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ABSTRACT

This study systematically investigated the influence of direction and frequency of rocking on the activity of two-month-old infants. Of the 84 subjects, 42 were males and 42 females. They were brought to the laboratory at least 2 hours after each feeding and placed supine in a bassinet. Rocking at 60 cycles per minute resulted in a greater reduction in activity than rocking at 45 cycles per minute. The direction of rocking (up and down, side to side, and head to toe) was not related to changes in activity. The finding that direction is unrelated to the soothing effects of rocking appears to be inconsistent with assumptions that rocking is soothing because it is similar to movements "in utero". The soothing effects produced by rocking and other forms of stimulation may be related to brain stem inhibitory mechanisms. (DP)

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THE SOOTHING EFFECTS OF VESTIBULAR STIMULATION AS DETERMINED BY FREQUENCY AND DIRECTION OF ROCKING

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Abstract

The purpose of this study was to examine the influence of frequency and direction of rocking on the activity of two-month-old infants. A six-point rating scale was used as the measure of activity. Ss were placed supine in a bassinet. Rocking at 60 cycles per minute resulted in a greater reduction in activity than rocking at 45 cycles per minute. The direction of rocking (up-and-down, side-to-side, and head-to-toe) was not related to changes in activity. The finding that direction is unrelated to the soothing effects of rocking appears to be inconsistent with assumptions that rocking is soothing because it is similar to movements *in utero*. The soothing effects produced by rocking and other forms of stimulation may be related to brain stem inhibitory mechanisms.

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The Soothing Effect of Vestibular Stimulation as Determined by the Frequency and Direction of Rocking

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Rocking of one form or another has been used to soothe distressed infants in many cultures (Bowlby, 1969). Although the usefulness of rocking has been debated for some time (Holt, 1922, Zahorsky, 1933), until very recently there had been no systematic research on the soothing effects of rocking. Gordon and Foss (1966) demonstrated that rocking in the form of gently shaking the infant's bassinet for 1/2 hour was effective in reducing the frequency of crying in neonates. Birns, Blank, and Bridger (1966) compared the soothing effect of rocking with auditory, oral, and thermal stimulation. They reported that when exposed to these stimuli, neonates were less aroused than during a nonstimulus control period, but that no one stimulus was more effective than any other. These two studies showed that rocking was soothing. Unfortunately, these reports did not include a description of the frequency, amplitude or direction of movement.

More recent investigations have been concerned with the physical parameters that determine the soothing effects of rocking. Ambrose (1969), Pederson and Ter Vrugt (1973), and Ter Vrugt and Pederson (1973) have investigated the influence of frequency and amplitude of rocking in a vertical direction. Ambrose reported that frequencies of 60 or 70 cycles per minute with an amplitude of 2 3/4 inches were more effective in terminating crying in neonates than lower frequencies. Pederson and Ter Vrugt have investigated the influence of both frequency and amplitude of vertical rocking on the activity of 2-month-old infants. In a series of experiments, frequency has ranged from 0 to 90 cycles per minute and amplitude has ranged from 2 to 5 inches. Within these ranges the soothing effects of rocking were positively related to frequency and amplitude. The correlation between activity during the final 5 minutes of the 15-minute rocking session and linear acceleration (a parameter that reflects both frequency and amplitude) was .87. Although the upper ranges of vestibular stimulation employed by Ambrose and by Pederson and Ter Vrugt were fairly intense, there was no indication that the relationship between soothability and intensity is curvilinear. In fact, Ter Vrugt and Pederson (1973) found that the difference in activity between rocking at 60 cycles per minute and 90 cycles per minute was greater than that between 30 and 60 cycles per minute. It is unlikely that future studies would be able to demonstrate that rocking at intensities greater than those already investigated are less soothing since major increases in intensity might cause physical injury (Caffey, 1972). Thus these findings provide fairly complete knowledge of the simple physical parameters that determine the soothing effectiveness of vertical rocking.

