Comparisons of Incipient Music Responses Among Very Young Twins and Singletons

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Introduction

IN SEPTEMBER, 1960, the Florida State University Institute of Human Development began a multi-disciplinary longitudinal research designed to study intensively not less than twenty pairs of preschool-age twins and an equal number of non-twins matched by age and sex in a laboratory situation. The research project described herein was affiliated with the twin study of the Institute of Human Development. R. L. Witherspoon, director of the Institute, was the principal investigator of the twin study. Irvin Cooper was the directing professor of this study, which received financial support from the Florida State University Research Council.

A review of the literature reveals that sensitivity to music is present in very young children, but there appears to have been no significant attempt to determine when musical responses first emerge, or the nature of these early responses. Studies which have dealt with the rhythmic development or singing development of very young children have rarely indicated in music symbols musical patterns which emerge either spontaneously or by imitation. Finally, there has been insufficient research to establish any norms as to the number of infants or young children who possess a measurable sensitivity to music, or the degree of sensitivity to music found among this age group.

Nowhere in the literature did the writer find evidence that investigation of music responses among twins of any age has taken place; furthermore, a team of graduate students working with the Florida State University Institute of Human Development in 1961 compiled a bibliography of 94 twin studies, none of which dealt specifically with music responses among twins of any age.

The present study was undertaken in order to determine (a) the approximate age at which responses to music become apparent in twins and singletons; (b) the percentage of twins and singletons of this study who, by age two years, exhibit a measurable degree of response to music; (c) the approximate degree of music response present in twins and singletons of this study; (d) the types of music stimuli which evoke the greatest responses from the twins and singletons; (e) the influence of growth and experience during the duration of this study; and (f) the nature of overt primitive musical expressions, either spontaneous or evoked, of twins and singletons.

The study also sought to test the following general hypotheses: (a) that there is no significant difference in the degree of response to music of twins of different sex during infancy and early childhood; (b) that there is no significant difference in the frequency or degree of response between paired twins and their corresponding singleton controls; (c) that there is no significant difference in the evocative power of specific music stimuli; (d) that there is no significant difference in response scores of various observation periods;

and (e) that there is no significant difference in the intra-pair differences of twin-pairs' and singleton-pairs' responses to music.

Subjects for this study were twelve pairs of same-sex twins between the ages of nine months and thirty-one months, and a like number of singletons, matched by age and sex. Seven pairs of twins were female, the remaining five pairs being male. In no instance did the difference in ages of twins and matched singletons exceed fifteen days; the average age difference was 7.0 days.

Because of the nature of this research a random sample could not be employed; all subjects were white and with few exceptions, middle class.

Beginning in March, 1961, tests and observations of the forty-eight subjects took place at monthly intervals for four consecutive months. Singleton observations were scheduled within three days of the observation of the twins with whom they were matched. The duration of each complete observation period was approximately 40 minutes.

In the hope of allowing an atmosphere of freedom, and also in the belief that children do not reveal their individual diversity or their full capabilities in unfamiliar surroundings; subjects, singly or in pairs, were observed in their home environments.

Kinds of activities included in the observation schedule were categorized as follows:

A. Observation of gross responses to music stimuli.

B. Observation of imitative or other responses to (a) regular pulsation (metronome) perceived visually and aurally (simultaneously); (b) brief rhythm patterns; (c) brief pitch patterns; (d) brief musical phrases (meaningful patterns); (e) brief songs (unaccompanied).

C. Observation of free-play activities.

A graduate music student, thoroughly familiar with the aims and methods of the study, assisted the investigator in all tests involving twins, enabling simultaneous observation of each pair.

In Part A of the observation schedule recorded music was introduced to elicit music response in the form of reflex keeping time to music, vocal imitation, gross physical activity, or other adaptive behavior. The music stimuli consisted of four tape recorded examples of piano music and four examples in which a symphony orchestra was the performing medium. Each stimulus was followed by twelve seconds of silence. The duration of each piano or orchestra stimulus was between 21 and 61 seconds.

One salient guiding principle in the selection of these stimuli was that the music should differ noticeably. Subsequent comparisons of responses to specific stimuli would then provide information concerning the general styles of music which elicited the earliest, most frequent, or greatest degree of responses in very young twins and nontwins. This aspect of the investigation was neither intensive nor extensive enough to provide conclusive evidence in this regard, but was intended to furnish provisional information which might be of some assistance in future research.

In each piano music stimulus one specific element of music was decidedly predominant: melody was predominant in stimulus one, harmony was predominant in stimulus two, rhythm was predominant in stimulus three, and dissonance was predominant in

stimulus four. The orchestral music was selected on the basis of its stimulative or sedative quality, stimuli one and three being stimulative and stimuli two and four being sedative.

