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Increasing Head Extension with the Use of Automated Contingent Music

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INCREASING HEAD EXTENSION WITH THE
USE OF AUTOMATED CONTINGENT MUSIC

by

Susan Corman

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Submitted to the
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in partial fulfillment
of the
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INCREASING HEAD EXTENSION WITH THE
USE OF AUTOMATED CONTINGENT MUSIC

Susan Corman, M.A.
Western Michigan University, 1979

The experiment was an attempt to increase proper head posture using automated music as a reinforcer and to determine if this behavior would generalize to another setting.

Two cerebral palsy and mentally retarded subjects participated. Subject 1 was a 24-year-old female, while Subject 2 was a 17-year-old male.

The two conditions included in this study were Baseline (no-music), and Treatment (music contingent on proper head posture). Generalization (no-music) was assessed throughout all experimental conditions. Both subjects wore the mercury-switch head apparatus during Baseline, Treatment and Generalization sessions.

During Baseline, the overall mean percent of proper head posture for Subject 1 and Subject 2 was 4.5% and 27%, respectively. During Treatment, the overall mean percent of proper head posture for Subject 1 and Subject 2 was 24% and 60.5%, respectively. Generalization of this behavior to another setting did not result.
ACKNOWLEDGEMENTS

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Susan Corman
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WESTERN MICHIGAN UNIVERSITY, M.A., 1979
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INTRODUCTION

Disorders such as cerebral palsy, polo, muscular dystrophy and multiple sclerosis destroy and/or weaken the necessary muscles and tendons which control body posture and movement. People afflicted with these disorders are often assumed to be incapable of maintaining appropriate body movement and posture. For some cerebral palsyed individuals, upright head posture is made difficult because of the weak muscles controlling it. The natural reinforcement of making better contact with the environment may not be strong enough to overcome this deficiency. The literature reveals four basic approaches to the treatment of improper head posture.

The traditional treatment for cerebral palsyed patients is the use of orthotic braces which support the body and aid in movement and control of specific body parts. The Milwaukee brace was designed for the purpose of improving visual and hand control. Mital, Belkin and Sullivan (1976) fit nine patients exhibiting problems with head, neck and trunk control with this brace. Wearing this brace enabled all nine of the patients to sit upright, control normal head posture, utilize their hands more efficiently, and also facilitated transport of the patients.

Two aids recommended by Hoffer, Garrett, Koffman, Guilford, Noble and Rodon (1974) for sitting and head control are the body braces with a Cloverleaf head support, and with a Sayr Sling. Both permit minimal movement of the head, thus allowing the patient to sit vertically and to have contact with the environment directly in front of them. These authors believe that orthoses "are rarely effective in resisting im-
pending deformity, but may be used to buy time for preoperative evaluation and postoperative positioning."

Methods of treatment which employ exercise have been carried out by Bobath and Bobath (1956) and Johnson (1978).

Working within an operant paradigm, Kozlowski and Richman (1976) applied contingent praise, smiles, nods, tickles and stroking of the head and/or cheek to modify eye contact, imitative vocalization, and head extension. Halpern, Kottke, Burrell, Fiterman, Popp and Palmer (1970) applied praise and tangible rewards contingent on proper head posture to fourteen cerebral palsied patients wearing head braces.

While these techniques may be successful with some patients over extended periods, they are time-consuming and expensive. An efficient and cost effective treatment technique for muscular disorders employ operant treatment devices. They have several advantages over orthotic braces and traditional exercise treatments in that: 1. The portable device provides immediate and continuous feedback, 2. It permits the necessary muscles to be actively employed in postural control as opposed to passively supported by orthotic devices, 3. Treatment can be continuously operative in the patient's natural environment, 4. The expensive as well as time-consuming task of shaping muscle control and/or exercise activities is eliminated and 5. Using automated recording equipment provides an objective, continuous and precise evaluation of the behavior(s).

Investigators experimenting with and using operant treatment devices have modified leg flexion and extension (Ball, Combs, Rugh and Neptune, 1977), weight bearing (Rugel, Mattingly, Eichinger and May,
(1971), finger praxis (Ball and McCrady, 1975), slouching (Azrin, Rubin, O'Brien, Aallon and Roll, 1968), foot drags (Spearing and Poppen, 1974), gross head movements and spasms (Sachs and Mayhall, 1971), spasmodic torticollis (Brierly, 1967), and an habitual head tilt to the left (Russell and Wooldridge, 1975). These disorders were successfully modified using this treatment technique.

