CHAPTER 7
DUKE UNIVERSITY

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INTRODUCTION
Four devices have been developed to help workers with physical disabilities insert documents into envelopes of different dimensions. Each device holds an envelope in a position for receiving documents, and aligns paper prior to insertion. Envelope insertion is then achieved through single-hand pushing actions. The devices are relatively inexpensive, portable, easy to operate, and suitable for use by individuals who lack fine motor control.

SUMMARY OF IMPACT
The client is a non-profit agency that meets the employment needs of individuals with physical disabilities by subcontracting mailing and packaging services. Employee salary is a function of competence in areas of mail preparation, such as document collation and envelope stuffing. The Envelope Inserting Aids will allow some workers to perform an additional task in the workplace. The client coordinator commented that the inserting aids will "increase production rate and pay, boost independence, self-esteem and confidence, and allow them to do much more of the job'.

TECHNICAL DESCRIPTION
Four aids (shown in Figures 7.1 and 7.2) were designed to accommodate the following envelope sizes: 10” x 13” (Fig. 7.1), 9.5” x 12.75,” 9” x 6,” and 9” x 4.” Each device consists of an aluminum aligner tray mounted on a plywood base. The tray has perpendicular, or angled, edges to align documents. Some perpendicular edges have an additional lip to ensure that documents stay on the tray.

The tray and its edges extend a few inches beyond the plywood base. A ledge is mounted over the tray extension, and the gap between the ledge and the tray forms a channel for documents to go into the envelope. The envelope is opened by pulling the envelope itself over the channel and is then secured with a clip. The clip’s purpose is to secure the envelope so that it does not become displaced with any pushing action. The top piece of the channel extends further into the envelope to provide stability and aligns documents properly. The tray extension is shorter so that documents will not remain in the channel upon envelope removal.

The shape of the channel is customized for each envelope. For business envelopes with triangle flaps (Fig. 7.1), the channel’s top piece has a triangular cut in the middle to enable the client to reach deeper and insert documents completely. The 9” x 6” aid requires a trapezoidal channel with a wider bottom to accommodate snug-fitting documents. The channel is elevated from the work surface by the plywood, so that envelopes can be inserted without moving the device.

The smooth continuous tray extends into the envelope, which minimizes snagging of documents. Documents on the aligner tray are pushed into the envelope through the channel. Aluminum edges are smoothed and rounded to ensure they do not cut the documents. Edges without a lip are fitted with
rubber hoses to minimize stress injuries to the wrist. A piece of Dycem is attached to the underside of each device to secure it to the table surface during operation.

After testing the devices with the clients, we determined that aligner edges were effective in keeping paper in the tray. Physical discomfort during envelope insertion was minimized because thin edges of the aluminum (without a lip) are padded. The static and kinetic friction between paper and aluminum is minimal but increases with contact pressure. Therefore, the most efficient manner to use the device is to push papers against the tray lightly.

The cost of parts for the four envelope inserting aids is approximately $100.
CUSTOM CANES AND BRACKETS

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INTRODUCTION
The goal of this project was to provide forearm canes with shock absorption to an active woman with osteoarthritis. Also, brackets were designed to mount the canes to a client’s powered scooter.

SUMMARY OF IMPACT
After using the devices (Figure 7.3), the client commented, “The shock absorbers have already made such a difference. I already don’t think I could go back to the regular canes. [The new canes] just take the impact so nicely and make my shoulders feel so much better. Being able to mount [the canes] on my scooter will make getting around so much easier, especially when I’m with [a child].”

TECHNICAL DESCRIPTION
The shock absorption component was developed by modifying the spring mechanisms from commercial shock-absorbing trekking poles. The commercial spring shock absorbers were composed of a threaded top stopper, a spring, a long hex screw, and a plastic molding. The poles were smaller in diameter than the client’s Guardian cane shafts, so custom parts were designed to fit the commercial shock absorbers into the Guardian canes.

An aluminum top stopper was affixed with screws into the Guardian cane shaft, and a machined plastic sleeve was fit around the commercial shock absorber to increase its diameter. Custom washers were designed to fit between the top stopper and the spring, as well as between the spring and the molding, to minimize the wearing effects of continuous use.

During initial tests, the torque exerted by the forearm canes caused the cane tips to rotate, loosening or tightening the shock absorber spring. To prevent this rotation, a setscrew was attached through the top stopper and into the long hex screw.

