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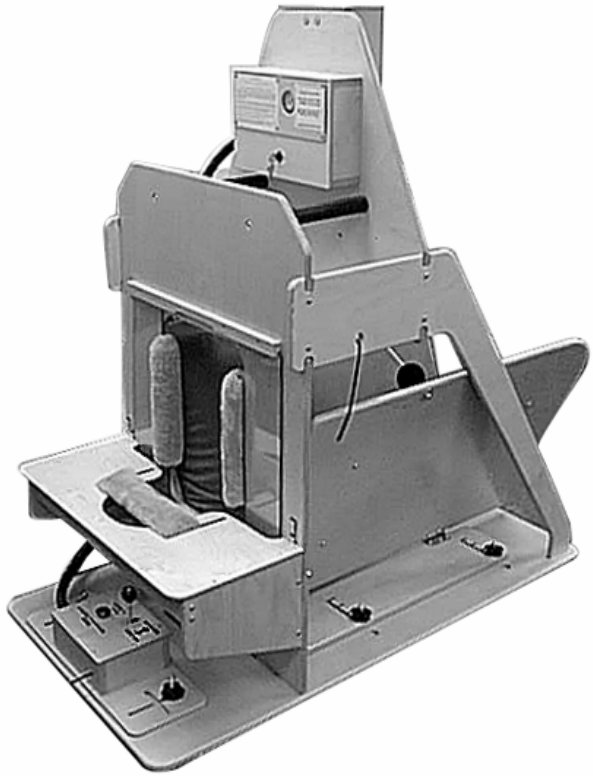
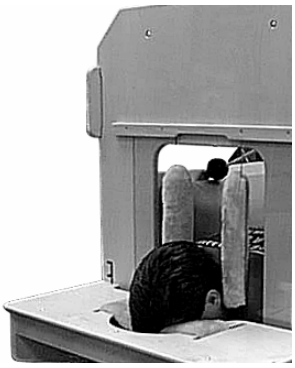
THE SQUEEZE MACHINE





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Autism Resources

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Temple Grandin's 'Hug Machine' www.autism-help.org/points-grandin-hug-machine.htm **Stephen Edelson, Ph.D.**

Questions and Answers

Q How Big Is It?

Crated for shipment, the machine is 65" tall, 65" long and 54" wide. Uncrated, it is 60" tall, 60" long, and 32" wide. Crated, the complete system with compressor weighs almost 350 pounds.

Q Who Can Use It?

The Squeeze Machine can be used by most people because it is adjustable in a number of ways. The machine has a series of slots and holes to allow approximately fourteen inches of adjustment in width at the base of the pads. There are also slots to adjust the headrest height... slides to adjust for differing head widths... and the hand control center is adjustable from side to side and from front to back. One set of pads is included, which will accommodate either children or adults.

Q What Is It Made Of?

The basic structure is constructed from thirteen-ply 3/4" birch plywood. The wood is sealed and lacquered for a durable smooth finish. All edges are rounded to ensure safety. The air controls are high quality with multiple safety devices included. The remaining parts are comprised of wood, metal, and plastic. The overall look is that of an educational style piece of furniture.

Q How Does It Ship?

Due to the size and the weight of the Squeeze Machine, shipment must be by truck. One normal machine crated weighs about 350 pounds. The air compressor that comes with the machine is quiet and compact, weighing only 25 pounds. You must have the ability to unload the crate from the truck either by use of handling equipment, loading dock or man power.

Q How Long Does It Take?

If the Squeeze Machine is in stock, the machine can be shipped as soon as credit is approved or a deposit is made. But to be safe, you should plan about six weeks for the machine to be completed and an additional week for shipping.

Q What Kind Of Warranty Does The Squeeze Machine Come With?

Therafin warrants its products to be free from defects in materials or workmanship for 90 days from the date of purchase (the date of shipment).

INTRODUCTION TO THE SQUEEZE MACHINE

The Squeeze Machine is to aid in the application of deep touch stimulation. The Squeeze Machine is constructed from cabinet grade plywood with a lacquer finish. The Squeeze Machine is shipped F.O.B. Therafin, Frankfort Illinois, completely assembled with an air compressor included.

THE FOLLOWING INFORMATION WAS COMPILED AND WRITTEN BY TEMPLE GRANDIN, MS AND JEANNE E. LEWIN, MS,OTR/L.

