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W.R. Crozier and A.J. Chapman (editors)

DEVELOPMENT OF MUSICAL SCHEMATA IN CHILDREN'S SPONTANEOUS SINGING

W. Jay Dowling

University of Texas at Dallas

During their second year children typically begin to sing spontaneously in a way clearly distinguishable from speech. I believe that regularities in the structure of these songs provide evidence for mental schemata controlling song production. In this chapter I describe the general pattern of development of children's singing, and then present an analysis of the spontaneous songs of two children illustrating schematic control over the melodic and rhythmic contours of the phrases used in the songs. Finally, I present a brief study of the children's memory for some of their own songs.

CHILDREN'S SINGING

Moog (1976) provides the most extensive description of the child's early music behaviour that we have. My observations are in general agreement with his. During the first year of life a baby produces babbling songs that are difficult to distinguish from the babbling of speech sounds. The infant uses this vocal play to explore the range of possibilities of the voice for pitch loudness and timbre. During the second year, as speech comes to be used increasingly for verbal communication, there is an increase in vocalizations that are clearly recognizable as songs. These early songs are different from speech in their use of discrete pitch intervals between more or less steady pitches of sustained vowel sounds, and in being rhythmically organized by a steady beat (at least within phrases). The pitch intervals the child uses are not those of the adult scale systems. The pitch wanders and sounds 'out of tune' to the adult ear. The wandering of the pitch involves both a high variability of interval sizes and a drift of what sounds to the adult like a 'tonal centre'. Identifiable variants of the 'same' song recur in the child's singing behaviour over periods of days or weeks, and then disappear to be replaced by new patterns. I have not observed any spontaneous song recurring over periods greater than 6 weeks, nor do such songs ever find their way into the basic repertoire of nursery tunes known to the average preschooler.

Table 1 lists the major points in this outline of the early development of the child's singing and of what typical songs are like around the age of 2 years. I have indicated with a 'Yes' in the column under each of 6 treatments of early childhood singing instances where their observations appear congruent with my general outline. Where there seemed to be no basis for deciding what the author thought, I have left a blank. I indicated disagreements with a 'No'. There are two areas of disagreement. Moorhead et al (1941-51) appear not to think the beat is as steady as I do. They contrast 'songs' with what they call 'chants' (of which more below), with the song characterized by 'its free and flexible rhythm (that of chant being rigidly confined in a beat structure)' (p.41). In my observations I found

the beat nearly always to be steady within phrases, and often steady across phrases. The main exceptions to the latter were when the child paused for a breath or to think. The steadiness of beat was the most striking feature that distinguished songs from speech. In songs, speech rhythms appear adapted to the beat, rather than vice versa. In fact the adaptation of the speech rhythms of the words the child is singing to the beat structure of the song is the main source of rhythmic complexity in these songs.

TABLE 1

Observation of Various Features of Children's Singing. Reported in Previous Studies.

	STUDY					
	BENTLEY (1966)	DAVIDSON et al (1981)	MOOG (1976)	MOORHEAD et al. (1945-51)	OSTWALD (1973)	REVESZ (1954)
FEATURE:						
Babbling songs before 1 year		YES	YES		YES	
Increased singing between 1 and 2			YES			YES
Discrete pitches	YES	YES	YES	YES		YES
Pitch Wanders	YES	YES	YES	YES	YES	YES
Steady beat within phrase	YES		YES	NO		
Songs recur		NO				YES

The other dissension from the general picture I have been presenting is by Davidson et al (1981) concerning the memorability and recurrence of spontaneous songs during the second year. Davidson et al see external standard songs as the main source of ordered patterns in the child's singing behaviour during the second year. They characterize early spontaneous songs as 'unpredictable and unmemorable', and suggest that 'to the extent that (such a) tune exists at all as a recognizable entity, it does so on the basis of its lyrics, not its tonal or rhythmic structure'. In contrast, I have observed recurrences of distinctive spontaneous song patterns over periods of up to 3 weeks around age 1:6 in the 2 children studied. Even at that age the child knows how she puts a song together -- she remembers a song pattern, a

schema. In fact, I found considerable evidence, here in agreement with the observations of Davidson et al, that when 2-year-olds produce standard songs they provide versions filtered through (or 'assimilated to') their own internal schemata.

MUSICAL DEVELOPMENT

These investigations were carried out in the context of existing theory and data indicating that the child develops the cognitive components of adult auditory information processing piece by piece over the first 8 years of life. Elsewhere (Dowling, 1982) I have reviewed evidence for a pattern of schema acquisition in which melodic contours (in the sense of ups and downs of pitch) are important even at the earliest ages, while the importance of stable tonal centres (the tonics of keys) appears later, around the age of 5 or 6. Still later, perhaps around 7 or 8, the child develops a sensitivity to the intervals of the musical scale and to violations of that pattern. This characterization of auditory cognitive development, in which the child is seen as acquiring components of adult cognitive skills that are retained and elaborated throughout life (rather than, say, discarded or radically restructured) is very similar to the general approach suggested by Keil (1981). And Krumhansl and Keil (1982) have provided a nice example of the child's continued growth in auditory sophistication through the elementary school years in the acquisition of more and more subtle differentiations in the hierarchical organization of the tonal scale system -- at each step adding on to the pattern that was there before.