The screw was tightened at a level of shock absorption comfortable for the client.

To attach the canes to the client’s powered scooter, commercial EZGrip brackets were attached on the rear fenders, and custom U-shaped guiding brackets on the front fenders (Fig. 7.4). Both were secured with screws through aluminum plates, to evenly distribute the screws’ forces across the plastic surfaces of the scooter. The client can mount the custom canes on her scooter by placing the bottom end of the shaft in the guiding bracket, then pressing the top of the shaft into the EZGrip bracket. The seat
of her scooter rotates so that she can mount one cane on each side of the seat.

The cost of parts is approximately $75.

Figure 7.4. Custom Canes on Scooter.
KITCHEN HELPERS

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INTRODUCTION
A set of devices has been developed to aid the client, a 13-year-old boy with cerebral palsy, in common kitchen tasks. These devices provide support for mixing foods, spreading condiments, opening jars and soda cans, and cutting food. The devices have been modified from commercially available products to provide more stability, grip and easier movement control. Each device is attractive, relatively inexpensive, and easy to assemble and operate.

SUMMARY OF IMPACT
The client can now be more involved in the kitchen, relying less on his mother, and improving his independence in some tasks: mixing salad and recipe ingredients, making his own sandwiches, opening jars and soda cans, and cutting food items such as lemons and sandwiches. His occupational therapist said "I feel [the devices] will make him independent with tasks that he normally wouldn't be. Independence is something that he needs, especially at this age."

TECHNICAL DESCRIPTION
The Kitchen Helpers (Fig. 7.5) consist of a mixing bowl (upper left), a jam stamp and Spreadboard (The Wright Stuff, Grenada, MS) (upper right), a jar opener (lower left), and a cutting board (lower right) (Figure 7.6) that functions both as a jar holder as well as a knife mount.

The mixing bowl assembly is used for mixing a salad or recipe ingredients. It consists of an 8 qt. stainless steel mixing bowl, an 8” diameter turntable and a gum rubber gripping ring. The bowl secures to the turntable using Velcro. The rubber ring fits tightly around the lip of the bowl, creating a good grip for turning and holding the bowl. The turntable allows our client to turn the bowl while mixing, eliminating the need to stir in a circular motion. The heavy base of the mixing bowl and turntable assembly makes it less likely for it to tip over. Rubber mats attached to the bottom of the turntable and a Dycem mat for the kitchen counter prevent the assembly from sliding.

The jam stamp and Spreadboard are used to spread different condiments evenly onto bread. The Spreadboard and squeeze bottles are available commercially. The jam stamp is adapted from a potato masher by welding a 4.5” diameter stainless steel plate to the bottom. The upright handle allows for easy movements of the jam stamp without bending the wrist. The large surface area allows the condiment of choice to be spread evenly with minimal movement.

The jar opener was modified from a commercial device (Good Grips Jar Opener, OXO International, NY) by attaching magnets to the underside, a finger hold to the top, and a brass weight to help stabilize the front.

The cutting board, which was modified from a commercial device (Swedish Cutting Board, Westons Internet, West Sussex, England), holds jars, and stabilizes a knife for cutting. Without the knife
mount, the cutting board serves as a jar holder with jars fitting tightly between a sliding panel and two square pegs. Two commercial quick-adjust bar clamps secure the cutting board to the countertop to prevent rotation. A custom aluminum knife mount allows foods to be cut safely with the Ergonoma chef knife (Grip Advantage, Inverness, FL) by bringing the knife down in a chopping motion. A custom guard surrounds the knife to further protect hands and fingers. The guard attaches to the knife with a small spring, so that the knife only drops below the guard when food is being cut, and only drops to the depth of the food. A spring pin in the knife mount allows quick removal of the knife for cleaning.

The cost of parts is approximately $250.
INTRODUCTION
The goal of this project is to provide a play station with sensory activities. This device allows children with and without various disabilities to interact, learn academic concepts, and develop motor skills. The device includes an adjustable height table and adapted sensory toys. The completed play station allows children of different abilities and differing heights, and children using wheelchairs, to interact with others at eye level.

SUMMARY OF IMPACT
The client coordinator commented regarding the Play Station: “All of the kids, even older kids, want to play with the sensory station. It's a great success here.... The dumping bin is the favorite for most of the kids.”