Responses of subjects to both piano and orchestral music stimuli were carefully observed and scored numerically according to the system shown below:

Facial Expression

Score

0 = Abstracted: no change of expression.
1 = Neutral: expression indicates awareness of stimulus, but not attention or emotion.
2 = Attentive: assumes attentive expression.
3 = Animated: expression reflects emotion (pleasure or displeasure).
4 = Participation: vocalizes (use plus sign if synchronizes with stimulus).

Bodily Movement

Score

0 = Abstracted: no change of bodily activity.
1 = Neutral: temporary cessation of motion; looks toward source of sound.
2 = Attentive: prolonged cessation of motion; moves toward source of sound.
3 = Animated: increased bodily activity.
4 = Participation: "dances," taps foot, or otherwise responds bodily (use plus sign if movement synchronized with stimulus).

Part B of the procedure was designed to measure children's willingness and ability to imitate simple music stimuli or to respond adaptively to them. Stimuli in each of the following categories were employed: (a) regular pulsation, (b) brief rhythm patterns, (c) brief pitch patterns, (d) brief musical phrases, and (e) brief songs. (See examples in Figure 1.) Due to the brevity of the stimuli of the rhythm, pitch, and phrase portions of the testing procedure, each stimulus was administered four times in succession. This was done in order to give subjects adequate opportunity for imitation despite temporary distractions, and also in an effort to make imitative response more compelling. When the subjects appeared inattentive, the examiners occasionally asked the children to "listen to Patty" (the vocal stimuli); otherwise, they were not encouraged to respond.

Tones of the rhythm patterns and all subsequent phases of the testing procedure were sung on the syllables "da-da" in the belief that this syllable from their environment was more likely to evoke imitative response than would other abstract syllables such as "loo" and "tah."

Each (rhythm, pitch, and phrase) pattern was followed by an interval of silence equal to twice the length of time required to perform the pattern. Approximately five seconds of silence followed each song. During this silence the subjects were observed carefully and their response, either vocal or physical, was scored numerically according to the following system:

Imitative Response

Score

0 = No response.
1 = Overt response: pattern is unlike stimulus.
2 = Overt response: pattern is similar to stimulus.
3 = Overt response: pattern closely approximates stimulus.
4 = Overt response: pattern is identical or practically identical to stimulus.

NOTE: A letter prefix of P or V with each number score except zero indicates whether the imitation was physical, or vocal, or both.

Part C of the procedure was devised to provide the investigators with opportunity to observe spontaneous rhythmic or melodic activities expressed either physically or vocally by the subjects. To be virtually assured

