CASE REPORT

Evaluating Movement for Switch Use in an Adult With Severe Physical and Cognitive Impairments

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Miranda is a young woman with multiple disabilities who has lived in a state school for persons with mental retardation for about 30 years. A recent goal of hers is to obtain a powered wheelchair. She has seen her roommate acquire one, and watching this roommate buzz around their home has filled Miranda with admiration and a desire to follow suit.

This case report documents the occupational therapy process, which involved two stages. First, we needed to determine if Miranda had the ability to use a switch to control communication and leisure devices. Second, we had to transfer and adapt the knowledge gained to find a suitable method of powered mobility for her. This was seen as a linear process with achievement plateaus along the way, where Miranda could enjoy switch-controlled activities while working toward her personal goal of powered mobility.

Client Information

Miranda is 33 years old and moderately retarded with spastic quadriplegia and athetosis secondary to anoxic encephalopathy. She has a right subluxed hip and scoliosis as a result of spasticity. Miranda is dependent on others for all of her self-care needs, including feeding and manual wheelchair mobility. She is highly motivated to speak despite severe dysarthria. Miranda lived at home until she was 2 years old, at which time she was admitted to a state school for persons with mental retardation, where she has lived until the present. She currently resides in a 20-bed intermediate-care cottage, which is a part of the state school. Her family visits regularly.

Miranda has received occupational therapy and other therapies most of her life. She has participated in dressing, feeding, bathing, and communication programs. She has received positioning, perceptual-cognitive, and fine motor training. At one point, she participated in a sheltered workshop. Her degree of mental retardation is difficult to assess and she has received IQ scores ranging from 66 to 100 on standardized intelligence tests.

For leisure activities, Miranda enjoys watching soap operas on television; likes anything to do with babies and small children; and enjoys listening to music, singing, and participating in dances by moving about in her wheelchair. She is currently attending a day activity program 5 days per week, where she participates in occupational therapy, physical therapy, speech therapy, music therapy, and adapted physical education.

Adapted Devices

Before any thought had been given to the possibility of Miranda getting a powered wheelchair, her thera...
pists were experimenting with electronic devices that would increase her functional skills. In 1986, Miranda’s occupational therapist tried fitting her with a chin switch so that she could operate adapted devices, such as a tape recorder, by using head movements. Miranda did not like anything near her face, however, so this type of switch was abandoned. The occupational therapist then designed an elbow switch, and the speech therapist tried using this switch with an augmentative communication device that used auditory scanning. The switch activated a tape recorder, and Miranda was to scan auditory messages and stop the recorder when it reached the message that indicated her needs.

Despite working hard and long, Miranda made slow progress and never truly mastered the use of the elbow switch. Her occupational therapist believed that perhaps communication by means of a mechanical device was not particularly important or meaningful to Miranda. It also appeared that Miranda did not fully understand the cause-and-effect relationship between operating a switch and getting a desired response—a relationship that must be grasped if the use of a switch is to be mastered.

Subsequently, the occupational therapist investigated Miranda’s hobbies and interests and, as a result, connected the elbow switch to a television, a slide projector showing pictures of small children, and a tape recorder with recorded music, all of which are highly reinforcing for Miranda. Miranda was soon able to master control of the elbow switch to activate these items. Nevertheless, she still did not transfer this learned skill to the auditory scanning device, from which it was deduced that communication by means of a mechanical device was not particularly important to her and that she would prefer to work on other skills. Miranda remains highly motivated to use what little vocal speech she has.

**The Powered Wheelchair**

In 1988, Miranda was evaluated by an occupational therapist (the second author) and a physical therapist to determine if she could learn to operate a powered wheelchair. It was thought that she could probably learn to use a joystick with her foot, which would allow her to maneuver a wheelchair in all directions. Because of the expense of powered wheelchairs ($8,000 for a suitable model for Miranda), however, Miranda’s therapists wanted to be sure that she could develop the control necessary to operate a foot joystick. Miranda would also have to increase her understanding of the cause-and-effect relationship as well as the more subtle relationships between operating a switch (or similar control) and the resulting response (e.g., the moving of a powered wheelchair in a specific direction in a steady, controlled fashion).