De Lucia (reported in Reese & Lipsitt [1970]) has investigated the influence of frequency of side-to-side rocking on the amount of crying in one month-old infants. In several different studies frequency was varied between 0 and 70 cycles per minute. Her results show that, as with vertical rocking, higher frequencies were more soothing than lower frequencies.

Van den Dale (1970) examined the influence of frequency of rocking in a head-to-toe direction on infants that ranged in age from 2 to 28 weeks. Rocking was presented for 1 minute at 30 or 60 cycles per minute at a 3-inch amplitude.

Faster rocking resulted in a greater reduction of activity than slower rocking. There were no differences as a function of age, sex, or maternal reports of rocking experience. In a second study, Van den Dale (1971) reported greater concordance in the influence of rocking on identical twins than on fraternal twins. The within-pair differences were small for identical twins under both the 30 and 60 cycles per minute conditions. For fraternal twins, the within-pair differences were greater under the 30 cycles per minute condition than under the 60 cycles per minute condition. Under the faster frequency condition, activity was suppressed in all infants.

The research reviewed above has consistently shown that the soothing effects of rocking within each direction are a positive monotonic function of frequency. Pederson and Ter Vrugt (1973) reported that the soothing effects of vertical rocking are also a positive monotonic function of amplitude. They concluded that maximum linear acceleration or vigor was the physical determinant of the influence of vertical rocking.

Although different investigators have used different directions of rocking, the influence of direction of rocking has not been systematically examined. The present experiment examined the relative effectiveness of up-and-down, side-to-side, and head-to-toe movement over a 5-inch amplitude at 45 and 60 cycles per minute.

Method

Subjects.-The Ss were 84 normal full-term infants (42 males and 42 females) who were brought to the laboratory at least two hours after feeding. The age range was from 52 to 68 days with a mean of 58 days. The names of these infants were secured from birth announcements in the local newspaper. Parental agreement to participate was made by telephone. Parents were paid five dollars for their infant's participation.

Apparatus.-The motorized rocker used by Pederson and Ter Vrugt (1973) was mounted on wheels so that head-to-toe and side-to-side rocking could be presented manually by pushing the rocker in the appropriate direction. The timing of these movements was paced by an electronic metronome which E heard through earphones. Vertical (up-and-down) rocking was driven by a variable speed motor.

Procedure.-Activity was assessed every 15 seconds by the rating scale described in Ter Vrugt and Pederson (1973). The rating scale ranged from rating 1 - quiet sleep to rating 6 - extremely agitated. Two observers independently rated 36 Ss as a reliability check. The correlation between those two sets of ratings was .97. Each infant was assigned to one of six groups formed by the factorial combination of three direction conditions (up-and-down, side-to-side, and head-to-toe) with two frequency conditions (45 and 60 cycles per minute). There were 12 Ss in each of the three 45-cycles-per-minute groups and 16 Ss in each of the three 60-cycles-per-minute groups. The assignment of Ss was random with the restriction that in each of the six groups, one-half of the Ss had a mean activity of 2.5 or less during the first minute of observation (low initial state) and one-half of the Ss had an initial activity rating of greater than 2.5 (high initial state). The amplitude (total length of the excursion) was 5 inches.

All Ss were placed on their backs in the bassinet with their heads secured by foam padding. They were observed for a total of 26 minutes that consisted of a 1-minute baseline, 15 minutes of rocking, and 10 minutes of postrocking.

The background sound level was 65 db. The sound level during rocking at 45 cycles per minute was 68 db and at 60 cycles per minute was 72 db for each direction.

Results

The observer ratings were averaged to form six periods: the mean for the 1-minute baseline, a mean for each of the three consecutive 5-minute intervals of rocking, and a mean for each of the two consecutive 5-minute intervals of post-rocking. The mean observer ratings for each direction condition as a function of frequency and period are presented in Table 1. A four-factor analysis of variance with initial state, direction and frequency of rocking

