EXPECTANCY AND ATTENTION IN MELODY PERCEPTION

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This article offers suggestions for operational definitions distinguishing between attentional vs. expectancy processes in melody identification. "Attention" is characterized as a process that selects stimulus elements for further processing, leading to the interpretation of whatever stimuli were picked up. That is, "attended" stimuli are heard as interpretable patterns or gestalts. "Expectancy," in contrast, in the context of discerning melodies hidden among distractors, leads to the isolation of a gestalt only when target elements more or less match the expected pattern. Otherwise, the listener is not able to interpret the auditory pattern. These suggestions are applied to a series of recent experiments that explore developmentally the consequences of violating expectancies at two levels: that of pitches within melodies, and that of pitches in the overall tonal scheme defined by a music key.

Expectancies are important in cognition. By expectancies, I refer here both to what our perceptual systems and brain expect and process automatically ("procedural" expectancies), as well as to what we can say we expect and process by means of explicit symbolic strategies ("declarative" expectancies). Procedural expectancies represent the tuning of perceptual systems to invariants in the world, and when actual events correspond to expectancies, processing is facilitated. Declarative expectancies are the natural outgrowth of our abstracted, explicit knowledge of the world. Both types of expectancy represent not only particular contingencies but also higher order relationships that hold among events–including invariants that hold across pieces and across styles.

Both procedural and declarative expectancies are important in the cognition of music. Expectancies in music facilitate processing as well as play a significant role in the generation of emotional experience. Emotion is especially involved with events processed automatically at a subconscious procedural level. It is against an array of expectancies that events in music are heard as either normal or surprising. It seems very likely that such surprising events trigger arousal in the autonomic nervous system and that (in accord with current psychological theories of emotion) arousal sets off an emotional reaction completed by the assignment of meaning to the surprising event (Dowling & Harwood, 1986). Such "surprises" often consist of small events picked up on a procedural level that produce arousal automatically. Further, the unexpected event signals an imbalance–a departure from stability–in the music pattern, and the resolution of that imbalance–the return to stability–provides an emotionally rewarding experience (Meyer, 1956). Meyer suggests that conscious, declarative access to that process can lessen its emotional impact.

In addition to their importance in shaping our experience of music, expectancies are also easier to study in music than in other psychological domains because the universe of music events is relatively limited and well-defined. The study of expectancy in music provides a fertile field in which to learn about the operation of expectancies in general. Expectancies represent knowledge of the world. In music, expectancies represent knowledge the listener has of a music universe–of a piece embedded in a style. On a procedural level, expectancies represent the tuning of perceptual mechanisms to music invariants. That tuning is, in part, provided by the overall constraints imposed by the functional architecture of the sensory systems and brain: pitches correspond to vibration frequencies between 20Hz and 20 kHz; easily recognizable melodies consist of notes succeeding each other at rates between 0.4 and 6.0 events/s (Warren, Gardner, Brubaker, & Bashford, 1991), etc. But as the listener grows up within a music culture, perceptual learning leads to more precise tuning of automatic expectancies corresponding to typical patterns in that culture. Listeners become very proficient at hearing those patterns.

A listener having perceptual experience with a certain style or a particular piece literally hears a different set of music events than does a listener lacking that experience. This is illustrated in a simple and direct way by the progress listeners make in the course of learning to discern familiar melodies hidden in the midst of interleaved distractor notes. When the listener first hears a melody interleaved with distractors (as in Figure 1a), the pattern sounds like a meaningless jumble of notes. However, after practice discerning such hidden target melodies, the listener begins to hear them clearly. To introduce the listener to these interleaved patterns, the practice session usually starts with patterns in which targets are set off from distractors by loudness and timbre differences (as represented in Figure 1b) or pitch differences (Figure 1c). Then those salient physical cues to the identity of target elements are gradually eliminated and the listener learns to hear the target even without obvious physical cues. An hour-long practice session generally suffices for better-than-chance performance. But even after 20 hrs or more of practice, listeners are still able to hear the target only when informed as to what melody to expect (Dowling, 1973). Given practice picking hidden targets out of confusing contexts (Figure 1a), and given the information that the target is a particular familiar tune (for example, "Twinkle, Twinkle, Little Star"), the listener can recognize the target, but not otherwise. A practiced and informed listener's experience hearing the pattern is thus quite different from that of a naive or uninformed listener.

