

THE EFFECTS OF CONTINGENT MUSIC AND DIFFERENTIAL REINFORCEMENT ON INFANTILE COLIC

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Summary—Infantile Colic is a behavioral syndrome characterized by paroxysms of excessive crying and increased motor activity, hypertonicity of the musculature, excessive flatus and erratic sleeping and feeding patterns. Ten to 40% of all infants are diagnosed as having Colic. The medical evidence to date does not justify any conclusions regarding the etiology or treatment of Colic. Typically, parents are advised to simply wait until Colic has run its course which is often 3–4 months. The behavioral program reported here was designed to increase behavior that competed with crying by reinforcing quiet alertness with music and parental attention. Concurrently, it attempted to inhibit excessive crying by a brief time-out procedure. A group of 8 infants diagnosed as Infant Colic were included in this study. The dependent variable, crying, was measured through direct observations based on hourly samples involving 30 observations of 2-min intervals. The independent variable consisted of a behavioral treatment package. A within-S reversal design was used to assess the functional properties of the treatment. The results show that across all 8 infants the introduction of the treatment package led to a substantial decrease in excessive crying of about 75% of the initial baseline. Further, a functional relationship was identified between the treatment and excessive crying behavior: crying decreased when the treatment was initially introduced, it resumed when the treatment was withdrawn and decreased again when the treatment was reinstated.

INTRODUCTION

Infantile Colic represents a behavioral syndrome characterized by paroxysms of excessive crying, increased motor activity and frequent disruptions in feeding and sleeping patterns. During a paroxysm the infant will suddenly, and with no apparent reason, cry and gradually increase the cry in intensity despite all efforts to soothe him. These paroxysms, in an otherwise healthy and well fed infant, may occur reliably during specific time intervals or intermittently throughout his waking hours (Asnes & Mones, 1983; Hide & Guyer, 1982; Levine, Carey Croker & Gross, 1983). Often this excessive crying persists for as long as 4 hr or more per day for 4 days or more in any week (Brazelton, 1962; Carey, 1984). The onset of crying is typically associated with the infant's abdomen being distended and tense, his legs being drawn up on the abdomen or momentarily extended and tense. A generalized hypertonicity of the musculature is commonly present as well as an increase in flatus.

It is estimated that 10–40% of all infants experience colic (Hide & Guyer, 1982; Illingworth, 1954; Jorup, 1952; Paradise, 1966). Colic occurs with equal frequency in males and females and birth-weight does not appear to be a significant factor (Asnes & Mones, 1983). Similarly, no significant differences have been found between colic and non-colic infants regarding intestinal contractions resulting in pain symptoms (Asnes & Mones, 1983; Levine *et al.*, 1983). While there is general agreement on the clinical characteristics of Infantile Colic, its cause is still unknown and the evidence for its treatment remains elusive (for a review, see Farran, 1983). Since Infantile Colic is not consistently associated with a pathophysiological process, Karofsky (1984) concludes that it is not a physical disease entity. The condition, he maintains, serves as a diagnosis of exclusion.

Colic has also been regarded as a disorder of a psychological nature. One view stresses emotional factors in the mother–infant interaction such as maternal anxiety, depression, and general

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instability in the infant's home environment but the findings are inconclusive (Bawkin, 1956; Paradise, 1966; Carey, 1968; Dilys, 1979; Carek & Capelli, 1981).

Another view of the mother-infant interaction places emphasis on the mother's handling of her infant not just when he is crying but also when he is quiet. That the infant-parent interaction holds the key to understanding the maintenance and possibly the very emergence of excessive crying behavior represents the behavioral approach to the problem of Infant Colic. The behavioral literature supports this conceptual notion. For example, Williams (1959) reported the case of a 21 month old baby whose crying behavior was drastically reduced when parental attention associated with crying was withdrawn. Further, Etzel & Gerwitz (1967) showed that a combination of extinction for crying and reinforcement for behaviors that compete with crying virtually eliminated crying behavior in two colicky infants.

More recently, Taubman (1984) carried out a study in which he compared the effects of two different mother-infant interactions on colic behavior. The parents in Group 1 were instructed to put the baby in the crib when he cried and let him cry for up to 30 min, to pick him up and try to calm him if he was still crying, and, failing that, to return him to the crib until the infant fell asleep or 3 hr had passed.