Infants notice changes in melodic contours, and melodic and rhythmic contours dominate perception and performance during the preschool years. (There is even better evidence for the infant's ability to detect contour changes than when I wrote the earlier review. Trehub et al (in press) have shown that 9-month-olds can indicate contour changes with a conditioned head turning response. From this characterization of the child's acquisition of song patterns we would expect that the main thrust of the child's control over songs during the first 5 years of life would be in the direction of controlling melodic contours. That is, there is little control during these developmental periods over pitch consistency in the sense of a tonal centre or of scale intervals. The main focus of this chapter is on the analysis of contour control in spontaneous songs in age range from 1:0 to 3:6 years. I took repetition of phrase contours as evidence for schematic control of phrases, and in the following analysis I looked for evidence of organization of those phrases under the control of higher-level schemata. Essentially I was looking for clues to the syntax of the child's early language. But before turning to the analysis of the songs I wish to discuss briefly the notion of 'schema' and what I mean by it in this context.

SCHEMATA

I use the term 'schemata' to refer to systematic patterns in the 'abstract knowledge listeners have about musical structure', to borrow a phrase from Krumhansl and Castellano's (1983, p.325) useful discussion of the term. They suggest that 'schema' be used to refer to those aspects of abstract musical knowledge that are engaged in the perceptual process. In that sense a schema is like a description of regularities of stimulus structure that hold across numerous particular pieces of music. In this chapter I emphasize the function of schemata in controlling patterns on the output side, in governing song production. Production schemata are like 'plans' by which behaviour is generated. It may be that the same or similar schemata function

in both aspects of music congition; that is, that there are truly 'sensori-motor' schemata underlying music perception and production. Such a possibility seems plausible, but further converging evidence is needed.

Another dimension involved in the characterization of schemata is that of the level of psychological reality they are thought to have. In terms reminiscent of Chomsky's (1965) outline of levels of reality for the syntax of a language, we might ask whether a schema is intended to function (1) simply as an efficient description of regularities of the external stimulus structure; or (2) as description of the knowledge the singer and listener has of the stimulus structure; or (3) as a description of the actual process by which that knowledge of the stimulus structure is applied. For verification description (1) would seem to refer to musiciological data, (2) to the sort of psychological data we have most readily available from scaling and memory tasks, and(3) to sorts of psychological data that we often wish we had more of but usually lack, that provide insights into underlying psychological processes. The types of schemata I discuss here mostly aim at level (2), being plans for the production of songs that display the knowledge the child has at a given stage of development concerning how a song should be constructed.

SONG SAMPLES

My two daughters, Calla and Erica, were born respectively on 10th June 1977 and 8th June 1979. Beginning in March 1978, I began to record samples of their vocalizations regularly, and I am continuing to do so. The observations reported below are based on recordings up to June 1982. The recordings were stereophonic and were made principally with a Superscope CS-200 portable casette recorder using its built-in condenser microphones, and with a TEAC CX-315 cassette tape deck using Sony ECM-200 condenser microphones. Occasionally I used a Superscope CD-302A cassette tape deck with the Sony microphones. I used Dolby noise-reduction with the latter two machines. The recordings were made on high-quality 90 minute cassette tape: early in the sequence for the most part on TDK D-C90 or Memorex MRX-1 (120 microsec bias); later in the sequence exclusively on Maxell UDXL-II-C90 or TDK SA-X-C90 (70 msec bias).

During the earlier years, before the children became used to the tape-recorder, the songs were sometimes hard to capture. Spontaneous songs are elusive in the sense that they occur at odd moments and the children are easily distracted from singing them. Moog (1976) cites the example of a mother who sang in answer to the song of a 2-year-old, who promptly stopped singing. I attempted to have a tape-recorder ready all the time to capture the songs as unobtrusively as possible. During the later years it was easier to record songs, since the children's singing was not interrupted when they noticed the tape-recorder. However, I was careful to record as many songs as possible in which the children were unaware of being recorded even at the later ages, as a check against the possibility that the children might sing differently under the 2 conditions.

The entire body of recordings consisted of 68.25 hours of tape. The first step in analysing the songs was to dub the songs from the original tape onto a tape consisting only of songs. This was done by a graduate student according to the following criteria. 'Singing' consisted of either florid vocal play or (more commonly) a period of vocalization consisting of relatively sustained vowels at mostly discrete pitch levels and having a

relatively regular temporal organization or 'beat'. Singing was easily distinguishable from speech on the basis of those characteristics. A 'song' was defined as an instance of singing bounded by either salient intervals (30 seconds) or speech. Reliability checks with another student and myself disclosed little disagreement on what constituted 'singing', or when songs began and ended.

These criteria selected 579 songs comprising 4.87 hours of singing. The songs were distributed evenly across the 5 year period with at least one song recording per month for a mean of 2.23 songs per week. The songs had a mean length of 30.3 seconds, with a distribution having many brief songs and a few quite long ones. Figure 1 shows some examples of the songs. Songs typically had a beat that remained steady within each phrase, but they did not always carry across phrases, as Moorhead et al (1941-51) and Moog (1976) observed. Slight disruptions of the beat are marked in Figure 1 with commas between phrases; a severe disruption is marked with a *luftpauzer*. Note the contrast between preschoolers' ability to keep a steady beat in spontaneous singing and their general inability to match the tempo of an external beat (Shuter-Dyson and Gabriel, 1981). Contrary to earlier observations, songs with a single 'note' duration were rare. More complex rhythms typically arose from the adaptation of speech rhythms to the beat.

