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My life in music cognition research

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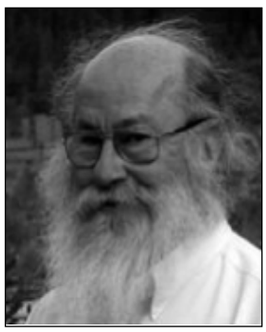
ABSTRACT — ***The author traces his interest and education in music from childhood through adulthood. He describes the development of ideas about his core work, involving interleaved melodies, auditory attention, memory representation for melody, and "expectancy windows," among other topics. Important ideas, influential teachers, and main collaborators are described from his dissertation work at Harvard to early jobs at UCLA and Cal State L.A., to his position in the School of Behavioral and Brain Sciences at UT Dallas. The author's interest in the development of melody perception stems from observation of his own children. More recent work on memory for melodies and on aging and music cognition is also covered. The article ends with a discussion of changes that have taken place in music psychology over the past 40 years.***

I was born in Washington, D. C., on February 4, 1941, and grew up in Northern Virginia where my father taught industrial arts (wood shop, metal shop, drafting, and printing) at Fairfax High School. Both my father and grandfather (my mother's father) played the violin, though my father, who had grown up in upstate New York, referred to what he did as "fiddling." Some of my earliest memories are of him playing dance tunes like *Turkey in the Straw* and *The Irish Washerwoman*. My mother played the piano, and Sinding's *Rustle of Spring* was one of our favorites. It's probably good that I didn't develop absolute pitch, however, because our ancient upright, though it had a good sound, could not be tuned up to standard pitch, and so I grew up listening to a B♭ piano.

Both my father and grandfather were avid collectors of records, and they each had about 500 or 600 of them. Both of them had extensive collections of Italian opera arias, including Caruso, Tito Schipa, John McCormack, and Jussi Björling. My father's favorite was Martinelli. Both of them were devoted to Fritz Kreisler. Once when I was six or seven, I



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was playing records at my grandparents' house, and I inadvertently sat on a Gigli "*La Donna é Mobile*"; of course the lacquer disc was smashed. I was very embarrassed, but I think my grandfather was just relieved that it wasn't something less expendable.

My father's collection differed from my grand- father's in its devotion to Gilbert and Sullivan; he had five or six of the operettas in their massive twelve-disc albums. During the 1940s one of my father's friends, who taught metal shop and who came from somewhere in the Southwest of England, got the high-school faculty and students to put on a Gilbert and Sullivan production, complete with a small orchestra which he would conduct from the piano. The most impressive role my father played was the Chief of Police in *The Pirates of Penzance*. I remember vividly his billy club—they turned out the billy clubs in wood shop—decorated with the words of his songs, just in case he forgot. ("When the foeman bares his steel …"). He was also Dick Deadeye in *H.M.S. Pinafore*, and at least one of my very proper aunts thought that my mother ought not to take me (then four or five) to see my father play such a scruffy character. She did, though, and I enjoyed it immensely.

The most spectacular thing my father did was only indirectly connected to music, however. At the end of the war he learned that the linotype machine from Gen. Patton's headquarters was being sold as surplus in New York, and he pursuaded the school

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adminstration to acquire it for his print shop. Then he and my mother and I went to New York where he arranged the sale and shipping for the machine, and my mother and I explored the city. Once the large and complicated machine was back in Virginia, he rebuilt it from the bottom up and restored it to working order. Linotype machines, a triumph of 19th-century technology, have since disappeared from the industrial landscape, but then it was useful to students to know how to operate them. The machines were in some ways dangerous monsters—apt to squirt molten lead at the operator at odd moments—but I always enjoyed watching and listening to them. The machinery was driven by a large cam shaft going through the middle of the machine, and as it went through its cycle, levers, connected to the various components that performed the machine's functions, were pushed and pulled in an elaborate and fascinating rhythm, difficult to notate. You could tell from listening to the rhythm what the machine was up to at each instant.