The parents in Group 2 were instructed to try to never let the baby cry, but to feed him, give him something to suck, hold him, stimulate him, and let him sleep when he cried. Parents were instructed to rearrange these efforts as they saw fit if the infant continued crying for more than 5 min.

According to Taubman, Group 2 showed a reduction in crying in less than a week while the crying of babies in Group 1 continued unabated. While this study is most provocative, it has serious methodological problems that limit its validity and interpretation.

First, the procedure for Group 1 is not an extinction procedure since it does not withdraw reinforcement (the parental attention) for crying. Instead, it directs the parent to let the infant cry for the first 30 min and then to pick him up to try to calm him down. Not surprisingly, this procedure maintained the infants' crying since it scheduled intermittent reinforcement (parental attention) for persistent crying.

Second, Taubman reports a substantial reduction in crying when parents of Group 2 used a combination of meeting the infant's needs and preventing him from crying in the first place. These results suggest that colic behavior may result from parent's failure to respond to the infant's physical needs. These results are difficult to reconcile with the literature on colic which describes a colicky infant as "an otherwise healthy baby" who persists in his crying despite all efforts to feed, change, burp, and play with him. Taubman's data consisted only of parents' reports of the duration of their infants' crying. No direct observations of the infant's excessive crying behavior were collected. Therefore, it is not possible to determine the reliability of the data.

Some recent findings on the behavioral treatment of another psychogenic difficulty in infants point to the usefulness of focusing on the mother-child interaction.

Failure-to-Thrive infants have physical growth failure often in combination with malnutrition and delay in motor and social development. It has been shown that non-organic Failure-to-Thrive infants, who have medically related deficits in the absence of identifiable organic bases, may be effectively treated through behavioral methods (Finney & Christophersen, 1983). Consistent with this view, a recent study involved three infants diagnosed as non-organic Failure-to-Thrive (Larson, Ayllon & Barrett, 1987). This study, based on direct and systematic observations of mother-infant behaviors, employed a combined behavioral package that included music and positive reinforcement (parental attention) for adaptive eating behavior and a brief time-out for food refusal. The behavioral treatment implemented by parents increased the infants' eating behavior dramatically and virtually eliminated food refusal. The present study attempted to extend these findings to infants diagnosed as Infant Colic. The major strategy of the present study consisted of (1) reinforcing the infants' adaptive behavior with music plus parental attention and (2) inhibiting crying behavior by following it with cessation of music plus a brief time-out. In addition, this study assessed the relative effects of music in decreasing crying behavior when the music was (1) made non-contingent on behavior and (2) when it was made contingent on quiet behavior as a component of differential reinforcement. Further, this study examined the functional relationship between the infants' crying and the behavioral treatment.

METHOD

Subjects

Ss were 8 infants whose families were referred through the Well Baby Nursing Unit of a southern medical hospital. Each baby had been diagnosed by their pediatrician as having Colic.

The Ss ranged in age from 3 to 7 weeks of age, and the age of colic onset ranged from 1 day to 3 weeks. Four of the eight Ss were male, six Caucasian, one was Black and one Hispanic. The average length at birth was 20.6 in. with a SD of 1.12 in. while the average birth weight was 8 lb 1 oz with a SD of 1.23 lb. Six of the infants were full term and two were premature. Seven of the infants were vaginal deliveries and one was delivered via C-section. Three of the infants were delivered through natural methods with no medical intervention. While labor was induced for 2 of the infants none of them experienced complications during birth. Six infants were bottle-fed and had a history for formula changes including Similac, Similac plus iron, Prosobee, and Enfamil plus iron. Two infants were breastfed.

Parents' characteristics. Six of the mothers were married and two were single parents. The length of marriage prior to the infant's birth ranged from 2 to 11 yr. For four of the mothers this was their second child, and for three the baby was their first one. For one mother, this was their third baby after one miscarriage. All the mothers received pre-natal care.

Six of the families were from upper socio-economic conditions and two were on welfare. All of the mothers stayed at home with their babies except for one who worked part-time in the evening (for details, see Larson, K. unpublished manuscript).

Behavioral recording and evaluation

Definition and recording of colicky behavior. The presence or absence of crying behavior was recorded through an interval recording procedure consisting of 30, 2-min, intervals per hour of observation. Crying, the dependent variable, was defined as such when (1) a cry, whimper or fuss, loud enough to be audible, occurred that lasted for at least 10 consecutive seconds of a recording interval, and (2) pauses in crying were <30 consecutive seconds during the same interval.