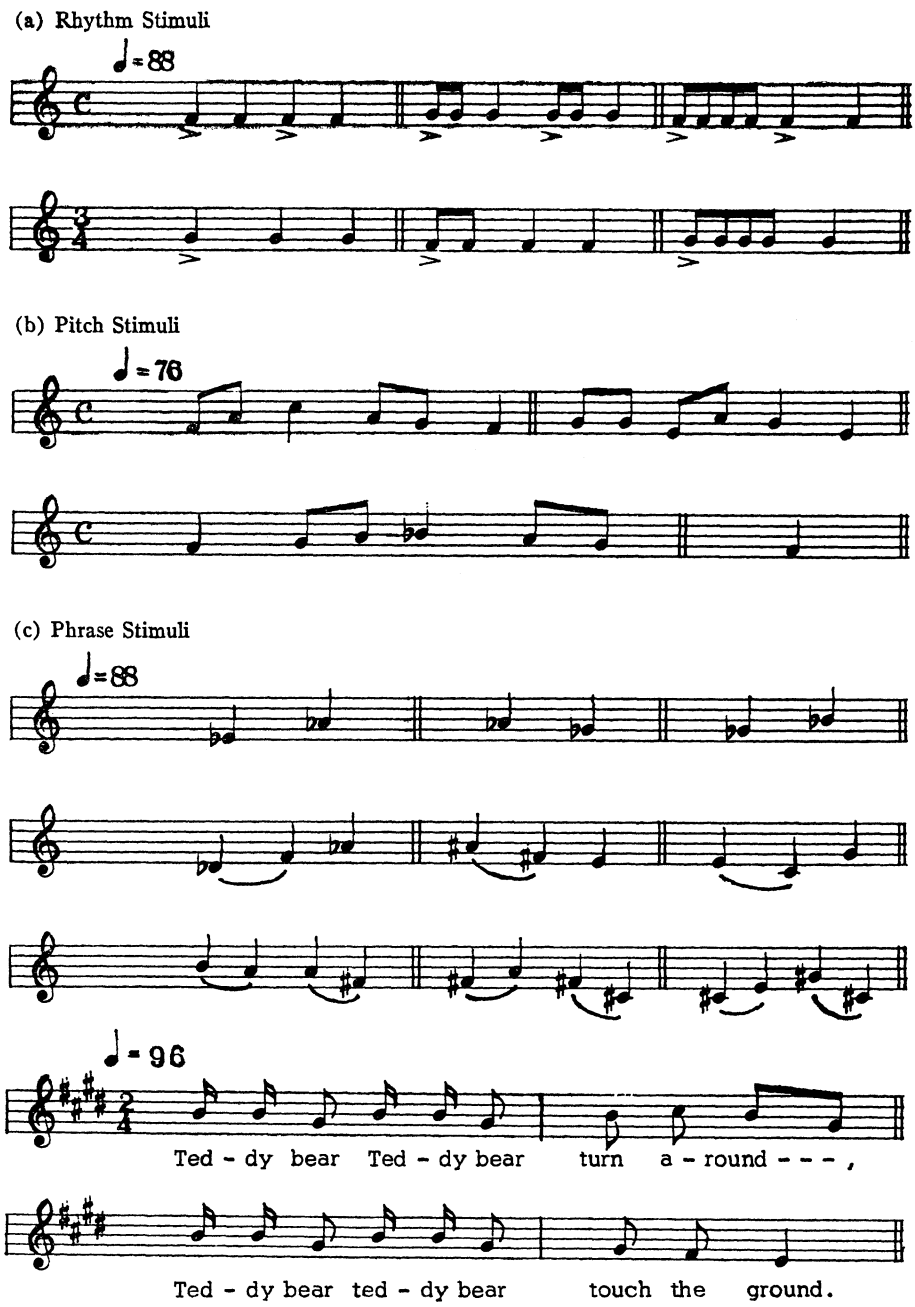


Figure 1

"Teddy Bear" (From THE FIRST GRADE BOOK of *Our Singing World* series. Used by permission of Ginn & Company, owner of the copyright.)

that some musical behavior could be observed at each observation, two small musical toys, a one-octave xylophone and a tom-tom, were provided for the subjects during this portion of the testing. A third toy, a maraca, was added for the third and fourth observations to renew the subjects' interest. Children were allowed freedom to play as they desired for a period of eight minutes. Meanwhile the observers, attempting to be unobtrusive, notated as accurately as possible in music symbols any rhythmic or vocal activities which appeared to be musical patterns. The tempo and pitch of these patterns were determined by the use of a stop watch and a pitch pipe.

A pilot study of smaller dimension was first undertaken to provide empirical evidence of the effectiveness of the procedure. Corrective revisions were made in those features of the procedure which appeared to be in need of improvement. The foregoing description of the research design included these revisions.

The pilot study provided the two observers an opportunity to determine reliability of scoring. Although only four observations were made, each observation yielded 122 response scores, thus providing two sets of 488 scores each for comparison. Percentages of agreement obtained ranged from .75 to 1.00 for the various types of responses.

Additional information concerning the earliest indications of musical sensitivity as observed by the subjects' parents was gathered by means of a parent interview conducted immediately after the final observation period. Data thus collected were viewed purely as supplementary to the major aspects of the investigation.

In the process of analyzing the data, a need for a single aggregate score for each subject representing his or her total response to external music stimuli became increasingly apparent. Employment of such scores enabled inter-pair comparison of total responses of subjects. The aggregate score for each subject was computed as follows: the total number of responses to a specific phase of the procedure (piano music, or rhythm, or pitch, etc.) was multiplied by the mean degree of response to the stimuli of that phase; these six products (one for each test phase) were then summed to form the "aggregate response score."

An indication of the degree of similarity of music responses of twins was attained by determining the intra-pair differences of twins, determining the intra-pair differences of singletons, then comparing the differences of those differences.

Significance of differences of music response scores of twins and singletons was determined by use of the Wilcoxon matched-pairs signed-ranks test or the Friedman two-way analysis of variance.

Results

A clear understanding of the systems of scoring employed is essential to correct interpretation of the data, so reiteration of previous assertions seems prudent. "Frequency of response" means, simply, the number of occurrences; "degree of response" has two applications: (a) as a measurement of facial and bodily response, it represents the magnitude of the response, (b) as a measurement of imitative response, it represents the degree to which the response resembles the stimulus. "Frequency" scores represent the *total* number of responses, while "degree" scores represent the

mean degree of *non-zero* response scores.

The periodic pulsation of a metronome proved to be unproductive of sufficient responses, so this portion of the data was discarded.

