THE EFFECTS OF THE FREQUENCY OF VIBRATION APPLICATION ON THE ACQUISITION OF HEAD ERECT BEHAVIOR IN PRONE

by

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B.S., Washington University, 1980

Submitted to the Department of Special Education and to the Faculty of the Graduate School of the University of Kansas in partial fulfillment of the requirements for the degree of Master of Science in Special Education

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ABSTRACT

This study utilized an alternating treatment design to investigate the effects of the frequency of vibration application on the aquisition of head erect behavior in the prone position in 4 preschool children with multiple handicaps. Frequency of head lifts and cumulative duration of head erect behavior were recorded during a 3 minute session with the child positioned prone over a wedge. Intervention consisted of vibration applied to the paraspinal neck and back extensor muscles for the first 2 minutes of each session. Intervention sessions randomly alternated between treatment once and twice a day, to assess the effects of the frequency of vibration application. Results of the study demonstrated no statiscally significant differences in performance between treatment conditions. Limitations of the study and implications for future research, as well as the use of vibration as a therapeutic tool for facilitating motor behaviors are addressed.

ACKNOWLEDGEMENTS

There are many people who deserve special thanks for their help and support this past year.

To the many members of the research committee for their guidance. To Jane Rues, Dick Whalen, and Doug Guess for serving as my committee. Special thanks to Jane for all her help, support, and patience.

To Debbie Cook, Kay Westman, Susan Cannon, Tracy Kuharski, Denise Campbell, and Barbara Weltzer for their assistance, guidance, support, and patience during the study.

To my buddies who often listened to my ramblings: Donna, Carolyn, Tina, and Beth: big hug.

To Aileen, Jean, Kim, and everyone at United Cerebral Palsy for welcoming me into the classroom; and to the children and their parents for their participation and cooperation during the study.

A very special thank you to Jim for his endless and unselfish hours at the typewriter.

Thanks to Wayne and Melanie Thompson at EDM for the generous use the computer.

Finally, to my family and friends far away, the letters, phone calls, and visits kept my head erect. Now my summer is really here, let's take advantage...

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CHAPTER I

INTRODUCTION

Vibration, a repetitive proprioceptive stimulus, is a treatment technique often used by therapists to improve motor function in individuals with handicaps. Vibration is used to: desensitize hypersensitive skin interfering with oral-motor activity; facilitate contraction of the vibrated muscle (Heininger and Randolph, 1981); reinforce weak voluntary efforts; reduce spasticity (Bishop, 1974); and relieve muscle spasm and pain (Eklund and Hagbarth, 1966). Additionally, vibraiton provides a means of investigating muscle spindle function (Bishop, 1975). Typically tendon taps and "H" responses (monosynaptic reflex elicited by electric current) are used to investigate the monosynaptic (phasic) functioning of the muscle spindle. Vibration provides a means of investigating muscle spindle functioning via the polysynaptic pathways elicited by spindle discharge. Bishop (1975) suggested the use of vibration as a potential prognostic tool in the detection of certain disease processes such as Parkinsonism, and upper motoneuron and cerebellar diseases. Apparently the vibratory induced impulses impose a sufficient burden on the central nervous system (CNS) to unmask incipient weaknesses.

Although vibration is a widely used clinical tool, there is little empirical evidence to validate its effectiveness, particularly with children who have severe handicaps.

The following review of the literature summarizes the motor and neurophysiological effects of muscle vibration, and characteristics of the tonic vibratory reflex (TVR). Studies of persons with muscle tone abnormalities are also discussed to provide an understanding of the implications of vibration as a therapeutic technique.

Literature Review

Motor Effects of Vibration

Vibration used for therapeutic purposes is a high frequency, low amplitude stimulus applied directly and locally to a specific selected muscle or tendon (Bishop, 1974). The motor effects of vibration include: contraction of the vibrated muscle; relaxation of the antagonist; and suppression of the monosynaptic stretch reflexes (MSR) of the vibrated muscle.

The reflex contraction of the skeletal muscle in response to vibratory stimulation is the TVR. The TVR is the result of the primary (Ia) afferent fibers easy excitability to vibratory stimulation. The vibratory induced rate of IA discharge activates the anterior horn cells, which then depolarize the alpha motor neurons, resulting in a sustained (tonic) contraction of the vibrated muscle (Heiniger and Randolph, 1981; Marsden, Meadows and Hodgson, 1969; Lance, DeGail and Neilson, 1966; DeGail, Lance, and Neilson, 1969). The TVR is a variant of the classic stretch reflex, as both the TVR and the stretch reflex share the same afferent fibers (Bishop, 1974). Vibration of the muscle spindle resembles a stretch stimulus in its effect on Group Ia endings (Gillies, Lance, Neilson and Tassinari, 1969). The TVR is not a simple spinal reflex, it requires both spinal and supra spinal support via polysynaptic pathways.

A second motor effect of vibration is relaxation of the antagonist (Eklund and Hagbarth, 1965, 1966). Through reciprocal inhibition, excitability of the motoneurons innervating the antagonist is depressed (Bishop, 1974). Lance, DeGail and Neilson (1966) elicited a TVR in the quadriceps then simulutaneously applied vibration to its antagonist, the hamstring muscle. The hamstring muscle never contracted, and the quadriceps contraction ceased after a short latent period, supporting the principle of reciprocal inhibition.

A third motor effect is suppression of the monosynaptic stretch reflexes (MSR) of the vibrated muscle (Bishop, 1975; Eklund and Hagbarth, 1965, 1966; Lance, Burke and Andrews, 1973; Marsden et al., 1969). This suppression is a result of presynaptic inhibition at the alpha-motoneuron pool (Arcangle, Johnston and Bishop, 1971; Delwaide, 1973; Gillies, Lance, Neilson and Tassinari, 1969). Gillies et al., (1969) demonstrated suppression of the MSR in the cat by vibration regardless of whether the MSR was elicited via peripheral nerve or dorsal root stimulation. The motoneurons inability to respond to monosynaptic stimulation while active in the production of the tonic contraction illustrates the presynaptic nature of the MSR inhibitory process.

Characteristics of the TVR

Studies utilizing electromyograms (EMG), stain guage dynamometers and qualitative observations have revealed specific characteristics of the TVR. The TVR has been elicited in every skeletal muscle except the facial and tongue muscles, and in persons of all ages from newborn babies to person over seventy years of age (Hagbarth and Eklund, 1966).

Archangle et al. (1971), Lance et al. (1973), and Marsden et al. (1969) used EMG recordings to demonstrate the progression of the TVR. Upon application of the vibrator, an immediate twitch of increased muscle tension is recorded, which may be followed by a short (50 - 100 millisecond) silent period. Over the next 20-60 seconds of vibration muscle tension slowly and progressively rises until reaching a plateau. The TVR is maintained at this plateau as long as vibration is continued. The maximum plateau during the TVR never excedes a fraction of muscle tension developed during maximal voluntary effort (Hagbarth and Eklund, 1966; Matthews, 1967), indicating that only part of the motoneuron pool can be activated reflexively by vibration. Hagbarth (1973) suggested a possible explanation for the progressive rise in tension with the TVR, in that vibration becomes a more effective stimulus as the muscle becomes more firm via active contraction.

EMG recordings show that muscle action potentials persist for a second or more following the termination of vibration, reflecting the after- discharge from the motoneuron pool. After-discharge is a result of the reverberating circuits within the motoneuron pool and is an inherent characteristic of polysynaptic reflexes (Eklund and Hagbarth, 1965, 1966; Hagbarth and Eklund, 1969; Guillies, Burke, and Lance, 1971).

Lance et al. (1966), and Marsden et al. (1969) demonstrated another characteristic of the TVR. They found that a previous period of vibration potentiated the response to a second or subsequent period of vibration. Maximum potentiation occured when the interval between vibratory stimuli was about 5 seconds, although some enhancement of the second response was evident at three minute intervals. The post-vibratory potentiation always disappeared within 5 minutes. Repeated bursts of vibration at short intervals led to progressive potentiation until the final tension achieved was close to maximal force the subject could exert voluntarily. Potentiation depends on muscle relaxation between stimuli, and is lost when the muscle is voluntarily contracted between periods of vibration.

Potentiation is due to the effects of afferent discharge, and can be produced by electrical stimulation of Group I afferent fibers prior to vibration (Marsden et al. 1969). Brown, Engberg and Matthews (1967) demonstrated in the cat that direct stimulation of static or dynamic fusimotor fibers sensitized spindle endings to vibration. Afferent fibers stimulated electrically prior to vibration responded to a previously ineffective amplitude of vibration, or discharged impulses at a greater frequency for a given vibratory stimulus.

Lance et al. (1966), and Marsden et al. (1969) found that reinforcement during vibration did not augment the tonic contraction although tendon-jerks were increased. However, reinforcement such as clenching fists and teeth for 5 to 10 seconds just prior to vibration does augment the subsequent contraction by as much as 100 to 150 percent. Additional stimuli prior to vibration that may augment the evoked response include pain-ear twisting, hyperventilation, and adrenalin infusions.

The progressive build up and after-discharge are indicative of a polysynaptic pathway. Other evidence that the TVR has polysynaptic central connections include volitional inhibition, and its abolishment with drugs and spinal transections.

Marsden et al. (1969) reported that vibratory induced tonic contraction may be stopped at any time by concious effort, apparently without withdrawal of fusimotor activity. It is unlikely that this occurs in the monosynaptic pathway from the spindle to the muscle. Neither the tendon jerk nor the "H" response were abolished during the volitional inhibition of the tonic contraction, indicating that voluntary inhibition of the TVR is achieved at spinal or supraspinal levels.

With the administration of drugs known to block polysynaptic pathways (i.e. barbituates) the TVR was suppressed, unlike the tendon-jerk (monosynaptic reflex) which could still be elicited (Lance et al. 1966). An absent or depressed TVR following spinal transection is suggestive that higher neural centers must play an important role in supporting the TVR (Gillies et al. 1971).

The strength of the TVR widely differs among individuals. However, the TVR was reproduced from trial to trial, and day to day in a given individual (Bishop, 1974). Bishop further reported that the strength of and individual's tonic reflex does not correspond to the strength of that individuals phasic reflex. Several factors influence the strength of the TVR including: location of the vibratory stimulus, initial length of the vibrated muscle, frequency and amplitude of the vibrator, CNS excitability including temperature of the vibrated muscle, head and body position, and drugs.

There exists some controversy in the literature regarding location of the vibrator. Some researchers (Eklund and Hagbarth, 1966; Eklund and Steen, 1969) advocate vibration on or near the tendon, while others (DeGail et al., 1966) advocate vibration over the muscle belly. This controversy may have little validilty in applied research in children with multiple handicaps whose muscles are often small, underdeveloped, or atrophied. The size of the smallest vibrator head may prevent selective stimulation of the muscle belly or tendon.

Lengthening the muscle to or near its maximum physiological length evokes a stronger TVR. Brown, Engberg, and Matthews (1967) demonstrated certain conditions in which vibration excites virtually all primary endings to discharge one impulse for each cycle of vibration. They found stronger TVRs in the soleus and peroneus longus muscles of anaesthetized cats when the muscles were stretched to their maximum length prior to application of vibration.