Home observations. Direct observations of infant's crying behavior were made at the infant's home. These observations were randomly taken Monday–Sunday between 8:00 and 11 a.m. and 12 noon and 8:00 p.m. Occasionally, this schedule was altered to accommodate the family's personal needs. Observations were 1-hr in duration and occurred 1–4 days per week. The mean number of home observations was 2 hr per week per S. Each infant was observed for a total of 6–7 weeks. In addition a follow-up check was made at the home of each infant 2 weeks after the conclusion of the study.

Training of caretakers. Prior to the study, the infants' caretakers were trained to observe and record their infant's crying behavior obtaining an interrater reliability of 90%. Thus, through the study the mother, or a significant other, made observations of the infant concurrently but independently from the investigator. These observations yielded additional reliability measures of crying behavior. To assess the relative distress caused by their colicky baby, parents were asked to rate their feelings on a 7-point Likert Scale, prior and subsequent to the study.

Experimental design and procedures

A multiple baseline design across three groups of Ss was employed: two groups consisted of three infants each and a third group of two infants. In addition, a within-Ss reversal design was employed to assess the functional properties of the independent variable namely the behavioral treatment package. Specifically, periods of baseline (no treatment), were alternated with periods of treatment. Measures of infants' crying were collected under three major conditions.

(1) Baseline (no treatment): during this condition parents were instructed to continue doing what they found was most helpful to soothe their crying infant.

(2) Non-contingent music: during this condition a musical selection (chosen by the mother) was played on a non-contingent basis for one-half (randomly selected) of the 1-hr observational session.

(3) Behavioral treatment: during this condition. (a) the musical selection and parental attention, were made contingent on the infants' quiet/alert behavior. Parents were instructed to turn the music on their cassette player when the infant was quiet and alert for 30 sec or more. At such times,

reinforcement, in the form of parental attention, included making eye-contact, talking softly, touching, rocking, walking, playing with the baby and generally being loving and affectionate. (b) termination of the music and a brief time-out period (3–5 min) in a portable infant carrier away from the parent were made contingent on crying behavior. Parents were instructed to first turn off the cassette player when the infant cried and to attend to his needs. Next, they started time-out if feeding, burping, changing the infant failed to stop the infant's crying. The time-out was reset if at the end of the period the infant was still crying. Parental attention was discontinued during the time-out period.

RESULTS

The results show that the introduction of non-contingent music produced no appreciable change in infant crying. Therefore, this additional period of observation may be used as an extension of baseline against which to compare the effects of the behavioral treatment package. When music, as part of a differential reinforcement package, was made contingent on quiet but alert infant behavior it led to a rapid and substantial reduction in infant crying. The average reduction for all eight infants was in the order of 80–90% of the initial level of infant crying. The inter-observer agreement between parents and the investigator was uniformly above 90%.

The results are shown in terms of multiple baselines across infants as well as a within *S* reversal design for each.

Figure 1 shows Group 1: Danny, Nancy and Arthur. It can be seen that Danny and Arthur had about the same level of crying (70%) under baseline and under non-contingent music. Nancy's