Recognizing "Twinkle, Twinkle" in the pattern shown in Figure 1a illustrates the two aspects of expectancy that I emphasized at the outset. The listener in this task needs explicit declarative information concerning which target to listen for. Even a practiced listener cannot identify such a hidden melody without some way of narrowing the range of possibilities. But the listener must also rely on procedural knowledge developed through practice in discerning interleaved targets. Perceptual learning with similar patterns leads the listener to focus automatically on relevant features, identify recurring feature clusters, and integrate clusters of features into higher-order units (following LaBerge's list, 1980). Further research with the hidden-melodies task suggests that listeners learn to focus expectancies on regions of pitch and time where the notes of target melodies are likely to occur. For example, they find it easier to focus on the beat rather than off the beat to pick up target notes, that is, on the odd-numbered notes in Figure 1a vs. the even-numbered notes (Dowling, Lung, & Herrbold, 1987).

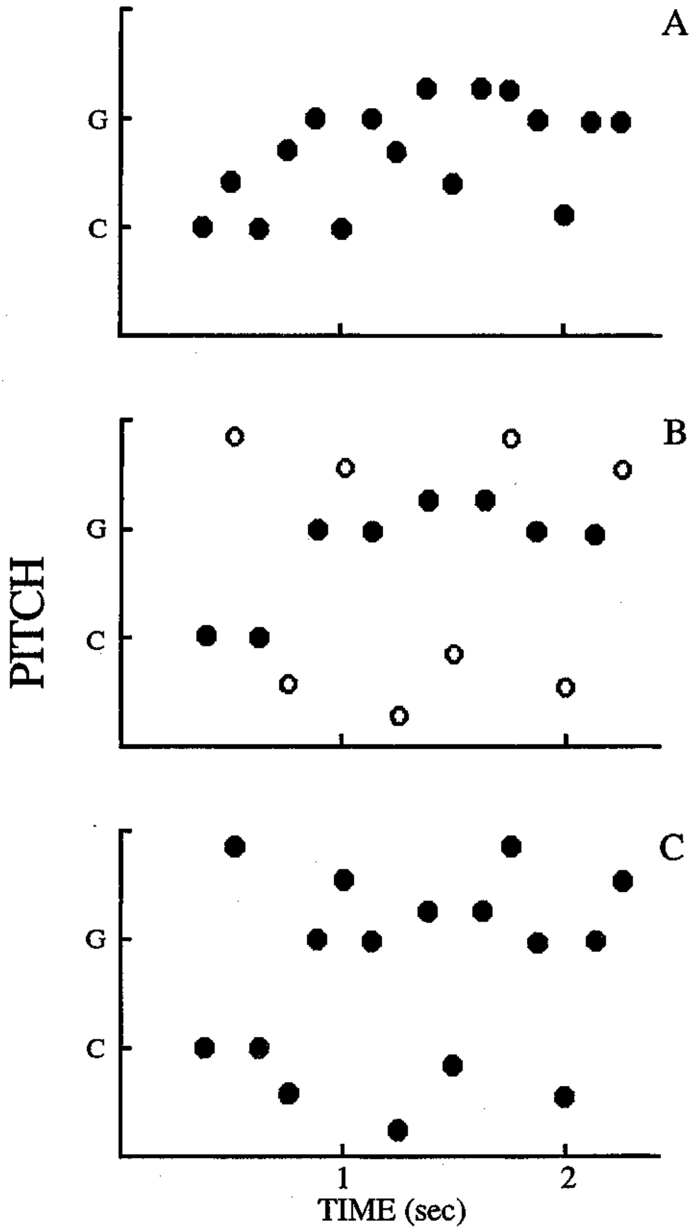

Figure 1. Three conditions in which target melodies are presented with temporally interleaved distractors: (A) hidden target (filled circles) of same timbre and pitch range as distractors; (B) salient target (filled circles) with different timbre distractor notes (open circles) in background; (C) hidden target (filled circles) with same-timbre distractors outside the target pitch range.