SCHOOL YEARS

The machine also facilitated the school print shop taking on a project proposed by my father's friend, Phil Fuller, the school band director, who came to Fairfax with a master's degree from Northwestern. Mr. Fuller was active in the Virginia Band and Orchestra Directors' Association (VBODA), and wanted to put the VBODA Manual, the list of approved solo and ensemble pieces for state music festivals, in better shape. We took on the job of publishing the manual. I was then 10 or 12 and adept at typesetting and making corrections in the set type after its proofs were corrected, and this exercise familiarized me with the solo literature available in print for a wide range of instruments. (It has always surprised me that there was no equivalent of *Books in Print* for published music.)

When I was eight or so my parents consulted with Mr. Fuller because they thought it was time for me to begin learning to play an instrument, which I was eager to do. After considerable testing and discussion we settled on the baritone horn, and Mr. Fuller, who had played trombone in a ship's band in the South Pacific, became my first music teacher. I think I made decent progress, but as I approached high school it became apparent that I would never have any facility with the upper register of the baritone, and the logical choice seemed to be to switch to tuba. I was very happy playing tuba, and continued to play all the way through graduate school. I particularly enjoyed the Bach cello suites and Beethoven's cello sonatas, though I must caution the reader that those are much more fun to play on the tuba than to listen to. My younger sister is an excellent flutist, and I heard quite a lot of the standard flute literature, and we enjoyed playing Handel's flute sonatas with the tuba as the continuo instrument.

When I graduated from high school in 1959 my parents gave me a trip to New York with Mr. Fuller to have a lesson from Bill Bell, the eminent New York tuba player, and to see a show. As luck would have it, we were able to see *West Side Story* at the Winter Garden. I had been a fan of Leonard Bernstein's all through the 50s, trying never to miss his illustrated TV lectures on our seven-inch black and white screen. The opportunity to see *West Side Story* was irresistable, and I pursuaded Mr. Fuller that we really had to see it. (He had some misgivings because he viewed some of the content as "adult." However, I think my parents fully approved, in spite of what my proper aunts might have said.) The show, as you can imagine, was absolutely stunning, musically and visually and emotionally. I had never seen anything like it. I remember vividly the moment when, in the darkened theater, the alto begins singing *Somewhere*.

Another good experience Mr. Fuller facilitated for me was to have me serve as student director of the band during my senior year. We had a stage band that played during intermission for the junior and senior plays, usually medleys from Broadway shows. I got to select the music (from *South Pacific*, *Oklahoma*, and *The King and I*) and rehearse and direct the performances. I also made an arrangement of one of Bach's Christmas Cantatas (No. 142—some say it was written by Johann Kuhnau) that the choir was working on for the Christmas concert, but as it turned out we only did the final chorus with band and choir together.

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COLLEGE

After graduation, attracted by the prospect of a snowier winter than in Virginia, and encouraged by Mr. Fuller, I went to the Music School at Northwestern to continue my education. I had done well on the SATs as well as on tuba, and they gave me a scholarship. (As I found out when my daughters went off to college, scholarships are no longer allotted on the basis of competence, except in sports.) At this point my good luck in playing the tuba really came into play, since the tuba teacher at NU was Arnold Jacobs, tubist with the Chicago Symphony. (His marvellous 1951 recording with Rafael Kubelik of Bydlo from Moussorgsky's *Pictures at an Exhibition* is still in print.) Not only was he a great tuba teacher, encouraging us in very basic things like breathing and in exciting the instrument with the correct frequency of buzz in the mouthpiece to hit the right pitch, but he was also doing research with his colleagues in the symphony on the physics and physiology of playing brass instruments. He discovered, for example, that for every octave you go up across the whole brass range, the air flow through the instrument halves and the pressure inside the mouth doubles. This is why trumpet players turn red in the face and tubists tend to hyperventilate. This emphasis on empirical research had a definite influence on me.

I had a good experience in music school, learning to sing better in tune, studying piano for two years, and taking a quarter of clarinet and of double bass. I got a job singing in the choir of St. Luke's, a very high Episcopal church in Evanston. Having been brought up Catholic but with a dearth of good music in the churches in Virginia, I was now able to participate in Medieval and Renaissance church music on a grand scale. We would march around the church in our choir robes and sing English translations of Gregorian chants (the *Dies Irae* at funerals was especially good), and Elizabethan motets. And our choir director, Mr. Boe, was a really fine organist and would treat us to elaborate postludes by Bach, such as the "St. Anne" Prelude and Fugue in E♭.