Eklund and Hagbarth (1966) applied vibration to 100 adults to evaluate various factors influencing the strength of the TVR in nonhandicapped humans. EMG activity, muscle force, and joint movement were recorded during vibration on a multichannel inkwriter. They reported an increse in the amplitude of vibration increased the strength of the TVR. Amplitudes around 1-2 mm. seemed to be the most effective. A further increase, up to 3.3 mm tended to result in discomfort, withdrawal reactions, and possible spread of vibration to surrounding muscles and bones. Their results also indicated increased frequency of the vibratory stimulus (upper limit 200Hz) increased the response in regards to both the slope of the rising phase and the maximum maintained tension. The strength of the response also increased with increasing muscle length, however strength of the response was less dependent on muscle length if the subject voluntarily maintained the muscle contraction. Other factors which influenced the response to vibration included: 1) temperature - a much stronger TVR is noted when the muscle to be vibrated is cooled than when warmed; 2) tonic neck reflexes - a stronger extensor response is elicited when the subject is supine, and a stronger flexor response is elicited when the subject is prone; and 3) caloric stimulation of the labyrinths to evoke vestibular reflexes increased the TVR on the ipsilateral side.

Studies in Persons with Muscle Tone Abnormalities

Several studies have investigated the effects of vibration and the resulting TVR in persons with muscle tone abnormalities (Eklund and Steen, 1969; Hagbarth and Eklund, 1966; Ioku, 1973; Kanda, Homma, and Watanabe, 1973; Cannon, 1982; Hasenback, 1982; and Sheffey, 1983). Comparing EMG recordings of normal and spastic muscles revealed that although the basic pattern of responses to vibration are similar, some differences do exist (Kanda et al. 1973).

Hagbarth and Eklund (1966, 1968, and 1969) have pioneered the use of vibration as a therapeutic technique in the treatment of individuals with muscle tone abnormality. Manifestations of motor disorders such as spasticity, weakness, rigidity, and tremor can be accentuated by vibration, although vibration can be used to facilitate voluntary power and active range of motion in some persons with spastic paresis.

Hagbarth and Eklund (1968) investigated the effects of vibration during rest and attempted volitional movement on 90 adults with hemi-, quadri-, parapareses due to upper motor neuron lesion, Parkinsonism, and cerebellar syndromes. Small electric vibrators with the frequency of 150-160Hz and an amplitude of 1.5-2mm were attached transversely over the tendons of the biceps brachii or quadriceps muscles. The effects of vibration were evaluated by observation, EMG recordings, potentiometers, and strain-guage dynamometers. Results indicated that the response to vibration started and stopped more abruptly in spastic as compared to normal muscles. Volitional power and range of motion increased in the week or paretic muscle with the application of vibration, and decreased when the antagonistic hypertonic muscle was vibrated. In subjects with hemiparesis, vibration to the palmar side of the wrist resulted in an abnormal tendency toward pronation. In cases of severe hemiparesis, a sustained contraction was observed in muscles acting at neighboring joints and occasionally in the antagonistic muscles which are normally inhibited during vibration via reciprocal inhibition. No improvement of volitional motor performance was noted with the application of vibration to the muscles of persons with Parkinsonism, or cerebellar disorders. Further an impaired ability to perform alternating movements was observed, as well as increased tremors of the vibrated muscles, its antagonist, and muscles acting at neighboring joints in individuals with Parkinsonism.

In a similar study Burke, Andrews, and Lance (1972) vibrated the quadriceps and triceps surae muscles of individuals with spasticity, Parkinsonism, and normal muscle tone. Surface electrodes placed over the muscle belly recorded the EMG activity. Results confirmed those of Hagbarth and Eklund (1966 and 1968), and demonstrated no relationship between the type of spacticity or the site of lesion and variation in the TVR of hypertonic muscles. The TVR could not be elicited in clinically completed spinal cord lesions. Many persons with spasticity reported that the weakness and spasticity seemed less severe from 20 minutes to 2 hours following vibration.

Eklund and Steen (1969) fastened small electric vibrators with a frequency of 100-200Hz and an amplitude of 1.5mm over or close to weak or paretic muscle tendons on 200 children with various motor handicaps. A maximum of 1 to 2 minutes of continuous vibration was applied to the muscles to be trained in normal movement patterns. Results indicated that vibration of a paretic muscle increased its volitional power through the resultant TVR and/or through the reciprocal inhibition of the spastic antagonist, thereby decreasing the abnormal postures that often accompany spasticity. The duration of these effects varied among individuals, and were apparently related to the individuals utilization of movement following vibration. Reduced spasticity was reported up to 30 minutes following vibratory training, particularly if the individual remained active. No obvious advantage to vibration was found in children with hypotonicity. With verbal instruction and careful application of the vibratory stimulation, children with athetosis or dystonia were found to have increased normal patterns of movement. Vibration was also useful in revealing ataxic components and slight hypertonicity in "clumsy children" when tendon reflexes were normal and motor tests were suggestive of a developmental delay. A common finding with various handicapping conditions was improved body awareness and accompanying urge to move.

Single subject designs have been incorporated in several studies on the effects of vibration with preschool age children with severe and multiple handicaps. Vibration at a frequency of 119Hz and an amplitude of .5mm was used in each of these studies.

Cannon (1982) investigated the effects of vibration on the aquistion of head erect in prone. Subjects included children with increased muscle tone and children with decreased muscle tone. Vibration was applied to the neck and upper back extensors for 2 minutes with the child positioned prone over a wedge. Results indicated an increase in head erect behavior and an accompanying increase in EMG activity during vibration.

Hasenbank (1982) investigated the effects of vibration on chewing behavior. Subjects muscle tone varied and included both hyper- and hypotonisity. Vibration was applied to each of the muscles of mastication for 10-15 seconds, for a total of approximately 75 seconds of vibration. Results indicated an increase in vertical chewing, although no effects were noted with rotary chewing.

Sheffey (1983) investigated the effects of vibratory stimulation on the acquistion of upper extremity in prone in children with multiple handicaps. Two vibrators were applied to both sets of paraspinal neck and back extensor muscles for one minute and to both sets of elbow extensors for one minute. Results indicated an increase in upper extremity weight bearing postions in one subject; and an increase in the frequency and duration of forearm propping in the second and third subjects.

Investigation Related Questions

The purpose of the present study was to investigate the effects of the frequency of vibration application on the acquisition of head control in preschool children with multiple handicaps. Head control was chosen because of its critical significance on all subsequent motor development (Rues, 1981). The importance and necessity of investigating techniqes that may facilitate motor function is critical to children with cerebral palsy and other handicapping conditions who frequently display marked delays in the acquisition of motor skills, including head control.

In preparing for this investigation the following questions were considered:

1. Does an increased frequency of vibration application to selected muscles result in a cumulative effect leading to an increased rate of acquistion of the target beharior?
2. Were the effects of vibration apparent only while the muscles were being vibrated?
3. Does the acquisition of head erect behavior in prone facilitate the development of other important motor behaviors?

CHAPTER II

METHOD

A description of the subjects, setting, materials, and equipment that were used are presented in this chapter. In addition the experimental procedure, research design, and reliability measures are described in detail.

Subjects

Four preschool children who demonstrated deficits in head control participated in this study. The subjects attended a developmental program serving children with multiple handicapping conditions. The preschool program was located in a midwestern metropolitan area. The children attended the program 5 days per week from 9:00 A.M. to 3:00 P.M. Criterion for subject selection was an inability to maintain the head erect while prone for 100 seconds in a 3 minute (180 second) time sample. The duration of the study was 11 weeks.

An authorization and release form were signed by each child's parent(s) prior to their participation in the study. A copy of this form and the letter to parents explaining the study are included in Appendix A.

Subject 1. Kristie was a 3 year 9 month old girl with severe multiple handicapping conditions, including spastic-athetoid cerebral palsy with quadraplegic involvement. Kristie exhibited fluctuating muscle tone and poor head control in prone. She wore bilateral hearing aids due to a profound sensorineural hearing loss and corrective glasses. She has retrolental fibroplasia. She has taken phenobarbital and dilantin since birth for control of seizures. Kristie has a history of chronic bronchitis and severe hypoglycemia. Surgeries include: eye surgery for correction of strabismus, trachiostomy, gastrostomy tube, resection of pancreatic adenocarcenoma, removal of cyst in abdomen, as well as lung and intestinal surgeries. Prior to initiation of intervention, Kristie exhibited less than 1 second of head erect behavior in a 3 minute time sample.

Subject 2. Sally was a 4 year 7 month old girl with spastic-athetoid cerebral palsy, with quadreplegic involvment. She exhibited flucuating muscle tone, and poor head control in prone. Sally was receving phenobarbital for seizure control. She presented with nystagmus and intermittent estropia. Immediately prior to participation in this research study Sally was involved in a research investigation studying the effects of dynamic inversion on head erect behavior in prone. During baseline for the dynamic inversion study Sally had an average of 60 seconds of head erect in a three minute time sample. Her average head erect rose to 74 seconds during intervention.

Subject 3. Kyle was a 1 year 9 month old boy with spastic cerebral palsy, quadriplegic involvement, with more involvment on the left side. Kyle was receiving phenobarbital for control of seizures. Kyle presented with bilateral pendular nystagmus, common in blindness. His visual acuity was estimated to be 20/200 or worse. Prior to initiation of intervention, in a three minute time sample Kyle displayed 3 to 90 seconds with an average of 54 seconds of head erect behavior.

Subject 4. Lucy was a 1 year old girl with spastic cerebral palsy, quadraplegic involvement. She had an occipital encephalocele corrected at 5 days of age. For 4 months following surgery, Lucy received phenobarbital for seizure control. Lucy had a large frontal fontanelle and a large hole at the base of her skull, as well as a 3 centimeter area of porencephaly in the occipital lobe. Behavioral responses to visual and auditory stimulation were inconsistent. Results from the auditory brainstem response test indicated neurologically abnormal responses on the left; however responses on the right were reported to be within normal limits. Prior to initiation of intervention, Lucy displayed 74 seconds of head erect in a three minute time sample.

Setting

The research was conducted in one of two small rooms connected to the large classroom areas. These rooms contained cots for naps. The cots were stacked and placed to the rear or side of the room. All sessions occurred during the hours of attendance at the preschool program. During data collection only the persons involved with the study were usually present, however all parents/grandparents observed an intervention session with their child/grandchild on one occasion.

Materials and Equipment

Data Sheet. The frequency and cumulative duration of head lifts during a 3 minute measurement period were recorded on the data sheet. (Figure 1). Columns are included for total frequency and cumulative duration during vibration and post vibration, as well as for totals of the entire session. Also included was a column to indicate the occurence of seizure activity.

Timing device. A tape recorder with prerecorded time checks was used to assist with data collection. The tape indicated the initiation of the trial and vibration, and the passage of an additional minute to indicate the end of the trial.

Vibrator. The Oster "vibra-massage" electric vibrator, (model number 398-02), was used to apply the vibratory stimulation. The low setting with a frequency of 119 Hz and amplitude of .5mm was used. Vibrator specifications (Appendix B) were obtained from Sobsey (1982) who had the Oster vibrator model number 217-02 calibrations checked, as this information was not provided by the company. Model number 398-02 was used because the 217-02 model was no longer available and technical advisors to the Oster Company reported that only cosmetic changes were made with no alterations to the motor.

Wedge. A prone wedge was used for positioning the child during intervention sessions. It measured 6 inches in height, and 14 inches

EFFECT OF FREQUENCY OF VIBRATION ON HEAD ERECT
DATA SHEET

NAME:

DATE:

OBSERVER:

SESSION NUMBER:

	SESSION	HEAD LIFTS	CUM. DUR.	SEIZURES
DURING VIBRATION	A			
TOTAL				
%				
POST VIBRATION	A			
TOTAL				
%				
OVERALL TOTAL FOR A				
OVERALL % FOR A				

****

DURING VIBRATION	B			
TOTAL				
%				
POST VIBRATION	B			
TOTAL				
%				
OVERALL TOTAL FOR B				
OVERALL % FOR B				

Figure 1. Intervention data sheet.

in length. Lateral guides could be adjusted from 6 1/2 to 10 1/4 inches. The surface on which the child's trunk rested and the lateral supports were covered with vinyl. The wedge was purchased from an "Equipment Shop" catalog.