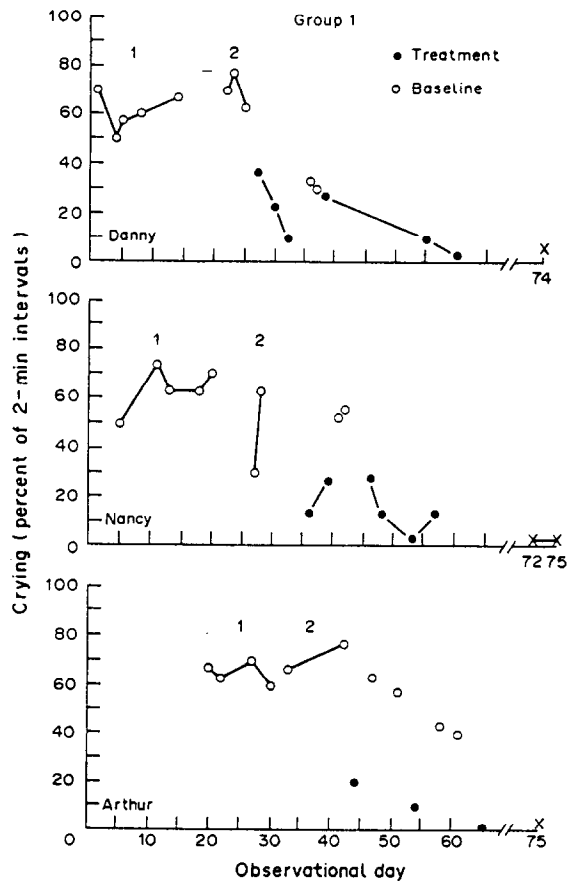


Fig. 1. The percentage of intervals in which crying was observed across three infants: Danny, Nancy and Arthur. The designation of 1 indicates baseline condition (no treatment) during which the mother continued her own routine to soothe her crying infant. The designation of 2 indicates the introduction of non-contingent music alone. Baseline periods of no treatment (○) alternated with the behavioral treatment package (●). A follow-up (x) was also conducted after the treatment was discontinued.

crying decreased momentarily from about 70 to 30% when non-contingent music was introduced. However, the next data point under non-contingent music shows her crying increased to baseline level. In each case, when the behavioral treatment package was introduced it resulted in a 70% reduction in infant crying. When the treatment was discontinued and baseline conditions were in force the infant's crying resumed immediately. Again when the behavioral package was reinstated the infants crying decreased substantially and quickly. Arthur's crying behavior is seen under a rapid alternation of baseline and treatment conditions identifying the functional relationship between the treatment and crying behavior.

Figure 2 shows Group 2: Afton, Bob and Michael all had about the same level of crying (80%) under baseline and under non-contingent music. Michael's crying is responsive to the treatment when it is rapidly alternated with baseline conditions. There is a reduction of crying when the behavioral treatment is introduced, an increase in crying when the treatment is withdrawn, and again a reduction in crying when the behavioral treatment is reinstated. Similar results were obtained with Bob and Afton.

Figure 3 shows Group 3: Susan and Mary had about the same level of crying (70–80%) under baseline, and under non-contingent music. However, once the behavioral treatment was introduced the crying for both infants decreased to one tenth of its initial level. When the treatment was withdrawn the crying increased 3-fold. Again, when the behavioral treatment was reinstated the infants' crying was once again drastically reduced.

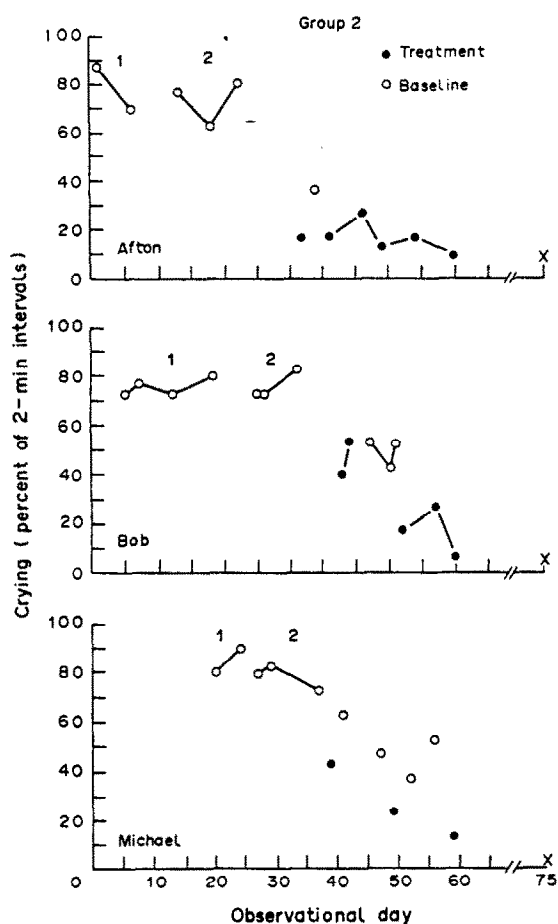


Fig. 2. The percentage of intervals in which crying was observed across three infants: Afton, Bob and Michael. The designation of 1 indicates baseline condition (no treatment) during which the mother continued her own routine to soothe her crying infant. The designation of 2 indicates the introduction of non-contingent music alone. Baseline periods of no treatment (○) alternated with the behavioral treatment package (●). A follow-up (x) was also conducted after the treatment was discontinued.