I spent two years in the Music School, but was gradually drawn more and more to psychology. I saw, especially in the work of Donald T. Campbell, an approach in which the kinds of question I was puzzling about—questions about man's place in the universe, about our understanding of our world, both natural and social, and about the meaning of music—could be addressed empirically. Campbell's approach was in the tradition of the American pragmatism of Peirce and James and Dewey, which is to say basically Kantian with a heavy dose of Darwinian evolution. I began to read Campbell's papers and took his Social Psychology course, and decided to major in psychology. I went to talk with him and told him I would like him to be my advisor. He agreed, on the condition that I would be responsible for knowing the requirements printed in the Catalog. I immersed myself in the comparative psychology of knowledge processes, doing an honor's thesis on that topic. And since coming to UT Dallas I have been teaching a core course on the history of psychology, subtitled "Minds and Machines Since 1600." Besides Peirce, I have been most impressed with the work of Spinoza, who was very early able to see through the shortcomings of Cartesian dualism and provide a coherent account of mind and body.

After transferring to Arts and Sciences, I stayed in the band, which I enjoyed, and continued to study tuba with Mr. Jacobs. One thing I did have to do with the switch was choose a foreign language. For reasons which are not entirely clear to me, I chose French, and that turned out to be a very fortunate choice. I began to enjoy reading French literature, and when I became more and more interested in the psychology of music, I realized that Francès's *La Psychologie de la Musique* was one of the main classics in the field, along with Helmholtz's *On the Sensations of Tone* and Leonard Meyer's *Emotion and Meaning in Music*. So when the opportunity to translate Francès's book arrived in the 80s, I was well prepared (Francès, 1988).

In my junior and senior years I became more and more interested in the emerging field of psycholinguistics, and when I talked with Prof. Campbell about that he took Saporta's new reader in the field down off the shelf and said, well, let's see where the people are who are doing that. We picked Illinois and MIT and Harvard. I had done well on the GREs and received a Woodrow Wilson Fellowship, and the interdisciplinary program in Social Relations at Harvard admitted me. So in 1963 I graduated

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from college and headed for Harvard. At the same time I married Caroline Monahan, whom I had met at Northwestern. We split up eight years later, but she remained a good colleague after that, and completed her doctoral work with Ed Carterette at UCLA.

Between college and grad school I spent the summer teaching tuba at the College of William and Mary's summer band camp, which I had attended since I was 14. I arranged Bach chorales for the eight budding tubists in my class to play, two on a part. I quickly realized that major thirds are quite dissonant in the lower-middle tuba range, something I would understand better after reading Plomp and Levelt (1965). I also arranged Mozart's *Concert Rondo*, K. 371, to play with the band, and we presented it at the final concert of the summer.

GRADUATE SCHOOL

My first advisor at Harvard was Roger Brown, and I served as a research assistant on his fascinating and ground-breaking child language development project. It was a heady experience, with our group meeting frequently with Chomsky and the MIT linguists to plot strategy. I was mostly involved with the Center for Cognitive Studies, which then was down the street from the future William James Hall and was organized by Roger Brown and George Miller and Jerome Bruner. The second year I was there the Cognition Center acquired one of the first laboratory computers, a Digital Equipment Corporation (DEC) PDP-5, and we graduate students learned to program it. Don Norman was the faculty member most directly involved with it, and he thought it would be a cute idea to have it play Christmas carols for the staff party. It was a large and intimidating machine—it filled a large room and had whirring fans to keep it cool—even though it had only 56K of core memory. He wired the lowest accumulator bit to an amplifier so we could output a square wave, and I wrote assembly-language programs to turn that bit on and off at the right frequencies to produce the songs. When filtered appropriately this sounded ok.

Our success with the Christmas carols led Don Norman to think that we might use the audio output from the computer for psychological experiments. He suggested that we might explore Miller and Heise's (1950; Heise & Miller, 1951) trill threshold, and that the effect, where tones alternating in separate pitch ranges split apart into separate perceptual streams, might be interesting to explore in terms of music. We set about temporally interleaving melodies on the computer, and seeing how far apart we had to shift them in pitch in order for them to split apart and become individually recognizable. This led to my dissertation, the results of which were published in Dowling (1973b). Due to the operation of the Zeitgeist, other laboratories were working on this problem at the same time, which led to some noteworthy publications (Bregman & Campbell, 1971; Van Noorden, 1975).