There have been recent investigations using operant treatment devices to increase proper head posture in cerebral palsyed individuals. Silverstein (1978) improved sitting posture and head extension with a 5-year-old female and a 5-year-old male cerebral palsyed subjects. A chair was constructed which detected sitting posture. Sitting posture was automatically reinforced with music and verbal feedback. Within sixteen, thirty minute sessions, Subject 1 increased sitting posture 62%. The percentage of sitting posture during Baseline was not given. Due to abnormal muscle patterns used to achieve proper sitting posture, the chair was equipped with a device which emitted a tone contingent upon improper head posture and music contingent upon proper head posture. Sitting properly as well as head extension were exhibited 50% of the time. Using a stabilometer connected to a straight-backed slope-seat chair, Subject 2 increased body stability from 15% to 80%. The stabilometer magnified the body movements which provided sensory feedback via the tilting table. A light mounted on a lap tray also provided feedback contingent on proper sitting posture. A mercury-switch head apparatus connected to a helmet was used to detect head posture. The subject was instructed to keep the light on and was praised for proper sitting and head posture. During thirty minute sessions, the
combined task behaviors increased from 2% during Baseline to 16% during Treatment. The results reported by this author demonstrated that sitting posture and head posture can be simultaneously increased. The results are difficult to interpret as it is not clear which variable(s): music, tone, light or praise increased sitting and head posture. It could be hypothesized that successful intervention for head control would result in the concurrent improvement of sitting posture as it is difficult to extend the head for long durations when the body is slouched.

Using a multi-element design, Murphy, Daughty and Nunes (1979) demonstrated that contingent music increased upright head posture with four female and two male multi-handicapped and profoundly retarded students. A photo-electric relay system monitored head positioning. The overall mean percent that all subjects held their head erect was 21% during Baseline and 65% during Treatment. Their study demonstrated the effectiveness of automated music contingent on proper head posture, however, the main purpose of their investigation was to demonstrate the efficiency of the multi-element design. Consequently, it is difficult to determine the long term effects of treatment as the study was conducted over a three week period. Generalization of this behavior to the natural environment was not assessed as the apparatus could only be used in the experimental setting.

Using a mercury-switch head apparatus connected to a transistor radio, Ball, McCrady and Hart (1975) implemented a head control training procedure with two cerebral palsied subjects; one 17-year-old and one 9-year-old. Both subjects wore body braces throughout the study. During the non-contingent music condition, Subject 1 held her head el-
evated for less than one minute out of every ten minute session. During the contingent music condition, her head was elevated for 9 of the 10 minutes. Subject 2 held his head elevated for an average slightly less than $\frac{3}{2}$ of the ten minutes during the non-contingent music condition. During the contingent music condition, his head was elevated or tilted backward (due to an error in the design of the apparatus) on the average of $\frac{7}{2}$ of the 10 minutes. Generalization of this behavior was not assessed.

Grove, Dalke, Fredericks, and Crowley (1975) utilized a neck apparatus on four cerebral palsey subjects ranging in age from 10 to 16 years. Experiment 1 involved a single subject reversal design consisting of no-feedback, non-contingent music, and contingent music on appropriate head positioning. The overall mean percent of thirty minute sessions that elevated head posture occurred was 22% during Baseline, 15% during the non-contingent condition and 92% during Treatment. Experiment 2 involved three subjects in a reversal design. Baseline consisted of no-feedback while Treatment consisted of contingent music coupled with social approval contingent on proper head posture. The overall mean percent of twenty minute sessions that elevated head posture occurred during Baseline for Subject 2, Subject 3, and Subject 4 was 24%, 6% and 11%, respectively. During Treatment conditions, the overall mean percent of twenty minute sessions that appropriate head positioning occurred for Subject 2, Subject 3, and Subject 4 was 8%, 52%, and 8%. Though their investigation supported the use of feedback contingent on proper head posture, it is not clear which treatment variable improved head extension as the subjects in
Experiment 2 were exposed to both music and social reinforcement. Furthermore, generalization of this behavior was not assessed.

