The Finishing Touch
An Object of Linking Body and Mind

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Master of Science in Architecture with a concentration in Industrial Design.

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Bill Green

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Robert A. Dorgan

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William R. Sevebeck

this book is dedicated to the loving memory of my father, Edward Armand McLeod.
watching him work with tools got me interested in making things.
watching him provide his family with a loving home helped me see the important things in life.
watching him as a minister called to serve GOD nurtured my young faith and brought me a richness in life which often surpasses understanding.

thank you, daddy.

Standing for line of sight
Smooth pivot backswing
Downswing strike the ball
Follow through

Break down these elements of putting, and it sounds simple, yet any player will confirm that one never entirely escapes the element of chance involved when trying to sink a putt. Can this unknown quantity of chance be minimized for a more reliable outcome? Allowing for the human body's ability to commit specific movements to memory, such as a master craftsman wielding a tool, or a musician playing an instrument, can a player of golf develop this muscle memory and produce more positive results on the green? With training, will the putting technique be more dependable, and therefore inspire more confidence in the putting stroke?

Train to link body and mind
When the club strikes the ball
Know the stroke is true.

Though it would be nearly impossible to prove, it is probably safe to assume that early golfers had little knowledge of the concept of linking the body with the power of the mind to improve their skills on the golf course. There is evidence the ancient Greeks used imagery techniques more than two thousand years ago, but it did not make its way to acceptance in western thinking, or sports training, until more modern times.[1] During this history of golf's development, many of the changes which took place that affected the game involved the evolution of the equipment.

These changes in equipment were all basically technology driven. When someone invented a way to make a better ball, better clubs followed. The process of technological advancement continues today, so much so, that some argue the equipment is making the game easier and less challenging.

While it may be true some of the new equipment is a little more forgiving, allowing the average player to play a little better, it is difficult to imagine golf as any less challenging. It is, however, possible to imagine playing better golf, whether with a yard sale set of clubs, or with the latest nitro-titanium, laser balanced, custom fit wonder clubs. Imagining a better game of golf is something most players probably do, but how many realize their imagination may do more for them than any change in equipment?

Imagining, in this context more commonly referred to as imagery, or visualization, is described as forming a mental picture of a possible outcome or result. This technique has a long history of use in psychology, religion, and healing. Thinking visually takes place in all forms of human activity, whether abstract and theoretical, or regular everyday behavior.[2] Visualization can be used as an effective tool in a number of areas, and in particular, is helpful in preparing for physical tasks.

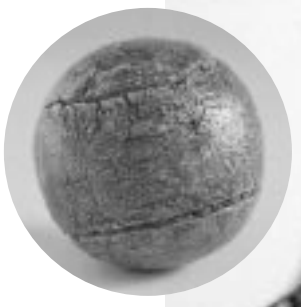
Plate 77, from The *Epitome* Of The *De Humani Corporis Fabrica;* The Illustrations From the Works of Andreas Vesalius of Brussels, Dover Publications, Inc.

A physical task repeated many times causes the development of muscle memory, which aids in future repetition of the task. Research has indicated that imagery causes detectable amounts of electrical activity in the muscles that would be used in the actual physical movement, which contributes further to the development of muscle memory for the activity visualized.[3] This way of building muscle memory may be nearly as effective as physically engaging in the activity.[4]

It is important to note that imagery can take either a positive or a negative form, and both can have an influence on the activity. If the mental images are not focused on the best possible outcome, forming a realistic and complete picture, then the outcome may fall short of the expected result. The use of all of the senses to form this vivid, mental image seems to work the best.[5] Thinking positively can do more for the end result than just keeping one's spirits up.

Mental imagery in itself is a technique which can be practiced and learned. It is a good first step toward training for a particular task. Can the process of imagery be aided by providing cues? Would the introduction of an object enhance the efforts of mental imagery to achieve greater end results with the task to be learned? To begin to answer this question begins the process of design.

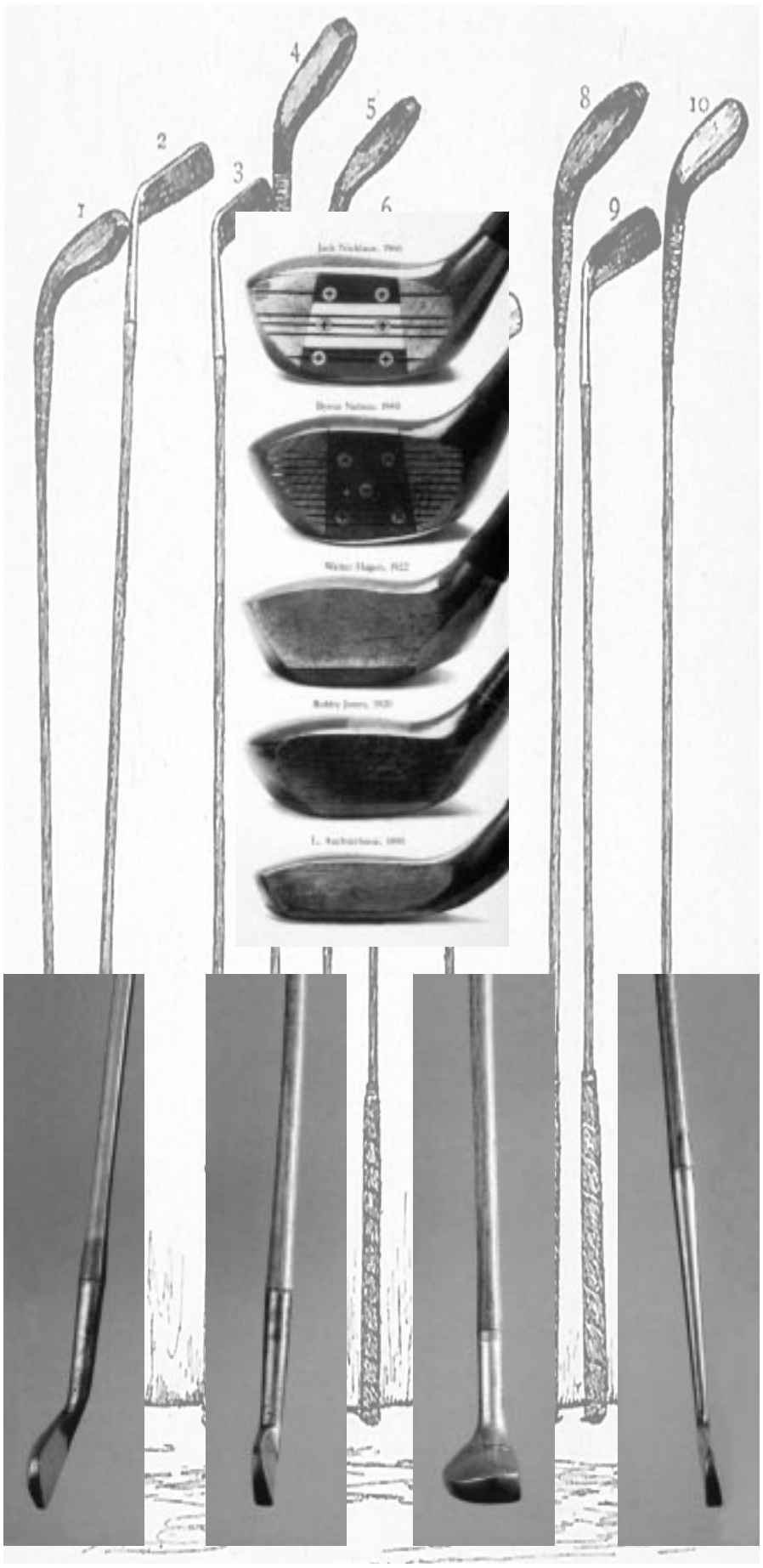
The Royal and Ancient Golf Club of St. Andrews, Scotland. [6]



Golf balls:(l-r) featherie, gutta percha (guttie), Haskell. [7]
Golf clubs: examples of early drivers, 1690-1870. [8]

