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Construction and operation of the mutli-trainer

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Abstract

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CONSTRUCTION AND OPERATION OF THE MULTI-TRAINER

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Doctor of Optometry

By

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and

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PROBLEM:

To design a visual training instrument which could be used to enhance the basic manipulatory skills: namely, rotations and fixations, with the following limitations in mind:

A. Portability.

B. Simplified operation.

C. Easily replaceable parts.

D. Simplicity of construction.

E. Low cost construction.

INTRODUCTION:

The Multi-Trainer was designed to enhance the basic manipulatory skills: monocular and binocular rotational movements, and monocular and binocular saccadic fixations. The operator may, by changing the rotating target, use the instrument for acuity and suppression training. The convergence and divergence function may also be varied by using a phorometer with rotary prisms when doing manipulatory training. The Multi-Trainer uses smaller fixation targets than most conventional models, thus eliminating the small erratic searching versional movements of the eyes when moving over the target area itself.

DESCRIPTION:

The pilot model measures 18 X 15 X 7¼ inches without the supporting legs. The legs supporting the instrument measure 11 inches by 4 inches. The shape is as illustrated in picture number 1. This particular model is painted flat black but other colors may be used if so desired. The distance between the saccadic targets is 14 inches in the horizontal and eleven inches in the vertical.

CONSTRUCTION:

The following materials will be required for constructing the Multi-Trainer.

1 Fuse holder
1 2A fuse
4 Double pull double throw switches
2 350 Ohm 10 watt resistors
1 50 Ohm 10 watt resistor
1 250 Ohm Potentiometer
1 tuner return switch
1 2 pole five position switch
8 #44 radio panel bulbs
1 electrical motor and modified gear box
1 surplus filament transformer
1 T.V. Line cord assembly
1 T.V. Line chasis type socket
8 bayonet type minature sockets
1 motor mounting bracket (hand made from Iron, shape depending on the type of motor used)
1 Aluminum control panel
1 wiring harness
1 8 point terminal strip
3 rubber grommets
Pine board, 6 feet long by 7¼ inches in width
220 square inches of 3/4 inch ply board

220 square inches of ½ inch ply board
2 ¼ inch wing nuts and bolts (three inches in length)
1 ¼ inch by 10 inch plexiglass rod (to be machined as illustrated in diagram #3)
16 1½ inch wood screws
25 5/8 inch chrome wood screws
plastic wood for filler material
½ pint of flat black or gray paint
sand paper for smoothing.

The box which contains the electrical apparatus is made from 3/4 inch pine. The size being 18 X 15 X 7½ inches. The front of the box containing the fixation targets is 3/4 inch ply-board, the back is 1/2 inch ply-board with a circular hole cut out for the electrical motor. This particular motor was slightly over eight inches in length. A tin can has been fitted into this hole to decrease the motor noise. The legs supporting the instrument are made from 3/4 inch pine. Picture #1 is a perspective view of the front and side of the instrument.

Diagram #3 indicates the construction of the fixation targets and how they are inserted into the ply-board face of the instrument. After insertion it is suggested that airplane glue be used to keep them in place. The wide end of the plexiglass peg is polished with tooth paste to allow the light to move toward the target point. The target point is not polished.

The control panel is on the top of the case and is

lettered as illustrated in diagram #2. The panel is made from aluminum which has been sanded and coated with automobile polish. The lettering was done with a small paint brush using black paint. The lettering explains the function of each switch.

The rotating arm is made of aluminum, such as a large knitting needle, this arm is seven inches in length. The arm is mounted on a coupling which fits over the rotor shaft of the electrical motor by means of friction. This arm can easily be removed by the training technician. A small circular target is attached to the end of the aluminum arm, this may be of any desired size or color. Other targets may be used such as a plateau spiral or a colored round disk.

The wiring technique used in this particular instrument is illustrated by diagram #1. The electric motor used is a 27 volt Dc shunt aircraft fuel injection motor, it has been rewired to run on 110 volts AC. The shaft is mechanically coupled through a multiple gear speed reducing unit or gear box to an eccentric operated oscillating or reciprocating switch. The purpose of this power driven switch is to alternately complete the circuit to each pair of panel bulbs. Which pair of bulbs,

that are alternately lighted, is determined by the selector switch setting. When a pair of panel lamps are being alternately lighted, each lamp of any pair is lighted for the same time duration, approximately 180 degrees of the timing cycle as is the other lamp of the pair. A transformer is used to cut the voltage down to 6 volts, which is required to light the #44 dial panel bulbs, of which there are eight in this particular model. One leg of the 6.3 volt transformer secondary is connected to one side, or terminal of all lamps. The other leg is completed to only one lamp at a time, which one depending on the setting of the saccadic selector switch and the speed of the motor operated switch. The 250 Ohm resistor is of the calibrative type, the value of which was selected at the time of construction. Originally the speed was too fast, so a 50 Ohm 10 watt resistor was connected between the calibrative resistor and the power line to the electrical motor, thus giving us the desired range. This 27 volt shunt motor can be obtained from an Army surplus store for around five dollars.