TECHNICAL DESCRIPTION
The Sensory Play Station is shown in Fig. 7.7. The table frame is constructed from commercially available aluminum framing and connectors (Bosch-Rexroth Inc.), making the table sturdy, lightweight, and weather resistant. The table is 25.5” wide by 37.5” long -- small enough to fit through a doorway though large enough to allow multiple children to interact together. Two inexpensive, commercial plastic bins with lids fit into the top of the play station frame. These bins are removable to allow the sensory medium such as sand or water to be changed. A Movotec Lift System (Suspa Inc.), bolted to the legs of the frame, allows the table height to be adjusted from 25” to 37” by turning the crank of a hydraulic pump. To prevent the crank from becoming accessible to children, a cable lock is mounted on the frame. To improve mobility of the table, locking casters are mounted to the table legs with custom aluminum brackets.

Several sensory activities promote interaction between children and provide exposure to academic concepts. Two custom-designed toys are permanently mounted to the frame (Fig. 7.8). The first, called the tipsy toy, consists of a bucket attached to a string. When a large ring on the end of the string is pulled, the bucket tips over, pouring its contents into one of the activity bins. This activity helps improve motor skills and encourages teamwork while addressing the academic concepts of cause and effect, and gravity.

The second custom toy is a teeter-totter. The teeter-totter is constructed out of weatherproofed wood with plastic containers secured to each end using Velcro. Since the toy is centered over the table, a student can fill one container while another student fills the other container. This activity addresses the academic concept of heavy vs. light and more vs. less. In addition, several commercial sensory toys were purchased to add fun and educational elements to the play station.

The cost of parts is approximately $750.
Figure 7.8. Custom Toys: Tipsy Toy (background) and Teeter Totter (foreground).
INTRODUCTION
The client is a 17-year-old girl with cerebral palsy. She cannot transfer into her motorized wheelchair comfortably without the assistance of others. The goal of this project was to build a device that allows her to get into her wheelchair as independently as possible. A lift was constructed. It attaches to her wheelchair and uses the seat-height actuator as a lifting mechanism. The device lifts her about 8” off the ground to make sitting in the wheelchair easier; it also serves as a footrest when the wheelchair is in use.

SUMMARY OF IMPACT
The client’s physical therapist said, “The finished product will enable only one person to assist instead of two because they will not have to lift her. Also, more people will be able to assist – for instance, her sister who is smaller than her mother, and other friends who don’t have special training. It will also give [her] more independence in the future [when she is] away at college and in a more independent living situation in a dorm or apartment. It will also assure that those helping her will not have to risk back injuries.”

TECHNICAL DESCRIPTION
The Lifting Assist (Fig. 7.9) uses the seat-height actuator of the powered wheelchair as the lifting force. The operational sequence is as follows: First, the client stands on a platform with the wheelchair seat in the lowered position. Second, the seat actuator is extended, causing the wheelchair seat and platform to rise by about 8”. Third, the platform is locked into place vertically. Fourth, the seat actuator is retracted, lowering the seat to its minimum height. At this point, the client is approximately 8” closer to the seat vertically than she was on the ground. Finally, the client sits down with minimal assistance.

The final design comprises a mounting component, a linear stabilization component, a platform, and a locking system. The mounting component consists of a rectangular plate, connected by two ¾” square insertion rods to the footrest attachment sleeves below the wheelchair seat. Two shaft clamps and a vertical lock bar attach to the front of the rectangular plate.

The linear stabilization component includes two 25-mm diameter shafts, the tops of which are secured to the shaft clamps. Two pillow-block linear bushings slide freely on the shafts, and attach to the rear of the
platform, allowing it to move vertically. Locking collars mount on the shafts below the bushings, causing the platform to rise as the seat actuator extends.

The platform base has a trapezoidal shape, 12” on the end nearer the wheelchair, 14” on the other end, and 11.5” deep; these dimensions give the client maximum space given the constraints of the wheelchair. The base is covered with a piece of non-slip rubber. The rear of the platform is 12” horizontally by 6” vertically. The platform sides taper from 6” at the rear to 1” at the front, providing rigidity and maximum foot visibility for the client.