In 1971, Harris theorized that, "faulty proprioceptive feedback due to desensitization of stretch receptors may be responsible for athetoid movement. Treatment, therefore should involve the improvement of sensory inflow from the limbs." Harris, Spelman, and Hymer (1974) trained nine athetoid, cerebral palsied children ranging in age from 7 to 18 years to increase proper head control with a mercury-switch head-control trainer. During training, an increasing rate of clicks were heard as their heads deviated from the neutral position. Illuminated lights representing the direction of head tilt were displayed on a screen in front of them. Because auditory and visual feedback treatments were only partially successful in improving head posture, a movie projector, connected to the apparatus presented a movie contingent upon proper head posture. While this investigation revealed an improvement in head posture ranging from a few seconds to more than five minutes, the fact that two independent variables were used at the same time as well as the addition of a third independent variable with some of the children makes it impossible to determine which was critical.

Wooldridge and Russell (1976) trained twelve cerebral palsied children to increase proper head posture using a head-position trainer. Three forms of feedback were used: a signal to the ear when the head moved out of the feedback-free area, a visual display of their performance on an accumulated performance indicator, and for some children, tangible rewards were given after increases in the duration

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of upright posture. An ABA design was incorporated in the study for
ten of the subjects while an AB design was used for two of the subjects.
Three of the subjects demonstrated postural control under the feedback
condition and after the cessation of training. These three subjects
were given tangible rewards contingent upon proper head posture. Six
of the subjects demonstrated consistent improvement under the feedback
condition, though improvement after training was not found. Three of
the children demonstrated improved ability when using feedback, but did
not exhibit continual improvement. Methodological inconsistencies and
varied assessment and training techniques inherent in this investiga-
tion prohibit making any definite conclusions concerning the effects
of treatment.

Harris, Spelman and Hymer (1974) and Wooldridge and Russell (1976)
apparently assumed that informational feedback alone was successful in
modifying head posture for some subjects. This belief implies that in-
formation is in itself reinforcing. In a discussion of the problems
concerning the usage of the term "feedback", Schwade (1979) stated
that "a feedback procedure consists of presenting a measure to a sub-
ject about his or her behavior." He further explains that if feedback
is to be effective, it must function as a conditioned reinforcer or a
conditioned punisher, and/or a discriminative stimulus. This is only
possible if the feedback was associated with other reinforcers and
punishers in the individual's prior history.

Therefore, for those subjects in the previously mentioned studies
who did not respond appropriately under the information feedback condi-
tion, it was necessary to pair a reinforcing stimulus with the informa-
tional stimuli in order for the feedback to be effective. Those sub-
jects who responded appropriately under the information feedback condi-
tion alone, did so, not because the information was in and of itself 
reinforcing, but because information had been paired with a reinforc-
ing stimulus during the subjects' prior history, thus making the in-
formation stimuli conditioned reinforcers.

The preceding review of the literature demonstrates the effective-
ness of one or more automatic feedback treatments used to improve head 
posture. However, due to the methodological problems inherent in many 
of these investigations, the results are difficult to interpret. Fur-
thermore, it remains to be determined how well this procedure can be 
generalized across settings.

Given these considerations, the purpose of the present study was 
to determine if proper head posture could be attained using one treat-
ment; automated music connected to a mercury-switch head apparatus. 
In addition, the assessment of generalization to another setting was 
incorporated in this investigation to further determine the usefulness 
of the procedure.
METHOD

Subjects.

Two non-ambulatory, physically handicapped and mentally retarded students attending the Kalamazoo Valley Multi-handicap Center were selected as subjects for this study. Both subjects infrequently exhibited proper head extension. It was determined by their teachers and occupational therapists that the lack of head control interfered with their sitting posture and academic work. Subject 1, a 24-year-old female was medically diagnosed as an athetoid, severely, spastic quadriplegic with hydrocephally. Subject 2, a 17-year-old male was medically diagnosed as an athetoid, cerebral palsy quadriplegic. In addition, he had a substantial hearing loss due to perinatal hypofia. Both subjects were psychologically diagnosed as trainable mentally impaired. They were naive to any systematic head control procedure, though a head control procedure consisting of prompting the head up was inconsistently implemented at the center during non-experimental sessions.