The motor reversing switch is of the double pole double throw type and serves to reverse the motor armature rotation by changing the direction of the current through

the armature. In either the clockwise or counter-clockwise position the current through the field coils flows in the same direction: By reversing only the armature, the field-armature relationship is changed.

This instrument will not operate unless the power switch is turned on. When the power switch is turned on and the "lites" switch is in the "off" position no voltage is delivered to the saccadic bulbs, even though the motor is running. The motor will always run when the power switch is on, regardless of the positon of the other switches.

The "Hi-Lo" speed switch, when in the "Hi" position, shorts out the 100 Ohm resistor, eliminating the voltage drop of the resistor, thus raising the voltage to the motor giving a high speed range. This switch, when set on low, drops the voltage across the 100 Ohm resistor causing less voltage to reach the motor and thus providing a low speed range. Vernier or fine adjustment of either range is provided by th 250 Ohm rheostat which is in series with the motor circuit at all times.

INSTRUMENT OPERATION:

Diagram #2 illustrates the control panel of the Multi-Trainer, this panel is located on the top of the instrument. As previously stated, the power switch must

be in the "on" position for this instrument to operate. When the power is on, the electric motor operates, the speed of which is determined by the position of the "Hi-Lo" switch and the setting of the 250 Ohm calibrative resistor. The "CW" indicates clockwise rotation, of the shaft and "CCW" indicates counter-clockwise rotation. The motor speed of the instrument can be varied to suit almost any purpose. When the rotator is moving clockwise the range is from 8 RPM to 64 RPM. When the rotator is moving counter-clockwise the range is from 2 RPM to 80 RPM.

The saccadic lights are activated by means of the "Lites" switch, the selector switch continues to operate whether the switch is in the "On" or "Off" position. When the power switch is "On" and "lites" switch is "on" the saccadic targets will alternately light up, depending on the speed setting controlling the electric motor. The "Saccadic" switch detemmines which pair of targets are to be alternately lighted. When the motor is running clockwise the saccadic "lites" will alternate at a rate of from 8 cycles per minute to 64 cycles per minute. In the counter-clockwise direction the saccadic target alternates from 2 cycles per minute to 80 cycles per minute. The rate of alternation depends, as noted

previously, on the speed of the electric motor.

Several different types of rotating targets may be attached to the shaft, such as a plateau spiral or a painted disk with a fixation target on the periphery. These various targets will slip on easily over the rotating shaft.

DISCUSSION:

The Multi-Trainer combines two instruments in one, a rotator and a saccadic board. This instrument can be built by a competent practitioner by following the diagrams and reading the contents of this thesis.

Dr. Harold Haynes of Pacific University has discussed the possibility of using a gray background instead of a black background behind the fixation targets. Dr. Haynes has also suggested the possibility of using a peripheral stimulus around each fixation target, such as a painted circle. Dr. Haynes feels that this peripheral stimulus may decrease the required learning time to develope adequate fixation skills. This suggestion should certainly be investigated, as it may allow the practitioner to reduce the number of training sessions presently required by techniques now in use.

FUTURE PROBLEMS:

We would like to suggest a testing procedure to determine if the Multi-Trainer could be used effectively to decrease the time required for versional skill enhancement.

Twenty-five subjects are to be used. All subjects are to have the same case typing as per OEP and be of the same general age group, plus or minus one year. Prior to training, an Opthalmographic record is to be made of each patient.

Five of these patients will be given versional training using the conventional squint corrector and Ward board. These patients are to be one meter from the instruments during training. The patients are to wear their habitual distance RX.

The second group of five patients will receive versional training on the Multi-Trainer. A black background will be used and the patients will be seated twenty inches from the instrument. The training will be done with the patients habitual near RX in place.

The third group of five patients will be trained exactly as the second group but the fixation background will be of gray construction paper.

The fourth group is to be trained as are groups two and three but a black background with a red circle, two inches in diameter and 1/8 inch in width is to be painted around each fixation target.

Group number 5 will receive the same training as groups numbered 2, 3, and 4, the only difference being that the background will be of gray construction paper with a red two inch circle painted around each fixation target, this is to be 1/8 inch in width.