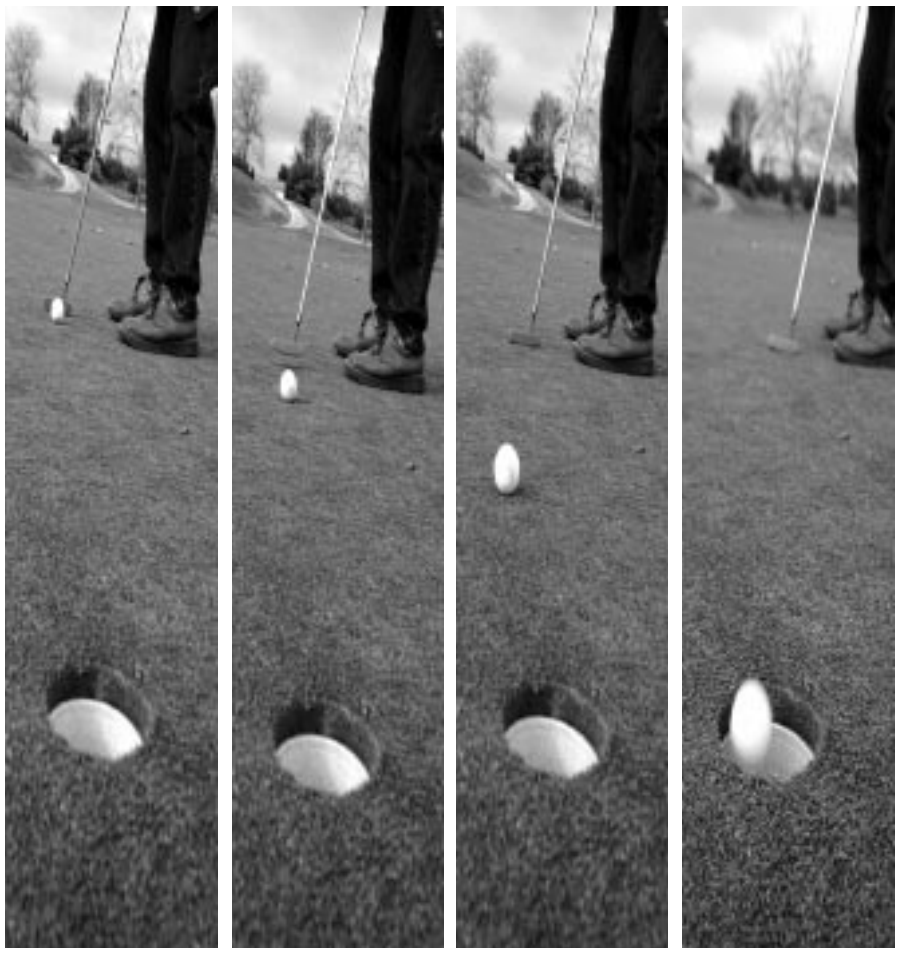
This thesis began with a search for a topic which could be studied with a passionate interest. Finding a subject of interest and trying to raise it to a level of passion would have been a mistake, since an in-depth study of such a subject would become tedious. The idea of learning to love something might not hold up under such scrutiny.

The game of golf is one which usually has a definite line separating those that either love or hate it. Though still somewhat new to the game as a relatively regular player, I felt my interest in golf would carry through, and carry me through a study developed around a certain element of the game.



Above: Examples of different drivers. [9]
Below: Various putters from the 1880s through the 1930s. [10]
Background: Typical set of clubs from the late 1800s. [11]

My initial approach for the thesis was to study golf club design, specifically the driver and the putter, as these two clubs are generally subject to the most personal scrutiny when a golfer is choosing clubs. With this information I was planning to design a driver and a putter. I decided to narrow the focus to concentrate only on the putter after reading that putting accounts for approximately forty-three percent of strokes in an average round of golf.

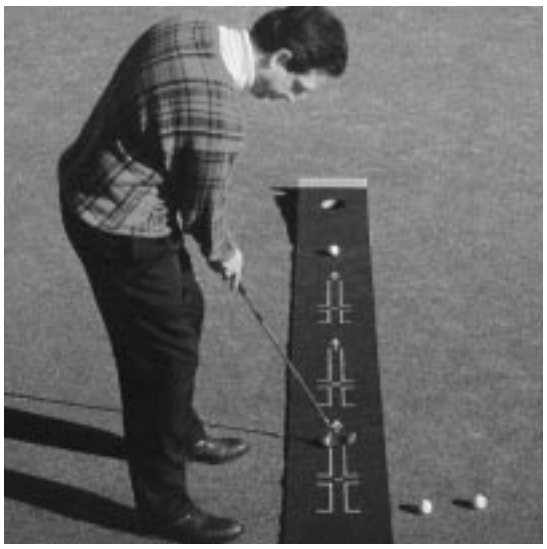


After reading “The Tao of Golf,” by Leland T. Lewis, my attention shifted to the act of putting itself. Many players do not give putting the same level of attention when practicing as they do other elements of the game. With this in mind, I wanted to concentrate on developing a putting trainer.

“The highest is the simplest, and yet, the simplest is the most difficult.”

The Master Key of Tai Chi

Electric Putting Partner



Putting Training Device

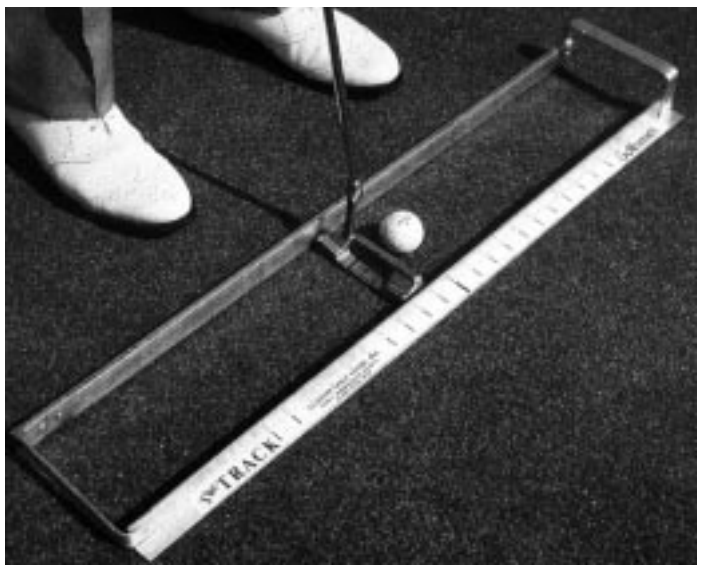
Trainermat

As the image of a design emerged, I looked at products already on the market to understand their approach, and to help clarify mine.

Quite a number of putting trainers are available. To simplify the characteristics of these trainers, they can be divided into two groups.

The first group primarily provides the user with target practice. Hitting or missing the target is the main source of feedback.

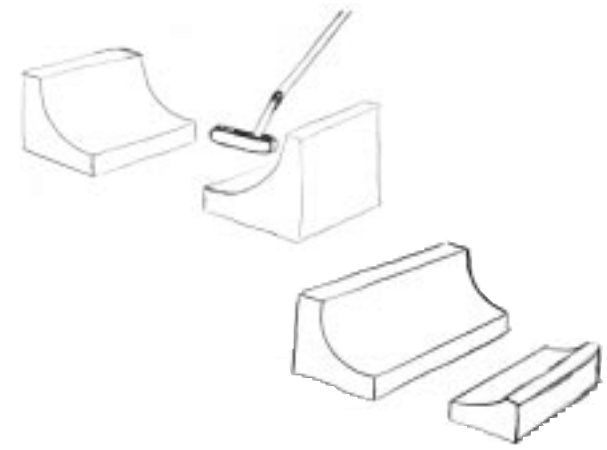
The Puttband

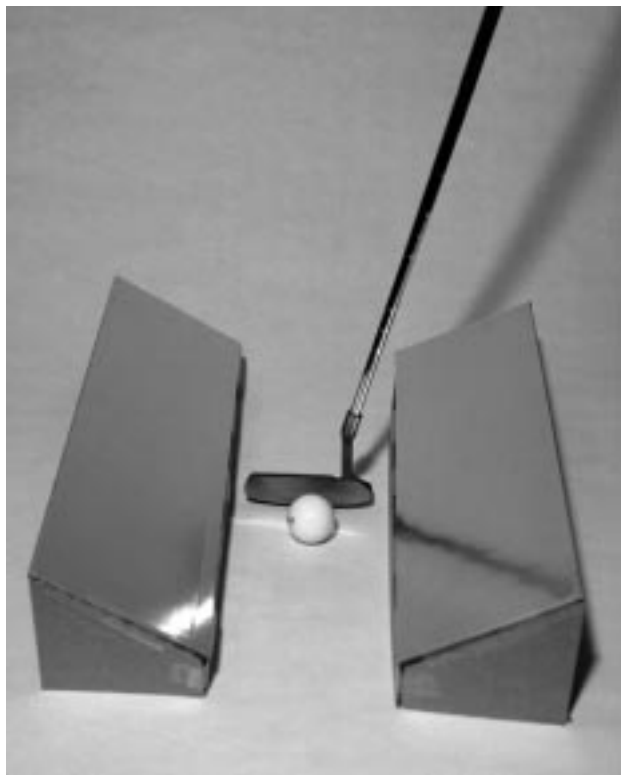


The Track

The Putting Track

The second group consists of putting trainers which work primarily as stroke guides. These work under the premise that training the actual putting stroke will produce better putting on the golf course. Some can be used in conjunction with a target to help monitor results.