Statistical comparisons of subjects' responses to the various music stimuli revealed these findings:

1. Twin children responded to piano music significantly less frequently than singletons (P = .006), but there was no significant difference in the degree of response of the two groups of subjects.

2. Both the frequency and degree of response to orchestral music was significantly less among twins than among singletons (frequency, P = .043; degree, P = .021).

3. There was no significant difference between twins' and singletons' frequency of response to rhythm stimuli, but twins' degree of response was significantly less than that of singletons (P = .020).

4. Twins' response to pitch patterns was significantly less frequent (P = .010) and to a lesser degree (P = .008) than singletons' responses.

5. The frequency of response to phrases was significantly less among twins than among singletons (P = .036).

6. There were no significant differences in subjects' responses to songs.

Table 1 shows comparisons of combined aggregate scores of pairs of

TABLE 1
COMPARISONS OF COMBINED AGGREGATE SCORES OF PAIRS OF TWINS AND PAIRS OF SINGLETONS

Sex	*Age in Months*	*Twin Pair*	*Singleton Pair*
F	9.2	48.70	111.30
F	14.5	113.64	75.12
M	15.4	86.72	77.48
M	15.6	51.77	27.80
F	20.2	85.70	125.17
M	20.4	18.84	73.58
F	22.6	30.69	134.59
M	23.3	41.57	81.25
M	23.6	98.17	137.62
F	25.2	38.02	221.90
F	26.3	78.72	15?.95
F	31.4	59.13	252.30

N = 12; T = 7; P = .005
H_0 rejected

TABLE 2
RANK TOTALS OF TWINS' AND SINGLETONS' FREQUENCY AND DEGREE OF RESPONSE TO PIANO AND ORCHESTRAL MUSIC

Response	*Stimulus One*	*Stimulus Two*	*Stimulus Three*	*Stimulus Four*	Xr^2	*P*
			Piano Music			
Frequency						
Twins	74.0	58.0	75.5	32.5	30.16	.001
Singletons	66.0	60.5	69.5	44.0	9.56	.050
Degree						
Twins	66.0	55.5	73.5	45.0	11.58	.010
Singletons	62.5	57.0	80.0	40.5	19.89	.001
			Orchestral Music			
Frequency						
Twins	81.0	47.0	71.0	41.0	27.30	.001
Singletons	84.0	49.0	67.5	39.5	26.84	.001
Degree						
Twins	81.5	44.5	69.5	44.5	25.83	.001
Singletons	69.0	47.0	80.5	43.5	23.56	.001

TABLE 3
RANK TOTALS OF TWINS' AND SINGLETONS' FREQUENCY OF RESPONSE TO IMITATIVE PHASES (PART B) OF OBSERVATION SCHEDULE

	Rhythm	*Pitch*	*Phrases*	*Songs*	*P*
Twins	31.5	29.5	26.0	23.0	—
Singletons	40.0	40.5	25.5	14.0	.001

twins and pairs of singletons. On the basis of statistical comparison of these scores, the null hypothesis that there are no significant differences between aggregate music response scores of twin-pairs and singleton-pairs was rejected, twins being less responsive than singletons.

Table 2 shows that differences in both twins' and singletons' responses to specific piano and orchestral stimuli were statistically significant. Among both piano and orchestral stimuli, stimuli one and three were more evocative than stimuli two and four.

The Friedman two-way analysis of variance by ranks was employed to compare scores of frequency and degree of response to the four phases of Part B, which sought to evoke imitative responses. These comparisons of subjects' responses to various imitative phases of the observation schedule are presented in Tables 3 and 4.

Table 3 indicates that the frequency of response evoked by rhythms, pitches, phrases, and songs, did not differ significantly for twins, but did for singletons, response to rhythms and pitches being more frequent than response to phrases and songs. The degree of response of twins was not significantly different among the variables in Table 4, while singletons' degree of response was significantly different. Responses to songs were much less than to other variables.

As indicated in Table 5, intra-pair differences of twin subjects were not significantly different from intra-pair differences of singleton subjects.

Comparisons of subjects' responses during each of the four observations indicate the variations in frequency of response and degree of response from observation to observation.