TABLE 2

Description of Spontaneous Song Samples from Two Children in Age Ranges 1:0 - 2:0 years and 3:0 - 3:6 years

AGE:	1:0 - 2:0		3:0 - 3:6	
CHILD	CALLA	ERICA	CALLA	ERICA
Number of Songs	27	14	40	40
Pot-Pourri	0	1	15	12
Original	27	13	25	28
'Chant'	1	2	9	0
Phrases/Song	8.56	5.43	6.13	8.65

Table 2 provides a description of the sample of 121 songs I analysed. The sample includes literally all the solo songs by either child in the age range 1:0 to 2:0, and the first 40 songs following the age of 3:0 -- for each child covering the age range of 3:0 to about 3:6. That there were fewer solo songs from Erica than from Calla between 1:0 and 2:0 reflects the social environment -- it was harder for her to do any activity alone than it had been for her older sister, and her parents were less free to leap into action to activate the tape-recorder than when there was only one child in the family.

Table 2 categorizes the sounds as either 'pot-pourri' songs (Moor, 1976) that were largely based on parts of external models (usually just one), and 'original' songs that were not. Figure 1(B) provides an example of a pot-pourri song based on an alphabet song using the tune of 'Twinkle, Twinkle'. The single pot-pourri song in the earlier sample from Erica is due to the influence of her older sister, who sang versions of 'Twinkle, Twinkle' quite often during that year. I think the term 'pot-pourri' is appropriate to describe all those children's versions of 'standard' songs that failed to copy the adult models exactly. Even when the children's songs were modelled on standard songs the songs were presented as filtered through the child's own song-production system, as Davidson et al (1981) noted in connection with children's versions of a song they were trying to learn. This is analogous to Brown's (1973) observations of children's modelling of adult speech, in which the child produces the adult sentence filtered through the child's own syntax. Clearly the songs of Figure 1(B) and (C) display such filtering.

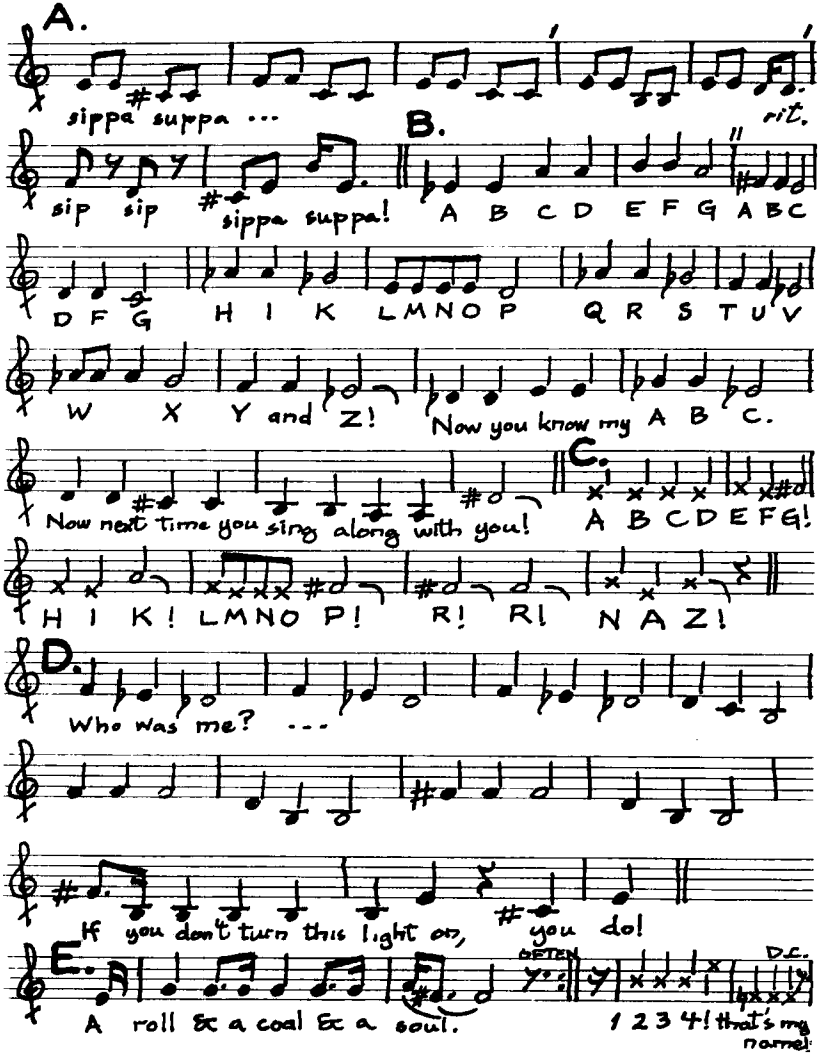
Moorhead et al's (1941-51) distinction between songs into 'songs' and 'chants' was reflected in these data. The 'chant' is a distinctive performance style: musically simple, repetitive, and loud. Other songs were more complex and often private. Figure 1(B) and (C) present 'straight' and chant versions of an alphabet song. Chants were almost always social. Moorhead et al in their preschool setting found a preponderance of chants. I found relatively few. Both pot-pourri and original songs occurred in chant versions, and the numbers shown in Table 2 include both varieties. (That is, 'chant' is not a third way of categorizing the songs in Table 2, but rather 'chant' versus 'non-chant' is a cross-cutting pair of categories to 'pot-pourri' versus 'original'). In this sample they occurred mainly with the older sibling singing socially with the younger when the younger was too young to join in effectively: namely, in the 3-year-old sample from Calla. Chants certainly occurred when Erica was 3 and Calla 5, but not as solos; by then the children invariably sang them together.