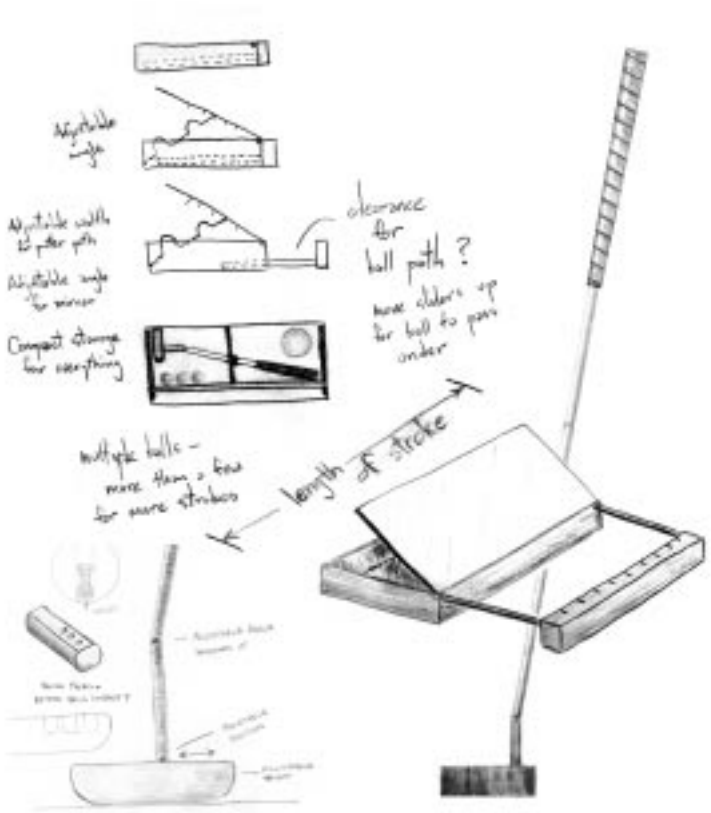


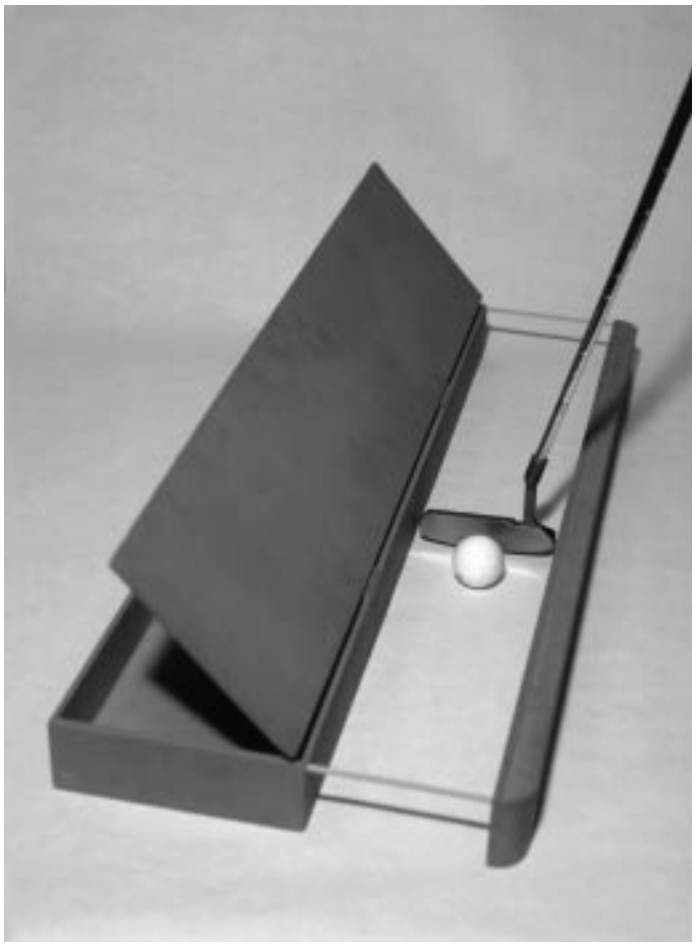
Model 1

Influenced by Lewis and by Dave Pelz, who wrote the book, *Putt Like the Pros*, I felt that a putting trainer which functions as a stroke guide has the most potential to produce positive results for golfers. The putting stroke can be practiced to become more consistent, which leads to better putting. In my research I came across several stroke guide trainers, though all of these lacked the range of feedback I wanted to experience in a putting trainer.

Understanding the potential for successful use of imagery in training for a physical activity, I wanted the putting trainer to provide more feedback to the user to increase the likelihood for positive mental imagery. This would be achieved primarily with the use of mirrors to reflect relationships between club, ball, and body posture.

The first study model was assembled to look at the concept of creating a path to guide the putting stroke, with mirrored surfaces providing visual feedback.





Model 2

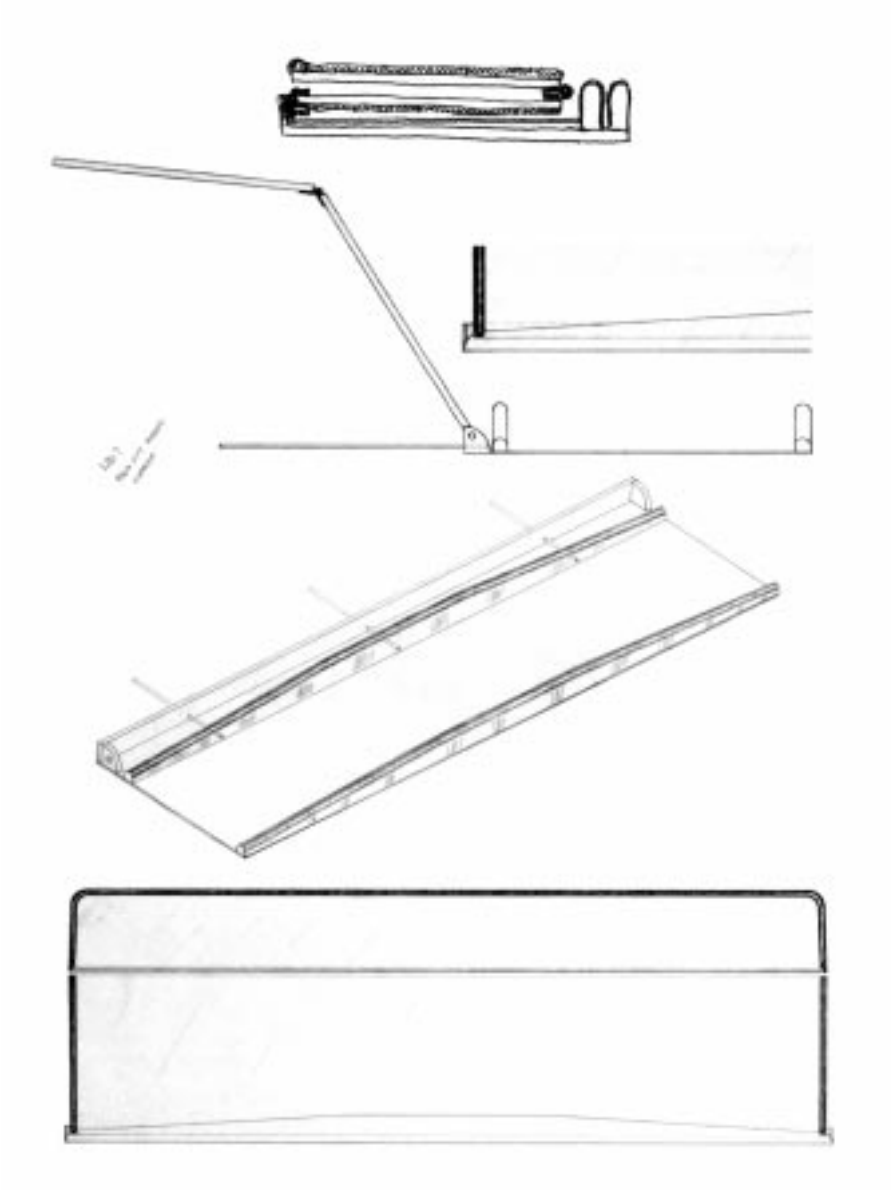
In the early concepts, I wanted to include an adjustable putter as one of the components in the putting trainer. This element was eventually eliminated as it could become the subject of a separate project.