INTRODUCTION

Why is the Squeeze Machine more effective than rolling in a blanket or mat for deep touch stimulation? The Squeeze Machine can apply much greater pressure than a blanket and still be comforting and soothing to an individual. The second advantage is the amount and duration of the pressure can be precisely controlled by the client. A third advantage is that the client can apply the pressure to his or her self. The therapist can easily control the maximum pressure that can be applied by adjusting the pressure regulator on the Squeeze Machine.

Lorna Jean King, OTR, Director of The Center for Neurodevelopment Studies, Inc., Phoenix, Arizona, is currently using the Squeeze Machine in her clinic. She has found that this unique piece of equipment has a calming effect on hyperactive and autistic clients.

> In our practice we have found the Squeeze Machine to be very useful in the treatment of tactually defensive children. The child receives a specific amount of pressure to the lateral body surfaces for an amount of time controlled by the child. The machine has high interest value and the children who need pressure-touch the most seem to be most eager to use it. It is certainly a valuable piece of equipment.
>
> Lorna Jean King,OTR
> February 1986

Rationale for the use of the SQUEEZE MACHINE

Deep touch-pressure stimulation is recommended for hyperactive, autistic, and distractible children who manifest tactilely defensive behavior (Ayres, 1964, 1973). Firm touch-pressure has both a modulating and a calming effect on both humans and animals (Ayres, 1979, Grandin, 1984, King, 1979), whereas light touch tends to increase behavioral disorganization in infants. Swaddling, a form of firm touch-pressure, has been shown to calm infants (Anderson, 1986). Because the brain interprets self-initiated touch sensations differently than those sensations imposed by another individual, Ayres (1979) suggests that effective therapy procedures should include providing situations in which the client stimulates his or her own tactile receptors.

Autistic children prefer near or proximal sensory stimulation (i.e. tactile, gustatory, olfactory) to distance, or distal, types of input (i.e. auditory, visual)(Kooth, Marielli, & Cohen, 1981; Schopler, 1965). In the developing central nervous system, the tactile system, along with the vestibular-prorprioceptive system, is one of the first systems to myelinate (Gottleib, 1971). This may explain why a child with an immature or damaged central nervous system often craves tactile, especially firm touch-pressure, and vestibular-proprioceptive stimulation. The brain depends on the integrity of the vestibular and proprioceptive systems to balance the tactile sensory flow (Ayres 1979).

Sensory stimulation stimulates the nervous system's neuronal connections to proliferate. Animal studies reveal that rats placed in an enriched environment with other rats and toys with which to play have larger brains with greater dendritic growth than those rats in standard laboratory cages (Greenough and Juraska, 1979).

Ayres (1964, 1973) states that firm touch-pressure may help stimulate maturation of the dorsal column system. Firm touch-pressure helps reduce arousal in an immature or damaged nervous system by enhancing the inhibitory pathways at the receptory site (Ayres, 1979). The SQUEEZE MACHINE provides a constant sensory input for an extended period of time. This input, being of the same frequency and amplitude, may build up a constancy and consistency of sensory patterns

fundamental for the perception of changing patterns of sensory input within the individuals central nervous system (Goody, 1958).

Grandin (1986), a "recovered" autistic child, suggests that as a child used the Squeeze Machine, the individual could apply intense yet pleasant stimulation to his or herself. Since the Squeeze Machine is designed to feel very much like being held by another person, the device might help the child to accept, and perhaps enjoy, being held or touch by another person. Once the child learns to operate the Squeeze Machine, human affection is the next step. Grandin, speaking from her personal experience with the Squeeze Machine, feels that the child's active control of the amount of touch-pressure he or she receives is of foremost importance.

The Squeeze Machine has been used for several years, and continues to be used, in Lorna Jean King's program for the treatment of autistic and hyperactive children and adults. The device has been helpful in reducing hyperactivity. A hyperactive adult, who used the Squeeze Machine for twenty minutes, reported feeling (as well as acting) calmer the next day. The clients initiate the use of the Squeeze Machine; stimulation is never forced upon the individual (Grandin, 1986).

Literature Review Related to Touch-Pressure

Animal studies indicate that the tactile and pressure stimulation will reduce arousal. Rubbing and pinching a cat's paw decreases tonic activity in the dorsal column nuclei and the somatasensory cortex (Melzack, Konrad, & Dubrobsky, 1969). Kumazawa (1963) found that pinching a rabbit's skin with one to eight rubber padded clips creates a deactivated EEG pattern; the rabbit manifests reduced muscle tone and drowsy appearance. Pinching a horse's upper lip has a calming effect and the horse's response to pain is reduced (Lagerweij, Nelis, Wiegant, & VanRee, 1984).