TABLE 5
COMPARISONS OF INTRA-PAIR DIFFERENCES OF AGGREGATE RESPONSE SCORES OF TWINS AND SINGLETONS

Sex	*Age in Months*	*Intra-Pair Differences of* *Twins*	*Singletons*
F	9.2	14.83	14.06
F	14.5	13.80	9.43
M	15.4	15.70	2.61
M	15.6	2.39	6.84
F	20.2	9.73	20.40
M	20.4	1.53	14.62
F	22.6	2.68	14.72
M	23.3	15.00	32.92
M	23.6	38.88	11.69
F	25.2	3.16	2.12
F	26.3	12.62	26.75
F	31.4	17.10	4.84

$N = 12; T = 33.5; P > .133$
H_0 not rejected

TABLE 4
RANK TOTALS OF TWINS' AND SINGLETONS' DEGREE OF RESPONSE TO IMITATIVE PHASES (PART B) OF OBSERVATION SCHEDULE

	Rhythm	*Pitch*	*Phrases*	*Songs*	*P*
Twins	26.5	30.0	26.5	27.0	—
Singletons	34.0	39.0	31.0	16.0	.01

According to the findings of this study, three months' general growth and experience of twins or non-twins between the ages of 9.2 months and 31.4 months do not effect statistically significant changes to total responses to all stimuli at specific observation periods. In certain instances the rank totals of subjects' responses at specific observation periods were significantly different, but these displayed inconsistency: twins responded to piano stimuli more frequently and to a greater degree at the first observation period ($P = .01$); twins expressed a greater degree of responses to orchestral music at the second observation period ($P = .01$); singletons responded to rhythm patterns more frequently and to a greater degree at the fourth observation period ($P = .05$).

It was planned originally that this investigation would test the null hypothesis that there are no significant differences in music responses among twins of different sex during infancy and early childhood. Later it was decided that the number of male pairs and female pairs near enough the same age to be compared with each other was insufficient to obtain statistical reliability. Consequently, this null hypothesis was not tested.

Due to the importance of the factor of age in regard to the evolution of response to music, response scores of pairs of subjects to each phase of Part A and Part B of the observation schedule are presented in Table 6 according to subjects' ages. Statistical comparisons of responses to music according to subjects' ages were not possible because: (a) the number of subjects of similar ages was inadequate; (b) ages of subjects were not distributed in a manner which permitted convenient grouping for comparisons of age groups. Table 6 indicates that the influence of age differences upon music responses seems minimal among twins of this study, while older singletons were decidedly more responsive to most types of stimuli than were younger singletons. Possibly this is evidence that singletons develop more rapidly than twins.

Observation of subjects during four free-play periods of eight minutes each resulted in a collection of data that were subsumed under three headings: (a) tempos expressed in the performance of notes of equal value; (b) rhythm patterns containing both notes and rests, or notes of more than one value; (c) tuneful vocalization.

About 95% of all spontaneous rhythmic play of all subjects consisted of notes of equal value. Singleton children performed 966 spontaneous equal-note rhythmic groupings while twins performed only 585 such groupings; however, the mean of the median tempos of these groupings among singletons, 168MM, was virtually the same as the mean of the median tempo among twins, 173MM. Differences between median tempos of spontaneous equal-note rhythmic groupings of twins and singletons were found not to be statistically significant at the predetermined .05 level of confidence, so the null hypothesis that there are no significant differences between the median spontaneous tempo of twins and singletons was not rejected.

Twins and singletons performed a wide variety of rhythm patterns which contained either a combination of notes and rests, or notes of more than one value. Sixteen twins performed a total of 37 such patterns while 20 singletons performed a total of 55 such patterns which comprised about 5 percent of all spontaneous rhythmic

activity. Selected examples of these patterns are presented in Table 7. Several of these patterns possess remarkable metrical balance, depending, of course, upon the placement of accents.

The actual pitch and tempo of each tuneful vocalization expressed spontaneously during free-play periods was notated on staff paper. Selected examples of spontaneous tuneful vocalizations expressed by subjects during free-play are presented in Table 8. Examination of all spontaneous tuneful vocalizations revealed that all tones sung by twins were between c′ and c♯″, and tones sung by singletons were between a♭ and b′. The pitch interval which occurred most frequently was the major second.

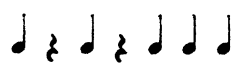
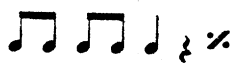
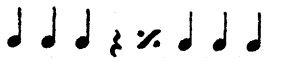
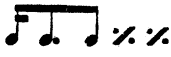
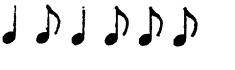
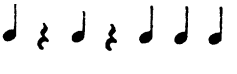
Discussion

The frequency with which very young children spontaneously match pitches with any measure of accuracy seemed limited, in view of the fact that only one pair, the oldest singletons (girls), had a mean score exceeding two; however, the statistical difference between twins' and singletons' degree of response to pitch patterns was highly significant ($P = .008$), singleton scores being greater.

