evolution of the cognitive processes pertaining to expectation in everyday life – forms of mental functioning that enabled early humans (and their predecessors) to survive in unpredictable and unforgiving physical environments, and have subsequently enabled contemporary representatives of our species to thrive in complex social and cultural situations. The underlying supposition is clear: it is essential that we are able to anticipate at least the short-term future on the basis of limited and imperfect information (and, further, that we are able to learn from situations where we have previously miscalculated) since we can never be certain what is going to happen next – ultimately, every moment is different from any that has occurred in the past; we all know that things never happen in exactly the same way twice. That's why we human and non-human animals alike have to be good at guessing – and a very sophisticated (though sometimes misguided!) guesser homo sapiens is, by all accounts. Now, a critical step in Huron's argument is that, at some stage in our evolution, we started to apply our guessing skills to what we now define as the developing art of music. That is, we apparently borrowed the instinctive responses from one (physical) domain and applied them to another (abstract) area of activity: unwittingly we exploited our biological responses for aesthetic ends (p. 35).

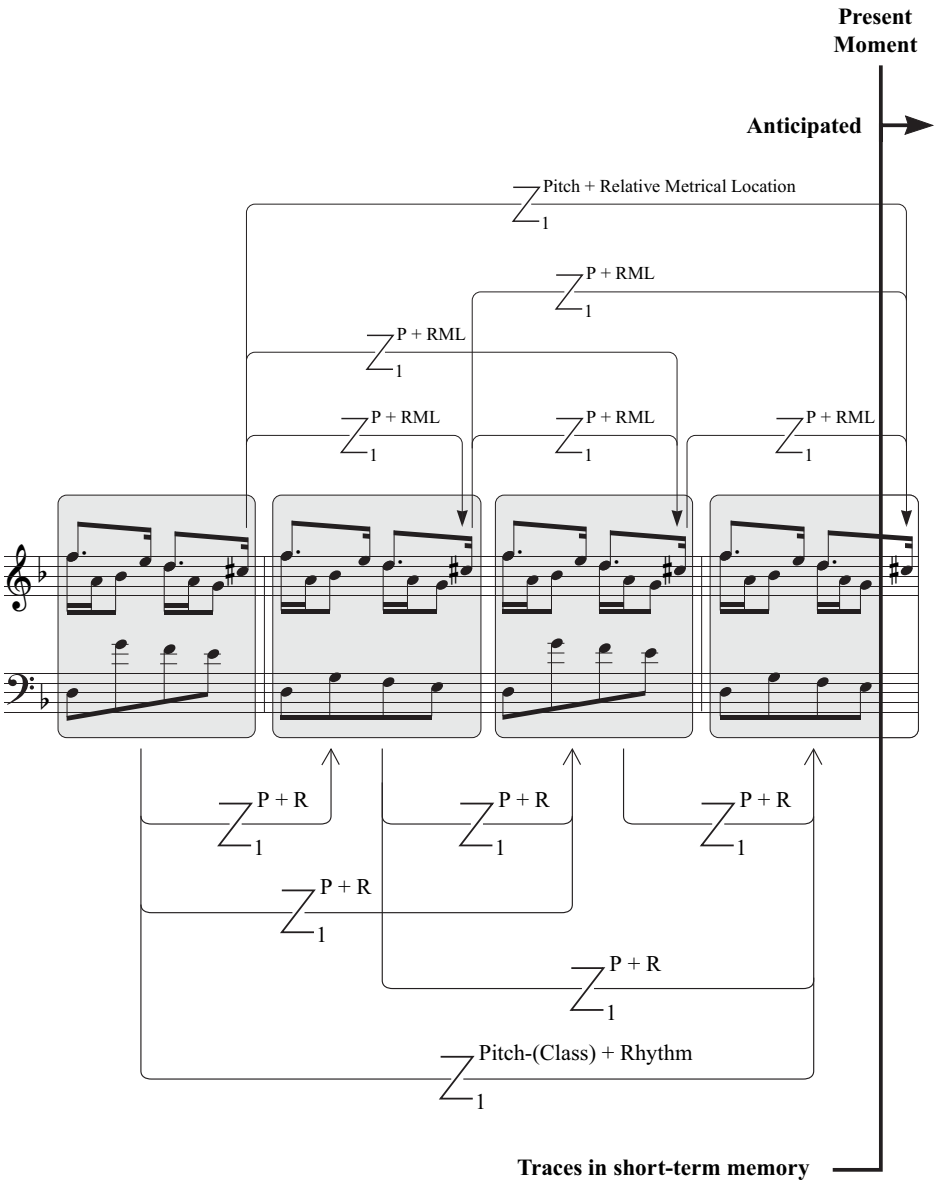

FIGURE 6 *The cumulative effect of between-group relationships gives a feeling of inevitability.*

This conjecture seems reasonable enough (though it is hard to see how it could ever be proved or disproved), but there is another, more subtle, stage in Huron's logic that goes unacknowledged: namely, that these same, primitive responses operate in our cognition of music today. But is this a fair assumption to make? Since many musics have evolved and continue to do so, is it not at least possible that there has been a corresponding change in the way that we handle them cognitively too? That is to say, have some genres and styles music moved far enough away from their evolutionary origins no longer to be dealt with through a direct

transfer of cognitive processes that we use in everyday life? Again, this is a difficult question to answer, but at least one that is worth pursuing for the value of the thinking that it demands.