The songs divided naturally into phrases, with average lengths of 5 to 9 phrases per song. Songs even at the age of one consisted of phrases having characteristic melodic (Dowling, 1978) and rhythmic (Monahan, 1983) contours with variants of the 'same' song appearing over periods of several weeks. The following analysis is based on that division into phrases, and the phrase contour served as the basic unit of analysis.

Division into phrases was easy and could be done with high inter-observer reliability. Formal description of the phrases in terms of melodic and rhythmic contour was more difficult and necessarily involved numerous acts of 'judgment'. The aim was to describe each phrase's melodic and rhythmic contour and decide which phrases differed from which others. To be different a phrase had only to differ in one contour element of either sort. Exceptions to that rigid rule arose when a phrase had different words that closely fitted the rhythm of a previous phrase, or when 'passing tones' were inserted into basically the same rhythmic outline. Examples of such variation are provided by the song 'Three Blind Mice' in which the third and fourth phrases ('See how they run') would be assigned the same phrase contour as the first and second ('Three blind mice'). The fifth through to the seventh phrases would have a different contour, while the eighth phrase ('As three blind mice') would be assigned the same contour as the first. The formal representation of 'Three Blind Mice' would thus be (AAAABBBA).

FIGURE 1

Examples of songs sung by the children at different ages: (A) by Erica at 1:3, (B) Calla at 3:2; (C) Calla at 3:2, 'chant' version; (D) Calla at 3:3; (E) Calla at 5:2 with cousin. Pitches are approximate, and the recurrence of a notated pitch does not necessarily indicate its exact repetition. "..." in the song text indicates repetition of the same words. Approximate tempos in quarter note values per minute were: (A) 68, (B) 132, (C) 160 and (D) 176.



I did all the formal descriptions of the songs before carrying out any further analysis, so the syntactic analysis did not influence the descriptions. (I was in fact surprised by the later results). I listened to each song several times on the tape of songs dubbed off the master tapes and made a rough diagram of the pitch and rhythmic contours of its phrases. This was difficult because the pitch wandered and was often indistinct. The rhythm was usually clear, but it was often hard to decide even with repeated listening whether a given rhythm was sung with the same or different pitch contour. Then I used the diagram and the heard song to write a formal characterization (like the one for 'Three Blind Mice') of the phrase contour pattern of each song. These patterns were used in the following analyses.

One example of the type of formal characterization I wrote for each song is the following description of Calla's 'Yeah, Yeah, Yeah, Yeah' song shown in Figure 2 of Dowling (1982, p. 417): (ABBCBBBBBCBB). There the judgment call involves the coding of the third phrase from the end. I chose to categorize it as a variant of 'C' (the fourth phrase), with an added passing tone. The songs in Figure 1 had the following descriptions: (A) (AAAAAB); (B) (ABBBBBBAC); (C) (ABBCBB); and (D) (AAAABCBCD).

STRUCTURAL PATTERNS

In my search for patterns in the higher-level organization of song structure I started by calculating phrase-contour type/token ratios (TTR) for the four samples. The TTR provides an overall measure of variety in the songs. The TTR has a value of 1.0 for songs with no repetition of phrase contours. Lower values reflect increased repetition - a TTR of .50 would mean that on the average each phrase contour would appear twice in a song. A song with the description (ABBCBBBBBCBB) for example would have a TTR of 3/12 or 0.25. The mean TTRs shown in Figure 2 reflect a trend toward greater variety in songs between the ages of 1 and 3. The shift in TTR from about .50 to about .59 was statistically significant ($F=4.10$; $df=1,117$; $p<.05$). No other effects in the Age x Child analysis of variance were significant.

The children's TTRs fell in the same range as those of 3 types of adult model. On the right side of the figure are TTRs from 24 nursery tunes common in the children's environment; 30 popular songs from the 1960's; and 30 Appalachian folksongs. The 24 nursery tunes were those that Calla could name as ones she knew at the age of 6. The popular songs were the first 30 in a book (Okun, 1971) that included songs of the Beatles, Simon and Garfunkel, Bob Dylan, etc. The folk songs were the first 30 in a standard collection (Sharp and Karpeles, 1968). For the adult songs I calculated the TTR on the first 8 phrases only, for more accurate comparison to the children's spontaneous songs which averaged about 8 phrases in length. For several of the folk songs this meant repeating a 4 phrase melody, for example. Thus the mean TTR for the folk songs is less than it would be in a typical performance where a 4 phrase melody would be repeated for numerous stanzas.

The overall shift of TTR in Figure 2 does not necessarily reflect a simple increase of sophistication with age. It is easy to imagine the TTR being pulled in opposite directions by various underlying tendencies in competition. The younger children often produce songs that simply repeat one element (low TTR), but also produce meandering songs with no repetition at all (high TTR) that display little evidence of higher-order structure. The older children include variety in their songs (increasing TTRs), but also display control over that variety through patterned repetition of contours (reducing TTRs).

The general pattern shown in Figure 2 masks more complex shifts in the details of pattern organization, to which I now turn.