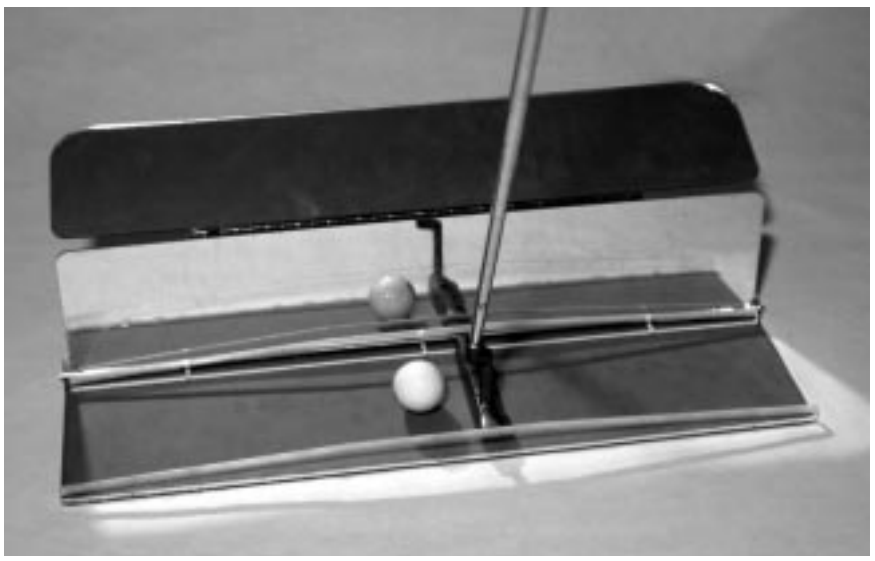
The second model began to look at the concerns of adjustability, compactness, and portability:

Adjustability in the width of the path and in the mirror angle.

Compactness of the product as a whole, which contributes to...

Portability for the benefit of the user.



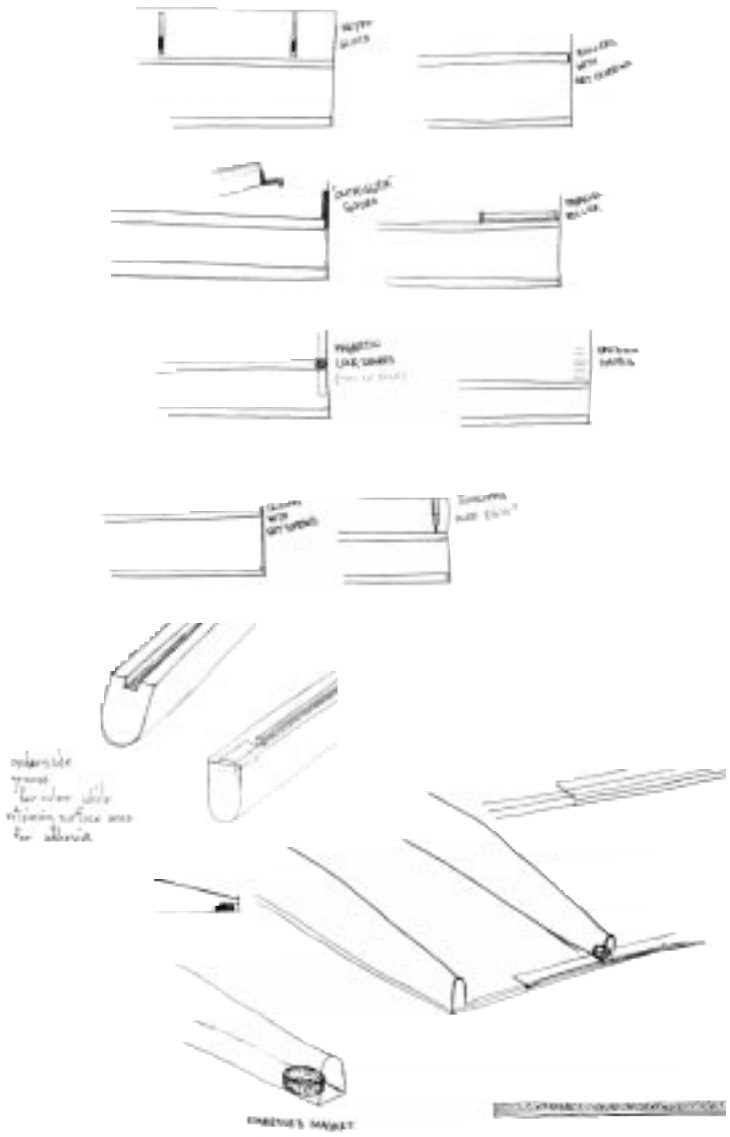


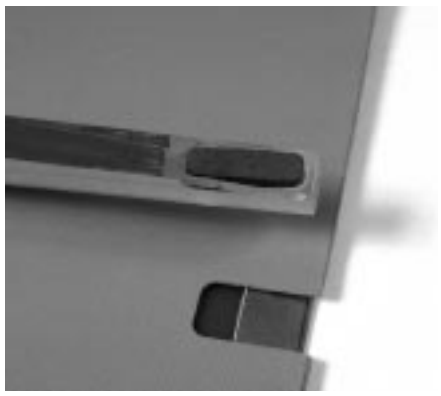
Model 3

With the third model, certain elements began to get more refined.

The rails were tapered to allow for some variation in the path of the putting stroke, yet requiring the path to be true at the moment impact with the ball takes place.

The mirror was divided into two parts for more adjustability and to allow more visual information to be received by the user.



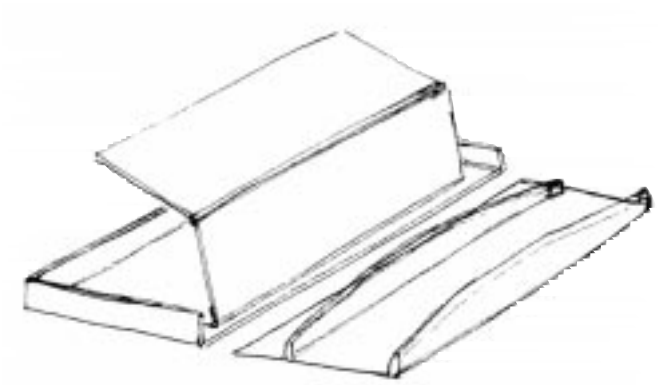


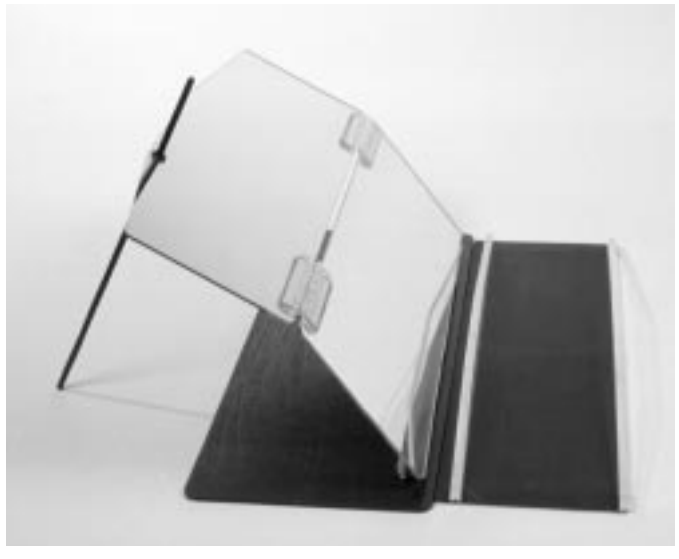
Magnet test model

To develop the function of the rails, I wanted the adjustability to be highly variable, and the mechanism to be easy to use. I also wanted the rails to have some visual contrast with the base to enhance the mental image of the path the putter must travel for a successful putting stroke.

Magnets in the rails provided a simple mechanism for adjusting the rails.

