Large Area Flap Switch to Control Battery-Operated Toys

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The beneficial effects of play to the overall development of the young child have been well documented in the fields of developmental psychology, education, and physical and occupational therapy (1-4). However, for many children with severe motor dysfunction, the opportunity to play is diminished or denied because of physical limitations (5-7). As a result, the disabled child may be lacking in experiences that normally lead to the development and refinement of gross- and fine-motor skills, as well as an understanding of cause-effect relationships.

Toys comprise a substantial portion of a child's world of play but are generally not designed with consideration for physically disabled or developmentally delayed children. Toys such as dolls or toy cars often are frustrating for children who are physically unable to hold or manipulate them. Therefore, mechanical, electric, and electronic toys may be more appropriate because they can run by themselves or with only minimal intervention. However, since their control switches usually require fine-motor coordination, and thus often cannot be operated by a disabled child, some modification is required in order to maximize the potential benefits of such toys.

One (simple) way of modifying battery-operated toys is through the use of a large-area flap switch (LAFFS) (Figure 1). A LAFFS is merely an extension of the toy's on/off switch with a large target area to facilitate remote control by the child. (The Appendix contains details on how to construct a fairly simple and low-cost LAFFS.) A therapist or parent can assemble this switch from inexpensive materials available at home, or from a hardware store, using only

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a handsaw, a screwdriver, and a pair of scissors. Once constructed, the LAFS will work with almost any single function battery-operated toy. The LAFS is not recommended for adapting toys that use electricity from a wall outlet since it is designed only for low-voltage battery-operated toys (maximum 9 volts). Furthermore, connection to a device powered through a wall outlet presents an electric shock hazard.

Basically, a LAFS consists of two pieces of plywood, hinged together along one side, with a simple contact switch or microswitch in between them. When attached to a battery-operated toy with a length of wire, the LAFS becomes the toy’s on/off switch. Normally, the toy will be off, but when the LAFS is lightly depressed, the simple contact switch or microswitch closes. This completes the electrical circuit and activates the toy for as long as the switch is depressed. The toy ceases to operate when pressure is removed from the LAFS surface, thus making operation of the toy contingent upon the child’s active response. This aspect of response contingency is felt to enhance the educational value of the LAFS. If the LAFS is properly constructed, almost any part of the body such as the hand, elbow, head, or foot can depress it by using only a light touch.

Two approaches can be used when attaching a LAFS to a toy: rewiring the toy, or employing an adapter (described fully in Part II of the Appendix). Methods of rewiring a toy are not included in this paper because the variability in the design of toys necessitates rewiring on an individual basis. An adapter is a simple alternative to rewiring that breaks the power circuit in the toy until the flap switch is depressed. It consists of two small squares of aluminum (cut from a metal pie plate) that are separated and held together with double-sided carpet tape and attached to the lead wire of the LAFS. Alternatively, the adapter can be purchased from one of several distributors of technical aids for the disabled (8,9). The adapter slips between a battery and its contact within the battery compartment of a toy and is connected to the LAFS with a length of wire. Both rewiring and the use of an adapter have their advantages and disadvantages. The advantages of an adapter are its ease of construction, flexibility of use (i.e., it can be used with almost any battery-operated toy), and low cost. Disadvantages of the adapter are that it will not work with snap-on 9-volt battery connections and that it might deteriorate with repeated use. This latter problem is considered negligible since another adapter can be easily, quickly, and inexpensively made. Rewiring is advantageous when the toy has a 9-volt battery; a number of flap switches are used to operate a multifunction toy; and a permanent connection is desired. However, poor rewiring may result in a damaged toy and a safety hazard. It is recommended that if rewiring is desired, a person with some basic electrical skills should be consulted. A local high school may be a good source of help in this matter.

The style and dimensions of the LAFSs are variable and depend upon both the needs of the child and the materials available. A major requirement is that the surface area of the LAFS should be large enough to allow the child to voluntarily move part of his or her body to it. The lead wire should be long enough—at least 6 feet—that the LAFS can be positioned easily within the child’s reach with the toy visible to the child. Also, a 6-foot lead wire will allow for some freedom in the case of a toy that moves.

It is important to recognize that there are many levels of play, and that the use of a LAFS with battery-operated toys addresses only a very basic level of play. Thus, it is felt...
that LAFS-operated toys are most appropriate for children at the sensorimotor stage of development (i.e., 0-2 years cognitive age). We believe that the main effect of playing with a LAFS-operated toy aside from the value of fun is to stimulate the development of cause-effect relationships, which are considered to be basic "building blocks" to higher levels of cognitive development (1).