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Insert Table 1 about here

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as between-Ss factors and periods as the within-Ss factor was used to analyze the observer rating data. The period X initial state, $F(5,360) = 11.54$, $p < .01$, and the period X frequency, $F(5,360) = 4.23$, $p < .01$, interactions and the main effects of initial state, $F(1,72) = 23.31$, $p < .01$, frequency, $F(1,72) = 5.63$, $p < .05$, and period, $F(5,360) = 43.58$, $p < .01$, were significant. The direction factor did not enter into any significant effect and initial state did not interact with frequency. The initial state x period interaction was due to a greater reduction in activity during rocking for the high initial state Ss than for the low initial state Ss. Follow-up tests on the period x frequency interaction (Newman-Keuls) revealed that the following differences were significant at the .01 level: observer ratings at R_3 were less than at BL for both the 45 and 60 cycles per minute conditions; ratings at R_3 and PR_1, (but not PR_2) were less for the 60 cycles per minute than the 45 cycles per minute conditions.

Discussion

Observer ratings of activity decreased with the onset of rocking and increased with its offset. As would be anticipated from previous studies, rocking at 60 cycles per minute was more effective in reducing activity than rocking at 45 cycles per minute. The results of the present study together with the conclusions from previous research indicate that of the three parameters of simple cyclical movement, the frequency and the amplitude of rocking are the major determinants of the soothing effects and the direction of movement is relatively unimportant. This later finding suggests that generalizations among studies of rocking that have used different directions can be made.

The failure to obtain differences between the various directions of movement raises questions about the validity of certain hypotheses about why rocking is soothing. For example, Zahorsky (1934) suggested that rocking is soothing because it imparts movement to the stomach and intestines and that this movement aids digestion. If movement of the internal organs is the critical variable then rocking in a head-to-toe direction should be more effective since this direction should impart greater movement to the viscera than the other two directions. The finding that direction is not an important determinant of the soothing effects also raises questions about the validity of the assumption made by Ribble (1965), among others, that rocking is effective to the extent that it is similar to movements imparted to the fetus *in utero*. Although the prenatal experience hypotheses are difficult to assess since they are not specific about the crucial frequency, amplitude or direction of movement, during the last trimester the fetus is presumably exposed more to movement in his head-to-toe plane than to movement similar to the side-to-side and up-and-down conditions employed in the present study. Based on this reasoning, it would be expected that head-to-toe movement would have been more soothing.

There is considerable evidence that other forms of stimulation as well as rocking lead to reduction of activity in infants. For example, Brackbill (1970, 1971, and 1973) has reported that continuous auditory, visual, thermal, and proprioceptive tactile stimulation presented either singly or in combination have a pacifying effect. The presentation of heart sounds (Salk, 1962; Roberts & Campbell, 1967), swaddling (Giacoman, 1971), and oral stimulation (Cohen, 1967) have produced a reduction in arousal. The common characteristics of soothing stimulation of various modalities appears to be (1) that the stimulus is at least of moderate intensity and (2) that the stimulus is either continuous or intermittent with a slow rise time. Although the pacifying effect of each modality may be mediated by different physiological mechanisms, it seems parsimonious to assume that a common brain function is responsible for the effect. One possible brain function is the inhibitory system in the brain stem that several investigators have suggested is responsible for the onset of sleep following habituation (Moruzzi, 1960; Lynn, 1966).

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Footnote

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Table 1

Mean Observer Ratings Averaged Over Initial State

Condition	Period					
	BL	R_1	R_2	R_3	PR_1	PR_2
45 Cycles per Minute						
Up-and-down.........	2.91	2.03	1.95	1.99	2.70	3.25
Side-to-side........	3.10	2.19	2.31	2.29	3.22	3.41
Head-to-toe.........	3.10	2.55	2.92	2.94	3.57	3.69
60 Cycles per Minute						
Up-and-down.........	2.95	1.94	1.69	1.54	2.51	3.84
Side-to-side........	3.06	2.49	1.89	1.42	2.10	3.25
Head-to-toe.........	3.30	2.19	1.78	1.90	2.56	3.24

Note: BL = 1-minute baseline, R = 5-minute blocks of rocking, PR = 5-minute blocks of postrocking.