TABLE 6
PAIRS OF SUBJECTS' TOTAL RESPONSES TO EACH TYPE OF STIMULUS AT ALL OBSERVATIONS SHOWN ACCORDING TO SUBJECTS' AGES

Age in Months	*Stimuli*						*Total Aggregate Score*
	Piano	*Orchestra*	*Rhythm*	*Pitch*	*Phrase*	*Song*	
			Twins				
9.2	23.46	21.24	2.00	1.00	1.00	0.00	48.70
14.5	45.88	37.43	17.45	8.39	1.00	4.00	114.15
15.4	27.79	17.38	6.00	8.50	23.05	4.00	86.72
15.6	18.21	29.06	0.00	0.00	4.50	0.00	51.77
20.2	39.43	33.27	1.00	0.00	0.00	12.00	85.70
20.4	13.09	5.75	0.00	0.00	0.00	0.00	18.84
22.6	12.81	13.88	0.00	2.00	2.00	0.00	30.69
23.3	13.21	13.61	8.75	6.00	0.00	0.00	41.57
23.6	35.54	26.02	16.80	15.81	1.00	3.00	98.17
25.2	14.94	14.58	0.00	0.00	7.50	1.00	38.02
26.3	37.85	38.87	1.00	1.00	0.00	0.00	78.72
31.4	27.65	14.98	2.00	5.00	2.00	7.50	59.13
			Singletons				
9.2	50.30	37.85	6.00	10.30	5.85	1.00	111.30
14.5	36.88	21.99	9.25	3.00	3.00	1.00	75.12
15.4	39.13	32.35	3.00	2.00	1.00	0.00	77.48
15.6	12.13	8.67	3.00	3.00	1.00	0.00	27.80
20.2	33.91	45.53	0.00	32.38	8.35	5.00	125.17
20.4	30.92	20.46	7.00	12.20	3.00	0.00	73.58
22.6	47.07	26.04	13.00	38.48	8.00	2.00	134.59
23.3	36.07	27.29	7.89	4.00	6.00	0.00	81.25
23.6	42.40	59.22	14.00	21.00	0.00	1.00	137.62
25.2	60.30	68.87	43.55	27.38	19.80	2.00	221.90
26.3	37.19	37.66	34.32	34.51	14.27	2.00	159.95
31.4	39.28	34.65	88.46	53.42	25.89	10.50	252.30

TABLE 7
SELECTED EXAMPLES OF SPONTANEOUS UNEQUAL-NOTE RHYTHM PATTERNS EXPRESSED BY SUBJECTS DURING FREE-PLAY PERIODS

Twin or Single-ton	*Sex*	*Age in Months*	*Obser-vation Period*	*Pattern*	*Tempo*
T	F	12.2	IV		(♩ = 74)
T	F	23.2	IV		(♩ = 116)
T	M	21.4	II		(♩ = 116)
T	F	25.2	I		(♩ = 169)
T	F	32.4	II		(♩ = 124)
S	F	10.2	II		(♪ = 118)
S	F	25.6	IV		(♩ = 159)
S	M	25.6	III		(♩ = 110)
S	F	27.2	III		(♩. = 150)
S	F	25.2	I		(♩ = 218)
S	F	29.3	III		(♩ = 196)

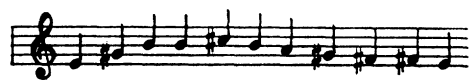
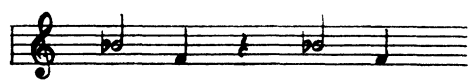
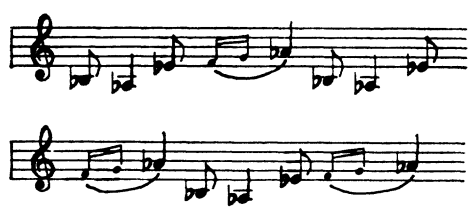
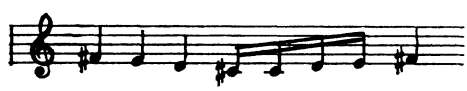
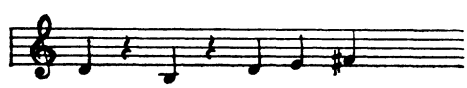
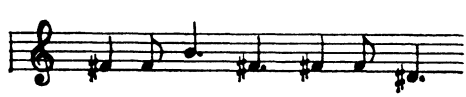
The most outstanding difference in subjects' responses to songs as compared with their responses to other phases employing vocal stimuli was the subjects' marked increase in overt signs of pleasure and attention, probably due to the textual appeal of the songs. This was true for both twins and non-twins. Such behavior as cessation of motion, smiling, increased bodily activity which ceased between stimuli, and foot or hand tapping was interpreted as indicative of attention and/or pleasure.