**Interim Devices**

To achieve the goal of understanding the cause-and-effect relationship, Miranda has been taught to operate several interim training devices that serve to increase her understanding of the consequences of controlling movement in order to activate a device. These activities have also met Miranda’s own goal of increasing her leisure skills and enjoyment. Consequently, during 1989, Miranda used an elbow switch to operate several devices that allowed her to participate in activities she finds pleasurable. These devices were a tape recorder to play music, a paint spin machine to produce artwork, a slide projector to view pictures of babies, and a blender to enable her to participate in a cooking group. The intention was for her to continue to use the elbow switch for recreational activities so that she could participate in these activities while also being able to operate a powered wheelchair by means of a foot switch or foot joystick.

**Evaluation**

Miranda’s occupational therapist and physical therapist collaborated in the evaluation of her muscular control and thought that flexion and extension of her left knee and left hip would be sufficiently reliable to operate a wheelchair with a foot switch and eventually with a foot joystick. Still, one cannot be sure of the client’s ultimate success in gaining control over a specific movement pattern. Intensive and extensive training is required to teach new skills to the client who is both physically and cognitively impaired, and preparing a client for a task as complicated as operating a powered wheelchair is a long-term project.

The occupational therapist at the therapeutic equipment center in the state school who evaluates clients for switch-operated devices and fabricates those devices assisted Miranda’s occupational therapist (the second author) in the evaluation and fabrication of Miranda’s foot switch. In planning the progression of movements required to operate a joystick with the foot, we decided to begin training with the forward motion through the activation of a momentary switch with the toe of the shoe (see Figure 1) and then proceed to the backward motion through the activation of a second switch with the heel (see Figure 2).

A square-bottomed trough with a smooth surface was made from thermoplastic material to enable the foot to slide forward and backward. Only a sliding motion was needed for Miranda to hit the switch. The switch is currently hooked to and is operating computer games and a communication clock in order for Miranda to learn the forward motion. Similar devices will be used in order for her to learn the backward motion. These devices were chosen because Miranda...
has indicated a desire to learn to read. She enjoys a computer program that has academic components and the reading clock that teaches her sight recognition of functional words (e.g., “Stop the hand of the clock when it reaches the word ‘Exit’

Training
A similar process was used by Miranda’s occupational therapist to teach her to use both the elbow switch in 1986 and the foot switch from March 1989 to the time of this writing. During training sessions for the elbow switch, the switch was attached to the wheelchair and a verbal explanation was given as to how to operate the switch. Miranda would try to operate the switch, and verbal cues were given as needed until she was successful. She was encouraged to repeatedly activate the switch so that she would eventually have the movement under voluntary control. The therapist and the devices acted as reinforcers to encourage Miranda to repeat the process. It took approximately 2 years for Miranda to be able to operate the elbow switch consistently.

Motivation and comprehension were enormous factors in Miranda’s ability to learn to operate the elbow switch. When the speech therapist attached the switch to devices designed to improve Miranda’s communication (i.e., a tape recorder with prerecorded messages and a pictorial communication device), Miranda was not particularly interested in the procedure. She was not, and is still not, motivated to communicate her needs any differently than she does now, that is, using her minimal speech abilities rather than mechanical communication devices. Consequently, because the therapists were not using the type of activities that motivated Miranda, teaching her to operate the elbow switch was a long and arduous process. The speech therapist believed at first that Miranda had visual-perceptual problems that would make a pictorial communication system inappropriate. Later, the therapist thought that Miranda did not have the muscular control necessary to operate the switch, and finally, she thought that Miranda could not cognitively grasp the connection between the switch and the operation of the device.

The second author thought that Miranda had all of the necessary skills to learn to use an adapted device, but that the right activities had not been found to motivate her. The occupational therapist attached the switch to items she thought might interest Miranda—a television, a tape recorder, and a slide projector. When the therapist saw the joy in Miranda’s face at turning on the television for the first time, she knew that a meaningful activity had been found and that Miranda had the physical control and the perceptual-cognitive abilities necessary to operate the switch.