Expectancy and Attention

Recognizing "Twinkle, Twinkle" in the contexts shown in Figure 1 also illustrates important contrasts between processes of expectancy and of attention. Attention can be directed in terms of salient features of the stimulus array. The listener can attend to a particular pitch region (as in Figure 1c) or to a stream of sounds having a particular timbre (Figure 1b). When attending to that pitch region or timbre the listener will hear and process whatever stimuli occur in the processed stream. The fact that the melody is the expected "Twinkle, Twinkle" is relatively unimportant in the sense that the listener would recognize "Frère Jacques" if it were substituted. Even a novel melody could be substituted for the expected target and the attentive listener would hear it clearly and remember it later. The attentional process picks up whatever is clearly differentiated in the stimulus pattern and passes it on for further analysis.

The process of attention thus contrasts with the process of expectancy involved in the recognition of a hidden melody as in Figure 1a. There when attention is simply directed to the stream of notes, the listener hears a meaningless jumble. The pattern does not "remind" the listener of anything. Even when told that the target is "a familiar tune" the listener still will not hear it without more specific information. It is only when cued as to which familiar melody to listen for that the practiced listener is able to discern it (Dowling, 1973). Attention and expectancy are alike in that both select stimulus elements for further processing. Attention selects all those elements defined by a salient feature, and those are interpreted even if they constitute a novel pattern. Expectancy, in contrast, selects only elements that match a hypothetical cued target. The listener can aim attention in terms of salient stimulus features.

The listener can also aim expectancies, attempting to pick up events in critical regions of the stimulus array. In Figure 1a this is like aiming expectancies at "expectancy windows" in pitch and time (Dowling et al., 1987). But aiming expectancies leads to different results from aiming attention. The information picked up through the expectancy process is not simply passed on to further stages of information processing for recognition. An unexpected but familiar tune occupying those windows will not be recognized by a highly practiced listener even if the pattern is repeated over and over (Dowling, 1973). Likewise a novel melody occupying those slots in time will not be heard as a coherent pattern–a *gestalt*–nor will it be remembered.

A process similar to that involved in hidden melody recognition seems to operate when the listener attempts to interpret octave-scrambled melodies. Deutsch (1972) showed that when the pitches of a familiar melody are assigned randomly to different octaves it becomes unrecognizable, even when the listener attends carefully to the succession of notes. The stimulus pattern doesn't remind the listener of anything. Furthermore, novel melodies presented in octave- scrambled form are difficult to recognize in their nonscrambled state. However, just as with interleaved melodies, listeners are able to tell whether a given stimulus array matches a cued melody already present in memory (Dowling, 1984). With octave-scrambled melodies, as with interleaved melodies, it is the listener's expectancy that is the critical element in producing recognition. The change in cognition and behavior as the result of changes in expectancy is sufficiently dramatic that I wish to suggest the use of this paradigm to specify an operational definition of one aspect of expectancy.

Operational Definitions of Expectancy

Based on the considerations above, operational definitions contrasting the processes of expectancy and attention should include specifications (a) of prior experience, (b) of stimulus conditions, (c) of instructions, and (d) of behavioral measurements. To be precise, I am setting out to define only those aspects of expectancy that lead to the selection of stimulus elements obscured by context, a selection process that looks superficially like the process of attention. Since the definition of expectancy in this restricted sense is more elaborate than that of attention, I will start with it.

Prior experience. For processes of expectancy to be brought into play, the subject must have some basis in memory for the guidance of stimulus selection. This is generally a representation of the pattern to be recognized, such as a familiar tune. In a study involving recognition of octave-scrambled melodies, for example, Dowling (1984, experiments 1 and 2) cued subjects with either an actual familiar melody or its title. There was no difference in performance in those two conditions. That long-term memory representations were involved in both conditions is shown by the result of cuing with an actual unfamiliar melody. Then performance declined significantly compared to performance following cuing with an actual familiar melody. This difference can be attributed to subjects' retrieval of a well-established long-term memory representation of the familiar melody to aid in recognition. Further, when subjects attempt to recognize novel octave- scrambled melodies it helps if stable representations of the cue can be formed quickly. Performance by musically experienced subjects was much better with novel tonal melodies than with atonal (Dowling, 1984, experiments 3 and 4), presumably because memory representations of the former could be formed more easily. In that case, a more general type of long-term memory representation, that of the tonal scale system, comes into play.