It is suggested that a LAFS should be used to increase the repertoire of playthings that a disabled child can enjoy and not as the sole method of playing. Also, since young children typically have a short attention span, a variety of battery-operated toys should be available for use with a LAFS. Notwithstanding these considerations, a LAFS can be a simple and inexpensive, yet powerful tool that allows a physically disabled or developmentally delayed child to control battery-operated toys that provide sensory stimulation and at the same time facilitate gross motor and cognitive development.

Appendix
Instructions for Adapting Battery-Operated Toys

Part I.

Construction of the large area flap switch (LAFS): The LAFS can be constructed from materials illustrated in Figure 2 and described below. Items marked with an asterisk (*) should be attached after the construction of the basic flap and the adapter described in Part II. The components of the LAFS are:

(a)—8 x 8 inch of 1/4 inch plywood to form the top flap;
(b*)—1 x 1 inch of aluminum (cut from a pie plate) attached to the plywood with double-sided carpet tape to form half of the contact switch;
(c*)—one wire of the lead “1” with 1/2 inch of exposed wire inserted between the tape and aluminum square (b);
(d*), (g*)—masking tape to hold wire leads in place;
(e)—two 1-1/2 inch hinges with 3/8 inch-long wood screws;
(f)—8 x 8 inch of 1/2 inch plywood to form the base;
(h)—1/2 inch-long steel round-head screws to form second half of the contact switch;
(i*)—second wire of the lead “1” with 1/2 inch of exposed wire wrapped around screw (h);
(j)—1/4 x 1/2 inch self-adhesive open-cell foam tape (weather-stripping) to give "bounce" to the top flap;
(k)—1/4 x 3/4 inch heavy duty self-adhesive sponge rubber (weather-stripping) attached along the edges of the underside of the base to prevent the LAFS from slipping on smooth surfaces;
(l*)—lead wire: 6-foot length of two-conductor 22 gauge stranded speaker wire that connects the LAFS to the toy;
(m*)—adapter (see Part II below for assembly and usage instructions).

Note—Exact dimensions and positions of parts are not critical, although it is very important that aluminum square (b) comes into contact with screw (h) only when the flap is depressed. The sensitivity of the LAFS can be adjusted by raising or lowering the height of the screw (h).

Part II.

Assembly of the LAFS toy adapter: Figure 3 provides an illustration of the steps listed below.

1) Cut two 1/2 inch squares of aluminum (A & B) from a metal pie plate. At the same time, a 1-inch square of aluminum (b) can be cut to be used on the flap switch (shown in Part I). Also cut a 3/4 x 5/8 inch rectangle of double-sided carpet tape (C) leaving the paper backing on.

2) Lay the tape "C" on a table surface, sticky side up, and place one of the wires from the lead, with 1/2 inch of wire strands exposed, over the tape.
Figure 3
Steps to follow in the construction of LAFS toy adapter.

(3) Place aluminum square (A) over the wire strands and press firmly onto the tape.

(4) Turn the piece over and remove the paper backing from the tape. Cut two slits in the tape on either side of the wire below square (A) and wrap the corners of the tape around the wire along the dashed lines as indicated.

(5) Place the second wire from the lead, again with 1/2 inch of exposed wire strands, over the tape.

(6) Place the second 1/2-inch square (B) over the wire strands and press firmly onto the tape.

Once the adapter has been assembled, the other end of the lead (strands exposed 1/2 inch) can be connected to the LAFS, one wire to aluminum square (b), and the other to the round-head steel screw (h). The adapter is then inserted into the battery compartment of a toy, between the terminal of a battery and its contact. The insulating tape prevents the flow of electricity from the battery to its contact. However, when the LAFS is depressed, a closed loop is formed to allow the electricity to bypass the tape by traveling through the aluminum squares and lead wire, thus completing the circuit to activate the toy.

When the adapter is used, the toy’s on/off switch must be left in the “on” position. If there is a push-button switch, then it must be fixed in the “on” position. This can be accomplished by taping the push-button down.

It should be noted that the low cost of this design may lead to some problems arising from extended use. These usually relate to the loosening of wires and wearing down of the aluminum squares. If problems do arise, it should be a simple matter to replace any parts or to re-attach any loose wires. If the toy runs continuously when the top flap is not depressed, make sure that there is a gap between screw (h) and square (b) and that the adapter is placed properly.

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REFERENCES
8. Prentke Romich Company, R.D. 2, Box 191, Shreve, Ohio 44676
9. Behavior AIDS, 1210 West Alameda Drive, Tempe, Arizona 85282