It must be conceivable, since music is fundamentally different from the 'real world', being not only replete with internal repetition but typically being replayed over and over again, that some of the mental operations we engage in attending purposefully to pieces have evolved in special ways too: perhaps the manner in which expectation works in day-to-day life no longer holds true for music. After all, pieces of music – metaphorical narratives in sound that, it seems, we just can't hear often enough – function in quite the opposite way from real-life scenarios, which we can never rely on to be repeated.

Therefore, should not our starting point for hypothesizing about the processing of expectations in 'real life' and in music differ too? While it seems appropriate to consider the former, with all its uncertainties, principally in terms of schematic expectations, surely, our primary assumption for the latter should be that veridical expectations are the dominant force, since listeners tend to know just what is coming next (for, as Huron points out, the great majority of the music that we listen to is well-known to us, and listeners 'are sensitive to the slightest changes from familiar renditions' – p. 241: listening to music for the first time is the exception rather than the rule).

In line with this, my reflections on hearing K.18 (once it was familiar) and, indeed, many other pieces, suggest that a significant part of my enjoyment of music comes from anticipating precisely what is going to happen next. It seems that musical sounds are intrinsically pleasurable, and that by anticipating them I can delight in hearing them all the more. Now, it seems very likely that an important part of that auditory pleasure is recognizing that some sounds, combinations and transitions occur more frequently than others (in context-dependent ways), but I sense that the non-conscious acknowledgment of this after the event is all that is necessary to get a corresponding 'schematic kick': I feel no requirement to have wagered probabilities in advance in order to appreciate, for example, that something is relatively unusual. The example that keeps coming to mind in this respect is the chord that occurs nine bars before the end of the first half of the second movement of Mozart's Symphony No. 40 in G minor, K.550. It results from a highly unusual transition from the tonic chord in root position (at this stage in the piece, B♭ major) to the subdominant minor in root position with a flattened seventh (here, $E♭^{7♭}$), a harmonic change that Mozart reinforces texturally and dynamically by moving from the strings, clarinet and bassoon playing 'piano' to the full orchestra playing 'forte' (Figure 7).

I can anticipate this stylistically unorthodox sound with some precision (I believe I would know if it were changed in any way), and I relish hearing it in my head just before it arrives. Then, once I start to perceive the chord, the full sensation hits me that (as far as metacognition permits me to ascertain) seems to be attributable in part to the sheer beauty of the harmony itself, and in part to its singularity, both as a free-standing sonority within the western Classical tradition, and in its context adjacent to other chords. But my sense is that I predicted that singularity and felt its effect during and after the event. That is, I believe that the schematically induced impact was a feature of present perception and then memory, rather than expectation.