Takagi and Kobagasi (1956) found that pressure applied to both sides of an individual's body reduces the metabolic rate, pulse rate, and oxygen consumption, as well as decreasing muscle tone.

The Squeeze Machine applies pressure to the body areas which are most sensitive for eliciting the "Skin Pressure Reflex," described by Takagi and Kobagasi n 1956.

Test results on normal individuals using the Squeeze Machine suggest that the device tends to lower some metabolic functions. Out of the 40 normal college students who experienced the Squeeze Machine in a behavioral study, 62 percent expressed a "like" for the apparatus and found it to be "relaxing." Some students found the Squeeze Machine "relaxing" for the first 10 to 15 minutes; it then became "annoying." Their response suggests that there may be an optimal level of stimulation which the central nervous system can tolerate (Grandin, 1970).

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OPERATING INSTRUCTIONS

SET UP

The Squeeze Machine is shipped fully assembled. After the crate and pallet have been removed, the machine will fit through a standard 36" door opening. Remove the air compressor and attach the air hose by pushing the hose into the red ring of the connector and then give a gentle pull to seat the hose. The machine can be disassembled for movement through small doorways. The disassembly and re-assembly of the machine is fairly complex and should be done as the final option. The disassembly instructions are available upon request. There are seven major pieces. They are: base, front panel, two sides, two side braces and the board the air cylinder and controls are mounted on. The plywood pieces are fastened together by bolts, screws and interlocking notches. During disassembly remove the board with the air cylinder first. After re-assembly inspect the machine and make sure ALL bolts have been replaced and tightened. It is especially important that the long bolts which screw into the rubber covered pipes are screwed all the way in. The two squeeze sides are easily installed by placing the E-slot over the upright bolt and installing the knob and the acorn nut. **DO NOT** unbolt the hinges.

COMPRESSOR

Currently all Squeeze Machines include an oil free air compressor. The furnished compressor has a preset pop off safety valve. The compressor has a small tank and will run most of the time the squeeze machine is being used. There is a red tip on the switch lever. On the bottom of the air tank is a drain valve to empty the condensation periodically.

The following information is only relevant if you choose not to use the standard compressor.

A commercially available electric ½ horse power compressor with an air storage tank is recommended. The factory set pressure switch on the compressor should be set at 100 PSI. DO NOT use an industrial or gas station compressor which has a maximum output of 150 PSI, Pressures over 100 PSI could cause serious injury to people using the machine. DO NOT use a homemade compressor. A suitable compressor can be purchased at a reasonable price at a lumberyard, paint store, farm supply, discount house or wholesale electrical house. These places will usually have much lower prices than retailers such as Sears. If you have any questions about the suitability of a particular compressor call Temple Grandin at 970-229-0703. Before you connect the compressor to the Squeeze Machine, read and obey all of the compressor manufacturer's instructions on compressor break-in and start up. Some compressors must have oil added before they can be run. Failure to add oil will wreck the compressor. Most compressor manufacturers recommend a break in period. The compressor is allowed to run for 15 to 20 minutes with nothing connected to it.

After the compressor is broken in, the Squeeze Machine can be connected. Most compressors come equipped with a rubber hose for inflating tires. Disconnect this hose. This kind of compressor will require additional fittings, which are not supplied with the squeeze machine. connect the fitting on the end of the black plastic air hose to the fitting where the rubber tire inflating hose was disconnected. Seal the pipe threads with Teflon tape (available at hardware store). If the fitting is the wrong size, an adapter fitting can be purchased at a hardware store. The regulator on the compressor must be set at the following settings:

Children 50 pounds per square inch (PSI)
Adults 75 pounds per square inch (PSI)

The pressure regulator on the Squeeze Machine inside the locked box must also be set. The recommended settings for this regulator are outlined below. These are the maximum settings.

Adults 60 to 75 PSI
Teens 50 to 60 PSI
Children 40 to 50 PSI

When the machine is initially introduced it is often advisable to start with lower pressures and then increase it. The locked box must be kept locked at all times!