FIGURE 2

Type/Token ratios for songs of the two children (Calla, solid line; Erica, dashed line) at ages 1:0–2:0 and 3:0–3:6 years, compared with TTRs from three types of adult model.

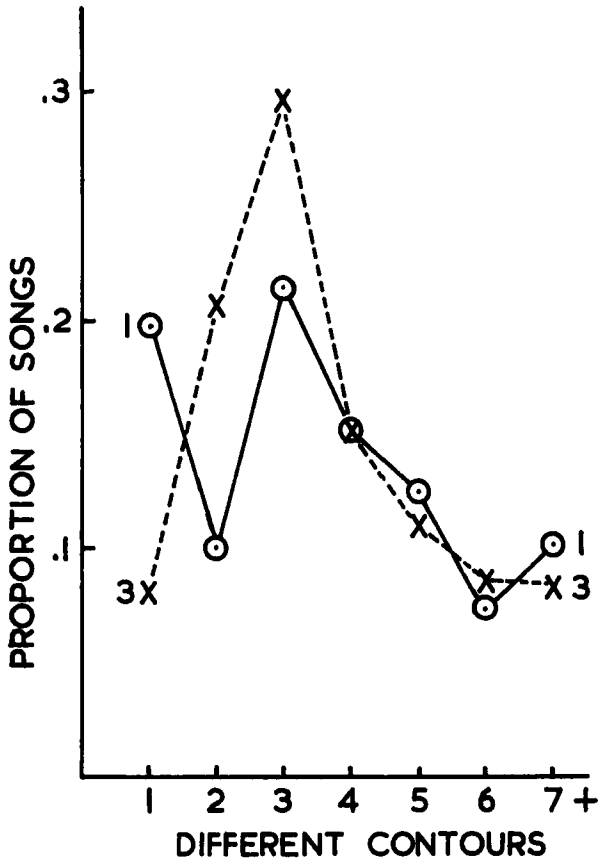


TABLE 3

Proportions of Songs of Different Syntactical Forms in Two Age Ranges for Two Children.

		AGE 1:0 - 2:0		AGE 3:0 - 3:6	
CHILD		CALLA	ERICA	CALLA	ERICA
TYPE OF STRUCTURE	EXAMPLE				
Simple Repetition (SR) (...XX...)	ABBCCD				
Delayed Repetition (DR) (...XY...X...)	ABAC	.44	.57	.40	.73
$\frac{DR}{DR + SR}$		.33	.34	.38	.45
Linear Sequencing (X Y Z etc.)	AABCCCDE	.56	.43	.60	.18
Two or Three Phrase Contours in Song with Repetition (X...Y...) or (X...Y...Z...) with at least one (...) non-empty	ABB ABAC	.30	.36	.60	.43
The above plus such songs having a single 'coda' element	ABBC ABCAD	.37	.43	.78	.68
The above rule plus (X..Y..Z)or(X..Y..Z..W) With at least one (...) non-empty					

NOTE Syntactic structures are in brackets ( ). X,Y,Z,W represent distinguishable phrase-contour elements. X^n represents n repetitions of X, $n \geq 1$. '...' represents any string of phrase-contour elements and may usually be empty.

I describe a series of measures of syntactic organization, starting with ones that show mild effects of age difference and progressing to measures that show stronger effects. Table 3 presents an outline of these measures. Each entry in Table 3 names a structure and gives a formal definition of it. There follows an example, and proportions of songs displaying the particular structure for the 2 children at the 2 age levels. The notation represents distinguishable phrase contours with different majuscules. Thus (...XY... X...) means that some phrase contour X is repeated somewhere in the melody and that some different phrase contour Y intervenes between the repetitions of X. Dots indicate areas that may or may not contain other phrases (except where specified as non-empty, where they must contain some phrase.) Repeated iterations of a single phrase contour are indicated by superscripts Thus (X^3) means (XXX).

Repetition

Simple repetition is the repetition of a phrase contour without intervening material. Delayed repetition refers to repetition across intervening material. I supposed that increased use of delayed repetition would characterize the older children's songs, since that would demonstrate structural control over contour elements across a filled time delay. The proportion of songs containing delayed repetition increased for Erica across the age range, but decreased for Calla. The ratio of delayed repetitions to all repetitions (DR / DR+SR) increased somewhat for both children, and may indicate part of what happens between 1 and 3 years; namely, that the singers control contour repetitions over longer time spans.

Linear Sequencing

The next possibility I tested was whether the children at earlier ages were using a very simple grammar I call 'linear sequencing'. That is, they might have been constructing songs by first repeating a contour element, and then going on to another contour element and repeating it, and so on, without any returns to prior contour elements. This supposition was only partly true, with the proportion of such songs decreasing between 1 and 3 for Erica but not for Calla.