Subjects often benefit in expectancy tasks from practice performing the particular task, as described above for the hidden melodies task shown in Figure 1. Extensive practice is not required in every task, however. Recognition of octave-scrambled melodies does not require nearly so much practice as recognition of interleaved melodies.

Stimulus conditions. For expectancy to be required for stimulus selection the stimulus array must be sufficiently complex so that the pattern does not automatically remind the subject of the target to be recognized. For example, Deutsch (1972) found that an octave-scrambled version of "Yankee Doodle" could not be identified by subjects who could identify it immediately in an unscrambled version. Dowling (1973) found that highly practiced subjects in an interleaved melodies task could not identify uncued familiar tunes from a restricted set of eight possibilities even after numerous repetitions. Again, those subjects would have been able to identify any of the targets immediately when presented without distractors. In general, there is no single, simple stimulus feature in the expectancy task that serves to separate target elements from distractors.

Instructions and behavioral measurements. Subjects must be instructed to attempt to discern the cued melody in the stimulus array. Subjects' success in following those instructions is then assessed by measuring the proportion of the various types of possible stimulus-response combinations. Methods of data analysis inspired by signal detection theory are required in order to combine information contained in hit and false-alarm rates. This is because we want to be sure that when the subject claims to discern "Twinkle, Twinkle" in the stimulus array that the subject's perceptions are really based on a selection of relevant "Twinkle, Twinkle" stimulus elements, and not simply the result of the subject's desire to be agreeable, for example. The use of signal detection approaches to data analysis is especially important in studies with children, who often have widely varying response biases. The most convenient indices of performance are under the receiver operating characteristic (ROC) derived from confidence-level response scales, and A', derived from simple yes-no responses. Both provide estimates of unbiased proportion correct where the chance level is 50%.

Operational definition of attention

Turning to attention, one finds simpler components of the definition at each step.

Prior experience. Aiming attention in terms of stimulus features does not require memory for targets. Attention can be assessed either by requiring recognition of a cued target that is already familiar, or by subsequent recognition testing for a novel target presented earlier under controlled-attention conditions.

For adults, practice with control of attention in a particular task is often useful, but specific practice is typically less essential than in the expectancy tasks. The aiming of attention in terms of features such as pitch does require perceptual learning that usually occurs in childhood. Andrews and Dowling (1991) found, for example, that when faced with the problem of identifying either "Twinkle, Twinkle, Little Star" or "Old Macdonald Had a Farm" when those tunes were bracketed by interleaved distractor notes in separate pitch ranges (as in Figure 1c), children improved their performance from around chance to above 80% correct between the ages of 5 and 10 years.

Stimulus conditions. To provide for aiming attention, the stimulus conditions must provide relatively salient features by which attention may be guided. Dowling (1973) found that differences of pitch, loudness, timbre, and apparent location could all function as cues for the direction of attention in the perception of interleaved melodies. Such cues define an input "channel" to which attention may be directed.

Instructions and behavioral measurements. Instructions often designate the stimulus feature by which attention should be guided: "Identify the melody that is higher in pitch;" "Listen to the melody in the right ear so that you will be able to recognize it later," etc. Then the subject's success in following the instructions can be assessed. As with expectancy tasks, signal detection measures should be used to assess the degree to which the subject reports hearing the target when it is really there, and avoids reporting hearing the target when it is not.

Attention, guided in terms of salient stimulus features, is difficult to split. It is hard to attend to two separate streams of notes at once. In contrast, the listener can expect more than one thing at a time. The listeners in Andrews and Dowling's (1991) study could identify either one of the two hidden targets. However, it remains to be seen how many different patterns could usefully be expected at once. It is clear from Dowling's (1973) results that listeners cannot use expectancy successfully when there are as many as eight possible targets.