The locking system includes two spring pins attached through the platform’s rear wall. The first spring pin locks into a vertical stationary bar on the wheelchair, originally intended for stationary platform mounting. A custom square rod attaches to the vertical stationary bar, extending its height. As the seat rises to maximum height, this spring pin locks into a hole in the vertical stationary bar extension, fixing the vertical height of the platform. When the chair is lowered to its minimum height, the second pin locks into the vertical bar attached to the rectangular plate of the mounting component. If the client tilts her chair, this latter spring pin holds the platform in the proper position while the first spring pin slides out from its hole in the stationary bar extension. To get out of the chair, an assistant pulls on the rings of the lock pins, which allows the platform to slide back down to floor level.

The cost of parts was approximately $1000.
LITERACY TENT

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INTRODUCTION
The Literacy Tent provides a literature-based, inclusive environment for use in a school. The tent includes a series of multisensory stimuli corresponding with a book's text, making the book accessible to both children with and without disabilities. A series of stimuli are mounted to the frame of the enclosure, for use with any book. For individual books adapted for tent use, book kits with specific stimuli are provided. The Literacy Tent provides opportunities for learning on many levels, from literacy to cause and effect to basic socialization.

SUMMARY OF IMPACT
The literacy tent is an enjoyable and educational asset available to the educators at the client school. One supervisor hopes to establish a lend-out procedure for tent use in regular and special education classrooms. She stated, "they could set up a literacy area around the tent. We'll put a few beanbag chairs on the floor and [designate] the area as a place for students to go and read. Then I can bring my students, and we can bring regular and special education students to the tent, set up the stimuli, and read an adapted book together."

TECHNICAL DESCRIPTION
The Literacy Tent (Fig. 7.10) includes three parts: a tent structure, a sensory environment, and kits containing stimuli tailored to specific books.

The tent structure is constructed from 1¼" furniture grade PVC, connected in a 5' x 5' x 5' cube, with a 2.5' high peak added to the roof. For portability, the frame fittings allow the cube walls to fold to the back and create a 5' x 5' vertical square. The frame can be completely assembled or disassembled in five minutes or put into storage in one minute. The structure's walls are made of fabric, affixed by industrial strength Velcro. The outer walls feature pockets sewn into the fabric, 2.5' off the ground, 6'

Figure 7.10. Literacy Tent.

The sensory environment consists of switches and switch-activated stimuli. The stimuli are generic in nature, so they can be incorporated into the reading of various books. Four custom switches were built to activate a tape recorder, a bubble machine, a fan, an aromatic fan, and Christmas lights. These switches were built by removing the light bulbs from push-on lights and providing 1/8" output jacks for controlling the stimuli. All switches and sensory
devices are mounted to the tent structure with industrial strength Velcro. The switch-activated tape recorder plays a book recording via a latch or timer mechanism.

Three book kits were developed; each provides smaller, specific stimuli to reinforce subjects in a given book. Each kit contains a tape of the book to be read, a laminated copy of the book, a curtain 2' in length, made of book-themed fabrics, and book-specific stimuli. For the adapted book On Halloween Night, the curtain was created from two Halloween-print fabrics, and stimuli include parts of a witch's costume, a bell, pumpkin scent, and chocolate candy. The kits for the books In the Tall, Tall Grass and Looking Great follow the same concept.

The cost of parts for the Literacy Tent was approximately $800.
INTRODUCTION

Our client was a two-year-old girl with athetoid cerebral palsy. To build head and neck strength, her parents and therapist wanted a device that would support her in a prone position that she could tolerate and would also allow her to crawl. The Toddler Crawling Positioner allows the client to be supported at a maximum angle of 45 degrees, which she can currently tolerate, down to 0 degrees, which will allow her to crawl once she builds adequate strength.

SUMMARY OF IMPACT

The Toddler Crawling Positioner will help the client develop strength by providing greater variety in therapy sessions. The client’s mother noted that, “It is an achievement in itself to have her happy in an assistive device. She seems to tolerate it just fine, which is remarkable.”

TECHNICAL DESCRIPTION

The Toddler Crawling Positioner (Figs. 7.11 & 7.12) includes a base, adjustment bar, connector piece, pommel, and torso support.

The base is composed of five extruded aluminum segments; four 2”x2”x12” square tubes comprising the legs, each coming off of the 2”x2”x28” spine at 60 degrees. The legs are outfitted with swivel caster wheels attached via lock collars and the spine is designed to mate with the adjustment bar. The entire base has been anodized in red and gold colors to give it vibrant, lasting color.