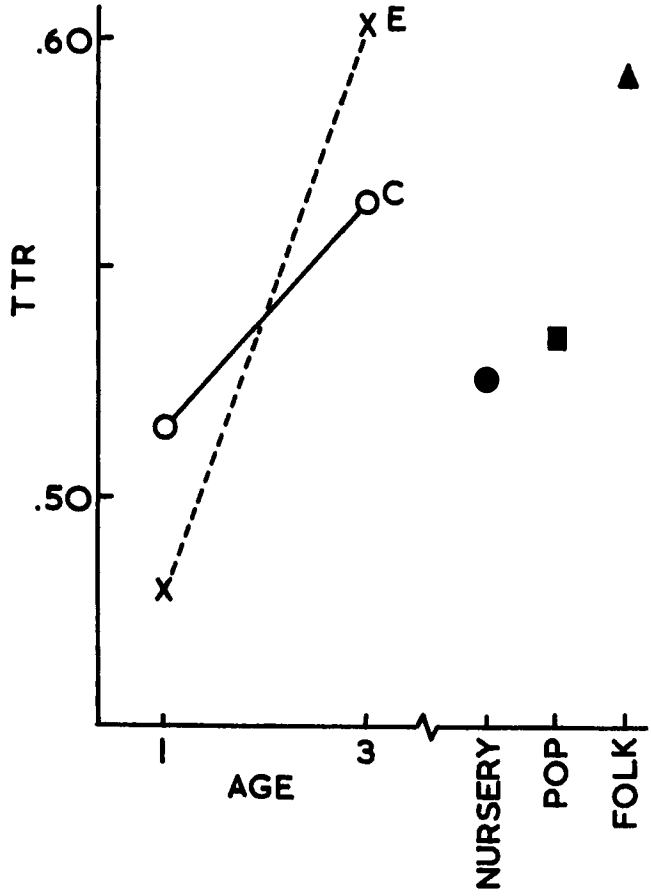
Variety of Phrase Contours

Next I looked at variety more directly by plotting the proportion of songs at the 2 ages containing different numbers of different phrase contours within the song, plotted in Figure 3. This showed a definite difference across age. The children at both ages had about the same number of songs using 4 or more different contours. However, between 1 and 2 the children had quite a few songs that simply repeated one contour. In contrast, the 3-year-olds were typically using the 2 and 3 phrase contours in a song and had very few one contour songs. This trend was also apparent in data from the individual children.

Table 3 shows the proportion of songs at each age that contain 2 or 3 contour elements and display some repetition; for example, (ABB) and (ABAC). Those proportions increase with age for both children. Figure 1(B) and the song in Figure 2 of Dowling (1982) provide examples of this form.

FIGURE 3

Mean proportions of songs of the two children at two different ages (1:0-2:0, solid line; 3:0-3:6, dashed line) as a function of the number of different phrase contours (types) in the songs.



This relationship is strengthened if we add to the foregoing songs that have 2 or 3 elements involving repetition and having a 'coda' - a contour element that appears only once at the end of the song. Examples are (ABBC) and (ABCAD). The increases in the use of this form of song are dramatic across ages, going from about 40% to about 73%. This song structure appears to be very typical of 3-year-old singing, at least for these children. Examples of songs with codas are shown in Figure 1 (A) and (D).

It is interesting to compare this performance by 3-year-olds with the same data from the adult models. Of the 3 types of model I analysed, only the nursery songs approach the children's output for this type of song pattern. The folk and popular songs each showed a 17% incidence. Just as the children in Brown's (1973) study of language development tended to 'overproduce' the simple grammatical forms they were just acquiring, so these children go well beyond their models in exploiting this family of simple melodic forms. This is evidence of an inner-directed mechanism for song-form acquisition. The children achieve more and more effective schematic control over the songs they sing. They do this not by simply copying cultural models, but rather by developing more and more sophisticated mental representations in response to their musical environment.

MEMORY FOR SONGS

I turn now to tests of the two children's memory for songs they sang. A longitudinal study such as this provides an opportunity to test for recognition and recall of spontaneous songs they personally created. If the production of songs is under schematic memory control, and if the associated schemata change from time to time during development, then a song produced during one time period should be difficult to retrieve at a later time if the relevant schemata have changed. Schachtel (1947) proposed essentially this model as an explanation of 'childhood amnesia', the general inability of adults to recall events from their first three years of life (see, for example, Sheingold and Tenney, 1982). The same processes should result in failures of retrieval even later in childhood, while schematic organization is still undergoing change. Exceptions to this retrieval failure should occur in cases where the song was initially rehearsed over a long enough period to carry through periods of schematic change.

These tests were carried out when the children were between the ages of 3:6 and 4:6, and 5:6 and 6:6. To be suitable for testing a song needed to have been performed at least several times and then to have dropped out of use completely for at least 6 months. I found 5 spontaneous songs (3 for Calla and 2 for Erica) that met these criteria. The songs were tested 6 to 9 months following their last natural occurrence. An example of such a song, highly memorable to the adult listener, is shown in Figure 3. I also found a group of 8 standard songs that met the same criteria.

The memory tests I used are listed in Table 4. In order of administration they were: (1) recall cued by circumstances of initial generation (or words or title in the case of standard songs); (2) recognition of first phrase; (3) recall of a subsequent phrase cued by the first; and (4) recall of a subsequent phrase cued by partial words. Of course success on test (3) would obviate the need for test (4). In the case of the song in Figure 3, for example, I asked Calla if she remembered the song that she and her cousin Jennifer had sung on a hike we took in the Colorado mountains. I described the occasion, and Calla indicated familiarity with it. (She had viewed slides of their hiking and singing together several times during the

intervening months). I asked if she could sing me some of the song they sang then. She could not remember it. Then I sang the first phrase and asked if it was the same song. She agreed that it was. I asked her if she could continue with the next phrase, but she could not. (With this song I added the information that the next phrase involved counting, but still with no success). Then I sang the tune of the second phrase 'Boop, boop, boop, boop, boop, boop, boop', but she still could not provide the words. These responses are indicated in Table 4 with N (for 'no') in all the columns but the second, where a Y (for 'yes') indicates agreement to recognizing the song.