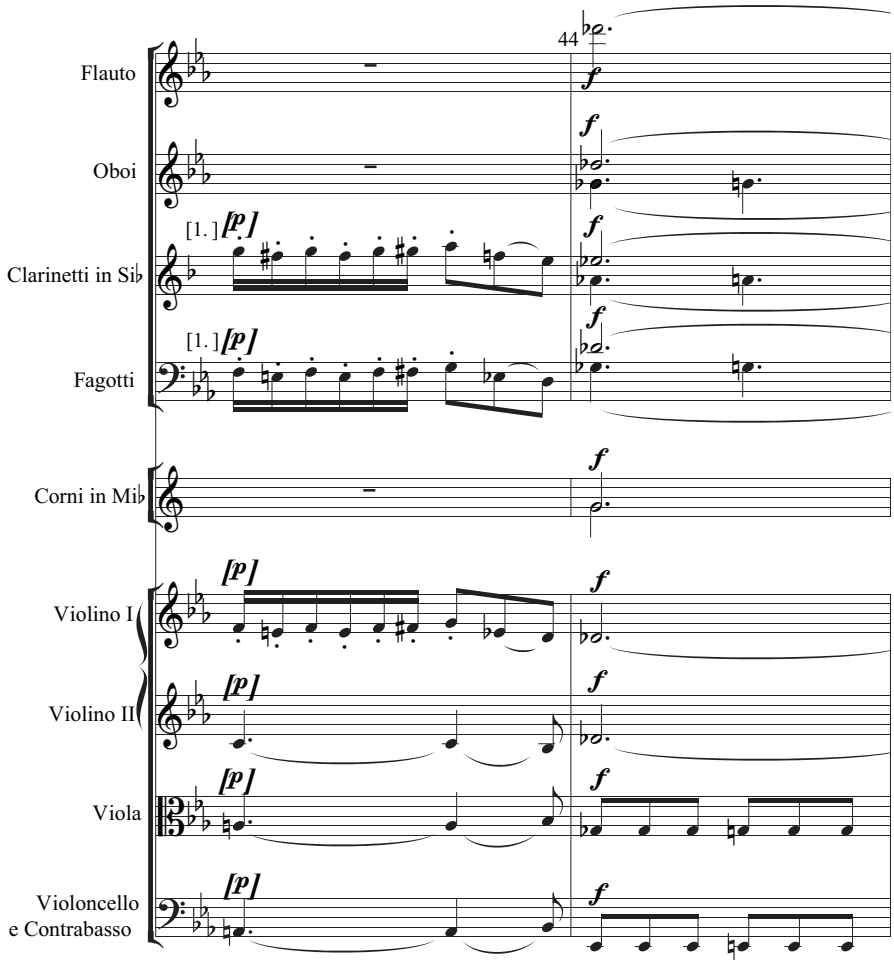

FIGURE 7 *Passage from Mozart, Symphony No. 40 in G minor, K.550, 2nd movement.*

Where does this leave first-time listening, though, if veridical expectation really is such an important part of the aesthetic experience? There are two observations that are of relevance here. First, as Huron points out (p. 229), music is typically replete with between-group repetition, which, as we noted in relation to my initial hearing of K.18, permits intraopus veridical expectation to operate, even in unfamiliar territory. Second, it may be that expectation does not operate, or operates minimally, in some situations, and that we can still appreciate music using only current perceptual input and memory. To reiterate the point made earlier, just because listeners can make musical predictions when they are asked to, doesn't mean that they usually do. It could be that these findings are an unintended consequence of music's highly structured nature that enables particular mental processing to take place that is to a greater or lesser extent artificial.

So my fifth question is the simplest of all (to ask):

5. How do we know that the ITPRA theory is not an ingenious interpretation of available data that actually has limited relevance to 'typical' listening experiences? Could not an alternative theory (along the lines sketched out above) fit the data just as well?

Such issues may remain imponderable for some time to come – and, ultimately, the way to judge the ITRPA theory may be not so much as to whether it is correct or more or less provable, but whether it is useful. Whatever one's position on this, there is no doubt that in stimulating people to think, to debate and to undertake further research, *Sweet Anticipation* is a brilliant work that will continue to inspire for many years to come.

NOTES

1. Adapted from David Temperley, personal communication, cited in my 'Musical structure, content and aesthetic response: Beethoven's Op. 110' (2005), p. 75.
2. In the manner of Huron, I shall digress briefly at this point to describe something of what my perception of the tonal framework was like. I have what can only be described as a quirky sense of absolute pitch (AP), which I became aware of in my late teens as a student at the Royal Academy of Music in London where I studied the oboe, piano and harpsichord. Apparently typical of 'late onset' AP, it is not universal and fluctuates somewhat. However, my sense of pitch is usually quite faithful for notes on the piano and harpsichord though, strangely, each pitch on these instruments appears to have a slightly different timbre which reflects the micro-timbral differences of the notes on the oboe (whereby fifth octave C has a relatively 'thin' sound, for example, whereas C♯ is somewhat 'nasal', and D is 'pure' and 'warm'). Moroever, these differences have somehow extended in my mind to different octaves on the keyboard. Stranger still, over the years, the whole set of pitch-classes has moved up a semitone, such that the Moonlight Sonata now sounds as though it is in D minor, for instance, and the Scarlatti sonata in question (K.18) appeared to be in E flat minor, though, of course, I was consciously able to work out its true tonality.
3. Zygon is Greek for 'yoke', implying a union of two similar things.
4. Clearly, zygonic relationships such as those depicted in Figure 3 offer a highly simplified version of certain cognitive events that may take place during meaningful participation in musical activity. Moreover, the single concept of a zygon bequeaths a vast perceptual legacy, with many potential manifestations: potentially involving any perceived aspect of sound; existing over different periods of perceived time; and operating within the same and between different pieces, performances and hearings. Zygons may function in a number of different ways: reactively, for example, in assessing the relationship between two extant qualities of sounds, or proactively, in ideating an attribute as an orderly consequence of one that has been heard. They may operate between anticipated or remembered sounds, or even those that are wholly imagined, only ever existing in the mind. Hence there is no suggestion that the one concept is cognitively equivalent in all these manifestations, but that it is logically so.
5. The issue of the anticipation of interpretive differences is beyond the scope of this review – though see Ockelford (2006, p. 121).
6. A separate issue on first hearing a piece is the *number* of successive repetitions or transformations of a motive that are expected, based on previous stylistic experience.

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