The adjustment bar connects the base with the torso support and is the mechanism for angle adjustment. It mates with the base via rounded teeth that oppose the load of the client, therefore locking it into place and eliminating the risk of becoming dislodged while the client is in the device.

The base is also connected to the torso support via the connector piece. This piece is a 2” by 13” extruded aluminum channel, fixed to the base by a pin joint and to the underside of the torso support by three wood screws. The connector piece also accommodates the pommel via a 0.25” wide milling, which allows for vertical adjustment of the pommel. The pommel is made of high-density closed cell foam over steel tubing, and is adjusted via a wing nut and bolt through the connector.

The torso support is made of a hardwood frame, upholstered with foam and waterproof vinyl. It is comprised of three pieces, connected via width-adjustable brackets and thumbscrews. Also provided are three sets of colorful, pre-washed Elmo-themed cover sheets to increase aesthetic appeal.

The cost was approximately $300.
Figure 7.12. Toddler Crawling Positioner with Client.
INTRODUCTION
The client is a professional dancer who has post-polio syndrome. She wanted a device to lessen the weight on her legs while onstage. The Dancer Assist consists of a lightweight mobile frame with a harness attached via a spring suspension. This device allows the client to perform jumps and other aerial maneuvers she could not perform before, while the support frame glides with her onstage. The Dancer Assist can be disassembled within minutes by hand, and is readily portable for the client.

SUMMARY OF IMPACT
The client commented that the device, “has really gone above and beyond my initial expectations. I think that the aerial dancing capabilities that I hadn’t expected have really expanded my repertoire as a dancer and I look forward to exploring these possibilities as I continue to work with [the Dancer Assist] in the future.”

TECHNICAL DESCRIPTION
The Dancer Assist (Fig. 7.13) contains three components: harness, frame and suspension system.

The frame is constructed of materials purchased from 80/20 company (Columbia City, IN). It consists of extruded aluminum struts, which are strong and lightweight. The door-frame design features three components: one "U" piece overhead and two "T" pieces for the wheel base. These three pieces are easily assembled using a slide-in joint on each side and secured by hand with a wing nut, all under two minutes.

The suspension system includes two springs, a safety spring and a heavy spring, connected in series. The safety spring is intended to support loads of up to 50 lbs, which is the amount of support that our client wanted while standing. When the client requires more support for jumping and full-body suspension, the safety spring is fully extended and the heavy spring incorporates. The springs connect to the harness by a pulley and cable system, which offers a smooth and secure connection to the two-point attachment at the waist, and allows the client to rotate her body even while fully suspended in the air. The design also features a ball-bearing swivel to anchor the suspension to the frame, which offers smooth and complete rotational freedom. All moving parts are enclosed inside a protective denim sleeve to prevent pinching or abrasion.

Finally, a lashing system, constructed from plywood, L-brackets and wood screws, holds the frame pieces securely together when disassembled for ease of travel.

The cost of parts for the Dancer Assist was approximately $825.
Figure 7.13. Dancer Assist with client.
DARKROOM MODIFICATIONS

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INTRODUCTION
Our client, a professional photographer, had a traumatic brachial plexus injury leaving her right arm paralyzed. To support her passion for photography, two major additions were made to her darkroom. The Developing Station gave her the ability to develop her own 35 mm film, while the Cassette Loader allowed her to load efficiently twelve large-format, 4”x5,” film sheets into six cassettes. One design challenge is that most of the operations must be completed in total darkness with only the left hand.

SUMMARY OF IMPACT
The client commented, “My attempts at handling film one-handed resulted in dropped film, frazzled nerves, and wasted time and energy. The two pieces of darkroom equipment designed for me… have restored my ability to easily handle film, which means the loading of sheet film into holders and the rolling of 35 mm film onto reels for developing are once again simple chores rather than major obstacles that take the fun out of photography.”

TECHNICAL DESCRIPTION
The Darkroom Modifications (Fig. 7.14) include a Developing Station and a Cassette Loader. The Developing Station is constructed of ¼” Lexan, and it has several custom components that facilitate one-handed operation for developing 35 mm film: a bottle opener on the side to open the film canister, a scissors to cut the film leader, and a custom fixture to hold the film reel. The entire station is attached to the table using a clamp that is easily operated with one hand.