The most interesting discovery I made in the dissertation occurred rather serendipitously. The same fellow grad students were generously serving as subjects in the series of experiments. In a typical series of trials I would start with two interleaved familiar melodies and move them apart in pitch until the listener could name one of them, thus measuring the pitch separation threshold for identification. But after they had been in a few of these sessions with the same eight melodies, the listeners were able to name most of the melodies even when they were interleaved in the same pitch range. So I decided to test some naive listeners by telling them what melody to listen for in the interleaved pattern. After some warm-up trials, listeners were able to achieve close to 100 % hits and 0 % false alarms in that task. I concluded that listeners are able to aim their auditory attention at the precise points in time and pitch where critical events are expected to occur, and evaluate those events in relation to their memory representation of the familiar melody with whose name they were cued (Dowling, 1973b). I also found a similar result when listeners try to recognize octave-scrambled melodies; when cued as to which melody to listen for, they can verify whether the cued melody is present in the octave-scrambled pattern (Dowling & Hollombe, 1977). I followed up these results in subsequent research (Dowling, 1978b; Dowling, 1984a; Dowling, Lung, & Herrbold,

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1987; Andrews & Dowling, 1991; Dowling, 1992), testing the extent of the "expectancy windows" within which expected events would be detected and exploring the development of this ability. This has led to more recent work using a paradigm in which the target sound is cued for pitch and time of occurrence using a little melody. We find that listeners react quickly and accurately to targets at expected times and pitches in the musical structure (Dowling & Tillmann, 2004).

UCLA

Before I had finished my dissertation, in 1966 I received a job offer from UCLA at the same time Don Norman moved to the new campus at UC San Diego. The prospect of a real paying job was irresistable, and I had always been curious about the west coast. (Prof. Bruner very kindly filled in as dissertation advisor when I finally finished in 1968.) I had an excellent learning experience at UCLA. I was assigned to teach the undergraduate core course in perception, with 225 students in the lecture hall. Since I had never even had a perception course, Ed Carterette and Jim Thomas (the vision researcher) became my mentors and told me what to read each week so that I could stay ahead of the class and know somewhat more than was in the basic texts we were using. There is absolutely nothing as motivating for learning as the realization that you are going to face 225 eager, inquisitive students every other day, and that you don't really want to give the impression that you don't know what you're talking about. I am totally convinced that this was the most effective way possible for me to learn perception.

My research at UCLA was focused on how we remember melodies. I found that whereas listeners have quite precise representations of familiar tunes, novel tunes—at least brief novel tunes—are at first encoded principally in terms of their ups and downs, their melodic contour (Dowling & Fujitani, 1971). This line of research led to the theory that melodies are represented in memory as a combination of their melodic-rhythmic contour plus the mapping of that contour onto a tonal scale framework (Dowling, 1978a).

My own favorite study was the next in this series on memory for melodies (Dowling, 1986a). In it I surrounded a brief melody with a chordal context that defined it as built around the tonic, the first degree of the scale, or the dominant, the fifth degree. (I constructed melodies that omitted the fourth and seventh scale degrees so that I could move them between tonic and dominant without distortion.) A melody would be presented in one of those contexts, and then after a filled delay would be tested in a new key with the context either relatively the same, or shifted between tonic and dominant. I found that nonmusicians did better than chance, and equally well with the same or the shifted context. The performance of moderately experienced listeners, though better than that of nonmusicians with the same context, fell to chance with different context. Whereas nonmusicians encoded the pitch patterns of the melodies independent of the context, the encoding of moderately trained musicians was context-dependent, and their performance suffered when the context was changed. In effect, these listeners were encoding the melodies in terms of the tonal scale-step values of the notes. ("Moderately trained" here means having had about 5 years of music lessons in their youth.) This is something their brains were doing automatically, and was clearly not under conscious control. Otherwise they would be able to take melodic dictation, something good musicians don't usually learn to do until the first years of college. These listeners would be surprised to learn what their brains were up to.