Positioning Device. A rectangular positioning shape was used to provide support to three of the subjects elbows when positioned prone on the wedge. The positioning shape measured 16 1/2 inches in length and 3 inches in width.

Miscellaneous Equipment. Two stopwatches with inaudible clicks, pencils, a marker and a sandbag for stabilization in the prone position were used in the study. Preferred toys were also used with each child to elicit and reinforce head lifts.

Experimental Procedures

An alternating treatment design was employed to investigate the effects of the frequency of vibration application on the acquisition of head erect behavior in the prone position. Subjects were randomly assigned one or two intervention sessions(s) per day. Each session consisted of one trial per child, 3 minutes in length. Data were collected during every session.

Positioning. Following removal of upper extremity clothing, each child was positioned prone over a wedge on the floor. A sandbag was placed across the pelvis to stablize the child on the wedge. Elbows were positioned at near 90 degrees of flexion, and resting on the positioning shape, with the exception of Sally, (Subject 2) whose elbows were positioned at near 90 degrees flexion resting on the floor. A marker was used to indicate the starting (occupit) and ending points (5th thoracic vertabrae) on either side of the spine (See Figure 2). The observer(s) was positioned directly in front of the child. Toys and social reinforcers were used to encourage head erect behavior.

The investigator was positioned behind the child, and activated the tape recorder which indicated the start of intervention.

Intervention. During the 3 minute session, each child was vibrated with the electric vibrator. The vibrator was applied to the paraspinal musucles of the neck and back moving slowly with moderate pressure from the occiput to the thoracic vertabrae, approximately 5 millimeters from the midline. The vibratory stimulus was alternately applied to the right and left paraspinal muscles for a duration of two minutes (See Figure 3). Data collection continued for 60 seconds following the termination of vibration. See Appendix C for the sequence of vibratory stimulating activities.

Measurement

Response definitions. Frequency of head lifts and cummulative duration of head erect in the prone position were the behaviors measured. These behaviors were observed during the three minute intervention session while the subject was maintained in the prone wedged position.

Head lift. The head was considered to be in the erect position

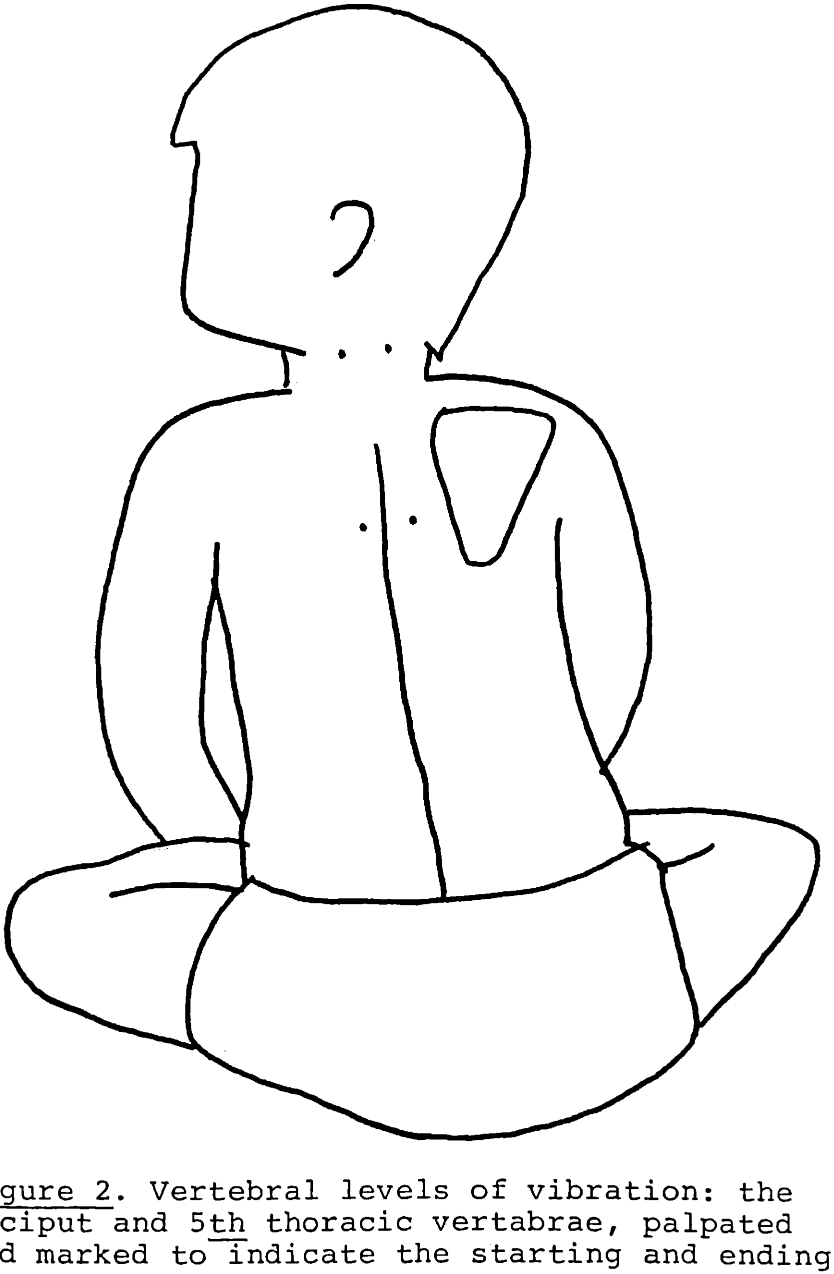

Figure 2. Vertebral levels of vibration: the occiput and 5th thoracic vertabrae, palpated and marked to indicate the starting and ending points of vibration.

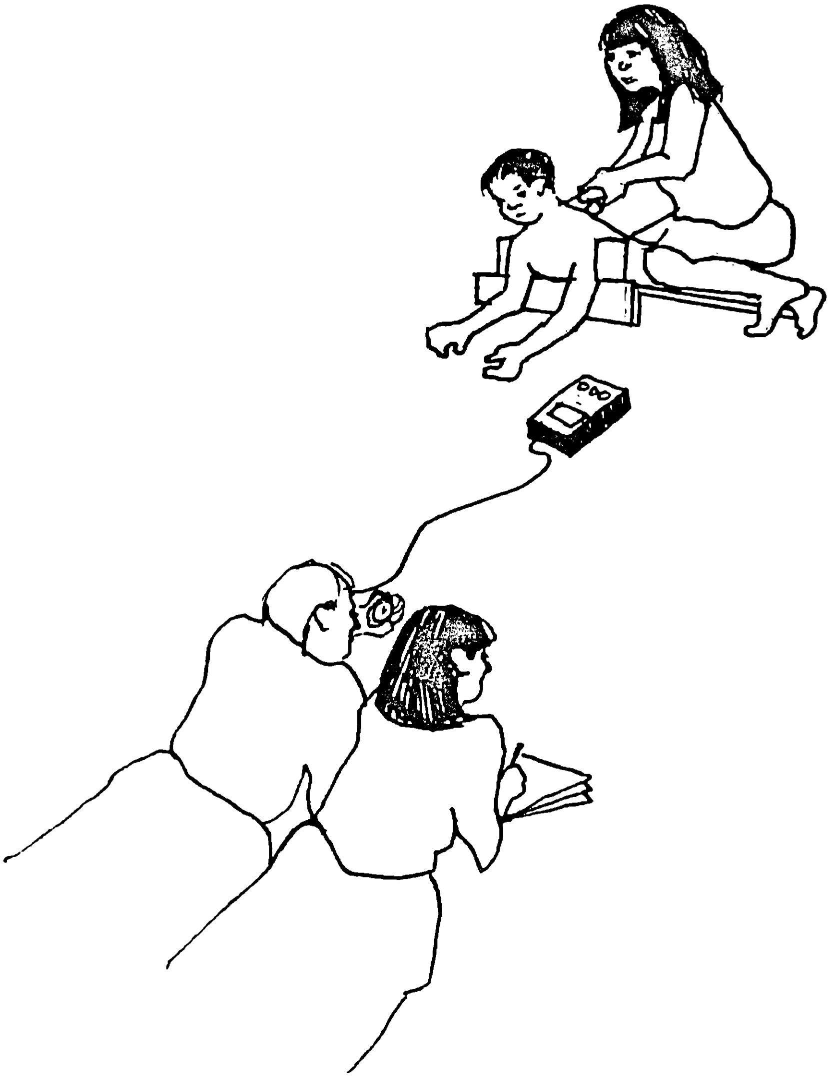

Figure 3. Position of the child prone over wedge, examiner applying vibration, and observers measuring and recording head erect behavior.

when no part of the head or neck (chin to clavicle) was touching or resting on the wedge or child's arm.

A trial began when the child, observer(s) and investigator were positioned appropriately, with the tape recorder activated and indicating the start of the session. Head lifts were recorded by hash marks (') in the appropriate column on the data sheet, with simultaneous activation of the stopwatch to measure cummulative duration of the head lift. The prerecorded tape indicated the passage of two minutes, signalling the cessation of vibration. The trial ended when the tape indicated that three minutes had lapsed. Data were collected during vibration (two minutes) and for one minute following vibration. A minimum of one hour lapsed between sessions on the days subjects received two intervention sessions.

The measurement system employed was developed by Foshage (1978) and revised by Rues (1981) to reliably quantify the emergence and aquisition of head erect behavior in handicapped and nonhandicapped infants and young children.

Procedures for Measuring the Covarying Behaviors: Upper Extremity Weight Bearing and Visual Fixation Skills

Upper Extremity Weight Bearing. Upper extremity weight bearing was selected as a covarying behavior because upper extremity weight bearing occurs developmentally in the nonhandicapped infant as head erect behavior is acquired. The topography of each subjects upper extremity weight bearing positions in prone were recorded every five sessions with the child positioned prone and unwedged. Upper extremity weight bearing probes occured at least 15 minutes after vibration intervention sessions. The positioning procedure was the same as noted for intervention sessions (refer to Figure 3).

A data sheet (Appendix D) was used to record the frequency and cumulative duration of head lifts, as well as upper extremity weight bearing postions. Upper extremity weight bearing positions were recorded only when the subjects' head was erect. The observer(s) recorded upper extremity weight bearing positions according to the following definitions:

head lift without arm support. The head was raised and an elbow angle less than 90 degrees was present.

head lift with forearm prop. The head was raised and an elbow angle greater than or equal to 90 degrees but less than 180 degrees was present.

head lift with extended arm prop. The head was raised and no part of the arm was touching the supporting surface. Only the hands were in contact with the supporting surface.

Combinations of the above definitions were possible. One arm occasionally fit one definition while the other arm fit a second defintion. Every possible combination of upper extremity weight bearing positions using these definitions were delineated by a column on the data sheet. The measurement code used was adapted from the measurement system developed by Rues (1981). Class I behaviors included all forearm props. Class II behaviors included all extended arm props.

Changes in upper extremity weight bearing positions while the head remained erect were recorded by subsequent hash marks in the appropriate column(s). If the child's head ceased to be erect, further upper extremity weight bearing positions accompanying subsequent head erect behaviors were recorded only when differing from the last recorded position. If a child lifted his/her head with both arms propped, lowered his/her head, then lifted his/her head without changing from a bilateral forearm position, only one hashmark was recorded on the data sheet in the bilateral forearm prop column.