To prevent unauthorized access to the compressor, it **must** be in a secured location such as another room or closet. The room or closet should be locked. The compressor can be located up to 100 feet away if noise is a problem. Additional air hose can be obtained from the factory. The pressure switch will automatically turn the compressor off when the tank is full, and turn it

on when tank pressure gets low. The pressure switch is set at the compressor factory. **NEVER** tamper with the pressure switch or safety pop off valve on the compressor.

In cold climates with below freezing temperatures the compressor must be located in a heated room. Locating the compressor in below freezing temperatures will cause condensation in the tank. Water condensing in the air tank may enter the air line and damage the Squeeze Machine. In warm climates the compressor can be placed on a porch or carport but it MUST be protected from water and rain. If the compressor is placed in a closet do not allow clothes or other objects to be piled on top of it. This could cause the air pump or motor to overheat.

MECHANICAL PRINCIPLES

An air operated cylinder provides the power to operate the machine. It is mounted above the squeeze sides. The rope attached to the squeeze sides is attached to the piston rod in the cylinder. When the piston rod retracts the squeeze sides are - pulled together. When the piston rod is extended the sides will fall open by gravity. Air from the compressor enters the cylinder and causes the piston rod to move. It works like a bicycle pump in reverse. When the control lever is pulled to the squeeze position air enters the retract side of the cylinder and is exhausted from the extend side. When the control lever is released the opposite happens. A flow control inside the locked box controls the speed of piston movement. It is pre-set at the factory and it usually does not require adjustment. Excessive loosening of the flow control will cause the piston to move in a fast jerky manner. Excessive tightening of the flow control may disable the machine by "turning it off". The flow control should be adjusted so that the cylinder moves in a slow, controlled manner.

When the control lever is pulled back to the squeeze position and held, the Squeeze Machine will apply pressure up to the maximum set on the regulator. When the user of the machine lets go of the control lever, all squeeze pressure is released very quickly. The control lever is designed to release the squeeze pressure automatically when the user lets go of it. Automatic release is a safety feature. Never override or defeat the automatic release feature. There is also an emergency release button, which can be pushed to release the squeeze pressure. If the user moves the control lever slightly towards the release position, he can slowly bleed off air pressure and set the pressure at a setting below the setting on the regulators. Most children and adults will quickly learn to operate the control lever and set the pressure.

ADJUSTMENT

Proper adjustment of the Squeeze Machine is essential. A common mistake is to make the space between the squeeze sides at the floor too wide (see diagram). The space between the squeeze sides at the floor should be adjusted so that the V shape of the squeeze sides support the person after pressure is applied. The space should be adjusted so that the client can place both knees side by side. A rough rule of thumb is 7 inches apart for children and 8 to 10 inches apart for adults. Never adjust the sides tighter than 7 inches apart. This is a safety rule to prevent entrapment in the machine. Measure the width from the inside edge of the plywood to the inside edge of the plywood. These measurements are for the width between the plywood. The adjustment slots are designed so that the sides can be angled to make the adjustment tighter at the hips or shoulders. Adult men usually require one notch looser at the shoulders and adult women require one notch looser at the hips. For children the width should be the same at both the shoulders and the hips. When the Squeeze Machine is properly adjusted the pressure will feel even at both the hips and the shoulders.

THE IMPORTANCE OF PROPER ADJUSTMENT CAN NOT BE OVER EMPHASIZED.

HEAD REST AND NECK PANELS

The height of the head rest must be adjusted so the client's back is level when pressure is applied. The forehead band can be moved forward or backward in the slot. To move the forehead band, loosen the knobs under the headrest. If the fabric on the head rest or sliding neck panels becomes soiled it can be easily removed and replaced. To remove the fabric cover from the neck panel, lift the panels out of the track and unscrew the narrow wood strips. If the client or clients are allergic or do not like the acrylic fur it can be replaced with different material. If additional padding is desired on the forehead band or on the neck pads, it can be easily installed.

PULLEYS AND ROPES

For the Squeeze Machine to operate correctly, the ropes attached to the squeeze sides must be looped around the two pulleys. In the newer models, the pulleys have been replaced with slides. If the rope breaks or becomes excessively loose it can be replaced or tightened. To tighten the rope, slide the black tennis ball off the connector and adjust the eyebolt. If additional help is needed call Therafin Corporation. Some units, which have cable clamps, can be loosened with a wrench to remove or tighten the rope. NEVER modify the design of the pulleys and cable clamps. The system is designed to restrict the travel of

the top of the squeeze sides. This is a safety feature to prevent entrapment or injury to small children. Adjust rope tightness so the cable clamps move up to the pulley but do not actually touch the pulley.