All training sessions are to be of the same time duration and sequence as follows:

Rotations: Speed 30 RPM

A. Monocular
   1. OD 2 minutes clockwise
   2. OS 2 minutes counter-clockwise

B. Binocular
   1. 2 minutes clockwise
   2. 2 minutes counter-clockwise

Fixations: 30 cycles per minute

A. Monocular

1. OD:	starting horizontal	30 seconds
	left oblique	30 seconds
	vertical	30 seconds
	right oblique	30 seconds
	horizontal	30 seconds
2. OS:	horizontal	30 seconds
	right oblique	30 seconds
	vertical	30 seconds
	left oblique	30 seconds
	horizontal	30 seconds

B. Binocular

horizontal	30 seconds
left oblique	30 seconds
vertical	30 seconds
right oblique	30 seconds

horizontal	30 seconds
right oblique	30 seconds
vertical	30 seconds
left oblique	30 seconds
horizontal	30 seconds

These twenty-five patients are to be trained for ten sessions on the same instrument. After ten sessions, Opthalmographic pictures are to be taken of each patient and compared to the first record. This type of testing procedure should give the experimentors the following information.

A. An index as to the training value of each instrument used.

B. Which target background is the best for versional training.

C. What distance should the training be done.

D. Which lenses are to be worn during versional training sessions.

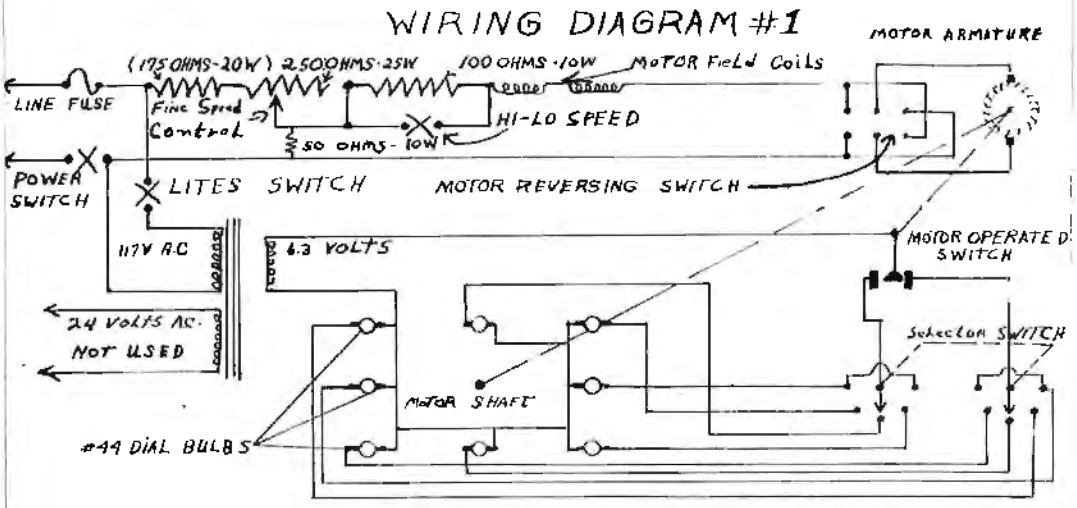
E. Does the target size make any difference in training time.

SUMMARY AND CONCLUSION:

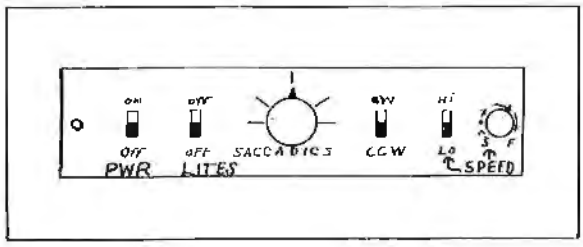
Presently when doing Orthoptic training the technician often begins with versional training. The squint corrector is used for rotational training but the cost is not within reach of many beginning practitioners. The squint corrector can only be used for one type of training: namely, rotational training. At the present time we do not believe that the average practitioner has a good workable saccadic board. The Multi-Trainer combines two instruments in one, a rotator and a saccadic board. The instrument is small and therefore can readily be moved around the training lab without difficulty. The Multi-Trainer can be built for around one hundred dollars by a competent electrician and will do the work of three or four hundred dollars worth of other versional training equipment. The Multi-Trainer allows the practitioner to begin training versions monocularly in all of the cardinal directions. Monocular training is the starting point in all training programs. We feel that this instrument will enable more practitioners to achieve a greater degree of success with their training therapy, as they now have an instrument which was designed to train the fundamentals of good binocular coordination.

MAY 1957

WIRING DIAGRAM #1



CONTROL PANEL # 2



FIXATION TARGET #3