Several weeks into the study a variation of the upper extremity weight bearing probe was added. Every tenth session, at least fifteen minutes following vibration, the subject was placed prone over the wedge for a three minute trial to assess head erect without vibration. This probe was added in an attempt to assess the contribution of the wedge to head erect behavior. The wedge was thought to possibly have a facilitory positional effect on head erect behavior as it places the neck and upper back paraspinal extensors on a stretch. The intervention data sheet (Figure 2) was used to record the frequency and cumulative duration of head lifts during this probe.

Visual Fixation Skills. Visual fixation skills were the second covarying behavior selected for all four subjects. Visual fixation skills normally develop sequentially beginning with momentary regard, progressing through prolonged regard and alternating regard until the child is able to reliably fixate on a small object (Bayley, 1969). Ten items (D5, D7, D14, D16, D19, F9, F12, AC34) from the Bayley Scale of Infant Development (1969) comprised the visual fixation code. Equipment included a red ring attached to a twelve inch string, a small pen light with a red cover, a bell, and a rattle. Initially every fifth session, on a day other than the upper extremity weight bearing position probe, the visual fixation code was used to assess and record each subjects visual skills. Several weeks into this investigation it was decided to change the visual fixation probe to every tenth session. Intervention sessions occured daily, as attendance allowed, and it was thought that biweekly, opposed to weekly probes would reveal any change(s) in the covarying behavior. One item (AC 34), glances from one item to another, was not administered as described in the Bayley Scale of Infant Development (1969). Instead of holding both items (about 8 inches apart) within the subjects visual field, both items were held about 15 inches apart outside of the subjects visual field. This procedure required a larger eye movement to glance from object to object. Refer to Appendix E for a copy of the visual fixation code.

Items were presented with the child supine, with head stabilized in midline. All items were scored pass/fail according to the criterion in the code. Refer to Appendix E for a copy of the data sheet.

Reliability Measure

Reliability measures were taken from direct observation of the child and were calculated separately for frequency, cumulative duration, upper extremity weight positions, and visual fixation assessment recordings. Reliability scores for frequency of head erect, upper extremity weight bearing and visual skills were computed by using the following formula:

$$\frac{\text{number of agreements}}{\text{number of agreements and disagreements}} \times 100\%$$

Reliability for cumulative duration of head erect was computed by using the following formula:

$$\frac{\text{smaller duration}}{\text{larger duration}} \times 100\%$$

The reliability figures for each session were added together, and divided by the total number of sessions to obtain an average reliability figure for each descriptor.

Persons participating in the reliability recordings included three Occupational Therapists, two Physical Therapists, and one Special Education Graduate Student.

Experimental Design

An alternating treatment design was employed in this investigation. In this design two treatments are alternately administered, and the effects on one behavior are observed. By comparing two treatments within a single subject, intersubject variability as well as the need for a baseline are eliminated. This is a particularly valuable aspect of this design. Applied research is often concerned with low rate behaviors which tend to be unstable. Investigation of behavior such as head erect may result in ascending baselines due to the attention to the target behavior.

With the alternating treatment design the data for each intervention (i.e. vibration once or twice) are plotted separately to allow a ready visual representation of the effects of each treatment (Barlow and Hayes, 1979).

CHAPTER III

RESULTS

This chapter presents interobserver reliability and performance data for each subject during the course of the study. Tables and figures provide graphic presentations of the data.

The interobserver reliability data are presented in Tables 1-7. These tables summarize interobserver reliability data for target behaviors of head lifts, cumulative duration, and covarying behaviors of upper extremity weight bearing, and visual fixation responses.

Subject 1 (Kristie). Interobserver reliability for frequency of head erect behavior in the prone position range form 60% to 100%, with a mean of 94%. These reliability scores represent data collected on 13 of 35 sessions, or 37% of the sessions. Interobserver reliability for cumulative duration of head erect behavior ranged from 57% to 100%, with a mean of 93%. These reliability scores represent data collected on 12 of the 35 sessions, or 34% of the sessions (see Table I).

Interobserver realibility for the covarying behavior of upper extremity weight bearing was 100%. Interobserver reliability for the frequency of head erect during the upper extremity weight bearing probes ranged from 75% to 100%, with a mean of 94%. These reliability scores represent data collected on 4 out of 4 sessions or 100% of the sessions. Interobserver reliability for cumulative

Table 1

Reliability Scores for Head Erect Behavior in the Prone Position for Kristie

Session Number	Reliability per Session Head Lifts	 Cumulative Duration
7	100	57
8	86	100
10	75	63
11(A)	100	--
11(B)	100	100
14	100	100
15(A)	100	100
15(B)	100	100
16	100	100
19(A)	60	100
19(B)	100	100
20(A)	100	100
20(B)	100	100
Mean Reliability	94	93

A: Data from first session of treatment twice a day

B: Data from second session of treatment twice a day

duration of head erect during the upper extremity weight bearing probes was 100% across the sessions. These reliability scores represent data collected on 3 out of 4 sessions, or 75% of the sessions (see Table 2).

Interobserver realibility for the frequency and cumulative duration of head erect behavior during the wedged probes was 100% (see Table 3.)

Interobserver reliability for the second covarying behavior, visual fixation ranged from 80% to 100%, with a mean of 93%. These reliability scores represent data collected on 4 out of 4 or 100% of the sessions (see Table 4).

Subject 2 (Sally). Interobserver reliability for the frequency of head erect behavior in the prone position ranged from 65% to 100%, with a mean of 92%. Interobserver reliability for cumulative duration of head erect behavior ranged from 85% to 100%, with a mean of 95% (see Table 5). These reliability scores represent data collected on 18 out of 40 sessions, or 45% of the sessions.

Interobserver reliability for the covarying behavior of upper extremity weight bearing ranged from 71% to 100%, with a mean of 86%. These reliability scores represent data collected on 3 out of 4 sessions, or 75% of the sessions. Interobserver reliability for frequency of head erect behavior during the upper extremity weight probes ranged from 78% to 92%, with a mean of 85%. These reliability scores represent data collected on 2 out of 4 sessions, of 50% of the

Table 2

Reliability Scores for the Covarying Behavior:
Upper Extremity Weight Bearing

Subject	Session	Reliability per Session Upper Extremity Weight Bearing	Head Lifts	Cumulative Duration
Kristie	1	100	100	100
	6	100	100	100
	11	75	—	100
	21	100	100	100
	Mean Reliability	94	100	100
Sally	6	78	100	71
	11	92	96	86
	21	—	82	100
	Mean Reliability	85	93	86
Kyle	1	100	100	100
	6	100	100	100
	11	89	88	100
	31	83	89	100
	Mean Reliability	93	94	100
Lucy	1	100	93	—
	6	83	93	—
	11	83	100	100
	21	100	88	100
	Mean Reliability	92	94	100

Table 3

Reliability Scores Across Subjects for the Wedged Probes

Subject	Session	Reliability per Session Head Lifts	 Cumulative Duration
Kristie	16	100	100
Sally	16	100	99
Kyle	16	100	96
	23	90	99
	26	94	98
	Mean Reliability	95	98
Lucy	20	100	100
	26	93	98
	Mean Reliability	97	99

Table 4

Reliability Scores for the Covarying Behavior: Visual Fixation

Subject	Session	Reliability
Kristie	2	100
	7	80
	12	90
	22	100
Mean Reliability		93
Sally	2	100
	7	100
	12	90
	22	100
Mean Reliability		98
Kyle	2	90
	7	90
	12	90
	22	100
	32	100
Mean Reliability		94
Lucy	2	100
	7	90
	12	90
	22	100
Mean Reliability		95

Table 5

Reliability Scores for Head Erect Behavior in the Prone Position for Sally

Session	Reliability per Session Head Lifts	 Cumulative Duration
8(A)	65	95
8(B)	95	95
9	91	96
10(A)	94	95
10(B)	100	89
12	91	100
13(A)	100	94
13(B)	91	95
14	100	96
17(A)	100	98
17(B)	73	85
20(A)	91	94
20(B)	95	88
21(A)	92	96
21(B)	100	99
23(A)	100	99
23(B)	75	93
25(A)	94	94
Mean Reliability	92	95

A: Data from first session of treatment twice a day

B: Data from second session of treatment twice a day

sessions. Interobserver reliability for cumulative duration of head erect during the upper extremity weight bearing probes ranged from 82% to 100%, with a mean of 93%. These reliability scores represent data collected on three out of 4 sessions, or 75% of the sessions (see Table 2).

Interobserver reliabiity for frequency of head erect behavior during the wedged probes was 100%. Interobserver reliability for the cumulative duration of head erect behavior during the wedged probes was 99% (see Table 3).

Interobserver reliability for the second covarying behavior, visual fixation ranged from 90% to 100%, with a mean of 98% (see Table 4). These reliability scores represent data collected on 4 out of 4, or 100% of the sessions.

Subject 3 (Kyle). Interobserver reliability for the frequency of head erect behavior in the prone position ranged from 78% to 100%, with a mean of 91%. Interobserver reliability for cumulative duration of head erect behavior ranged from 73% to 100%, with a mean of 91% (see Table 6). These reliability scores represent data collected on 24 of the 52 sessions, or 46% of the sessions.

Interobserver reliability for the covarying behavior of upper extremity weight bearing was 100%. Interobserver reliability for the frequency of head erect behavior during the upper extremity weight bearing probes ranged from 83% to 100%, with a mean of 93%. Interobserver reliability for the cumulative duration of head erect

Table 6

Reliability Scores for Head Erect Behavior in the Prone Position for Kyle

Session	Reliability per Session Head Lifts	Cumulative Duration
3	78	92
4(B)	87	73
5(B)	100	84
15(A)	94	95
15(B)	100	99
16(A)	100	89
17	95	76
19(A)	89	78
19(B)	86	86
20	93	91
21	100	99
22(A)	91	99
22(B)	96	95
26	100	96
27(A)	80	89
27(B)	100	95
29(A)	79	95
29(B)	76	99
31	94	91
32(A)	91	95
32(B)	88	88
33	86	97
34(A)	88	99
34(B)	89	79
Mean Reliability	91	91

A: Data from first session of treatment twice a day

B: Data from second session of treatment twice a day

behavior during the probes ranged from 88% to 100%, with the mean of 94% (see Table 2). These reliability scores represent data collected on 4 out of 5 sessions, or 80% of the sessions.

Interobserver reliability for frequency of head erect behavior during the wedged probes ranged from 90% to 100%, with a mean of 95%. Interobserver reliability for the cumulative duration of head erect behavior ranged from 96% to 99%, with a mean of 98% (see Table 3). These reliability scores represent data collected on 3 out of 3, or 100% of the sessions.

Interobserver reliability for the second covarying behavior, visual fixation ranged from 90% to 100%, with a mean of 94% (see Table 4). These reliability scores represent data collected on 5 out of 5, or 100% of the sessions.

Subject 4 (Lucy). Interobserver reliability for frequency of head erect behavior in the prone position ranged from 80% to 100% with a mean of 94%. These reliability scores represent data collected on 17 of the 47 sessions, or 36% of the sessions. Interobserver reliability for the cumulative duration of head erect behavior ranged from 82% to 100% with a mean of 91%. These reliability scores represent data collected on 15 of the 47 sessions, or 32% of the sessions (see Table 7).

Interobserver reliability for the covarying behavior of upper extremity weight bearing was 100%. These reliability scores represent data collected on 2 of the 4 sessions, or 50% of the

Table 7

Reliability Scores for Head Erect Behavior in the Prone Position for Lucy

Session	Reliability per Session	
	Head Lifts	Cumulative Duration
3(A)	100	82
3(B)	100	100
4(A)	100	92
4(B)	80	95
15	86	87
17	86	89
18	83	83
20	100	100
23(A)	100	—
23(B)	100	—
24	100	100
25(A)	100	86
25(B)	100	100
27(A)	80	83
27(B)	100	86
28(A)	92	92
28(B)	92	87
Mean Reliability	94	91

A: Data from first session of treatment twice a day

B: Data from second session of treatment twice a day

sessions. Interobserver reliability for frequency of head erect behavior during the upper extremity weight bearing probes ranged from 83% to 100%, with a mean of 92%. Interobserver reliability for cumulative duration ranged from 88% to 100%, with a mean of 94%. These reliability scores represent data collected on 4 of the 4 sessions, or 100% of the sessions (see Table 2).