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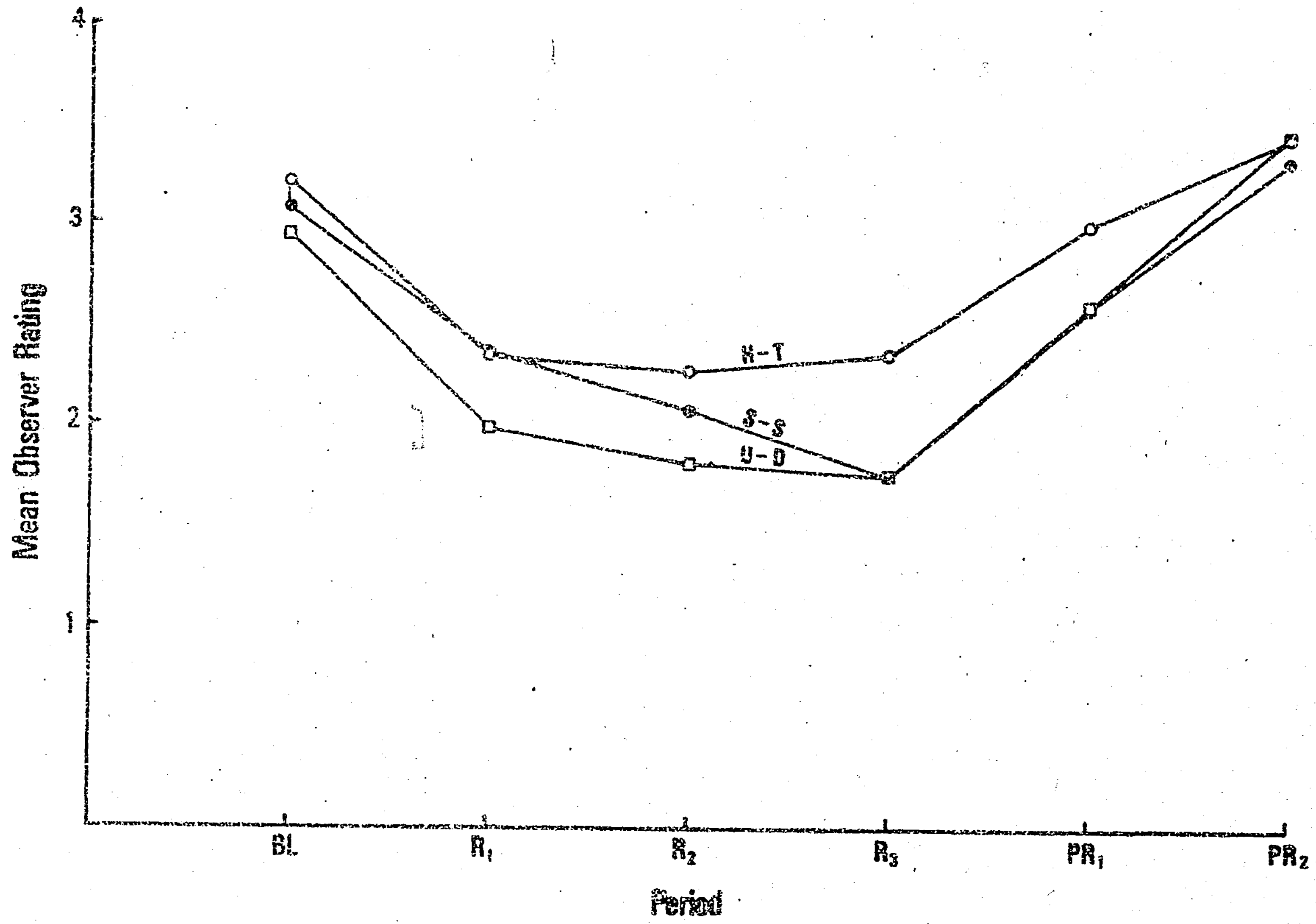

Figure 2 Mean observer ratings as a function of direction and period averaged over initial state and frequency (BL - Baseline; R = 5-minute blocks of rocking, PR = 5-minute blocks of postrocking).