Experiment

Now I wish to apply these definitions of aspects of attention and expectancy to an experiment concerning the development of perceptual skills involved in discerning hidden melodies. In this study, Andrews and Dowling (1991) varied the degree to which target melodies were hidden amid temporally interleaved distractors. In the easiest condition, targets were played in a salient timbre that made them stand out from the background of distractors (as in Figure 1b). That condition made relatively few demands on the organization of attention for the listener to be able to hear the targets clearly. In the next harder condition, (Figure 1c) targets and distractors were in the same timbre, but distractors were restricted to pitch ranges outside that of the target, bracketing it above and below. The listener could succeed in this condition by directing attention to the pitch region in which the target occurred. In the hardest condition, target notes and distractors all had the same timbre and were all intermingled in the same pitch region (as in Figure 1a). There the listener needed to use expectancies to solve the task.

The experiment was designed to invoke expectancies on three levels. The last condition of the task just described required the aiming of temporal expectancies at critical moments in the stream of notes, thus involving the organization of expectancies at a level of local stimulus elements. At the next broader level lie expectancies concerning events within the pattern of the target song itself. (Here a shift to "expectancy" in the more general sense is made, as opposed to the specific sense of a process contrasted with "attention" in the perception of interleaved melodies.) A target either followed the particular expectancies associated with a tune by being presented in a "straight" version, or the target wandered from the expected pitches. Wandering targets always preserved the contour (the pattern of ups and downs) of the original melody. There were two issues that the introduction of wandering targets was intended to address. First, the degree to which wandering itself disrupted performance even with salient targets could be taken as a measure of the flexibility of expectancies generated by the listener's memory representation of the tune. Second, the degree to which a listener might be able, under conditions requiring the focusing of attention (Figure 1c), to discern a wandering target would measure the degree to which the listener is able to pick up whatever pattern occurs within the region of focused attention. If listeners show no decrement in performance between straight and wandering targets under focused attention conditions, then attentional focusing is successful, since the unexpected pitches of the wandering target are being processed and interpreted accurately.

The third and broadest level on which this task addressed expectancies was that of the tonal scheme. The whole experiment was based in the key of C major in the sense that two-thirds of the targets were in that key and all targets began with that tonic. In order to violate expectancies at the level of the tonal scheme, half the wandering targets wandered away from the key of C major by introducing pitches from the distant tonality of F# major. The other half of the wandering targets remained within the original key. To the extent that memory for a well-known tune is bound up with a representation of the tonal scheme, then performance with altered-tonality wandering targets could be expected to suffer in comparison with same-tonality wandering targets. This difference should be most easily assessed with the salient targets, where the effect of the other variables was minimal.

Listeners in three age ranges between 5 and 10 years as well as adults served in the experiment. Their task was to say on each trial whether the target was "Twinkle, Twinkle, Little Star" or "Old Macdonald Had a Farm." One or the other was always present, so chance performance was 50% correct. The contrasts among stimulus conditions in the design provided for the assessment of listeners of different ages concerning (a) the degree to which they could focus attention on the bracketed pitch region and pick up the stimulus pattern occurring there; (b) the degree to which they could focus expectancies in time; and (c) the degree to which violation of expectancies at the levels of familiar melodic pattern and familiar tonal scale pattern would disrupt performance.

Addressing the latter expectancy issues first, Figure 2 shows the results for salient targets for the four ages studied. Across those ages, there was a series of shifts in the importance of the various melodic features. At the ages of 5 and 6 years, it did not matter whether a target wandered or not. Memory representations of melodies (or the strategies that applied them) were apparently not so precise as to require a precise target for identification. By 7 and 8years, wandering per se still did not affect identification, but tonality mattered.

Performance was equal for the straight and same-tonality wandering versions, but worse for the altered- tonality wandering versions. This suggests that the developing sense of tonality during this age range (Krumhansl & Keil, 1982) affects what counts for the child as a good version of a familiar tune. By the age of 9-10 years, preservation of the exact pitch intervals of the original tune has become the important feature for identification of the target. Wandering targets of either sort are not as easily identified as straight ones. It is only after the age of 10 years that listeners become flexible enough to identify targets consisting of inexact approximations to melodic shape almost as easily as precisely patterned targets.