Interobserver reliability for the frequency of head erect behavior during the wedged probes ranged from 93% to 100%, with a mean of 97%. Interobserver realibility for the cumulative duration of head erect behavior ranged from 98% to 100%, with a mean of 99%. These reliability scores represent data collected on 2 of the 3 sessions, or 67% of the sessions (see Table 3).

Interobserver reliability for the second covarying behavior, visual fixation ranged from 90% to 100%, with a mean of 95%. These reliability scores represent data collected on 4 of the 4 sessions, or 100% of the sessions (see Table 4).

Seizures. Interobserver reliability for the nonoccurence of seizure activity was 100% across all subjects and conditions.

Overall Interobserver Reliability. Interobserver reliability for frequency of head erect behavior in the prone position across all subjects ranged from 60% to 100%, with an overall mean of 93%. Interobserver reliability for cumulative duration of head erect behavior ranged from 57% to 100%, with an overall mean of 93% across all subjects.

Interobserver reliability for the upper extremity weight bearing probes ranged from 71% to 100%, with an overall mean of 97% across all subjects. Interobserver relilability for the frequency of head lifts during the unwedged upper extremity weight bearing probes ranged from 75% to 100%, with an overall mean of 91%. Interobserver realiability for the cumulative duration of head erect behavior during the upper extremity weight bearing probes ranged from 82% to 100%, with an overall mean of 95%.

Interobserver reliability for the frequency of head lifts during the wedged probes ranged from 90% to 100%, with an overall mean of 98%. Interobserver reliability for the cumulative duration of head erect behavior during the wedged probes ranged from 98% to 100%, with an overall mean of 99%.

Interobserver reliability for the visual fixation probes ranged from 80% to 100%, with an overall mean of 95% across subjects.

Performance Data

Performance data on the frequency and cumulative duration of head erect behavior for all subjects are presented in Tables 8 and 9.

Table 8 illustrates mean frequency and cumulative duration of head erect behavior across subjects for each of the three treatment conditions: once a day, first session of treatment twice a day, and second session of treatment twice a day.

Table 9 illustrates mean cumulative duration of head erect behavior during vibration (180 seconds) and immediately following

Table 8

Mean Frequency and Cumulative Duration of Head Erect Behavior During Intervention Sessions

	1x day			1st session of 2x day			2nd session of 2x day		
subjects	freq.	c.d.	%	freq.	c.d.	%	freq.	c.d.	%
Kristie	4	6	3%	4	4	2%	2	2	1%
Sally	10	139	77%	12	120	67%	12	112	62%
Kyle	15	87	48%	14	89	49%	15	81	45%
Lucy	7	46	26%	7	39	22%	8	55	30%

Table 9

Mean Cumulative Duration of Head Erect Behavior During Vibration (120 Seconds) and Following Vibration (60 Seconds)

	1x day				1st session of 2x a day (A)				2nd session of 2x day (B)			
Subjects	c.d. head erect during vibration	%	c.d. head erect post vibration	%	c.d. head erect during vibration	%	c.d. head erect post vibration	%	c.d. head erect during vibration	%	c.d. head erect post vibration	%
Kristie	5	4%	1	2%	3	3%	1	2%	2	2%	.3	.4%
Sally	93	77%	47	78%	83	69%	38	63%	75	62%	37	62%
Kyle	62	52%	25	42%	58	48%	31	52%	53	44%	28	47%
Lucy	28	23%	18	30%	27	23%	14	23%	33	28%	22	36%

vibration (60 seconds) across all subjects for each of the three treatment conditions.

Subject 1 (Kristie)

Frequency of Head Erect Behavior. Table 8 presents performance data on the mean frequency of head lifts across treatment conditions for Kristie. Mean frequency of head lifts were equal during treatment once a day and the first sessions of treatment twice a day (four head lifts). The mean frequency of head lifts dropped slightly (two head lifts) during the second session of treatment twice a day.

Cumulative Duration of Head Erect Behavior. Table 8 presents performance data on the cumulative duration of head erect behavior across treatment conditions for Kristie. The mean cumulative duration of head erect behavior was 6 seconds (3%) during treatment once a day, four seconds (2%) during the first session of treatment twice a day, and two seconds (1%) during the second session of treatment twice a day.

Kristie's mean cumulative duration of head erect behavior during vibration was 5 seconds (4%) during treatment once a day, three seconds (3%) during the first sessions of treatment twice a day, and two seconds (2%) during the second session of treatment twice a day. Mean cumulative duration of head erect behavior post vibration was one second (2%) following treatment once a day and the first session of treatment twice a day. Following the second session of treatment twice a day mean cumulitive duration of head erect behavior was .3

seconds (.4%) (see Table 9).

Upper Extremity Weight Bearing Probes. No upper weight bearing positions were recorded during four probes on this covarying behavior (see Table 10).

Frequency of head erect behavior during the unwedged upper extremity weight bearing probes ranged from 0 to 4, with a mean frequency of two head lifts per probe. Cumulative duration of head erect behavior during the probes ranged from 0 to 1 second, with a mean cumulative duration of .5 seconds of head erect behavior.

Wedged Probe. No head lifts were recorded during the wedged probe (see Table 11).

Visual Fixation Probes. Probes on this covarying behavior were conducted four times. Kristie consistantly (100%) passed items 1 and 2, momentary and prolonged regard. She consistantly (75-100%) failed the remaining visual fixation items including horizontal, vertical, and circular tracking, and glancing from one item to another (see Table 12).

Subject 2 (Sally)

Frequency of Head Erect Behavior. The mean frequency of head lifts during treatment once a day (10 lifts) was slightly less than the mean frequency during the first and second sessions of treatment twice a day (12 lifts) (see Table 8).

Cumulative Duration of Head Erect Behavior. The mean cumulative duration of head erect behavior was 139 seconds (77%) during

Table 10

Upper Extremity Weight Bearing Positions and Frequency and Cumulative Duration of Head Erect During Unwedged Probes

Subject	Session	Total # positions recorded	No Arm Support	Class I	Class II	Frequency Head Lifts	C.D. Head Erect
Kristie	1	1	1	--	--	1	.3
	6	1	1	--	--	2	.3
	11	1	1	--	--	3	1
	21	--	--	--	--	--	--
	mean	1	1	--	--	2	.4
Sally	1	22	--	11	11	8	148
	6	5	--	5	--	18	101
	11	7	4	3	--	12	23
	21	10	5	2	3	6	63
	mean	11	2	5	4	11	84
Kyle	1	1	1	--	--	2	2
	6	1	1	--	--	1	1
	11	1	1	--	--	9	8
	21	2	1	1	--	6	5
	31	1	1	--	--	12	19
	mean	1	1	--	--	6	7
Lucy	1	2	1	1	--	3	13
	6	6	3	3	--	6	130
	11	1	1	--	--	6	13
	21	2	1	1	--	8	38
	mean	3	2	1	--	6	49

Table 11

Frequency and Cumulative Duration of Head Erect Behavior Across Subjects during Wedged Probes

subject	session	frequency head lifts	cumulative duration
Kristie	16	0	0
Sally	16	13	128
Kyle	16	14	104
	23	19	73
	26	16	78
	mean	16	85
Lucy	16	10	30
	20	0	0
	26	15	104
	mean	8	47

Table 12
Visual Fixation Performance Data
Across Subjects

			visual fixation score								
subject	session	item: 1	2	3	4	5	6	7	8	9	10
Kristie	2	P	P	F	F	F	F	F	F	F	F
	7	P	P	F	P	P	F	F	F	F	P
	12	P	P	P	F	F	P	F	F	F	F
	22	P	P	F	F	F	F	F	F	F	F
	% passed	100	100	25	25	25	25	0	0	0	25
Sally	2	P	P	P	F	F	F	F	F	F	P
	7	P	P	F	F	F	F	F	F	F	P
	12	P	P	P	F	F	F	F	F	F	F
	22	P	P	F	F	F	P	F	F	F	F
	% passed	100	100	50	0	0	25	0	0	0	50
Kyle	2	P	P	P	P	P	F	F	F	F	P
	7	P	P	F	P	F	F	F	F	F	P
	12	P	P	F	F	F	F	F	F	F	F
	22	P	P	F	F	F	F	F	F	F	F
	32	P	P	F	F	F	F	F	F	F	F
	% passed	100	100	20	40	20	0	0	0	0	40
Lucy	2	P	F	F	P	F	F	F	F	F	F
	7	P	P	F	F	F	F	F	F	F	F
	12	P	P	F	F	F	F	F	F	F	F
	22	P	F	F	F	F	F	F	F	F	F
	% passed	100	50	0	25	0	0	0	0	0	0

treatment once a day, 120 seconds (67%) during the first session of treatment twice a day, and 112 seconds (62%) during the second session of treatment twice a day (see Table 8).

Sally's mean cumulative duration of head erect behavior during vibration was 93 seconds (77%) during treatment once a day, 83 seconds (69%) during the first session of treatment twice a day, and 75 seconds (62%) during the second session of treatment twice a day. Mean cumulative duration of head erect during post vibration was 47 seconds (78%) following treatment once a day, 38 seconds (63%) following the first session of treatment twice a day, and 37 seconds (62%) following the second session of treatment twice a day (see Table 9).

Upper Extremity Weight Bearing Probes. A decreasing trend in the frequency of upper extremity weight bearing positions is noted across the four probes on this covarying behavior. The ranges of frequency of upper extremity weight bearing positions was 5 to 22, with a mean of 11 upper extremity weight bearing positions per probe.

Class I behaviors (forearm props) occurred during every probe, ranging from 20% to 100%, with a mean frequency of 53% of recorded positions. The frequency of Class II behaviors (extended arm props) ranged from 0% to 50%, with a mean frequency of 20% of the recorded positions. The frequency of bilateral no arm support positions ranged from 0% to 50%, with a mean frequency of 27% of recorded positions. Bilateral no arm support positions occurred only during the third and fourth probes. At these times, the no arm support position was the primary position recorded (50% and 57% of recorded positions). During these probes Sally often moved in and out of the no arm support position when changing positions. The frequency of upper extremity weight bearing positions with the right arm in the nonsupportive position while the left arm was in a supporting position was 47% of all recorded upper extremity positions across four probes. The frequency of the left arm in a nonsupportive position while the right arm was in a supportive position was 2% of all recorded upper extremity positions across all four probes.

Frequency of head erect behavior during the unwedged upper extremity weight bearing probes ranged from 6 to 18, with a mean frequency of 11 head lifts per probe. Cumulative duration of head erect behavior during the probes ranged from 23 to 148 seconds, with a mean cumulative duration of 84 seconds (see Table 10).

Wedged Probe. During the wedged probe 13 head lifts with a cumulative duration of 128 seconds of head erect behavior (71%) was recorded (see Table 11).

Visual Fixation Probe. Probes on this covarying behavior were conducted four times. Sally consistently (100%) passed items 1 and 2, momentary and prolonged regard. Sally inconsistently (50%) passed items 3 and 10, horizontal eye coordination (red ring), and glancing from object to another. Sally consistently (75-100%) failed the remaining six items on the visual fixation code (see Table 12).