INTRODUCING THE CLIENT TO THE SQUEEZE MACHINE

All safety rules on the placard attached to the Squeeze Machine must be obeyed. The safety placard must NOT be removed or defaced.

The person using the Squeeze Machine has complete control over the amount and duration of the pressure. Many autistic, hyperactive or tactually defensive children and adults crave deep pressure. It has a relaxing effect on them. Most of these people will readily use the Squeeze Machine if they are introduced to it properly. Use of the machine must be voluntary. A client must NEVER be forced into the machine. To entice the client to use it, a therapist or an adult that the client trusts should demonstrate the machine, The demonstrator must actually use the machine to show the client that it will not hurt him. The person who demonstrates the Squeeze Machine should be completely familiar with it before he demonstrates it. If the demonstrator shows any signs of fear or apprehension he may communicate the apprehension to the client.

Some clients will immediately use the Squeeze Machine and additional demonstrations or encouragement are not needed. Some tactually defensive clients may hesitate and need additional encouragement. Often a therapist or other adult can coax the client into the Squeeze Machine by sitting in front of it. A tactually defensive client may use the machine for only a few seconds the first time. Each day, the client will be able to tolerate it for a longer time.

To obtain the maximum effect, the client should remain in the Squeeze Machine with pressure applied for 2 to 3 minutes. Some autistic children will use it for up to 15 minutes. Some tactually defensive clients will have an approach-avoid reaction. They crave the pressure, yet they pull away. This type of person will need alot of encouragement.

To achieve the most relaxing effect, the person using the machine must be in the correct position. See the diagram. When the person is in the correct position the pressure will be evenly applied. The relaxing effect will also be enhanced if the user closes the sliding panels snugly around his neck. The padded panels provide a place for the user to rest his shoulders against. They also apply additional pressure to the base of the neck and the shoulders. Some clients will readily get into the machine and apply the squeeze pressure, but they are reluctant to close the panels around their neck. The client should be encouraged to close the panels, but they must NEVER be forced closed.

Some clients will prefer to apply constant pressure. Others will prefer to tighten up the squeeze and then release it repeatedly. The most relaxing effect can sometimes be obtained by slowly releasing the pressure and then slowly increasing it. The client can release the pressure slowly by moving the control lever part way to the release position. He can also increase the pressure very slowly by moving the lever part way towards the squeeze position.

For best results, the Squeeze Machine should be located in a familiar place. If it is located in a strange place it will be more difficult to get the client to use it and relax. Warmth will also increase the relaxing effect. Some clients prefer to have a blanket placed on their back while they are in the Squeeze Machine.

CALMING EFFECTS OF TOUCH PRESSURE

JOURNAL OF CHILD AND ADOLESCENT PSYCHOPHARMACOLOGY
Volume 2, Number 1, 1992
Mary Ann Liebert, Inc., Publishers

Calming Effects of Deep Touch Pressure in Patients with Autistic Disorder, College Students, and Animals

TEMPLE GRANDIN, Ph.D.

ABSTRACT

Many people with autistic disorder have problems with oversensitivity to both touch and sound. The author (an autistic person) developed a device that delivers deep touch pressure to help her learn to tolerate touching and to reduce anxiety and nervousness. The "squeeze machine" applies lateral, inwardly directed pressure to both lateral aspects of a person's entire body by compressing the user between two foam-padded panels. Clinical observations and several studies suggest that deep touch pressure is therapeutically beneficial for both children with autistic disorder and probably children with attention-deficit hyperactivity disorder. Only minor and occasional adverse effects have been noted. Data are reported that shows a similar calming effect in nonreferred college students. A review of the animal literature reveals that animals have similar calming reactions, and also suggests possible additional physiological effects of deep touch pressure. At present, there are increasing anecdotal reports of the clinical value of the squeeze machine, including suggestions that it can be used to reduce required doses of psychostimulant medications. More clinical studies are needed to evaluate the potential role of this seemingly beneficial form of "physiological" stimulation.

INTRODUCTION

Certain sensory processing problems may be explained by cerebellar abnormalities. In addition to the familiar roles of the cerebellum in motor coordination and balance, there are suggestions that the cerebellum may also have functions in sensory processing. Early studies found that stimulation of the cerebellar vermis caused a cat to become hypersensitive to touch and to sound (Chambers 1947). More recent work in rats also suggests that the cerebellum acts as a modulator of sensory input for various sensory modalities, effectively functioning as a type of volume control; lobules V, VI, and VII of the vermis appear to be the most crucial sites (Crispino and Bullock 1984).