The results shown in Figure 2 thus support the notion that the child's expectancies concerning the pitch events in a familiar tune change through the ages of 5 to 10 years and beyond. The child progresses from a very global and not precisely differentiated set of expectancies for the target (5-6 years), to expecting that the target will

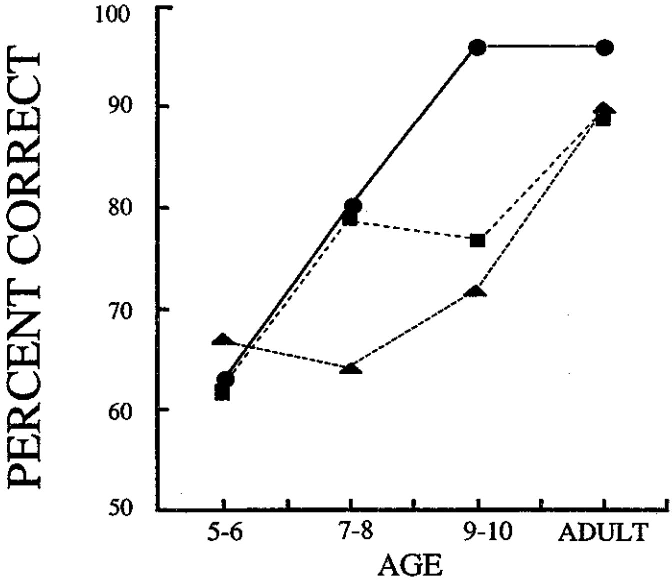

Figure 2. Proportion correct responses for salient targets at different ages. Targets either matched expectancies (straight targets–circles), or violated them by wandering in pitch. Same-tonality wandering targets (squares) remained within the key of the original, while altered-tonality wandering targets (triangles) departed from it. (After Andrews & Dowling, 1991)

stay in a constant key (7-8 years), to expecting the target to follow the exact interval sizes of the original melody (9-10 years). Sometime after the age of 10, listeners become more flexible in their strategies, and are able to use imprecise contours for melody identification when the task demands it. I shall return to the issues raised by these results below in connection with another experiment, since the six-year-old's failure to respond to violations of expectancy introduced by wandering is puzzling and may have depended upon the particularly simple structure of the present study.

The results of testing the focusing of attention within a specified pitch region are shown in Figure 3 by filled symbols. This ability begins to emerge in the 7-8 years age range, and is clearly established for picking up straight versions of the tunes by 9-10 years. The ability to focus attention in the critical pitch region and pick up even the unexpected wandering versions of the tunes, however, was well established only for the adults.

The most difficult task was to discern hidden melodies that were thoroughly embedded among distractors in the same pitch region (open symbols in Figure 3). In terms of the present conceptual scheme, this was a matter of aiming expectancies at critical points in time. Though there appears to be some evidence that the children can do this, in that performance with hidden straight melodies was almost uniformly

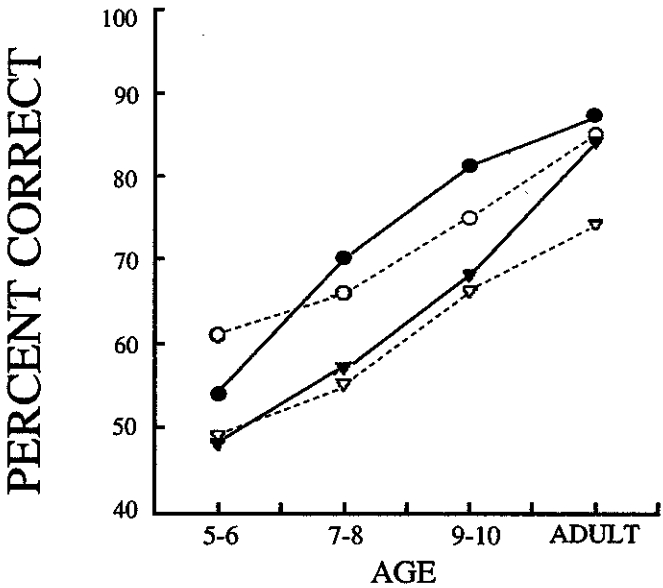

Figure 3. Proportion correct responses for hidden targets at different ages. Targets were interleaved with same-timbre distractors either within the same pitch range (open symbols) or outside it (filled symbols), and were either straight (circles) or wandered (triangles). (After Andrews & Dowling, 1991)