Setting.

The study was implemented at the Kalamazoo Valley Multi-handicap Center. Baseline and Treatment sessions for both subjects were conducted in a circular corridor approximately 400 ft. in length and 10 ft. in width. The corridor enabled teachers and students to pass from one classroom to another. Various academic sessions were carried out in the corridor as well. Generalization for Subject 1 was assessed in a rectangular classroom approximately 40 ft. in width and 130 ft. in length. This room contained several tables, chairs, and play equipment. File cabinets were used to partition off one classroom from
another. Throughout the day, one-to-one and group academic sessions were carried out. During Generalization, the subject, seated at a table across from a therapist participated in a number acquisition task. During this time, there were various activities going on in the classroom with other children. For Subject 2, the assessment of generalization was studied in a rectangular classroom approximately 35 ft. in width and 70 ft. in length. This classroom was similar to the one used with Subject 1. During Generalization, Subject 2 was placed upright in a standing orthotic table when participating in a word acquisition task. Academic sessions with other children were carried out during this time.

Apparatus.

The head device was designed to measure head posture. To accomplish this, two U-shaped-glass-tube mercury-switches with contacts on both ends were mounted on a CBA stereo headphone. Lateral head movements beyond 20 degrees closed the circuits of the switch mounted on the top of the headphone. A forward or backward tilt of the head beyond 20 degrees closed the circuits of the switch positioned on the left side of the headphone. These mercury-switches were wired to a manual switch, relay, DC battery pack, sonalert, Panasonic cassette recorder with taped music, and a Sears solid state cassette recorder used for collecting data.

During Baseline and Generalization conditions, the manual switch was to the left. Either one of the mercury-switch closures activated the relay, causing the sonalert to sound. The sonalert was used to record the duration of the response. During the Treatment conditions,
the manual switch was turned to the right. When the mercury-switch circuits were opened, the relay electro-magnet de-energized which caused music from the recorder to be heard through the headphone. The Sears cassette recorder recorded the sonalert sound during Baseline and the music during Treatment.

The subjects heard a variety of contemporary music during Treatment. Such artists as Neil Diamond, Carly Simon, Rita Coolridge, Linda Ronstadt, John Sebastian, Jim Croce, Hoyt Axton, Jimmy Buffett, Kris Kristofferson, Van Morrison, Joni Mitchell, Gordon Lightfoot and Helen Reddy were taped. All electrical equipment (excluding the head device) were placed in an Alpine daypack and placed on the back of the subjects' wheelchairs or tilt table.

**Experimental Design.**

The design used in the present study was a multiple baseline across subjects with a brief reversal (Baer, Wolf, and Risley, 1968).

**Procedure.**

The present research was conducted for fourteen weeks over a five month period. Daily experimental sessions lasted approximately 25 minutes each. The subjects wore the head device during Baseline, Treatment and Generalization sessions.

**Baseline 1.**

The subjects were slowly wheeled around the corridor for approximately 25 minutes daily. They did not receive feedback during this condition. The apparatus was wired so that movement beyond 20 degrees from the neutral position sounded a sonalert which was automatically recorded on the Panasonic tape recorder. The sonalert was
wrapped in sound absorbing material so that the sonalert would not be heard by the subjects. The subjects' head was placed in the neutral position at the beginning of each session. Each session began when the equipment was turned on and terminated when the equipment was turned off.

**Treatment 1.**

During Treatment, music was contingent upon proper head posture. When the head deviated 20 degrees beyond the vertical position, music automatically terminated. Before the beginning of each session, each subject's head was placed in the neutral position. The sessions began with the onset of the equipment and ended with the offset of the equipment. The subjects were slowly wheeled around the corridor for the approximately 25 minute daily sessions. The duration of music was recorded on the cassette recorder placed in the daypack on the back of the subjects' wheelchairs.

**Baseline 2.**

Baseline 2 was identical to Baseline 1.

**Treatment 2.**

Treatment 2 was identical to Treatment 1.