These results and those of Dowling (1978a) and the studies on interleaved and octave-scrambled melodies reviewed above led me to the conclusion that melodies are not encoded in memory in terms of successions of intervals (as is often claimed), but rather as a succession of pitch classes in a moveable-do system (Dowling, 1991b, pp. 54-55). This is because: (1) Melodies can be recognized when intervals have been disrupted, as in interleaved or octave-scrambled melodies. (2) Intervals are most easily recalled with reference to melodies, and not vice-versa. (3) The tonal hierarchy is defined in terms of pitch classes, not intervals. (4) Pitches are easy to hold in short-term memory, but intervals

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are not. (5) Inversions of intervals, which retain the pitch classes but change the interval, are often treated as functionally equivalent in music. (6) Dynamic tendencies of pitches in a tonal context, like the attraction of the leading tone toward the tonic, operate in terms of pitch classes and not intervals. Taken together with more recent results (Dowling, Tillmann, & Ayers, 2001, Dowling & Tillman, in preparation) this leads me to believe that the characterization of the memory representation of a melody as scale plus contour (Dowling, 1978a) is fundamentally sound.

It was at UCLA also that, with my student Dane Harwood, I began to write *Music Cognition* (1986). Ed Carterette was immensely helpful in that enterprise, from enthusiastic encouragement to helping to find a publisher, to giving every page more than one careful critical reading. He also sponsored my becoming a Fellow of the Acoustical Society of America.

CAL STATE L.A.

Due to my lack of organization and failure to publish very much, I didn't get tenure at UCLA. (Though I can't claim to have felt this way at the time, I now think their decision was entirely reasonable, and I would do the same.) As an example of my disorganization: Note that it took five years between completing my dissertation and getting it published (and considerable patience and exertion of editing skills on the part of Saul Sternberg, to whom I am forever grateful). Advice to young researchers: Get organized right away and publish your work as fast as possible! I spent two years in a temporary position at Cal State L.A. Teaching there was a good experience in preparation for coming to UT Dallas. We served a highly diverse population of students mostly returning to school to finish their education, and we were conscientious in offering everything one needed to complete a degree in the evenings as well as the daytime. They were kind enough to provide me with some research space, which was at a premium on that campus. I literally shared a broom closet with another faculty member, complete with brooms and mops. The main result was a study on dichotic listening to Baroque flute duets, some of them canons (like *Row, Row, Row Your Boat* and *Frère Jacques*). The question was, what memory strategies do listeners use to decide whether what they are hearing is a canon? I found that it depends on which ear is leading. If the right ear leads (and the input is presumably processed mostly in the left hemisphere), the encoding strategy is more analytic, and success depends on the time lag between presentation of relevant details in the two parts. If the left ear leads, encoding is more holistic and doesn't depend as much on the time lag (Dowling, 1978b).

UT DALLAS

Due to the year-to-year nature of my position, I kept applying for jobs, as many as 140 in a year. At last one materialized at the new campus of the University of Texas at Dallas. The new chairperson and the new vice-president interviewed me at the LA airport because the campus was still under construction in the spring of 1975. UT Dallas was self-consciously interdisciplinary and I fit right in. It has been fun to help organize a new campus which has grown steadily and is now becoming a major university. My colleagues here, especially Jim Bartlett, Hervé Abdi, and the composer Robert Rodriguez, have been congenial and helpful and fun to work with. I served as chairperson in Psychology and in our graduate program in Applied Cognition & Neursocience for about 14 of the last 32 years (up to the spring of 2000), and enjoyed the mostly helpful and cooperative atmosphere of our school and campus administration. I am sure I am happier here than I would ever have been in LA.