superior to that with hidden wandering melodies across the entire age range, it was only with adults that performance with hidden straight melodies caught up with performance in the less thoroughly hidden conditions.

It has been my contention here that picking up the thoroughly hidden melodies is not accomplished by aiming attention in the same sense that picking out a melody from between distractors in separate pitch regions is. If it were, the listener should be able to discern any target hidden among the distractors, and not just the expected one. But performance here with wandering hidden targets remained markedly below that for the other conditions even for adults. The fact that it was above chance at all is probably due to the small set of possibilities (two) and the fact that the pitches of wandering targets did not differ substantially from the expected. When faced with a similar task with a set of eight possible targets (all quite distinct), highly practiced adults perform at chance (Dowling, 1973).

Violations of Melodic Expectancy

The results shown in Figure 2 suggested that five- and six-year olds have relatively imprecise and undifferentiated expectancies for the pitches of familiar tunes. This is surprising in the light of other evidence concerning children's melodic memory.

Children's singing, for example, shows fairly precise adherence to the interval patterns of well-known melodies at that age, and even younger children are able to notice pitch interval distortions in familiar tunes (Dowling & Harwood, 1986). I thought it very likely that the strategies by which the children applied their expectancies was due in part to the simplified design of the experiment. Andrews and Dowling (1991) used only two melodies and regularized rhythms so that both melodies were presented as isochronous sequences (in order to facilitate the interleaving of distractor notes). Therefore, we followed this study with a more elaborate version consisting of just salient targets without distractors, in which they used four familiar tunes with their natural rhythms, all different from one another ("Mary Had a Little Lamb," "London Bridge Is Falling Down," "Here We Go Round the Mulberry Bush," and "Pop Goes the Weasel").

In the analysis of the children's correct responses shown in Figure 4, the interaction of Condition x Age that bears on our argument was significant at the 0.05 level (Dowling, Andrews, & Kwak, 1991). At first glance, it is clear from comparison with Figure 2 that the addition of natural rhythms led to a marked improvement in performance for the younger children. (Note that chance is now 0.25 rather than 0.50.) But what about the effects of violating expectancies with wandering targets? How much of the story from Figure 2 of successive developmental stages for the emergence of this or that melodic feature can be found in Figure 4?

First, it is clear that tonality makes a difference across all ages, and not just in the

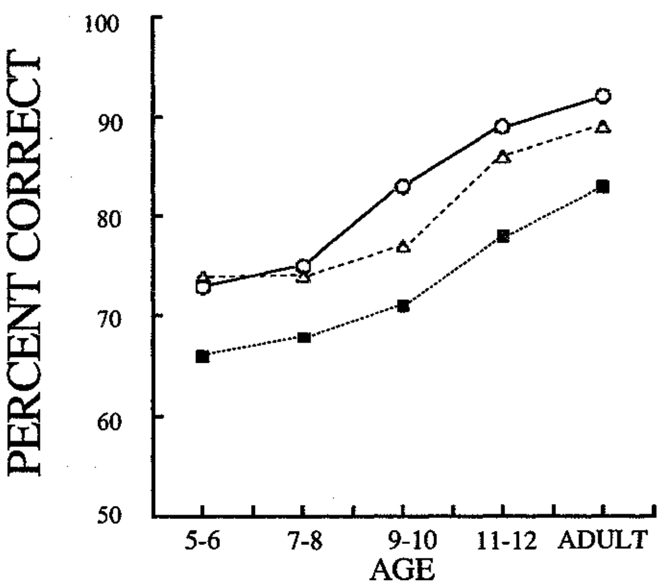

Figure 4. Proportion correct salient targets at different ages. Targets were presented with their natural rhythms and without distractors: straight targets (circles), wandering same-tonality targets (triangles), and wandering altered- tonality targets (filled squares).