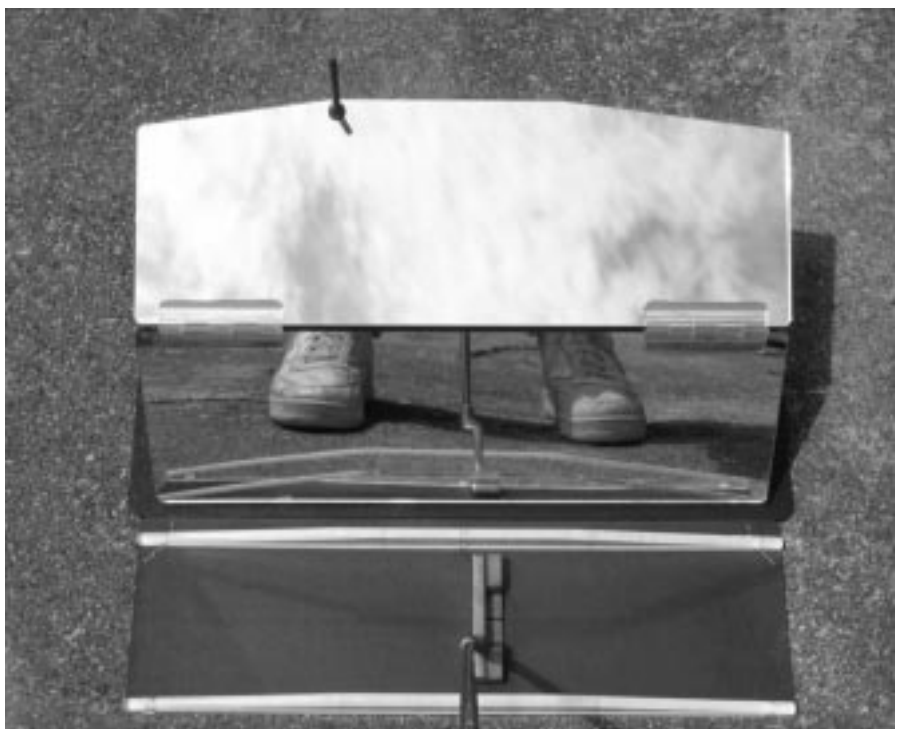
Painting the bottom of the rails created enough contrast when viewed from above to make the path well defined.





First complete working model

The model became two distinct parts: the stroke guide, and the compound mirror. This gives the user more flexibility with placement of the mirror, varying what information is reflected, and also allows the two components to be used independently according to how the user wishes to practice.



User Study

To conduct some research on the putting trainer, several of these first working models were made and given to different golfers, who varied in age, number of years of playing experience, and in overall skill level. This provided a range of useful feedback about the effectiveness of the trainer during use.

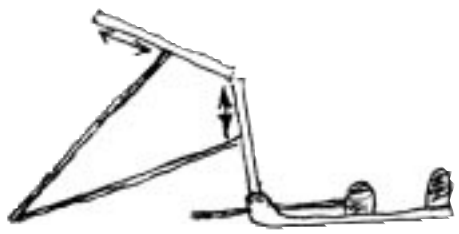
Below are some of the comments from the test users:

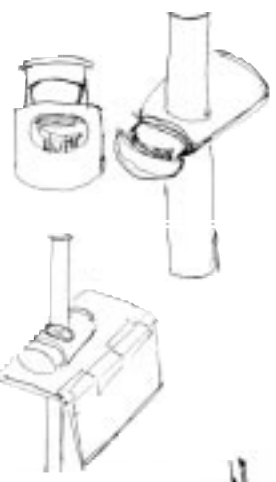
“It seems the feedback could be stronger. There is no consequence if the club touches the rail. Perhaps sound, or the rail tipping over might intensify the stroke action.”

“Feet position helped to keep consistent stroke.”

“The bottom mirror helps me think about my body in relation with the ball, but the top mirror helps me think about the mechanics of my shoulder movement and not moving my head.”

“The feedback is sufficient to tell me when I’m off, but some more lines parallel to the face at address would help me see my mistakes more exactly.”

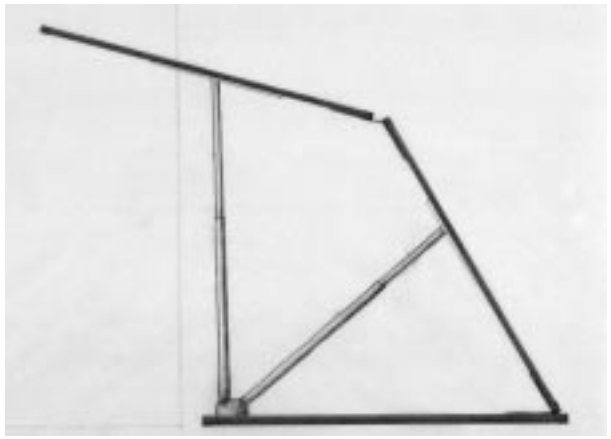




Early prop rod

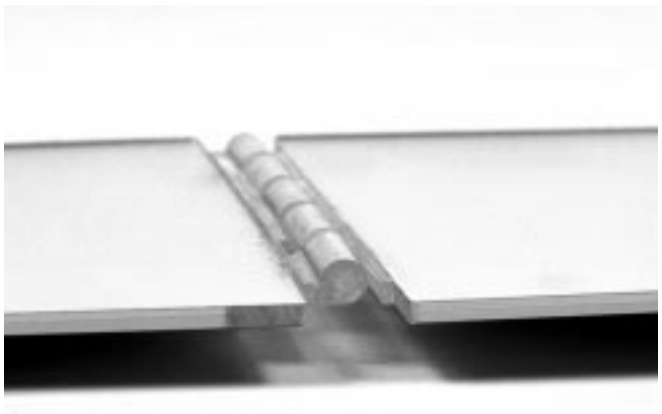
Test model easel bracket

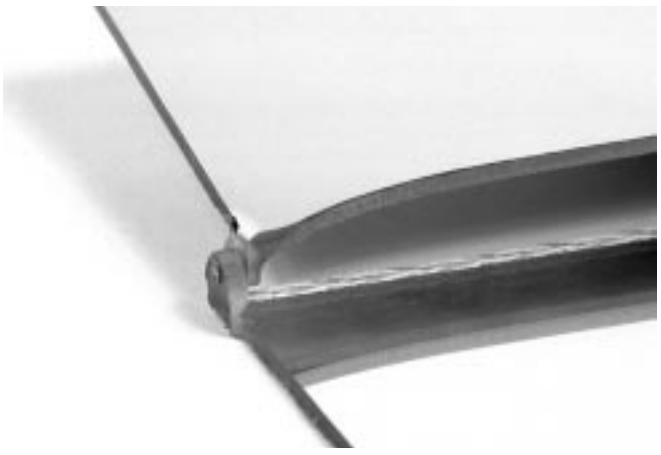
In order for the mirrors to be set in any variety of positions, a simple adjusting mechanism was needed. This was not easily solved because the compound mirror assembly with two mirrors and two hinge points was often prone to collapsing in on itself. Early attempts at an adjustable prop rod provided the needed stability, yet were not very easy to adjust when trying to change the mirror position. Off-the-shelf locking clips were tested, offering a quick solution, though ease of adjustment was still not satisfactory. The model given out to testers had a combination system using a prop rod and an easel-type bracket. This did not give a very broad range of adjustability for the lower section of the mirror.



First telescopic supports for mirrors

The mirrors became fully adjustable by using a telescoping prop rod for each section. The rods now provided a very smooth action to adjust the mirrors, and they nest compactly in the support base when the compound mirror assembly is folded for storage.

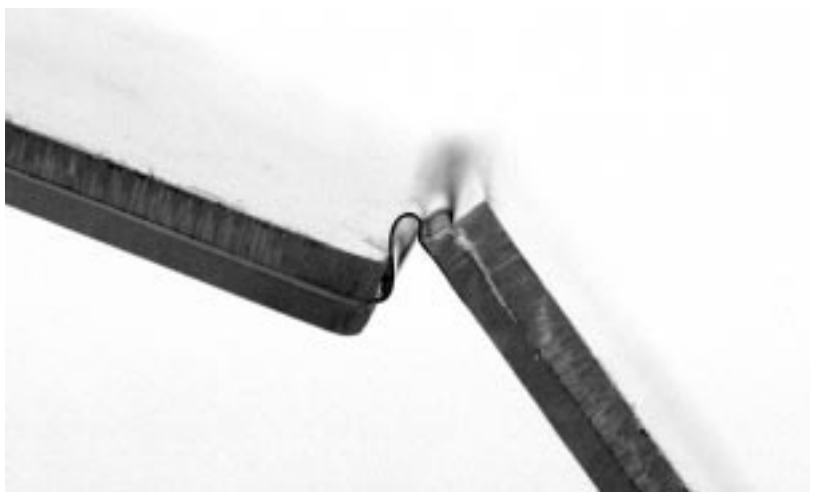




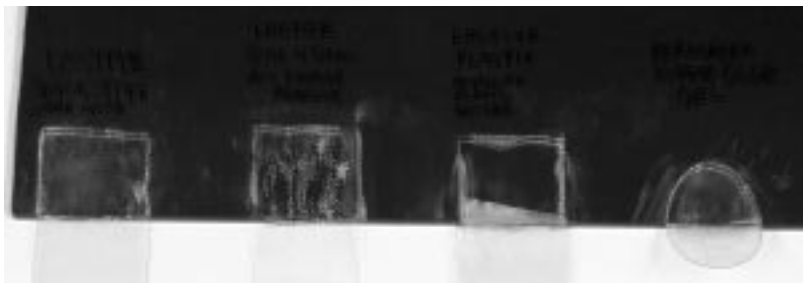
The hinges on the compound mirror allow the two mirrors to be positioned at different angles during use, and also allow folding the whole assembly flat for storage.