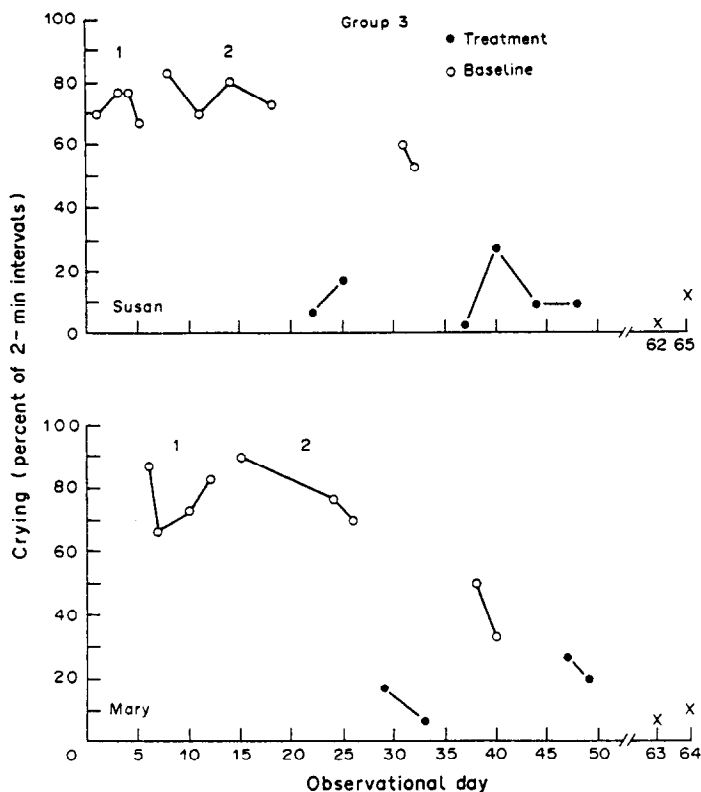


Fig. 3. The percentage of intervals in which crying was observed across two infants: Susan and Mary. The designation of 1 indicates baseline condition (no treatment) during which the mother continued her own routine to soothe her crying infant. The designation of 2 indicates the introduction of non-contingent music alone. Baseline periods of no treatment (○) alternated with the behavioral treatment package (●). A follow-up (×) was also conducted after the treatment was discontinued.

The parents' ratings of the distress caused by their colicky infant reflected these changes in that their mean level of distress decreased from a pre-treatment level of 4.8 to a post-treatment level of 1.7. This substantial reduction in reported distress was uniform across all parents.

DISCUSSION

These results confirm those of Larson, Ayllon & Barret (1987) indicating that contingent music combined with differential reinforcement increase adaptive and drastically reduce maladaptive behavior in infants. Further, these findings serve to extend the generality of the findings of the behavioral treatment package to include babies diagnosed as Infant Colic.

Methodologically, the within-S reversal design rules out alternative explanations such as age of infant's onset of colic, passage of time, familiarity with the observer, the effects of music on the parents themselves, etc. These results, taken individually and as a group, indicate that there is a functional relationship between the behavioral treatment package and the rapid and uniform reduction in infant crying. Further these findings suggest that colicky behaviors may be adventitiously learned and maintained by the attention they produce.

That sound may play a special role in learning is an issue that has been recognized previously. However, it has been experimentally shown that the presence or absence of sound may not be the critical issue as much as the way in which sound is scheduled relative to behavior. For example, Azrin (1958) showed that a sound with discriminative properties increases performance but not when it lacks such properties. Complex sounds and their reinforcing effect on infant's behavior have also been studied experimentally. Indeed, it has been shown that infants' behavior increases when group singing (Butterfield & Sipperstein, 1972), female singing (DeCasper & Carsten, 1981), and maternal speech (DeCasper & Spence, 1986) are made contingent on the infant's behavior. Further,

Goldstein (1980) in studying the emotional effects of music on adult Ss found that they often reported that what made a certain musical passage special to them was their past associations with it. In addition, music has been found to facilitate positive affective responses to certain phobias (Eiffert, Craill, Carey & O'Connor, 1988). These and related findings (Deutsch & Parks, 1978) suggest that sounds and music, in particular, may be useful in both reinforcing behavior and in setting the occasion for it.

It would seem that the time is ripe for exploring the interaction of music and behavior and, indeed, developing "techniques that provide easy entry into the affective system . . ." so as to modify behavior more effectively (Rachman, 1981, p. 285).

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