The most difficult aspect of the design was determining the best method to accurately, easily, and safely cut off the leader of the film at a 90-degree angle. The client inserts the film into a guide slot, which ensures that the film is positioned correctly every time and holds the film in place once inserted. Then, she cuts the film leader using a pair of scissors with the handles removed, which are attached to the developing station, perpendicular to the guide. Since the scissors handles are removed, the client opens and closes the scissors by grabbing a thumbscrew that is attached to the bottom blade. In this manner, the client can hold the film while cutting the leader, while using one hand.

The Cassette Loader is designed to assist the client in loading 4” x 5” sheet film into commercial film cassettes. The design is based on that of a commercial CD storage stand. The client can load up to six empty film cassettes into slots on our device. This holds the cassettes in place so that she can easily load the film each one, turning the unit upside down to load both the top and bottom side. The cassette loader is constructed of ¼” and ½” Lexan pieces, connected using an acrylic adhesive. Lycra-covered neoprene on the front allows tension to be applied to the front of the cassette, and also helps keep the exposure door open when loading the film. A handle helps the client turn the device over, which is necessary for cassette loading.

The cost of parts was approximately $150.
Figure 7.14. Client with Darkroom Modifications.
INTRODUCTION
The client is a ten-year-old girl with Cerebral Palsy who enjoys therapeutic horseback riding. To allow her to communicate with the instructors and the horse, we developed a mount that attaches her DynaVox communication device to her English saddle. The mount consists of two parts: an adjustable saddle clamp, and a DynaVox attachment bracket. The mount allows her to see and use the touch screen surface, giving her more freedom to make decisions and communicate while on the horse.

SUMMARY OF IMPACT
The DynaVox Mounting System allows a non-verbal rider to communicate with others while riding. The rider now has the capability to express where she wants to go. The client coordinator commented, “It’s so simple! That’s when you know you done a good job. This is huge for us. We’ve been trying to do this for years but we couldn’t find anything I was comfortable with putting an $8000 piece of equipment on.”

TECHNICAL DESCRIPTION
The DynaVox Mounting System (Fig. 7.15) consists of a saddle clamp, quick release attachment, and upper mount. The saddle clamp attaches from the front to the rear of the saddle, with a threaded rod linking either end. This rod resides under the saddle, where a gap provides about an inch of clearance between the saddle and the horse’s spine.

Both end pieces are machined from brass. The front piece is threaded to accept the rod, while the rear piece has two sidewalls with a groove between, where the rod protrudes. A large knob with a tapped opening works like a wing nut to tighten the saddle clamp to the saddle.

The quick release attachment consists of two parts. The first contains a slot with dimensions 0.75x0.25x2.5”, which is welded to the front piece of the saddle clamp. The second part includes a rectangular brass rod that fits snugly in the slot. A T-handle spring pin holds the two parts together, and a lanyard attached to the upper mount prevents the pin from getting lost.

The upper mount was made by modifying a commercial cymbal stand with two pivot joints. One pivot joint is welded to the front end of the rectangular brass rod. A ribbed bar extends 4” from this joint. At the end of the bar is the second joint to which attaches a vertical tube to hold the DynaVox. The tube connection includes two 90 degree welded joints to center the DynaVox over the saddle. By adjusting the two pivot joints, the DynaVox can be positioned for safety and convenience. The DynaVox itself is attached to the upper mount using a commercial part from DaeSSy (Daedalus Technologies, Richmond, BC) made specifically for these devices.

The cost of parts was approximately $300.
Figure 7.15. Dynavox Mounting System.
MORSE CODE TRAINER

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INTRODUCTION

For people with limited mobility, Morse code is an attractive alternative to computer access because it involves only two keys, dash and dot, as opposed to the more complex traditional keyboard. We designed a device to help ease the transition from more traditional means of interfacing with a computer to Morse code. The Morse Code Trainer is portable, provides audio and visual feedback, is accessible to a wide variety of clients, and incorporates variable timing to facilitate the learning process.

SUMMARY OF IMPACT

The client coordinator commented, “The Morse Code Trainer will allow my clients without the physical access skills for computer use, to investigate Morse code as a computer access option. Commonly, people have a misconception that Morse code is overly complicated and, therefore, they are reluctant to pursue this option, despite its advantages over switch scanning... By allowing my clients to take the trainer home and practice this technique, they will be able to make a more educated decision, and hopefully understand Morse code’s potential to allow for efficient and effective computer access for people without adequate hand control.”