There was also some concern that Miranda would require a long lead time before she could activate the switch, which would have made operating a wheelchair impractical. One day, however, while Miranda was watching her favorite soap opera on television, the set turned off unexpectedly in the middle of an exciting part of the story. Miranda immediately switched the television back on, thus indicating that when motivated, she could operate the switch quickly.

Around this time, Miranda began to realize that being able to operate a switch would allow her to do things she wanted to do—that she could control parts of her environment and exert some power on her own behalf. For Miranda, this was a remarkable realization. Perhaps because she has lived in a deprived environment so much of her life (30 years), it took a long time for her to be aware of the array of items with which she might interact and investigate. Miranda has

Figure 1. Activation of a momentary switch with the toe for forward movement.

Figure 2. Activation of a momentary switch with the heel for backward movement.
rarely had the opportunity to explore her environment due to her physical limitations, her limited cognitive abilities, and the paucity of her surroundings.

The occupational therapist attached the elbow switch to other reinforcing devices, and Miranda made great strides in gaining control over the switch. Making the switch operate a television required constant pressure on the switch, which improved Miranda's shoulder stability; operating a slide projector required an on-off movement to advance the slides, which improved her control over changing shoulder movements. Incidentally, by attaching the switch to a computer, the therapist also learned that Miranda could match and identify most of the letters of the alphabet.

When it came time for Miranda to learn to operate the foot switch, training sessions proceeded in a similar format to those used for the elbow switch. Sessions lasted 30 to 40 min and occurred twice a week. It took Miranda approximately 3 months to be able to operate the foot switch smoothly in the forward direction with the left foot. She then moved on to the operation of a similar switch located behind her heel, which would initiate backward movement of the wheelchair (see Figure 2). Following a similar training method and schedule, Miranda has mastered the use of the heel switch. Unfortunately, discrete switches will allow the wheelchair to be maneuvered in only two directions (forward and backward), which is cumbersome and permits only straight-line movement. Conversely, a joystick, which permits 360° movement, enables the user to follow a curved path and thus produces a more direct and smooth route.

In view of Miranda's success with the switch, an adapted joystick has been fabricated by technicians at the therapeutic equipment center. Miranda is now learning to use the joystick in training sessions that occur twice a week with the second author and twice a week in a training group. She is doing well with the forward and backward motions and can bring her foot to the neutral position to stop the chair on request. The joystick is currently attached to a direction indicator training box, designed by the staff of the therapeutic equipment center, which indicates whether the joystick is in a forward, backward, right, or left position. This device is used to simulate powered mobility; when Miranda pushes her foot in a particular direction, a corresponding light flashes and the therapist pushes the wheelchair in that direction.

The progression to each new step has renewed Miranda's excitement and enthusiasm for the whole project, because she can see the progress she has made toward her goal of independently operating a powered wheelchair. It has also provided a boost to the occupational therapist, because it is always encouraging to see one's clients making progress.

**Summary**

Miranda's family members are most supportive of the goal for her to have a powered wheelchair and encourage her when they visit. Motivation has been the key to Miranda's success at learning to operate switches in order to explore and learn from her environment. As long as the outcome available from operation of a switch is desirable for Miranda, she works hard at controlling her movements so as to activate it. Conversely, if the ultimate advantage of operating the switch is unclear to her, she is unwilling to make the effort. The occupational therapist's role is crucial, in that she realizes the importance of motivation and consequently designs activities and rewards that are important and meaningful for Miranda. Miranda's life has been considerably enriched by the introduction of mechanical aids into her leisure sphere. She has become more interested in her surroundings and is excited about exploring possibilities for future rewarding activities, such as academics. A notable additional benefit has been that Miranda now displays a more assertive attitude on her own behalf.

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**Editor's Note.** To continue the Case Report department, we need and welcome reports that document the practice of occupational therapy for specific clinical situations. Guidelines for writing case reports are available from the Editor.