Early tests looked at rigid hinges, and also at forming a hinge with the acrylic of the mirror itself. These hinges worked with a limited range of motion, and sacrificed compactness.

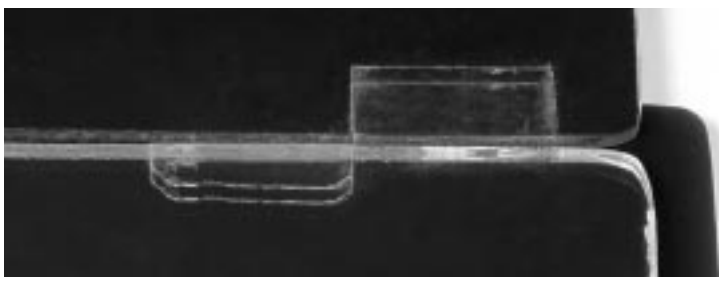
Book binding tape hinge



Vinyl sheet failure



Adhesive tests



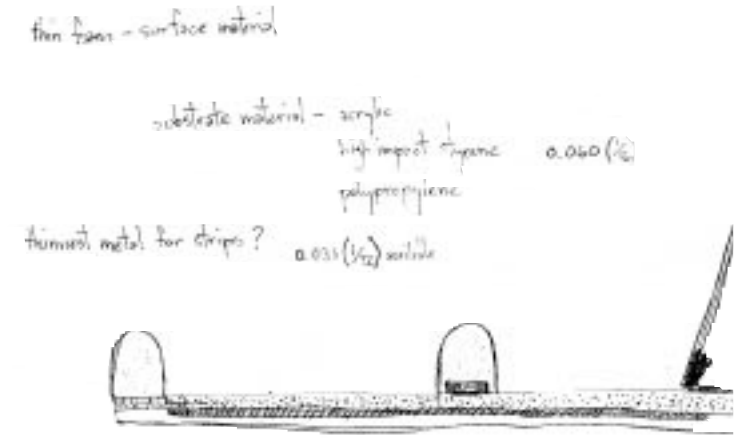
Opposed vinyl strips

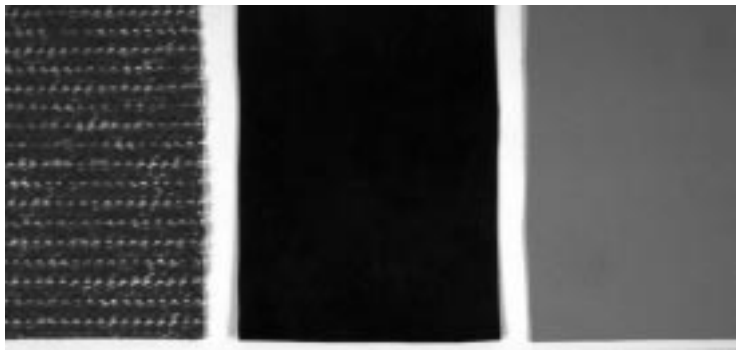
After rigid hinges proved unsuitable, flexible hinges were tested. Different tapes, such as book binding tape, were used with the expectation that the flexibility and strength would make a durable hinge. The connection of the lower mirror to the support base is not as demanding, and the tapes worked as planned, but the joint between the upper and lower mirrors failed with the tape due to the weight of the upper mirror.

A similar failure occurred at this joint when flexible vinyl sheet was used as a hinge sandwiched between two pieces of acrylic–the vinyl could not support the weight.

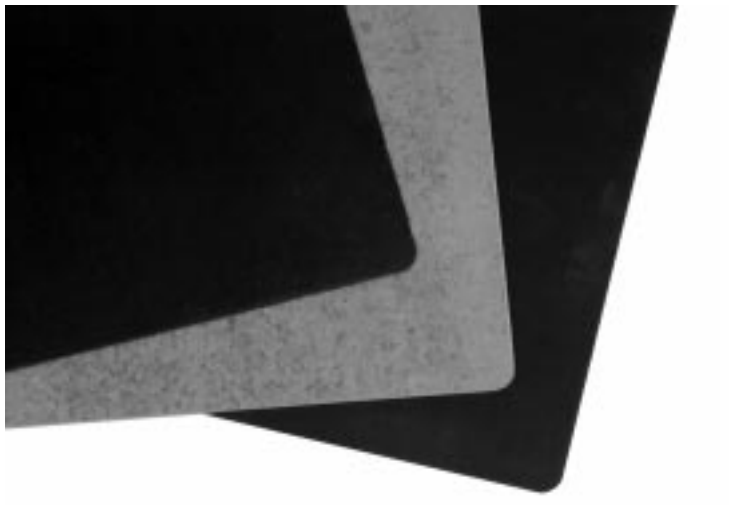
The sheet vinyl still seemed like a viable hinge material, and different adhesives were tested with the acrylic mirror, to find one which produced minimal hazing, or blush.

Using opposing strips of vinyl which pass from the back of one mirror to the front of the other proved to be a very flexible hinge with the necessary strength to support the upper mirror throughout its range of movement.





Rubber samples tested for surface material: (l-r) non-skid carpet base; fiber-reinforced neoprene; jar-lid opener sheet.

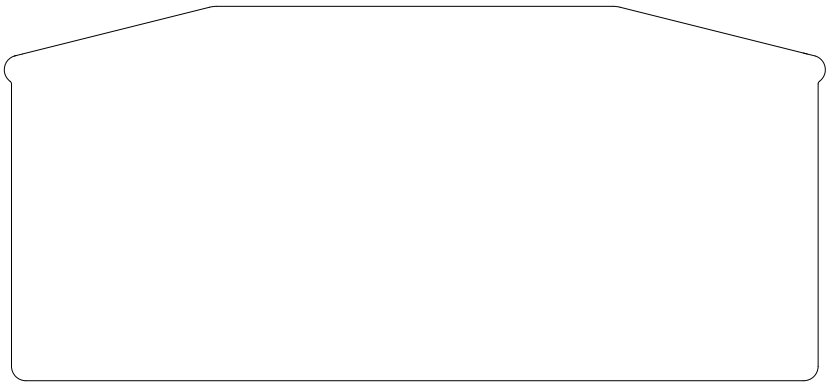


Stroke guide base sandwich of jar opener rubber and sheet metal.

Material selection for modeling was based on availability and fabrication techniques. Some materials were used because they could be cut with a laser cutter to make precise parts. The acrylic mirror, the acrylic base supporting the mirror, the rubber surface of the stroke guide, and the acrylic rails were all cut with the laser cutter. The metal layer in the stroke guide base was made using conventional methods.

Samples shown on the left are the types of rubber tested for the putting surface, and the thin sheet metal sandwiched between the "jar-lid opener" rubber sheet used for the final base.

A.