**Generalization.**

During Generalization, the apparatus was wired so that the music was not heard by the subjects. Subject 1, seated across from a therapist in a classroom participated in a number acquisition task for approximately 25 minutes daily. The therapist held the number cards up at eye level and asked her to identify the number. Correct responses were reinforced with praise ("very good", "you're working hard", etc.)
and a token. Frequently, questions were answered in a quiet voice or were avoided. If this continued to occur after frequent prompts, she was ignored until an appropriate response was emitted. During the first 24 sessions, four therapists alternated conducting this session. They inconsistently prompted head extension and inconsistently ignored inappropriate head posture. For the remaining sessions, the experimenter conducted the academic training. Correct academic responses were reinforced regardless of head posture. Subject 2, positioned on an orthotic tilt table, participated in a word acquisition task. The therapist, standing beside the subject, asked him to point to a word on the wordboard taped on the wall directly in front of him. A correct response was reinforced with praise ("excellent", "good pointing", "nice work", etc.) regardless of head positioning. Before the beginning of each session, both subjects were placed in the neutral position. Sessions began and ended with the onset and offset of the equipment.

Recording.

The onset and offset of the sonalert sound and/or music for each session was automatically recorded during the session on a cassette recorder. Using a stopwatch and event recorder, the duration of sonalert sound and non-music were recorded at the end of each day. The mean percent duration of proper head positioning for both subjects during all conditions was determined by dividing the duration of inappropriate responding by the total time for each session, multiplying by 100 and then subtracting the total from 100.

The reliability assessors used a stopwatch to record the duration
of sonalert sound and/or non-music from the taped sessions. Reliability was assessed for 40% of the experimental conditions. During the first seven weeks of the experiment, one independent reliability assessor was utilized. Two different reliability assessors were used during the last seven weeks of the experiment. Reliability was calculated using the formula:

\[
\frac{\text{Smaller } \% \text{ Proper Head Posture}}{\text{Larger } \% \text{ Proper Head Posture}} = \% \text{ Reliability}
\]
RESULTS

The overall mean percent agreement of reliability for Subject 1 and Subject 2 was 99% and 97%, respectively. The overall mean percent reliability during Baseline for Subject 1 and Subject 2 was 99% and 98%, respectively. The overall mean percent agreement of reliability during Treatment for both subjects was 99% and 93%, respectively. During Generalization, the overall mean percent agreement of reliability yielded 99.5% for Subject 1 and 98% for Subject 2.

Figure 1 shows the percentage of every daily session that Subject 1 held her head in the extended position during Baseline and Treatment conditions. From Fig. 1, it can be seen that a stable baseline was obtained over the eleven sessions of Baseline 1. The average percent during Baseline that Subject 1 held her head in extension was 3%. Treatment was implemented on the 12th session which resulted in an abrupt increase in proper head posture. The percent of appropriate responding ranged from 0% to 85% with an overall mean of 25%. During session 31, and 42-54, instructions were given at the beginning of each Treatment session. The instructions were, "When your head is up, you will hear music." During Baseline 2, the percent of appropriate head responses decreased to a mean of 6%. During the last five sessions, Treatment was reintroduced which resulted in a mean increase in head extension of 23%. As a function of the music contingency, proper head positioning increased 19.5% over Baseline.

Figure 2 shows the percentage of every daily session that Subject 2 held his head in the extended position during Baseline and Treatment conditions.
FIGURE I: SUBJECT I, TREATMENT

PERCENT APPROPRIATE HEAD POSTURE

SESSIONS

BASELINE

TREATMENT

SESSIONS

BASELINE 2

TREATMENT 2

V - Vacation
D - Device Breakdown
A - Absent

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conditions. Head extension is presented as a function of the music contingency. Data for Subject 2 was not recorded properly for the first three sessions of the experiment. Therefore, the first Baseline session was conducted three days after the beginning of the experiment. As can be seen from Fig. 2, the percentage of proper head posture during Baseline 1 ranged from 8% to 60% with a mean of 25%. During Treatment 1, proper head positioning increased to a mean of 67%. This was accomplished over twenty-two sessions and ranged from a low of 54% to a high of 90%. A return to Baseline produced a decrease in head extension to a mean of 30%. The reinstatement of music during Treatment 2 resulted in a mean percent of proper head extension to 54%. An overall increase in the mean percent of proper head positioning was 33% from Baseline conditions.