7-8 year group. For this expanded sample of more natural sounding melodies, the violations of expectancy at the level of the tonal scheme caused problems for listeners attempting to identify it from its rhythm and pitch contour. This effect is similar to the effect that Bartlett and Dowling (1988, experiments 2 and 4) found with adults' judgments of contours of pairs of five-note melodies in a short-term recognition memory task. Bartlett and Dowling found that when the contours of the two melodies were actually the same, subjects were less likely to think they were the same if the second melody violated the tonal scale expectancies set up by the first. Same-contour pairs were judged "different" more often when the second member of the pair introduced pitches outside the tonal pattern established in the first member of the pair. Thus, in both the short-term memory task of Bartlett and Dowling and the long-term memory task of Dowling, Andrews, and Kwak (1991) violations of expectancy at the tonal scale level led to decrements in performance in judgments of other features of melodies.

The results just described show the degree to which expectancies can be embedded in automatic procedures of melodic information processing, not accessible to declarative mental analysis. The subjects in Bartlett and Dowling's (1988) experiments were instructed to judge melodic contour, and the contour similarities and differences to be judged were rather obvious ones produced by the shift of one pitch in the middle of a five-note melody from the lower octave to the upper or vice versa. Nevertheless, the subjects' behavior was affected by shifts of tonality. The subjects in Dowling, Andrews, and Kwak's (1991) experiment were attempting to recognize distortions of familiar tunes whose rhythmic patterns and pitch contours remained intact. There again, performance was affected by violations of tonal scale expectancies that had no direct relationship to the aspects of the melodies subjects were attempting to judge. At a declarative level, subjects were unaware that their judgments were affected by tonality relationships.

Second, apart from their poorer performance with altered-tonality-wandering targets, five- to eight-year-olds in the Dowling, Andrews, and Kwak (1991) study performed equally well with straight and with same-tonality-wandering items (Figure 4), as did the subjects in Andrews and Dowling (1991) (Figure 2). And for both groups, it was at ages 9-10 years that wandering itself became an important feature of the targets, and performance for wandering vs. straight targets diverged. In both cases, this performance difference diminished with older subjects.

Summary

The studies reviewed here were aimed at testing the importance of a variety of levels of melodic expectancy in developmental perspective. Different profiles emerged for expectancies at different levels. The violation of tonal scale scheme expectancies affected melody identification: only in the age range of 7-8 years for a simple task with two isochronous melodies, and across all the age groups tested in a more complex task with four rhythmically differentiated melodies. The violation of expectancies specific to each familiar melody (produced by introducing targets that wandered in pitch) affected performance at age 9-10 years in both experiments. Younger and older subjects were relatively unaffected by wandering per se.

The experiment by Andrews and Dowling (1991) contrasted processes of attention and expectancy in the identification of melodies temporally interleaved with distractor tones. We claimed that attention could operate in the condition where distractors were in separate pitch regions from targets. In that case, subjects could direct their attention to the relevant pitch region and pick up whatever pattern occurred there. Even wandering targets that violated specific melody pattern expectancies could be identified when attended to in this manner. Adult subjects performed almost as well with wandering as with straight targets in that condition (Figure 3). In contrast, when distractors were intermingled with target elements in the same pitch region, attentional processes were insufficient to select target elements. Subjects relied on expectancies, and were able to recognize straight versions of the melodies when they occurred. Even adult subjects were not able to achieve much success identifying wandering targets in that condition, and the fact that their performance was better-than-chance could be attributed to the limited stimulus set and the closeness of the unexpected pitches to the expected ones.

Attention selects stimulus elements for further processing on the basis of some shared stimulus feature, and whatever is selected is passed on for further processing and interpretation. Expectancy selects elements that match expectancies, and elements that depart markedly from expectancies are lost to processing.

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