Subject 3 (Kyle)

Frequency of head erect behavior. Mean frequencies of head lifts were equal during treatment once a day and a second session of treatment twice a day (15 head lifts). The mean frequency of head lifts dropped slightly (14 head lifts) during the first session of treatment twice a day (see Table 8).

Cumulative Duration of Head Erect Behavior. The mean cumulative duration of head erect behavior was 87 seconds (48%) during treatment once a day, 89 seconds (49%) during the first session of treatment twice a day, and 81 seconds (45%) during the second session of treatment twice a day (see Table 8).

Kyle's mean cumulative duration of head erect behavior during vibration was 62 seconds (52%), 58 seconds (48%), and 53 seconds (44%) during treatment once a day, and the first and second sessions of treatment twice a day. Mean cumulative duration of head erect behavior during post vibration was 25 seconds (42%), 31 seconds (52%), and 28 seconds (47%) following treatment once a day, and following the first and second sessions of treatment twice a day (see Table 9).

Upper Extremity Weight Bearing Probes. No upper extremity weight bearing positions, with the exception of a single Class I (forearm prop) position, were recorded during five probes on this covarying behavior.

Frequency of head erect behavior during the unwedged upper extremity weight bearing probes ranged from 1 to 12, with a mean frequency of 6 head lifts per probe. Cumulative duration of head erect behavior during the probes ranged from 1 to 19 seconds, with a mean cumulative duration of 7 seconds of head erect behavior (see Table 10).

Wedged Probes. Frequency of head lifts during the three wedged probes ranged from 14 to 19, with a mean frequency of 16 head lifts per probe. Cumulative duration of head erect behavior during the wedged probes ranged from 73 to 104 seconds, with a mean cumulative duration of 85 seconds of head erect behavior per probe (see Table 11).

Visual Fixation Probes. Probes on the covarying behavior were conducted five times. Kyle consistently (100%) passed items 1 and 2, momentary and prolonged regard. He inconsitently (40%) passed items 4 and 10, vertical eye coordination (red ring), and glancing from one object to another. Kyle consistently (80-100%) failed the remaining six items on the visual fixation code (see Table 12).

Subject 4 (Lucy)

Frequency of Head Erect Behavior. Mean frequency of head lifts were equal during treatment once a day and the first session of treatment twice a day (7 head lifts). The mean frequency of head lifts increased slightly (8 head lifts) during the second session of treatment twice a day (see Table 8).

Cumulative Duration of Head Erect Behavior. Lucy's mean cumulative duration of head erect behavior was 46 seconds (26%) during treatment once a day; 39 seconds (22%), and 55 seconds (30%) during the first and second sessions of treatment twice a day. Lucy was the only subject whose cumulative duration of head erect behavior increased rather than decreased from the first to the second session of treatment twice a day (see Table 8).

Lucy's mean cumulative duration of head erect behavior during vibration was 28 seconds (23%), and 27 seconds (23%), and 33 seconds (28%) during treatment once a day, and the first and second sessions of treatment twice a day. Mean cumulative duration of head erect behavior during post vibration was 18 seconds (30%), 14 seconds (23%), and 22 seconds (36%) following treatment once a day and following the first and second sessions of treatment twice a day (see Table 9).

Figure 4 presents Lucy's cumulative duration of head erect behavior performance data during the course of the study. This graphic depiction of Lucy's performance should be viewed in light of her motoric involvement, lack of verbal skills, and general unresponsiveness to stimulation. Lucy's initial performance, (up to and including session 11), while variable, resulted in a mean cumulative duration of 78 seconds of head erect behavior per session. A retrospective analysis of the data suggested that by session 12 Lucy was becoming ill. She was unable to communicate this, as she had not cried or fussed since birth. Performance data recorded by

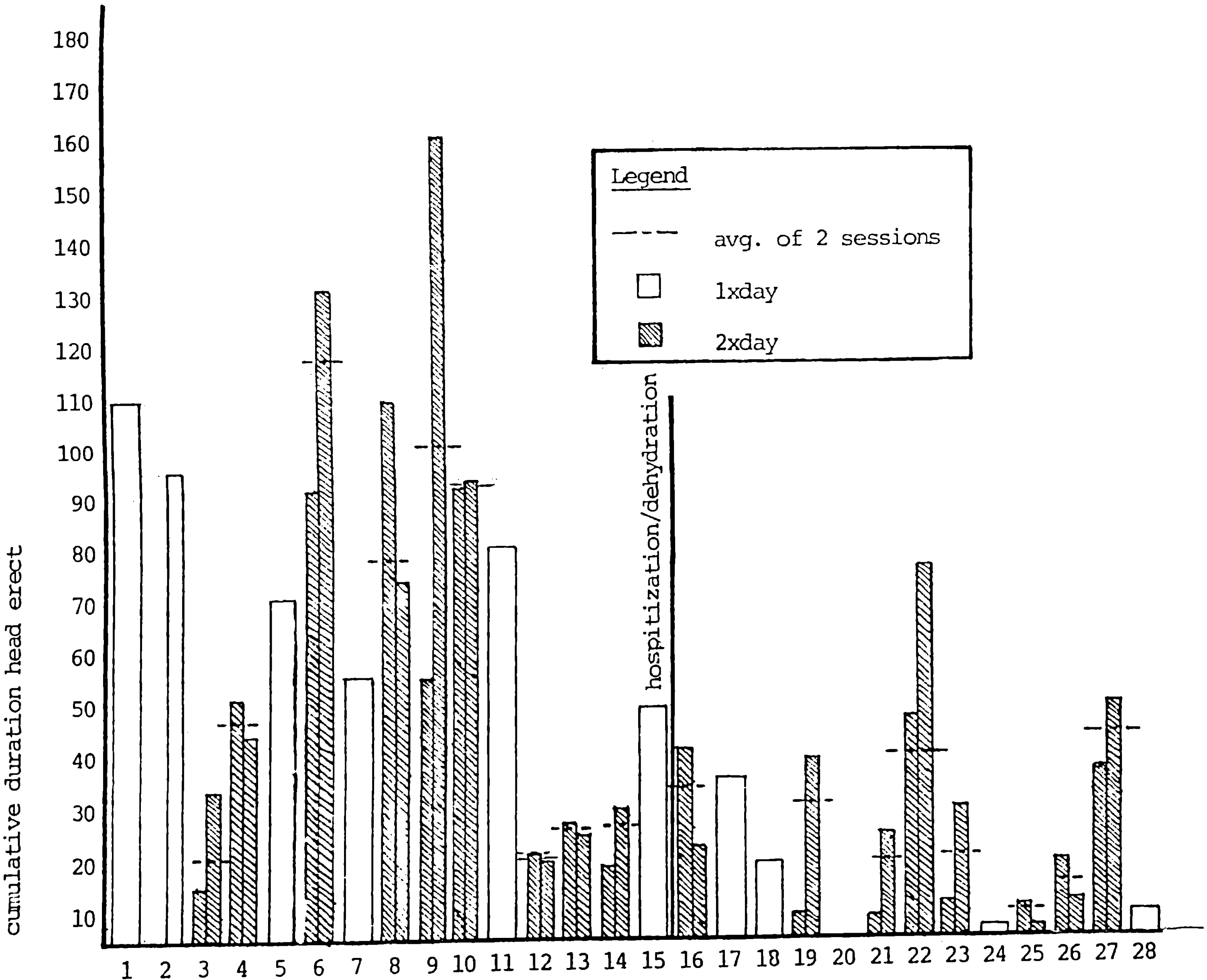

Figure 4. Lucy's cumulative duration of head erect across treatment conditions

educational staff also reflected a dramatic decrease at that time. Lucy was hospitalized by the end of the week for severe dehydration. Following her hospitalization Lucy got a cold and was occasionally absent. At the conclusion of the study Lucy had not yet returned to initial performance levels.

Upper Extremity Weight Bearing Probes. Four probes on this covarying behavior revealed the following performance data: mean frequency of no arm support was 63% of all recorded positions; mean frequency of Class I (forearm prop) positions was 38% of all recorded positions. No Class II postions were recorded.

Frequency of head lifts during the unwedged upper extremity weight bearing probes ranged from 3 to 8, with a mean frequency of 6 head lifts per probe. Cumulative duration of head erect behavior during the probes ranged from 13 to 130 seconds, with a mean cumulative duration of 49 seconds of head erect behavior per probe (see Table 10).

Wedged Probes. Frequency of head lifts recorded during the three wedged probes ranged from 0 to 15, with a mean frequency of 8 head lifts per probe. Cumulative duration of head erect behavior during the wedged probes ranged from 0 to 104 seconds, with a mean cumulative duration of 71 seconds of head erect behavior per probe (see Table 11).

Visual Fixation Probes. Probes on this covarying behavior were conducted four times. Lucy consistently (100%) passed item 1, momentary regard. She inconsistently (50%) passed item 2, prolonged regard. Lucy consistently (75-100%) failed the remaining 8 items on the visual fixation code (see Table 12).

Statistical Significance

The Froedman Two-way Analysis of Variance (Siegel, 1956) revealed no statistical significance between any of the treatment conditions or probes for any of the subjects.

CHAPTER IV

DISCUSSION

An alternating treatment design was used to investigate the effects of the frequency of vibration application on the acquistion of head erect behavior in prone. In this chapter results from the reliability data are summarized. Performance measures across subjects and treatment conditions are discussed in reference to investigative questions: 1) Does an increased frequency of vibration application result in a cumulative effect leading to an increased rate of acquistion of the target behavior?; and 2) Are the effects of vibration apparent only while the muscle is being vibrated? A final issue involved the measurement of covarying behaviors in relation to question 3) Does the acquisition of head erect behavior in prone facilitate the development of other important behaviors? The subject's handicapping conditions as they relate to the effects of vibration are considered. Limitations of the study and suggestions for future research are included.

Measures of Interobserver Reliability

The target behavior of head erect involved the simultaneous measurement of frequency of head lifts, and cumulative duration of head erect behavior in a three minute session.

Head Erect Behavior. Interobserver reliability scores for the frequency of head lifts and cumulative duration of head erect were consistently high across subjects and treatment conditions. Mean reliability scores for the frequency of head lifts ranged from 91% to 94%, with an overall mean of 93%; for cumulative duration scores ranged from 91% to 95%, with an overall mean of 93%.

Upper Extremity Weight Bearing Probes. Interobserver reliability scores for upper extremity weight bearing probes were consistently high across subjects. Mean reliability scores ranged from 86% to 100%, with an overall mean of 97%. Reliability scores for Kristie, Kyle, and Lucy were 100% during each probe period. These reliability scores were high due to agreement that the main position demonstrated was head erect with no arm support. More variability was noted with Sally's reliability scores. Sally's upper extremity weight bearing positions were more difficult to record due to the speed in which she moved through positions.

Mean interobserver reliability scores for the frequency of head lifts and cumulative duration of head erect during the upper extremity weight bearing probes were consistently high across subjects. Mean reliability scores for the frequency of head lifts ranged from 85% to 94%, with an overall mean of 91%; for cumulative duration scores ranged from 93% to 100%, with an overall mean of 95%. These reliability scores during the upper extremity weight bearing probes were consistent with the reliability scores for frequency and cumulative duration of head erect behavior during treatment. The simultaneous measurement of an additional behavior did not compromise interobserver reliability.

Wedged Probes. Mean interobserver reliability for the frequency of head lifts and the cumulative duration of head erect during the wedged probes were consistently high across subjects. Mean reliability scores for the frequency of head lifts ranged from 95% to 100%, with an overall mean of 98%; for cumulative duration scores ranged from 98% to 100%, with an overall mean of 99%.

Visual Fixation Probes. Mean interobserver reliability scores across subjects for visual fixation were consistently high. Mean reliability scores ranged from 93% to 98%, with an overall mean of 95%.