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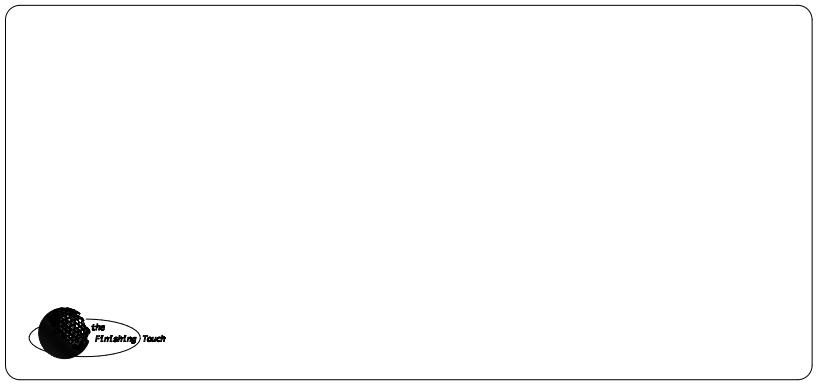

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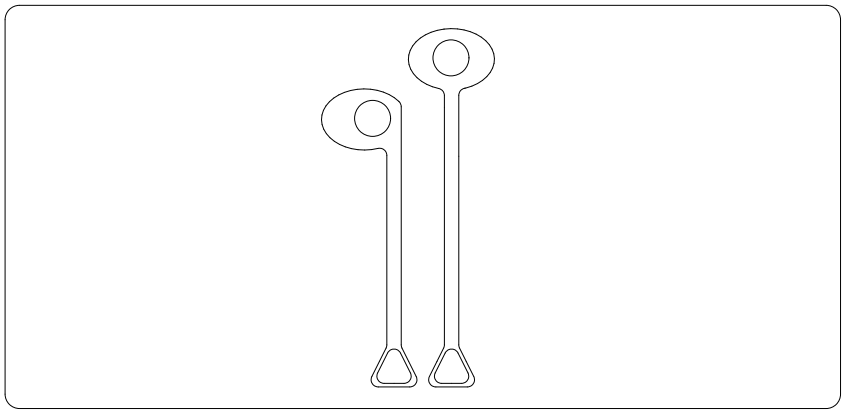

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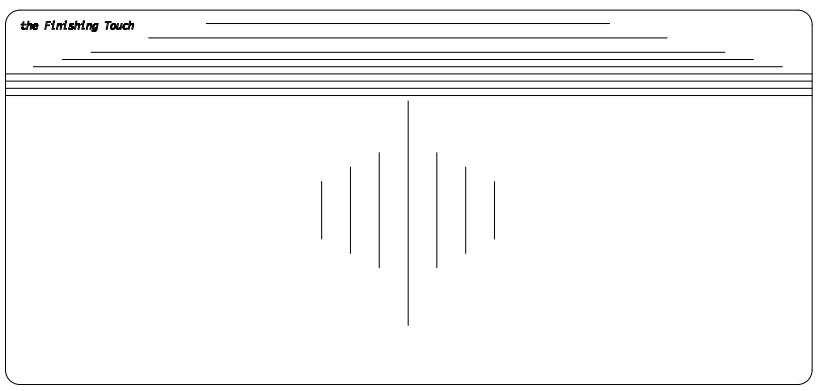
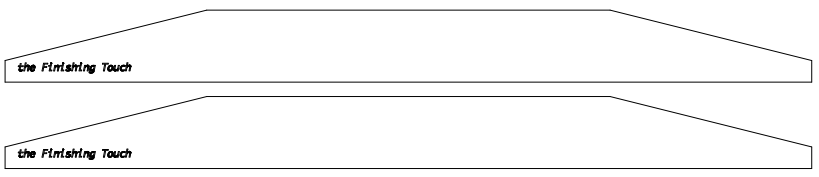
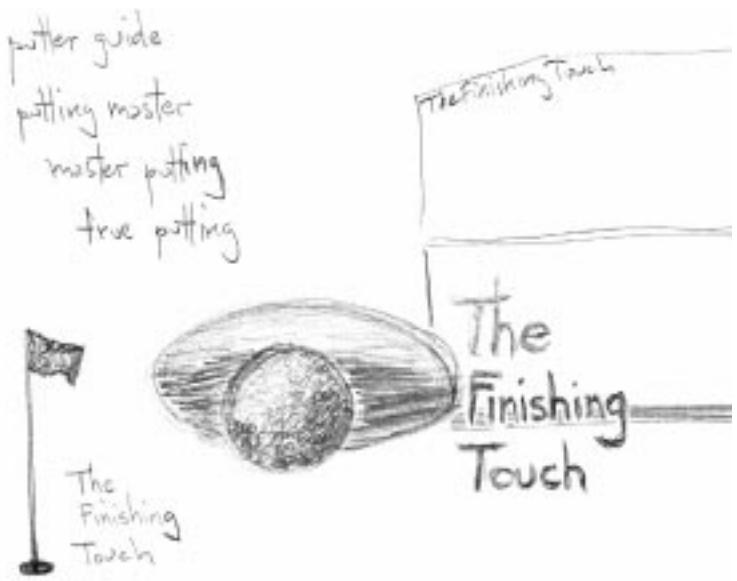


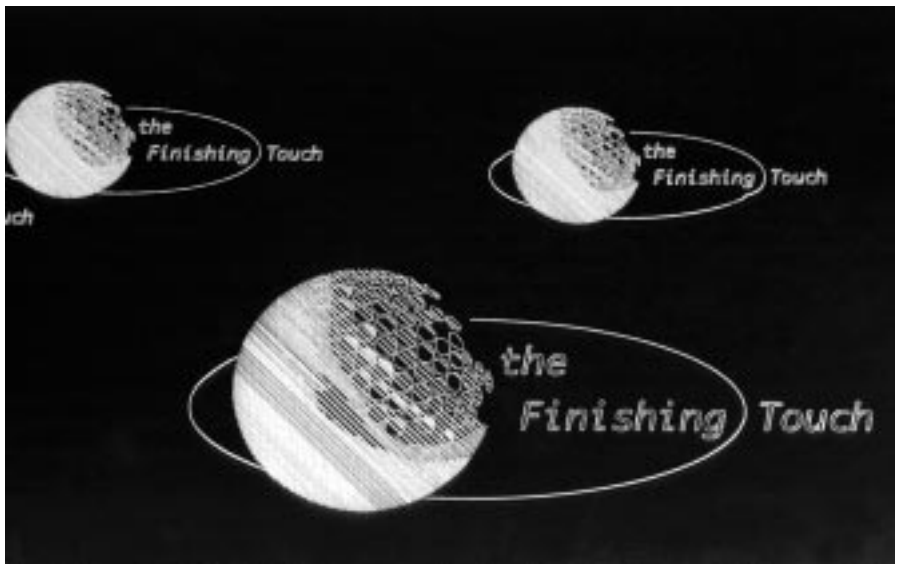
E.



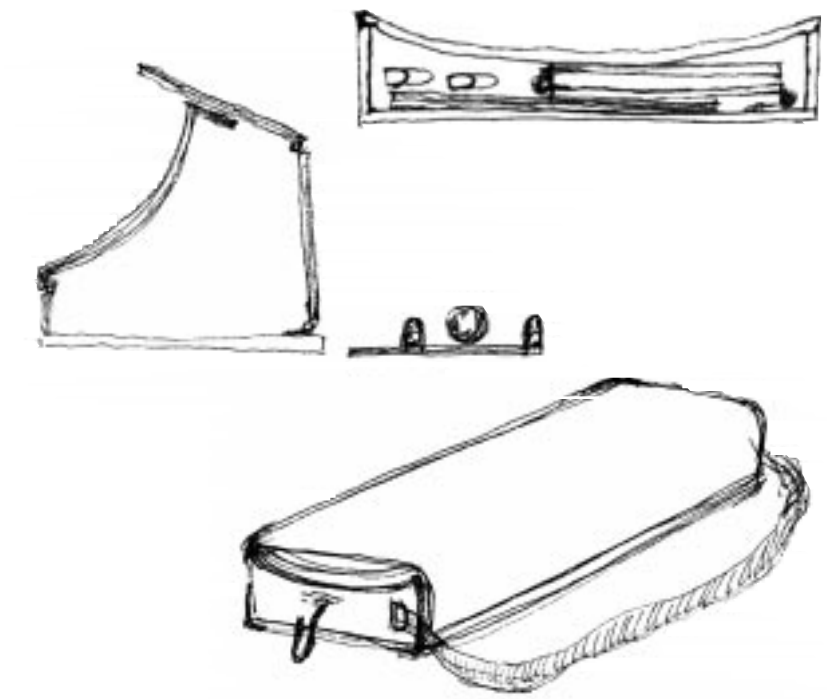
The laser-cutter used to cut many of the parts is computer controlled and requires drawings generated in CAD software which can export DXF files. This composite drawing represents all of the parts cut with the laser.