Spontaneous Songs

The result in Table 4 suggest that the children's memory for their own spontaneous songs was at best weak. Though they always assented on the recognition test, they never recalled any parts of the song not presented in the test.

Lures

As a further check on the meaning of the children's positive recognition responses, I constructed 3 lures for each child to use in 'catch' trials. I tried to match the lures closely to the children's own styles from 6 months before the test. For the cued recall trials I attributed each song to a real time period, such as 'around the end of school', or 'just before your birthday'. There was a greater tendency to reject lures than to reject actual songs on the recognition test: 2 out of 3 lures were rejected. In one case where Calla was doubtful of the authenticity of the lure she nevertheless went on to invent a continuation of it -- definitely a reconstructive process in memory!

Comparison of hit and false-alarm rates in the recognition tests would seem to indicate better than chance accuracy in recognition of actual songs. However, one should keep in mind that the lures were only an adult's imitation of the children's styles. The lures could possibly have been distinguished from actual songs on the basis of style alone, apart from particular memories for the specific songs. That is, in terms of a knowledge-performance distinction the child may have known more about her own style at an earlier date than appeared in her song production at that time or than was apparent to the adult listener. Thus lures constructed by an adult could have unwittingly violated some unobserved principle of style. Further, the pairing of song and occasion could have been inappropriate from the child's point of view. One of Erica's 'No' responses, for example, when I introduced a lure with, 'I think you were singing this just before your birthday' was 'No, then we were just singing "Happy Birthday"'. Thus I think not very much should be made of the somewhat ambiguous degree of discrimination seen in the hit and false-alarm rates. I think it is a safe conclusion in view of these results and the complete absence of cued recall that the children's memory for their own spontaneous songs is weak, if not totally lacking.

TABLE 4

Responses to Tests of Memory for Spontaneous and Standard Songs and for Contrived Lures.

TEST:	EXTERNAL CUED RECALL	RECOGNI-TION, FIRST PHRASE	CUED RECALL, LATER PHRASE	WORDS OF LATER PHRASE GIVEN TUNE	NONE
Spontaneous Songs:					
Calla 1	N	Y	N	N	
2	N	Y	N	N	
3	N	Y	N	N	
Erica 1	N	Y	N	N	
2	N	Y	N	N	
Lures:					
Calla 1	N	N	N		
2	N	Maybe	Y		
3	N	N	N		
Erica 1	N	N	N		
2	N	Y	N		
3	N	N	N		
Standard Songs:					
Itsy-Bitsy Spider	CE	CE	CE		
Are You Sleeping	C	CE	CE		
Row, Row, Row	CE	CE	CE		
Hush, Little Baby		CE	C	E	
Good King Wenceslaus	C*	CE	E		
C: School Pageant (several songs)					C
E: Choir Songs					E
E: Preschool songs					E

* Calla sang the correct words to the tune of 'Yankee Doodle'

Standard Songs

The results with the standard songs tested after a 6-9 month delay were mixed. In Table 4 each child's initial (C or E) in a given column indicates success on that test. The songs divided into 3 groups: songs remembered quite well when tested with both recognition and recall ('Itsy-Bitsy Spider', 'Are You Sleeping' and 'Row, Row, Row Your Boat'); songs that were recognized and recalled with partial success ('Hush Little Baby' and 'Good King Wenceslaus'); and songs that were neither recalled nor recognized (Calla's school Christmas pageant songs and Erica's school music programme and church-choir songs). The third group of songs that were not remembered were distinguished by numerous practice trials during relatively short learning periods (less than 2 months). Though each song was learned to a criterion of 'memorization' suitable for group performance during that practice period, attempts at retrieval 6 to 9 months later failed completely.

The results of this study suggest that only songs that received numerous practice trials across a period of more than 2 months were well remembered 6 months later. This was true of both spontaneous and standard songs. This result is compatible with the schematic-control-of-song-production model developed here in that in such a view only songs that remained in the child's repertoire long enough to survive a change of schematic organization would be remembered after such a change.

An alternative characterization of these results is possible; namely, that distributed practice is more valuable than massed practice in song learning. Bahrick (1979) found that adults' retrieval of verbal materials when tested 6 months after learning was enhanced by spreading the learning trials over periods of months rather than massing them into a few days. But 'distributed practice' merely labels a phenomenon without providing an explanation. Bahrick presents evidence that suggests that his distributed-practice effect may have been due in some measure to the possibility of covert rehearsal of his materials. In the present case, covert rehearsal could occur only as long as production schemata remained relatively constant. The present results are compatible with both a 'distributed practice' and a 'schematic change' characterization. When a song fails to cross the boundary of a schematic change it drops out of the repertoire and becomes very difficult to retrieve at a later date.

Clearly some songs, usually standard nursery songs, remain in the child's repertoire from year to year. Four- and five-year-olds typically have about two dozen of these they can recall on demand (Dowling, 1982). The 24 nursery songs in the data comparisons above constitute Calla's list at the age of 6. The standard nursery songs that each child knows survive in the repertoire because of environmental support that keeps them in active use across relatively long time periods, perhaps spanning schematic changes. As Davidson et al (1981) note, these songs change with development in the direction of closer and closer approximations of the adult models. I encountered no instances of spontaneous songs making their way into the child's permanent repertoire.