The first three days of Generalization were not assessed for Subject 1 as the sonalert did not record adequately on the cassette recorder. Figure 3 shows the percentage of every daily session that Subject 1 held her head upright without the music contingency. During the first seven sessions that generalization was assessed, Subject 1 was in Baseline. The mean percent of appropriate head positioning at this time was 6%. Sessions 8 to 42 were conducted concurrently with Treatment 1. The mean percent of appropriate responses was 11%. Sessions 43 through 55 correlated with Baseline 2. A mean percent of proper head posture was 11%. During the last five sessions which coincided with Treatment 2, a mean percent of proper head posture was 24%. The overall mean percent of proper head posture throughout Generalization was 17%.
FIGURE 3: SUBJECT 1, GENERALIZATION

- **D** - Device Breakdown
- **A** - Absent
- **N** - No Academic Session

**PERCENT APPROPRIATE HEAD POSTURE**

**BASELINE**

**TREATMENT**

**SESSIONS**

---

**BASELINE 2**

**TREATMENT 2**

**SESSIONS**
The data in Figure 4 shows the percentage of proper head posture for Subject 2 without the music contingency during daily sessions. As can be noted from Fig. 4, the first thirty-four sessions of Generalization correlated with Baseline 1. The mean percent of appropriate responding was 15%. A mean percent of correct head responses during sessions 35-57 was 20%. These sessions coincided with Treatment 1. Sessions 58-63 were conducted simultaneously with Baseline 2. The mean percent of proper head posture increased to 32%. The last eight sessions which correlated with Treatment 2 resulted in a mean percent of proper head posture of 27%. The overall mean percent of appropriate head positioning was 24%.

The event recording charts revealed that Subject 1 held her head in extension during Baseline 1 from .5 seconds to 14 seconds, during Treatment 1 from .5 seconds to 240 seconds, during Baseline 2 from .5 seconds to 128 seconds, and during Treatment 2 from .5 seconds to 84 seconds. During Generalization, head extension ranged from .5 seconds to 96 seconds.

For Subject 2, the event recording charts show that head extension ranged from .5 seconds to 88 seconds during Baseline 1, from .5 seconds to 184 seconds during Treatment 1, from .5 seconds to 72 seconds during Baseline 2, and from .5 seconds to 80 seconds during Treatment 2. During Generalization, head extension ranged from .5 seconds to 76 seconds with the exception of session 70, whereby, head extension was 168 seconds.

A comparison of head posture for both subjects from the event recording charts show that Subject 1 maintained proper head posture less
FIGURE 4: SUBJECT 2, GENERALIZATION

BASELINE

TREATMENT

PERCENT APPROPRIATE HEAD POSTURE

SESSIONS

BASELINE 2

TREATMENT 2

SESSIONS

Vacation
D Device Breakdown
A Absent
N No Academic Session
frequently, but for longer durations, while Subject 2 frequently lifted his head for short durations.
DISCUSSION

In accordance with the findings of Ball et al. (1975), and Murphy et al. (1979), the present investigation demonstrated the effectiveness of music contingent on head posture. Furthermore, informal observation suggests that proper sitting posture was exhibited when the subjects engaged in proper head posture.

It is difficult to compare the results of the present study to the results reported by Ball et al. (1975) as their Treatment conditions consisted of only four sessions. As can be seen from Fig. 1, the effect exerted by the music contingency substantially weakened after the fourth session for Subject 1. It is possible that Ball et al. (1975) would have had a less dramatic effect if they had continued treatment for more than four sessions. Also, both subjects in their study wore body braces which may have made head extension less difficult.