When I moved to Dallas, Darlene Smith, whom I had met at UCLA, accompanied me, and we were married in January, 1976. Over the next three years we had two daughters, Calla and Erica, and having children was and still is one of the most exciting things in my life. I found them fascinating from the moment they were born. When they began singing around the house I recorded them. Singing is very different from speech-like babbling—it tends to hold vowels on steady pitches and to maintain some semblance of a beat. There were regularities in their

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spontaneous songs such as repetitions of kernel phrases at varying pitch levels, and codas that ended repetitious songs with a flourish (Dowling, 1982a, 1984b, 1988b, 1999). Even though the songs of two-year-olds do not yet use the tonal scales of the child's culture, the child moves among discrete pitch levels in singing. Calla and Erica still sing together, and sometimes let me sing, too, and are currently finishing graduate degrees in their fields of library science at Michigan and speech pathology at UT Dallas.

When we arrived at the new campus the university chorus needed everybody it could get, so Darlene and I joined the chorus and immediately plunged into singing in the Dallas Symphony's performance of Mahler's Second Symphony. For the next 10 or 12 years, our choir served as the symphony choir, performing in most of the classics of the repertoire for choir and orchestra, from Bach and Handel through Mozart and Beethoven to Stravinsky and Prokofiev. We joined in the first digital recording of Ravel's *Daphnis et Chloë,* with Eduardo Mata conducting. (A snippet of this is apparently still available on amazon.com on an album titled *Morning Favorites: Music to Wake Up To.*)

At UTD I began a collaboration with Jim Bartlett studying memory for melodies. He had completed a dissertation on memory for environmental sounds at Yale, and was very interested in memory for nonverbal materials, in addition to being a highly creative and methodologically sophisticated researcher. We found that the dominance of melodic contour in recognition holds for short delays between target and test, but that the exact pitch pattern becomes more important after filled delays (Dowling & Bartlett, 1981). We also found that in an immediate recognition task, the key distance (in the sense of the circle of fifths) between target and test affects the dominance of contour, in the sense that the illusion that you are hearing the same melody again in a near-key imitation (which preserves contour but not exact intervals as contrasted with a transposition which preserves both) is broken by moving to a distant key. The result was that same-contour false alarms decline steeply with key distance in a transposition-recognition task (Bartlett & Dowling, 1980). Furthermore, moving from a tonal pattern to an atonal pattern between target and test makes changes in melodies easier to spot than moving from atonal to tonal (Bartlett & Dowling, 1988). I continued this series of studies on tonality effects in melody recognition and on the time course of melody recognition with my students Melinda Andrews and SeYeul Kwak, both creative experimenters (Dowling, 1991a; Dowling, Kwak, & Andrews, 1995).

In the 90s Bartlett and I did a series of studies on aging and music cognition with Andrea Halpern from Bucknell, a collaboration that also included Andrews and Kwak. We studied listeners over a wide range of age and expertise, and looked at melody recognition from several angles including transposition recognition, recognition of familiar and unfamiliar melodies in normal aging and Alzheimer's disease, and the role of mode, rhythm, and contour in recognition (Halpern, Bartlett, & Dowling, 1995; Bartlett, Halpern, & Dowling, 1995; Halpern, Bartlett, & Dowling, 1998). We looked at the tonal hierarchy, in Krumhansl's (1990) sense, in aging (Halpern, Kwak, Bartlett, & Dowling, 1996). My favorites among the aging studies involved using Richard Warren's speeded and slowed melody identification task to look at cognitive slowing in aging (Andrews, Dowling, Bartlett, & Halpern, 1998). We started melodies very fast (20 notes/s) and slowed them down until they were identified, and conversely we started very slow and speeded them up, measuring the threshhold tempo for identification in each case. We found that expertise made much more of a difference in this task than age (a finding common to most of our aging studies), improving performance for both very fast and very slow stimuli. Increased age (up to 84 years) had an effect only on the fast end, which we interpreted as indicating that aging produced some decrement in rapid processing of stimuli, but did not produce an overall shift in the speed at which music is processed. We since replicated this study using a recognition memory paradigm (Dowling, Bartlett, Halpern, & Andrews, 2008).