ADDITIONAL OBSERVATIONS ON PITCH

During the next year I hope to be able to carry out a computer analysis of pitch patterns in the children's songs. Before then my observations on the use of pitches and intervals are necessarily less formal than I might wish.

However, I include some further observations because of their bearing on important issues.

A persistent observation that I believe to be based on very weak evidence, dating perhaps from studies by Werner (Révész, 1954), is that the interval of a descending minor third(-3 semitones) is basic to children's singing. An example is the occurrence of that interval in the taunting formula ('sol-mi-la-sol-mi') observed by Moorhead et al (1941-51). There was little evidence in the present corpus for a universal 'sol-mi-la-sol-mi' melody. That phrase pattern occurred exactly twice among the 121 songs in the sample analysed. When it occurred it was in game songs like 'Ring-around-a-rosie' but even there the final interval which in the model is a descending minor third was likely to be rendered as anything from a major second to a perfect fifth (-2 to -7 semitones). This variability also was characteristic on closer inspection of the descending minor thirds I previously reported from Calla at 1:8 years (Dowling, 1982, p. 416). These observations agree with those of Moog (1976) in finding no evidence for the universality of the interval of the descending minor third. (Moog even tried to teach an 18-month-old the 'sol-mi-la-sol-mi'pattern; without success). Moorhead et al (1941-51) found the descending minor third common only in social chants, and not in normal spontaneous songs. The cross-cultural evidence for the universality of a descending minor third outside of Europe is also weak. Blacking (1967), for example, found a definite preponderance of other intervals in children's songs of the African Venda.

There is reason to suppose that the perfect fifth might be a more universally occurring interval. One notion of the order in which children might acquire adult scale intervals is that they might acquire some more obvious large interval first and later fill in the smaller intervals within it. Whether that is the case or not, I did observe some instances of assimilation of various pitches of model standard songs to the perfect fifth. For example, the children at ages 4:5 and 6:5 sang together a variant of the taunting formula to the words, 'You'll never get more than us ...,' with the pitches 'mi-sol-sol-sol-sol-ti-sol-do', replacing the minor third 'sol-mi' with the perfect fifth 'sol-do'. Also, in singing together the chorus of the song 'Jimmy Crack Corn and I Don't Care' at ages 3:3 and 5:3 they sang the last occurrence of 'care' consistently on 'sol' instead of the 'la' of the model, substituting the fifth for the sixth degree of the scale. However, this assimilation of pitches to the fifth degree of the scale may simply be an example of regularizing less familiar intervals to better-known ones. Calla had learned the song 'Old Abe Lincoln Came Out of the Wilderness' at about the age of 5:6 years on the piano. In that version the melody contained chromatic alterations of pitches. Both children in singing it together at the ages of 4:2 and 6:2 substituted pitches of the major scale for the chromatic notes.

A concluding observation concerns the effects of early musical training. Both children started learning to play the piano at about 3:6 years, and due partly to a good teacher they both enjoyed the experience and learned much from it. I imagine their intonation during the pre-school years has benefited from the training, at least they often sing quite well in tune. They have good intonation on the standard songs they have learned, whether from learning to play them or from adult models (especially fanfares heard on television). However, contrary to what I would have expected from a theoretical model in which pitch is completely under the control of an internalized musical scale schema, their intonation in spontaneous songs often deviates from the scale. This is even true of Calla at the age of 6:6, and

is particularly the case when she is not aware of being observed. (This is perhaps similar to the adult phenomenon of loosely controlled intonation while singing in the shower). The musical scale schema is a useful theoretical abstraction, but the actual reference standards people use in producing good intonation in singing are probably quite specific, and often tied to single instances of interval occurrence. (This is evident in the way in which a musician retrieves an arbitrary interval by finding an instance of it in a well-known tune (Dowling, 1978, p. 351). It seems plausible that generalization of precise intonation across the board to novel melodies requires considerable experience with a variety of well-learned instances -- more than a 6-year-old is likely to have had. It is nevertheless clear that pitch production at this age is not so much under the control of a pervasive scale schema, as it is guided by the occasional relevance of particular instances.

CONCLUSIONS

Two main conclusions I want to emphasize in closing concern the relationship between children's songs and adult songs. First, when the child imitates an adult song model the result is a version filtered through the child's own song syntax. As I noted above, this is analogous to what happens when the child imitates an adult sentence in speech. This filtering was evident in both the spontaneous pot-pourri songs of the present study and in children's versions of a standard song they were trying to copy in the study by Davidson et al (1981). Second, as Moorhead et al (1941-51) observed, in the child's syntax we can see the origins of the adult's more articulated and elaborate version. It does not seem far-fetched to suppose with Teplov (1966), that the child's singing lays the foundation for the adult musical ear. As Keil (1981) suggested, the adult's schemata are not so likely to be radical restructurings of the child's, but rather subtler elaborations of them. The same basic patterns of novelty and repetition are found in both. The simple codas of the children's songs grow into the complex codas of the adult's compositions.

When I was preparing this chapter I discussed it with my children and received their permission to present examples of their songs. I asked them if there was anything about the songs that I should be sure to mention. After thinking for a minute, they said, yes, I should be sure to say that singing is fun!

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