In the Murphy et al. (1979) study, the overall mean increase in head positioning for all subjects was 25%. In comparison, an overall mean increase of head extension for both subjects was 26% in the present study. The difference in results might be due to the multi-element design used by Murphy et al. Their subjects were exposed to the music contingency for ten minutes of the twenty minute session. The remaining ten minutes consisted of no music. The short durations of music contrasting with no music within the same session might have produced a novel effect. Because twenty-five minutes of music was available daily in the present investigation, satiation on the music might have occurred.
Though Subject 1 responded inconsistently to the music contingency, a 19.5% increase in head posture resulted. Instructions were incorporated during sessions 31, and 42-54 as it was not clear whether she came under the control of the music contingency. There are various uncontrolled factors which might have contributed to the variability in her behavior. Beginning on session 43 and continuing to the end of the study, she received a custom-fit electric wheelchair. The novelty of the wheelchair may have accounted for the increase in head posture during sessions 43, 44 and 45. Another factor may be the occasional use of punishment included in the head control procedure during non-experimental sessions by the therapists at the center. When proper head posture was not achieved, the therapist either ignored her, put her in a corner or physically lifted her head. Consequation varied between therapists and was carried out inconsistently within therapy sessions. The effects of punishment in preceding sessions often carried over into the experimental sessions. On these occasions, her head would immediately drop down after the experimenter positioned it in the neutral position, and would continue to be down throughout the remainder of the session.

The music contingency exerted a high degree of control over head posture for Subject 2. As can be seen from Fig. 2, head extension varied considerably during Baseline. With the advent of Treatment, the variability of this behavior decreased.

Generalization of head extension to another setting was not demonstrated for either subject. As previously mentioned, during Generalization for Subject 1, four therapists alternated conducting this session for the first twenty-four sessions, while the remaining sessions
were conducted by the experimenter. As can be noted from Fig. 3, the
difference in head control procedures carried out by the therapists
and experimenter did not appear to have an effect on head control.
The increase in head extension during session 42 may have been due to
the fact that she was going to attend a circus immediately after the
session. During this session, sitting posture was upright and cor-
rect academic responses were made throughout the entire session. Dur-
ing session 53, academic training was conducted while the other child-
ren were out of the classroom. Working without distractions resulted
in a high frequency of correct responses and may have accounted for
the increase in proper head posture.

Generalization was assessed while Subject 2 stood in an orthotic
tilt table. During the word acquisition task, he pointed to speci-
fic words on the board in front of him. The difficulty of pointing to
the words may have lessened the likelihood that proper head posture
would be emitted. From session 53 to the end of the study, improve-
ments of the tilt table were made which made standing easier. This
may have accounted for the increase in head posture for the remainder
of the study.

For the normal individual, maintenance of head extension is rein-
forced by having better contact with the environment. In the case of
the physically handicapped individual, the effort of maintaining head
extension may compete with the natural reinforcement. For both sub-
jects, upward movement of the head was prompted, and head-up was im-
mediately reinforced with praise and/or tokens (although somewhat in-
consistently) at the center. Maintaining the head-up position was on
a thin schedule of intermittent reinforcement. Downward movement of
the head as well as maintaining the head down were inadvertently reinforced since it allowed for the subsequent opportunity for upward movement and the reinforcement. The transitional phases were reinforced rather than the maintenance of head extension. The subjects' long history of being prompted for the upward movement of the head may have been incompatible with the generalization of maintaining the head extended.

A possible solution to this problem would be to reinforce longer durations of head extension rather than upward movement or frequent extensions of short duration. This procedure used in collaboration with the head apparatus might facilitate the generalization of the behavior.

A disadvantage in using the present mercury-switch head apparatus was the frequent disconnections due to its fragile construction. One solution to this problem is the use of a manufactured head device which is currently available on the market.

A potential problem inherent in the design of this investigation was that both subjects may not have found music reinforcing on such a regular schedule; approximately 25 minutes during the same time period everyday. Scheduling treatment at different times everyday or at the same time on alternate days might remedy this problem.

In conclusion, the results of this experiment demonstrated that head posture can be operantly controlled by music. Though generalization of this behavior was not shown, the treatment can increase and maintain head extension. The benefits of using an automated head apparatus make this treatment cost effective in that: 1. The portable device provides immediate and continuous feedback, 2. The device permits the
necessary muscles to be actively employed in postural control as opposed
to passively supported by orthotic devices, 3. Treatment can be con-
tinuously operative in the patients' natural environment, 4. It elimi-
nates the expensive as well as time consuming task of shaping muscle
control and/or exercise activities, and 5. Using automated recording
equipment provides an objective, continuous and precise evaluation of
the behavior(s). Therefore, it would be beneficial to incorporate this
procedure into a physical therapy program or at home. The only limita-
tion of the device is that listening to music interferes with academic
training sessions.
REFERENCES