Two factors are prominent in comparisons of the combined aggregate scores of pairs of subjects:

1. The total responses of older twins were not consistently greater than those of younger twins, whereas responses of older singletons were generally greater than responses found among younger singletons. This resulted in greater twin-singleton differences being found among the older children.

2. The combined aggregate score of twin-pairs being significantly less

TABLE 8
SELECTED EXAMPLES OF SPONTANEOUS TUNEFUL VOCALIZATIONS EXPRESSED BY SUBJECTS DURING FREE-PLAY PERIODS

Twin or Singleton	*Sex*	*Age in Months*	*Observation Period*	*Pattern*	*Tempo*
T	M	27.6	IV		(♩ = 189)
T	M	23.6	I		(♩ = 122)
S	M	21.4	II		(♩. = 180)
S	F	23.6	II		(♩ = 68)
S	F	23.6	II		(♩ = 105)
S	M	24.3	II		(♩. = 65)

than those of singletons ($P = .005$) revealed that responses to music were notably less among twins than among singletons of this age group.

Both of these findings appear to evince the earlier development of single-born children. It seems appropriate to point out, also, that the largest aggregate response score of a twin-pair was exceeded by aggregate scores of seven non-twin pairs.

Concerning the "imitative response" portion of the observation schedule, two points must be emphasized.

First, the system of scoring was fixed and unchanged while the complexity or musical completeness of the stimuli varied. Therefore, the same numerical score assumed slightly different meanings depending upon the stimulus to which the subjects were responding.

Second, both physical and vocal responses were scored according to the same system. In actuality, physical responses could only manifest rhythmic expressions while vocal responses could manifest both rhythm and pitch. In retrospect, it seems unwise that physical responses were recorded in this portion of the observation schedule, but fortunately they occurred so rarely that they could have had only the most meager effect upon the tabulation of the findings.

Comparisons of intra-pair differences of subjects were made principally in order to examine the similarities of music responses among twins.

As anticipated, twins exhibited greater similarity in their responses to music than did singletons, especially in regard to frequency of response. Although differences between the intra-pair differences of twin-pairs and singleton-pairs did not attain statistical significance in these instances, all the probabilities fell between .064 and .138. It appears likely that statistical reliability would have been reached with a larger sample of subjects. Intra-pair differences in degree of response scores showed less consistency.

As similarities of response scores of twins and singletons are considered, it must be borne in mind that twins were observed simultaneously while singletons were observed individually. It seems probable that the proclivity of very young children to imitate each other may have influenced the similarity of the twins' responses while such influence was absent among singletons. It would have been desirable, of course, to observe twins individually, but such arrangements were not possible.

Close data analysis revealed certain findings which, although not statistically significant, show such consistent trends as to appear worthy of much consideration and perhaps further investigation.

First, rank totals of subjects' adaptive behavior responses to piano and orchestral music revealed that both the frequency and degree of response among twins and non-twins had a definite downward trend from the first to the last observation period. In contrast to those relatively parallel adaptive behavior scores, it was found that both the frequency and degree of responses of twins to Part B of the observation schedule (imitative responses to rhythms, pitches, phrases and songs) *decreased* from the first to the last observation period, while the same response scores of singletons *increased* from the first to the last observation period.

A likely explanation for the decrease of all subjects' responses to the piano and orchestral music is that responses of subjects were directly proportional

to the motivational conditions. To elucidate, the experience of having someone come into their homes and play music for them was novel and, in most cases, pleasant for the children, which conditions motivated responses to the stimuli. As this experience was repeated, unchanged, the children became accustomed to the situation and were less motivated to respond.

The reason must be sought for twins' imitative responses decreasing from the first to the last observation while singletons' imitative responses increased during that period. The most acceptable explanation seems to be that imitative responses of singletons were affected by experience and/or learning while those responses of twins, whose early development is slower than other children's, were not so affected. Since learning possibly was not taking place among twins, their interest decreased and with their interest, their responses.

Summary and Conclusions

Analysis and interpretation of data collected in this investigation produced these findings:

1. All twins and singletons exhibited some response to music. Gross response occurred far more frequently than did imitative response.

2. Total responses of older twins were not consistently greater than those of younger twins, whereas older singletons generally evinced greater responses than younger singletons. Responses to music were significantly less among twins than among singletons.

3. Responses of both twin and singleton subjects to piano stimuli were greatest to rhythmic music, less to melodic music, still less to harmonic music, and least to dissonant music. These differences were statistically significant. Stimulative orchestral music was significantly more evocative than sedative orchestral music among both twins and singletons.

4. Three months' growth and experience of twins or singletons during this investigation did not effect statistically significant changes in either frequency or degree of response to specific music stimuli.