TECHNICAL DESCRIPTION

The Morse Code Trainer (Fig. 7.16) uses a 16F876 PIC microcontroller (Microchip Inc., Chandler AZ), programmed in C to interpret user input. Two 1/8” mono jacks allow the use of any commercial switch for entering dots and dashes. Pressure switch jacks also provide for sip and puff input.

The Morse Code Trainer includes features to make it accessible to clients with a variety of disabilities. For visual accessibility, a high contrast LCD shows the character or characters entered. This LCD has an always-on yellow backlight, and blue background. It also has a large character mode for users with visual impairments. A speaker generates tones of different frequencies to indicate a dot or a dash. With a headphone jack, the device to be used in a room where other noises might be distracting. Variable controls are provided for end-of-character time and repeat time.

The device is powered by AA batteries, and is lightweight for portability. Although every function that may be entered into a computer (including mouse movements) can be encoded in Morse code, only the codes for the alphabet, numbers, the “enter” and “space” bars, and period were implemented for simplicity.

The cost of parts was approximately $225.
Figure 7.16. Morse Code Trainer.
INTRODUCTION
The use of pedaling as a therapeutic exercise is beneficial for children with a variety of physical disabilities because it develops better muscle tone, as well as improved left and right coordination. The goal of this project was to develop a stationary tricycle that could be used by a physical therapist working in an elementary school, during therapy exercises. The final design is a stationary tricycle that attaches to a classroom chair via a clamping system, and that adjusts to accommodate children of differing sizes and disabilities.

SUMMARY OF IMPACT
The client coordinator, commented, “as a pediatric physical therapist, I have longed for a therapy tool that would enable my preschool patients to work on reciprocal pedaling. The problem is that many physically-challenged children lack trunk strength and balance to sit on a standard tricycle while concurrently pedaling. There was no existing product that allowed pediatric patients to sit in a supported seat while practicing pedaling. Creation of this device will, without question, have impact on physically challenged children I interact with. It expands the repertoire of movement experiences I can offer these children to promote motor development. Best of all, it is colorful, stable and fun. It is a clinician’s dream to offer children a therapeutic activity that is also fun.”

TECHNICAL DESCRIPTION
The main body of the Stationary Tricycle (Fig. 7.17) was adapted from the front of a commercial tricycle that was designed for toddlers, and had a mechanism to adjust the seat-to-wheel distance.

A custom wheel mount lifts the front wheel off the ground so it rotates freely while the child pedals, providing interest and motivation for the child. The mount is constructed of 1” thick solid oak that is painted red. Rubber on the bottom, and on the interface between the mount and the tricycle, prevents slippage.

The chair attachment system (Fig. 7.17) securely attaches the tricycle to a classroom chair, and provides both vertical and horizontal adjustment to accommodate children of various sizes. The system consists of four separate components: the horizontal adjustment, the vertical adjustment, the hinge component, and the clamping system.

The horizontal and vertical adjustment tubes have a series of holes to allow for length adjustments using lock pins, which are attached with lanyards so that they will not be misplaced. The distance from the seat to the pedal is altered using the horizontal adjustment, which also serves as the connection between the tricycle and the chair attachment. The distance from the handlebars to the seat is altered by the vertical attachment. The angle at which the aforementioned pieces are connected changes the angle of the handlebars, which moves them closer or further from the child.

The hinge component serves as the connection between the adjustment pieces and the clamping system. It provides 180-degree rotation to accommodate both vertical and slanted chair legs. The clamping system consists of two metal slabs, which are pulled together by a screw and knob mechanism.

A bookstand, which was adapted from a collapsible music stand, attaches to the front of the tricycle with a threaded ring clamping system and knobbed screws. The physical therapist can place a book on the stand and have the client pretend to ride to different places pictured in the book. This provides added motivation for the client. The bookstand can also be easily removed when not needed. The pedals were adapted from commercial wheelchair pedals by painting them red and attaching foot cups to help children keep their feet engaged. Two
different size foot cups are included, and they are large enough to accommodate a child’s feet, with his or her shoes on.

The cost of parts was approximately $150.

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Figure 7.17. Stationary Tricycle.