Performance Data.

Head Erect Behavior. Mean performance data during intervention did not yield statistically significant differences between treatment conditions. However, a trend was observed in three of the four subjects regarding the effects of increased frequency of vibration application.

Cumulative Duration During Vibration. Kristie, Sally and Kyle demonstrated a slight descending trend in cumulative duration of head erect during vibration across treatment conditions. The highest mean cumulative duration of head erect was recorded during treatment once a day. All three subjects' mean cumulative duration of head erect decreased slightly during the first session of treatment twice a day; a further slight decrease was observed during the second session of treatment twice a day.

Lucy's mean cumulative duration of head erect behavior during the second session of treatment twice a day was slightly higher than her mean cumulative durations during treatment once a day and the first session of treatment twice a day. Lucy is the only subject who demonstrated a cumulative effect with increased frequency of vibration application.

A cumulative effect with increased frequency of vibration application was not observed with the other three subjects. Rather, they demonstrated a slight descending trend in mean cumulative duration from the first session to the second session of treatment twice a day.

Although it was anticipated that mean cumulative duration measures would be equal during treatment once a day and the first session of treatment twice a day, Lucy was the only subject who demonstrated equal mean cumulative duration measures during these two sessions. The other three subjects demonstrated a slight descending trend in mean cumulative duration from treatment once a day to the first session of treatment twice a day.

Due to the random alternation of treatment once and twice a day as well as the alternation of morning and afternoon sessions it is unlikely that fatigue is a contributing factor in the lower mean cumulative duration during the first session of treatment twice a day as compared to the mean cumulative duration during treatment once a day. However, fatigue may have contributed to the lower mean cumulative duration of head erect during the second session of treatment twice a day as compared to the mean cumulative duration during the first session of treatment twice a day. Analysis of data from the morning and afternoon sessions did not reveal a difference in performance.

Cumulative Duration of Head Erect Behavior Post Vibration. Each subject's pattern of mean cumulative duration measures post vibration across treatment conditions was slightly different; no trend was observed.

Sally's pattern of mean cumulative duration measures for the post vibration period across treatment conditions paralleled the descending trend of mean cumulative duration during vibration. A slight decrease in mean cumulative duration was noted from treatment once a day, to the first session of treatment twice a day, to the second session of treatment twice a day.

Kristie's mean cumulative duration measures were equal during treatment sessions once a day and the first session of treatment twice a day. A slight decrease in mean cumulative duration occurred during the second session of treatment twice a day.

Kyle's mean cumulative duration measures displayed an increase from treatment once a day to the first session of treatment twice a day. This was followed by a slight decrease in mean cumulative duration during the second session of treatment twice a day.

Lucy's mean cumulative duration decreased slightly from treatment once a day to the first session of treatment twice a day. Mean cumulative duration increased slightly following the second session of treatment twice a day.

Despite the variability of the patterns of mean cumulative duration post vibration across treatment conditions, each subject's percent of head erect behavior during and following vibration were relatively equal within subjects. The effects of vibration were apparent during and immediately following treatment.

Upper Extremity Weight Bearing. Data on the frequency and topography of upper extremity weight bearing positions during head erect and prone (unwedged) were collected across subjects in the form of probes. This was done in an attempt to study potential covariations in head erect behavior and upper extremity weight bearing. Rues (1981) hypothesized that an arm position measurement code may provide an early quantitative differentiation between varying types of handicapping conditions.

Kyle, a child with spastic quadriplegia, and Kristie, a child with spastic quadriplegia with fluctuating muscle tone demonstrated no upper extremity weight bearing positions. Lucy, a child with spastic quadriplegia inconsistently demonstrated occasional Class I (forearm prop) positions. Sally, a child with spastic quadriplegia with fluctuating muscle tone demonstrated upper extremity weight bearing positions during the study. She displayed a mean of 11 upper extremity weight bearing positions per probe, which corresponds with a mean of 11 head lifts per probe. The frequency of Class I positions (forearm props) was 45% of all recorded positions; Class II positions (extended arm props) were 36% of all recorded positions; and no arm support positions were 18% of recorded arm positions.

Sally demonstrated a decreasing trend in the frequency of upper extremity weight bearing positions across the probes. This decrease corresponds to a marked decreased in cumulative duration of head erect during the final two probes, and the occurance of no arm support positions. Sally also demonstrated a marked preference for upper extremity weight bearing positions with the left arm in a supportive (propped or extended) position, and the right arm in a non supportive position. This predominant asymmetrical upper extremity weight bearing was due to Sally's strong Asymmetrical Tonic Neck Reflex to the left.

Kristie, Kyle and Lucy rarely if ever demonstrated upper extremity weight bearing. None of these three demonstrated acquisition of the target behavior: head control in prone; overall head erect behavior occurred less than 50% of the time during the 180 second intervention sessions. Rues (1981) found that stability of head erect preceded the emergence of upper extremity weight bearing patterns in nonhandicapped infants and children.

Additionally, each subject's particular type and degree of muscle tone abnormalitly related to their performance. Kristie had spastic quadriplegic with fluctuating muscle tone. She was also an extremely medically fragile child. Her quick, random flinging movements were often of large amplitude and appeared quite uncontrolled. Kristie's extremely low performance data do not accurately reflect her frequent attempts to lift her head. She was unable to remain in the erect position without resting or touching her shoulders, or the lateral supports of the wedge. Her head control was so limited that it was highly unlikely for Kristie to develop upper extremity weight bearing patterns.

Kyle and Lucy both presented with spastic quadriplegia. Neither of these children displayed much movement, either spontaneously or when elicited. Similar to Kristie, both Kyle and Lucy exhibited low rates of head erect during intervention. The low rates of head erect may have contributed to the lack of upper extremity weight bearing patterns.

Sally also had spastic quadriplegia with fluctuating muscle tone. She displayed frequent, somewhat controlled spontaneous movements. She was also a very socially responsive child. Sally's performance data during intervention indicated that she consistently demonstrated high levels of head erect behavior with is a prerequisite for upper extremity weight bearing.

Wedged Probes. Data on the frequency and cumulative duration of head erect behavior while wedged (and not vibrated) were collected across subjects. Like the unwedged probes, at least 15 minutes lapsed between treatment and this probe. This probe was initiated later into the study to provide information regarding the positional advantages of the wedge.

Kristie displayed no head lifts during this probe; this is not unlike her behavior during the wedged probes or during the treatment sessions.

The similarity of Kyle's head erect behavior during the wedged probes and during treatment in contrast with his poor performance during the unwedged probe raised a question: could it have been the wedge and not the vibration which facilitated his head erect behavior. This question remains unanswered due to several factors including: 1) the late initiation of the wedged probes, and therefore the limited amount of performance data during this probe; 2) the possibility that post vibration potentiation was being measured. Previous research (Eklund et al., 1969; and Burke et al., 1972) found that the effects of vibration lasted from twenty minutes to two hours following treatment, particularly if the individual remained active. The positions and activities Kyle engaged in following treatment and prior to the probe was variable and depended on the classroom routine.

Lucy's performance during the wedged probes was variable, from 0 to 104 seconds cumulative duration head erect. However, her mean performance across treatment, wedged and unwedged probes was very similar. This again raised several unanswered question: 1) Since the wedged probes were initiated past the mid point of the study, was there a maintenance effect? 2) Since Lucy's mean performance was relatively equal during treatment and wedged and unwedged probes, did either vibration and/or the wedge have a major contribution in facilitating her head erect behavior.

Sally's performance during the single wedged probe was similar to her mean performance during intervention; her mean performance during the unwedged probes was slightly lower. It seems that the wedge may have contributed in the facilitation of Sally's head erect behavior, or that possibly the post potentiation effects of vibration were being measured.

Visual Fixation. Data on the occurence/nonoccurence of visual fixation were collected across subjects as an additional covarying behavior during the study. No clear trends or improvements were observed with any of the subjects. Only Item 1, momentary regard was consistantly (100%) passed by all four subjects. Item 2, prolonged regard, was fairly consistently (mean 88%) passed by all four subjects.

Effects of Vibration Across Handicapping Conditions

Although vibration is a widely used clinical tool there is little empirical evidence available to validate it's effectiveness. Important in applied research of this nature is the documentation of differential effects across handicapping conditions. Previous research (Cannon, 1982; Hagbarth and Eklund, 1966, 1968; Eklund and Steen, 1969; Burke et al., 1972) has suggested the effectiveness of vibration in counteracting the effects of spasticity or hypertonicity. Little research has investigated the effects of the frequency of vibration application on the acquisition of motor skills.

In this study the frequency of vibration application was randomly alternated between once and twice a day. Three of the four children in this study demonstrated no cumulative effects with increased frequency of vibration application. Rather, there was a slight descending trend with increased frequency of vibration application possibly reflecting fatigue. The fourth subject demonstrated a slight ascending pattern with increased frequency of vibration application possibly reflecting a cumulative effect.

Kristie's low rate of performance throughout the study may have been related to her inability to overcome gravity. It seems that the prone position may not have been the optimum position to work on head control with Kristie.

Lucy's performance during intervention changed dramatically approximately midway through the study (session 12). This rapid decrease in performance was related to the onset of illness. It is noteworthy that while Lucy was unable to communicate any signs or symptoms of her illness, performance data both for this study as well as data taken by classroom educational staff reflected an immediate decrease. Lucy's performance data following a brief hospitalization never returned to her pre-illness levels; this may have been a result of her weakness and prolonged congestion following her illness. This incident suggests that systematic data collection may be useful tool in the monitoring and detection of illness in children with severe and multiple handicaps. Children who are unresponsive, such as Lucy, are unable to communicate, and their affect, or lack of it may not be a reliable indicator of their general health.

Limitations of the Study

Limitations are discussed in relation to the number and type of subjects, and equipment utilized.

A larger number of subjects, and the inclusion of subjects with a variety of muscle tone abnormalities (e.g. athetosis, hypotonicity) would provide better information regarding the effects of the frequency of vibration application across handicapping conditions.

A systematic collection of data regarding each subjects general health for each session would aid in controlling extraneous factors. Additionally these data could possibly provide information regarding the variability of performance by allowing for a correlational check between illness and depressed performance. Notation of the type of activity in which each subject was engaged in prior to and following treatment would provide information regarding fatigue as well as the prolonged effects of vibration in relation to activity.

The inclusion of baseline measures would provide more information for comparison of the effects of frequency of vibration application, as well as comparison of performance during and following vibration.

The use of the wedge to place the neck extensors on stretch may have provided a positional advantage to the subjects allowing them to lift their heads more easily. More frequent wedged probes would have provided more information regarding the contribution of the wedge to head erect behavior.

The utilization of an EMG machine would have provided documentation regarding the elicitation of the TVR in each subject.

Implications for Future Research

Future research in this area is needed to address several areas. Further quantifications of the effects of frequency of vibration application across handicapping conditions is indicated. EMG documentation of the neurophysiological effects of vibration would add important information to a vibration study.

The positional effects of the wedge on the acquistion of head erect behavior needs further consideration. A study comparing head erect behavior while wedged, with head erect behavior while wedged and vibrated would begin to outline the facilitory effects of placing the muscles on a stretch.

Finally, a comparison of the effects of vibratory facilitation of head erect in the prone position in comparison to the supported sitting position across handicapping conditions would provide information regaring aquisition of the skill in different positions with differing gravitational influences.

CHAPTER V

SUMMARY

Vibration is a therapeutic technique frequently used in the treatment of individuals with motor handicaps.

The effect of the frequency of vibration application on the acquisition of head erect behavior in the prone position was studied in four preschool children with multiple handicaps. All four children presented with spastic quadraplegia, two with fluctuating muscle tone.