5. About 95% of all spontaneous rhythmic play of all subjects consisted of notes of equal value. The difference between median tempos of spontaneous equal-note rhythm patterns performed by twins and singletons was not statistically significant. The composite vocal range of all spontaneous vocalizations of all subjects encompassed an augmented tenth. The pitch interval which occurred most frequently in spontaneous vocalizations was the major second.

Because of the small number of subjects of the same sex and same age, sex differences were not determined.

Four general hypotheses were tested with these conclusions:

1. Combined aggregate scores of twin-pairs were significantly less than those of singleton-pairs, so the null hypothesis that there is no significant difference in the frequency or degree of response between paired twins and their corresponding singleton controls was rejected.

2. For reasons stated in 3 above, the null hypothesis that there is no significant difference in the evocative power of specific music stimuli was rejected.

3. Various observation periods' response scores did not differ significantly, so the null hypothesis that there

is no significant difference in response scores of various observation periods was not rejected.

4. Intra-pair differences were not statistically significant, so the null hypothesis that there are no significant differences in intra-pair differences of twin-pairs and intra-pair differences of singleton-pairs was not rejected.

Music training and education of the preschool child has traditionally been virtually ignored by parents and by music educators as well. Parents who consider it at all usually make little or no special effort to provide enriching musical experiences, regarding the preschooler as too young to be affected by such experiences. Only in rare instances has the professional training of prospective music teachers encompassed even minimal instructional experiences concerning the earliest musical development of the child. Analytical systems in numerous areas of study often begin with an intensive examination of the sources of phenomena; it is difficult to understand why the source of musical development, primary music responses, has received so little attention.

Varying degrees of response to music were apparent in all subjects of this investigation. These responses were manifest expressions of subjects' awareness of music stimuli. When perception of stimuli is adequately impressionable to elicit apparent responses, we can but assume that the stimuli, are meaningful, and some extent of learning is taking place. It follows, then, that the control of these experiments within the environment shapes the musical development of the child.

The importance of preschool musical experiences was cited many years ago by other researchers, including Williams, Sievers, and Hattwick (1933);[1] Updegraff, Heiliger and Learned (1938);[2] and Jersild and Bienstock (1934).[3]

Much more recently Bailey (1958)[4] wrote, "By the time a two- or three-year-old came to the nursery he had already acquired a wide and varied experience of music, and its elements of rhythm and sound. . . . Music, in one form or another, had become an important element in his life."

Thus, we are confronted with the fact that evidence of this and other research shows that preschool children *do* respond to music and *do* benefit from special musical experiences. This strongly implies that if children's musical experiences normally introduced in kindergarten and primary grades—such things as enriching listening experiences, vocal and rhythmic activities, teaching of concepts of high and low, loud and soft, fast and slow—were begun at the preschool level, it might serve to hasten, broaden and deepen the ultimate musical development of the child.

Further Research

A research project which is very closely related to the present study is now underway. Delton Alford, who gained a thorough understanding of this study in his position as research

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[1] Harold Marshall Williams, "Musical Guidance of Young Children," *Bulletin of the State University of Iowa, Child Welfare Pamphlets*, No. 29, 1933.

[2] Ruth Updegraff, Louise Heiliger, and Janet Learned, "The Effect of Training Upon the Singing Ability and Musical Interest of 3-, 4-, and 5-Year-Old Children," *University of Iowa Studies in Child Welfare*, XIV (1938), 83-131.

[3] Arthur Thomas Jersild and Sylvia F. Bienstock, "A Study of the Development of Children's Ability to Sing," *Journal of Educational Psychology*, XXV (October 1934), 481-503.

[4] Eunice Bailey, *Discovering Music with Young Children* (New York: Philosophical Library, Inc., 1958).

assistant, followed the same observation schedule, with the same twins and singletons (when possible) at intervals of one year and two years subsequent to this investigation. In this way, identical types of data have been accrued for three consecutive years, comparisons of which should provide important findings concerning developmental aspects of responses to music in preschool twins and singletons. Alford's investigation will also embrace certain phases of early responses to music which were not studied in the present research.

This study made no attempt to measure the correlation between frequency of response and degree of response to music stimuli. It would be of interest to know whether a positive correlation exists, not only among very young children, but also among older subjects.

The question of whether the possession of musical talent is the result of hereditary influences or environmental influences has long been a point of dispute among musicians and educators. Even after increased knowledge gained during the past half-century through psychological tests and measurements, study of musicality in family groups, and longitudinal case studies, there is still some question as to the principal determinant of musical talent. The author suggests that an extensive investigation of musicality of identical twins reared apart may provide new information which would contribute significantly to the resolution of the nature-nurture issue.

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