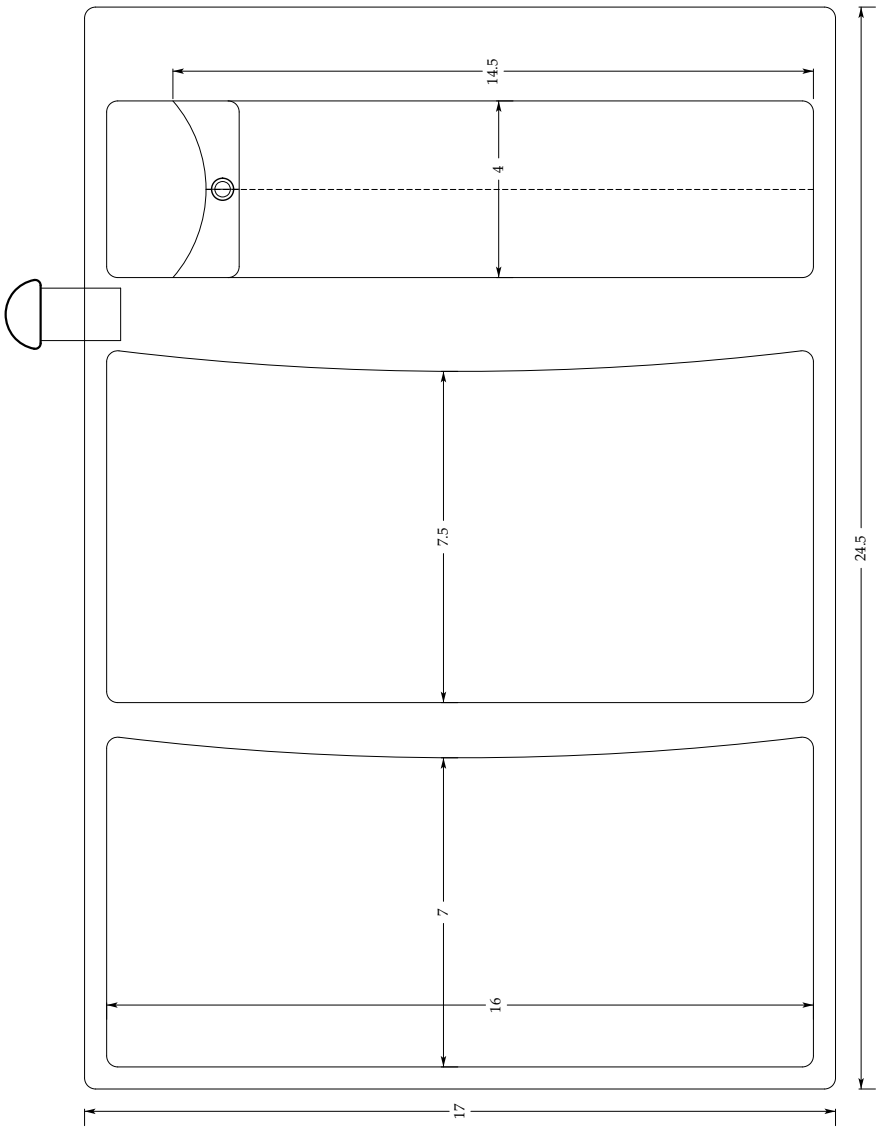
A. Upper mirror.
B. Lower mirror.
C. Mirror support base.
D. Stroke guide base. (lines and name were silk-screened)
E. Stroke guide rails.





A graphic logo was developed to take advantage of the laser-cutter score settings. Some test cuts on an extra piece of acrylic mirror helped to scale the logo for the final prototype.





Storage Case

Portability was one of the desired features for the trainer from the beginning. Early case designs were often rigid in an attempt to use them as a structural element in the support of the mirrors. This was never satisfactory in allowing the mirrors to be fully adjustable.

A soft-sided case is easier to handle, is less prone to damage from bumps, and the padding provides adequate protection for the putting trainer. A soft case can be carried alone, or easily attached to a golf bag for transport.

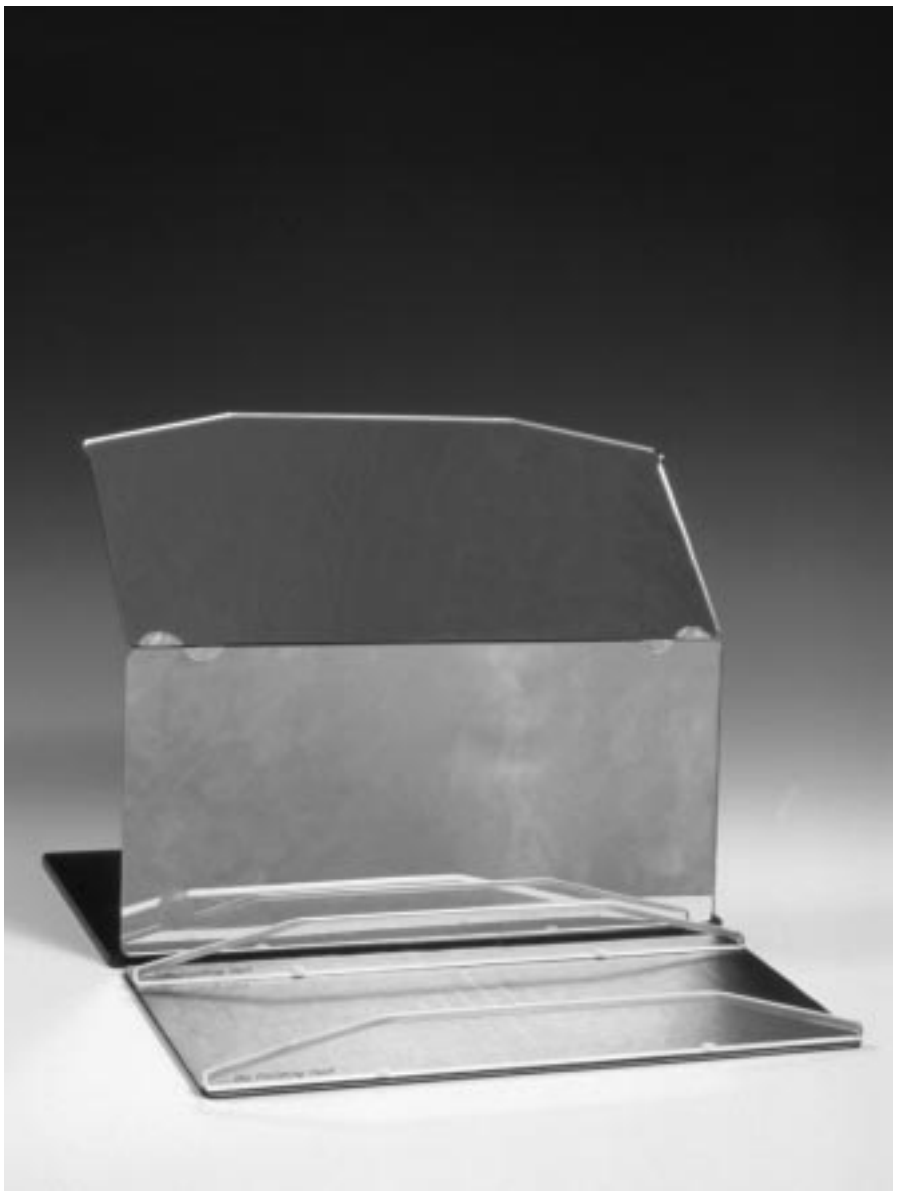
A pattern for a soft case was drawn on the computer, enlarged to full-size on a large format photo-copier, and taken with fabric and fasteners to a tailor shop to have a case made to test with the final model. The case functions much like a tool-roll, wrapping the pieces securely, with a simple loop strap for a handle.

Details of the Final Model

The telescopic mirror supports.
The vinyl hinge.
A rail magnet.
The base marks on the stroke guide.
The name and logo etched into the rails and the lower mirror.

Final Storage Case

Setting Up the Model



Final Prototype

The Finishing Touch

As the putting trainer was taking a more complete and final form, I began to realize the thesis was more than the product. This thesis has become more about the process of education, a process of exploration and discovery. It has been about realizing capabilities, limitations, and the ability to work through limitations. It has enabled me to begin to ask the right questions, and the ability to seek and produce the right answers.

When I worked in photography I developed a way of seeing to produce an image. I have now begun developing a new way of seeing, a new vision encompassing a wider field of view. My focus now is on design, and I question what I or, collectively, what we are capable of; is there something more, something better, for a thing, an object, a possibility.

With apologies to Larry Norman for taking an idea from his song, *Walking Backwards Down the Stairs*, and adapting it to my situation, this is my summation of a process of design.

> Beginning with a vision of an object, an idea, a picture in the mind of what we wish to create, we struggle to keep it within our view as we descend to the beginning of the process of design. We ask ourselves questions. We suggest solutions. We design the answers, if the answers can exist, in the hope of climbing back up to somewhere near the beginning and discovering that the essence of that first vision does exist in what we have made. Beginning with an end we begin toward that end. Beginning with an end the journey begins.

For my thesis I designed a putting trainer. I tried to create an object which can assist in forming a link between the body and the mind in order to perform a task successfully. The success of the thesis is that it has helped me learn to approach design with a broader perspective, and to understand the importance of simplicity so that I may strive to focus my vision to discover the essential. Find the essence. Know the stroke is true.

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