An alternating treatment design was utilized; intervention sessions randomly adternated between treatment once and twice daily. Vibration was alternately applied to the right and left paraspinal neck and upper back extensors, from the occiput to the fifth thoracic vertibrae for two minutes with the child positioned prone over a wedge. The frequency of head lifts and the cumulative duration of head erect behavior were recorded during the two minutes of vibration and for an additional minute following vibration.

Results of the study indicated no statistically significant differences in head erect behavior across treatment conditions, across subjects. However, a slight descending trend in cumulative duration of head erect behavior was observed in three of the children across treatment conditions, possibly reflecting fatigue. The fourth child demonstrated a slight ascending trend of cumulative duration of head erect behavior during the second session of treatment twice a day as compared to performance during treatment once a day and the first session of treatment twice a day, possibly reflecting a cumulative effect with increased frequency of vibration application.

Probes on the two covarying behaviors of upper extremity weight bearing and visual fixation revealed no clear trends or improvements. The late initiation of wedged probes during the course of the study revealed limited information regarding the positional facilitory effects of the wedge on head erect behavior. The wedge was thought to possibly facilitate head erect behavior by placing the neck and upper back extensors on a stretch. This area needs further consideration.

Limitations of the study were discussed and implications for future studies given.

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Appendix A

Consent Form

INFORMED CONSENT

1. As legal guardian of this child, I, ____________________ (name of legal guardian) hereby consent to the inclusion of ____________________ (name of child) in the study of the effects of vibration on the ability of handicapped children to hold their heads erect as described on the previous page.

2. I acknowledge that no guarantees have been made to me reguarding the results of this procedure.

3. I understand that skin irritation is apossible side effect of vibration, and that if any irritation occurs, vibration will be stopped and I will be notified.

4. I understand that I may withdraw my child from this study at any time.

5. I understand that the University of Kansas Medical Center, College of Health Sciences and Hospital does not maintain a policy of medical treatment or compensation for physical injuries incurred as a result of participating in biomedical or behavioral research.

6. I grant permission for the researcher to do the following:

   A. Take photographs of my child yes_______no_______

   B. Take videotapes of my child yes_______no_______

7. This form has been fully explained to me and I certify that I understand its contents.

____________________ (signature of person legally authorized to consent for child)

____________________ (date)

____________________ (relationship to child)

____________________ (signature of witness)

____________________ (signature of researcher)

Dear ______________________________,

I am a registered occupational therapist completeing my graduate studies in special education. I am interested in conducting a study on vibration. Specifically, I am interested in studing the effects of vibration on the ability of handicapped children to raise their heads.

In the proposed study I plan to apply vibration to selected muscles of the back and neck. Vibration will stimulate the muscles which help raise the head and neck. The duration of vibration will not exceed 2 minutes at any one time to prevent possible skin irritation. This treatment does not cause pain, discomfort, or electric shock.

During and immediately after vibration I will measure how long each child can hold his/her head up. Vibration will be applied approximately 6 times weekly. The data will be recorded approximately 3 times weekly, for approximately 4 months at your childs school. Each session will last 15-30 minutes.

Your child will not be identified by name in this study, and any tape recordings, photographs, or videotapes will be used only for purposes of collecting information, training other students to take information on head erect, and for presentation to my thesis committee. These tapes and photographs will be filed at the Childrens' Rehabilitation Unit at the University of Kansas Medical Center.

If you are interested in your child participating in this study, please indicate on the attached sheet. I will be available throughout the study to discuss the data collected on your child.

Sincerely,

Jeanne M. Kloeckner

Appendix B

Vibrator Specifications

VIBRATOR	SETTING	HERTZ	AMPLITUDE	STROKE PATTERN	WEIGHT	NOISE	HEAD SIZE	HEAD TYPE	POWER SOURCE	RATING	PRICE	COMMENTS
Oster 217-02	Lo	119	0.5mm	L //	1#	44-50	35mms 42mmcr 45mmdc 65 mmsc 55 mmTc	semi Flexible *	110VAC		$13	TVR DEM
	Hi	119	1.5mm	L //								
Fred Summers BK-5206	Lo	100 ps 87	2.2mm ps	O	1# 2℥		51mmd	rigid plastic	110 VAC		$43	
	Hi	130 ps 109	2.2 mm ps	O								
FRED SAMMONS BK 5207	Lo	73 ps 63,3	—	O	8℥	67-71	35mmc	rigid plastic	2 "C" BATTERIES		$7.50	
	Hi	53 ps 112,2	—	O		73-78						
Fred Sammons BK 5211	—	68 111,1		O	8℥	71-75	35mm c	rigid plastic	2 "C" BATTERIES		$6.50	
Fred Summers BK 5203 (Hitatchi Magic Wand)	Lo	83 ps 63,9	1,5 ps	O	1# 5℥	57-61	70MMS	soft Plastic foam	110 VAC		$43	
	Hi	100. 86,5	2,5 ps	O		64-68						
WAHL 4190 5 in 1	—	118	1,0mm	L /	1# 2℥	68-5-74 db	62mm 45mmdc 41mmcr 57mmsc 56mmTc	Flexible *	110VAC		$10.	heat applicator TVR DEM
Sears (BHH 2255) Orbital heat massager	Lo			O	2# 3℥				110VAC		$35	heat
	Hi			O								
Vibrosage Beauty Appliance corp Racine Wisc	—	116	?	L //	1# 3℥	68-73	63mms	hard plastic	110 VAC		?	TVR DEM

Sobsey, 1981

Appendix C

Sequence of Intervention Activities

Sequence of Vibratory Stimulating Activities

1. Upper body clothing (shirts and undershirts) are removed.

2. The child is placed in the prone position over a vinyl covered wedge with lateral supports.

3. A sandbag is placed across the child's pelvis for maintenance of the prone position, and to prevent the child from rolling off the wedge.

4. The child's elbows are flexed to approximately 90 degrees with forearms resting on the floor, or on a positioning shape if the arms if the arms do not reach the floor when elbows 90 degrees.

5. The beginning (occupit) and ending points (fifth thoracic vertibrae) of vibration are palpated and marked with a small dot from a marker.

6. Observers are in the prone position directly in front of the child, using toys and social reinfocement to elicit and reinforce head erect behavior.

7. The tape recorder is activated. A prerecorded tape indicates the start of the intervention session.

8. Vibratory stimulation is applied to the paraspinal muscles from the occiput to the fifth thoracic vertibrae. Vibration is applied alternately to the right and left paraspinal muscles for the duration of two minutes.

9. During the two minutes of vibration and for one minute following vibration an observer(s) records the frequency and cumulative

duration of head erect behavior.

10. Arms are repositioned when the child seems to be compromised and unable to independently change their nonhead erect position, and fingers are removed from the child's mouth.

11. The prerecorded tape indicates the passage of two minutes, signaling the cessation of vibration; as well as the passage of an additional 60 seconds signaling the end of the session.

Appendix D

Upper Extremity Weight Bearing Probe Data Sheet

NAME: BIRTHDATE: DATE:

OBSERVER(S): SETTING: RELIABILITY:

CODE:
↑ - no arm support
✓↑ - props on one forearm, other arm no support
✓✓ - props on forearms
✓| - props on one forearm and one extended arm
|| - props on extended arms
R - right arm
L - left arm

HEAD ERECT DESCRIPTORS			UPPER EXTREMITY WEIGHT BEARING DESCRIPTORS																		
Head Turns	Head Lifts	Cumulative Duration: Head Erect or	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	TOTAL
			↑	↑	↑	✓	✓	↑	✓	✓	✓	|	|	✓	|	|	↑	|	|	↑	
TOTAL																					

Appendix E

Visual Fixation Code
and Data Sheet

Visual Fixation Code

Momentary regard of red ring. Suspend the red ring by its string so that the lower edge of the ring is about 8 inches above the child's eyes as he lies on his back. Try to catch his gaze by moving the ring into new positions. Keep it slowly and gently in motion. (If the child's regard of the ring is prolonged, give credit for item 7 and procede to item 8).

Credit If the child regards the ring momentarily.

Prolonged regard of red ring. Administer as in item 5.

Credit if the child gives the ring more than a momentary glance, and looks at it for several seconds. If his eyes follow the ring through the complete horizontal excursion of item 8, this would be considered prolonged regard.

Horizontal eye coordination: red ring. When the child's eyes are on the red ring, move it slowly back and forth, right-to-left-to-right, several times (taking three or four seconds to move approximately one foot), about eight inches above the child's face. (Follow immediately with item 14.)

Credit if the child's eyes definately follow the moving ring through several excursions, even those his gaze may break away once or twice as at the end of an excursion.

Vertical eye coordination: red ring. (Administer immediately after item 8.) Move the ring slowly back and forth from chest to forehead several times along the child's midline, in a plane eight inches above him. (Follow immediately with item 16.)

Credit if the child's eyes follow the ring for several excursions

Circular eye coordination: red ring. (Administer immediately after item 14.) Move the ring in a circle about 12 inches in diameter above the child's eyes making several complete excursions. If his eyes leave the ring, move it into his gaze and resume circling when he has again focused on the ring.

Credit if the child follows this circular motion in both the upper and lower halves of the circle, even though his eyes may not follow in one continuous complete circle.

Turns eyes to red ring. With the child lying on his back, prop his head on each side with pillows or folded diapers so that his face is held upward. Lean over him, attract his gaze directly upward, then slowly move the red ring from the periphery toward his center of vision, first from one side then the other, maintaining a distance of twelve to fiften inches above his eyes. Note whether he turns his eyes at least 30 degrees to fixate upon the ring.

Credit if the child turns his eyes to each side when the red ring is at an angle of 30 degrees or more from the midline.

Horizontal eye coordination: light. Hold the small red shielded flashlight above the child's eyes to catch his gaze. Then move the light slowly back and forth, right-to-left-to-right, several times, about eight inches above the child's face. Take care not to direct the strong beam into his eyes.

Credit if the child's eyes definately follow the moving light through several excursions, even though his gaze may break away once or twice, as at the end of an excursion.

Vertical eye coordination: light. Move the light slowly back and forth from chest to forehead several times along the child's midline, in a plane about eight inches above him.

Credit if the child's eyes follow the light for several excursions in these up and down directions.

Cicular eye coordination: light. Move the light in a circle about twelve inches in diameter above the child's eyes, making several complete excursions. If his eyes leave the light, move it into his gaze and resume circling when he has again focused on the light.

Credit if the child follows the circular motion in both the upper and lower halves of the circle, even though his eyes may not follow in one continuous complete circle.

Glances from one object to another. While the child is lying in the crib prop his head midline, being careful not to block his ears. Hold the bell in one hand and the rattle in the other about fifteen inches apart, above his head. Gently shake one and then the other. Continue alternating between the bell and rattle several times, allowing several seconds between shakes for the child's eyes to move from one to the other.

Credit if the child's eyes move back and forth at least three times between the bell and rattle, in response to the sound of each.

Visual Assessment
Data Sheet

Childs Name ______________________ Examiner ________________

Date ____________________ Reliability ________________

Reference:
Bailey Test of Infant Development (Visual Component)

Materials:
Red ring
pen light
rattle
bell
scoring code

Item #	Ref.	Item title	pass	fail	other
1	D5	Momentary regard of ring			
2	D7	Prolonged regard of ring			
3	D8	Horizontal eye coordination: ring			
4	D14	Vertical eye coordination: ring			
5	D16	Circular eye coordination: ring			
6	D19	Turns eyes to ring			
7	F9	Horizontal eye coordination: light			
8	F12	Vertical eye coordination: light			
9	F15	Circular eye coordination: light			
10	AC34	Glances from one object to another			