RECENT WORK

When Hervé Abdi joined our faculty in 1989, coming from the Université de Bourgogne in Dijon, our ties with France were strengthened, and

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this encouraged me to collaborate with French colleagues. (Hervé and I share a mania for collecting discs, essentially aiming to have at least one exemplar of each noteworthy piece from 1600 to the present, Saint-Saëns excepted.) In particular I have enjoyed the opportunity to collaborate with Emmanuel Bigand at Dijon, and Barbara Tillmann at Lyon. For the past 10 years or so Tillmann and I have been working on an interesting memory effect that grew out of the convergence of two of our previous lines of research—mine on the early time course of memory, and her work with a musical jigsaw puzzle in which listeners put together a coherent piece out of fragments by aligning cadential patterns correctly (Tillmann, Bigand, & Madurell, 1998). We presented listeners with minuets in which one of the first few phrases would be a target. The minuet continued just as written, and after a shorter or longer delay (5 vs 15 s) arrived at a test item that was either an exact repetition of the target, a similar imitation (usually with the same melodic contour shifted to another pitch level), or different. We found that recognition performance, especially the ability to discriminate between targets and similar lures, improved with longer delays (Dowling, Tillmann, & Ayers, 2001). Our current theory is that in the early stages of memory encoding, the system has registered separate individual features of the musical phrases, but has not yet bound them together. In that case similar lures and targets can easily be confused with one another—think of the first and third phrases of Beethoven's Minuet in G: they share the same key and tonal scale, and they have the same rhythmic pattern and the same melodic contour; they differ principally in the pitch level at which that contour is bound to the scale. Before that binding occurs, they appear virtually identical, but after the contour is bound to the scale—in the first phrase starting on the third and going up to the fifth, in the second starting on the tonic and going up to the third—their differences are apparent (Dowling & Tillmann, in preparation). What is surprising here is, first, that so much processing of earlier phrases occurs while the listener is ostensibly attending to the ongoing music, and second, that it takes so much time, on the order of tens of seconds.

We have since replicated these results using the guitar music of Ottmar Liebert (Magner, Tillman, & Dowling, in preparation). These results with music are particularly suprising in that numerous studies of memory for prose stories have obtained the opposite result: a decline over time in the ability to distinguish between targets and similar lures. We tried the same paradigm with poetry, since poetry shares some of the rhythmic organization of music, but, like prose, involves verbal content. Our results with poetry struck us as more like the music results than the prose results: performance did not decline over time, and in some cases, improved (Tillmann & Dowling, 2007).

In 2000 I spent the fall semester in Dijon at Emmanuel Bigand's lab, and then Darlene and I spent the fall semester in Dijon in 2006. I really love living in France, especially in Dijon. We had an upstairs apartment just around the corner from the farmers' market, and walked everywhere. Dijon has large wooded parks all around the city, and you can take a bus to one end of a park and walk back through the woods. Lots of walking and really fresh veggies, as well as cheese and sausages, etc., induce a very healthful lifestyle. And there's a strong sense of friendliness and community in France—people helping each other on the bus, people out walking around town in the evening, people joining in community festivals in which all of downtown is roped off for pedestrians. There's relatively little of the feeling of "us and them," and a strong feeling of "we're all in this together."

One of the most enjoyable aspects in France came from the fact that a group of my colleagues, including Bigand and Tillmann and Sévérine Samson in Lille, had applied for and received support from the ANR (Agence Nationale de la Recherche) for a three-year study of music and memory, and they were gracious enough to include me. Every six weeks, 16 or 18 of us would gather for a day or two of intense discussion and planning of research, most often in Paris but on occasion in Marseille or Lyon. One goal is to produce a book of chapters covering the topic. I am convinced that this is a very healthy way to foster scientific interaction, and far more exciting and productive than huge conventions.

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CHANGES IN THE FIELD

There have been considerable changes in the field of psychology of music, and more specifically music cognition, over the 40-some years I have been involved in research. First, there is a field now, with lots and lots of energetic and creative researchers continually enlightening us. Fortunately, the field is still small enough that the size of our conferences still allows us to remain in touch with others in the field, and at the huge conferences like Psychonomics, we have sessions dedicated to music research. When I started out, I concentrated on pitch and melodic patterns because that was what interested me most. Fortunately, other researchers have concentrated on rhythm, and the field has been much enriched as a result. I think as we progress it becomes clearer and clearer why cognitive psychology in general needs to pay attention to our discoveries—this may be particularly true for rhythm. During the past ten years new methods for studying the brain have provided a continual stream of new insights into how music is processed, and I expect this trend to continue well into the future.

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