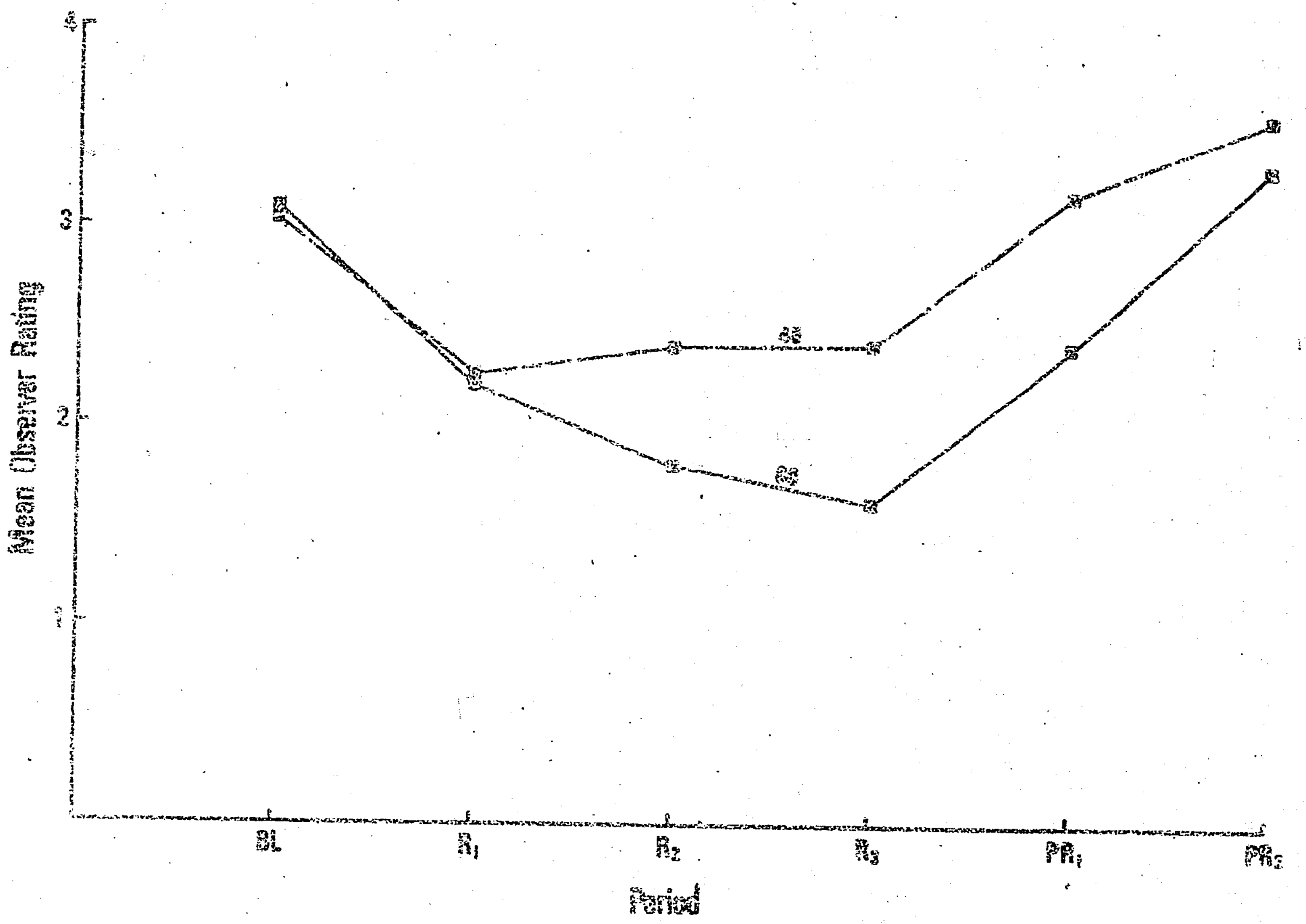

Figure 1. Mean observer ratings as a function of frequency and period averaged over initial state and direction (BL = 1-minute baseline, R = 5-minute blocks of rocking, PR = 5-minute blocks of postrocking).