People with autism have many sensory processing deficits, including problems in modulating sensory input (Omitz 1985). Most research on sensory processing problems in autistic individuals has studied the auditory and visual modalities. It may be hypothesized that some of the sensory processing problems in autistic disorder might be related to abnormalities of the cerebellum.

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Courchesne et al. (1988) found that a majority(14/18) of high-functioning adults with autistic disorder had cerebellar abnormalities. Brain autopsy research has also revealed cerebellar abnormalities in autism, especially in lobules V, VI, and VII of the vermis (Bauman and Kemper 1985, Ritvo et al. 1986).

When I was age 3, I had standard autistic symptoms such as intolerance to being touched, inability to speak, tantrums, and stereotypic behavior. I would stiffen and pull away when people touched me, and I was oversensitive to both touch and sound (Grandin 1989a, Grandin and Scarino 1986). Magnetic resonance image (MRI) scans have revealed that my cerebellum is undersized, and I have a slight balance problem.

I will describe here a deep touch pressure device ("squeeze machine") that I developed to help me overcome problems of oversensitivity to touch, and that allays my nervousness. Reactions of other people to the squeeze machine, including children with autistic disorder and attention-deficit hyperactivity disorder (ADHD) are also reported.

Finally, the animal literature on deep touch pressure will be surveyed, revealing that similar calming reactions may be generally observed in response to deep touch pressure in higher animals. However, in view of the possibility that cerebellar abnormalities may cause hypersensitivity to touch, the therapeutic response of children with autism to correctly applied deep touch pressure might be partially explained by a cerebellar mechanism.

CLINICAL EFFECTS OF DEEP TOUCH PRESSURE

Deep touch pressure is the type of surface pressure that is exerted in most types of firm touching, holding, stroking, petting of animals, or swaddling. In contrast, light touch pressure is a more superficial stimulation of the skin, such as tickling, very light touch, or moving hairs on the skin. In animals, the tickle of a fly landing on the skin may cause a cow to kick, but the firm touch of the farmer's hands quiets her. Occupational therapists have observed that a very light touch alerts the nervous system, but deep pressure is relaxing and calming.

Deep pressure touch has been found to have beneficial effects in a variety of clinical settings **(**Barnard and Brazelton 1990, Gunzenhauser 1990). In anecdotal reports, deep touch pressure has been described to produce a calming effect in children with psychiatric disorders. Deep pressure stimulation, such as rolling up in a gym mat, has been used to calm children with autistic disorder and ADHD (Ayres 1979, King 1989). Lorna King (personal communication, 1990) reports that children with sleeping problems appear to sleep better inside of a mummy sleeping bag, which adapts to fit the body snugly. It also has been used in reduce tactile defensiveness in children who cannot tolerate being touched. McClure and Holtz-Yotz (1991) found that deep pressure applied by foam-padded splints on the arms reduced self-injurious behavior and self-stimulation in an autistic child.

Research on autistic children indicates that they prefer proximal sensory stimulation such as touching, tasting, and smelling to distal sensory stimulation of hearing and seeing (Kootz et al, 1981). Autistic children will often seek out deep pressure sensations. At various lecture meetings of parents of autistic individuals, parents have reported to me various types of pressure-seeking behavior of their offspring, such as wrapping arms and legs in elastic bandages, sleeping under many blankets even during warm weather, and getting under mattresses. In my case, I used to crawl under sofa cushions and have my sister sit on them. A high functioning autistic woman stated, "I need heavy blankets on me to sleep well, or else my muscles won't calm down."

Deep touch stimulation is beneficial to normal babies (Barnard and Brazelton 1990, Gunzenhauser 1990). Institutionalized babies who received supplemental tactile stimulation, mainly deep touch pressure, developed more normally (Provence and Lipton 1962). Premature babies who receive stroking and tightly bound swaddling also are reported to show definite benefits (Anderson 1986, Field et al. 1986, Licb et al. 1980).
The strong need for deep touch stimulation is suggested in Harlow and Zimmerman's classic experiment (1959): baby monkeys would cling to and press against a soft cloth mother surrogate which provided contact comfort, over a wire surrogate that provided milk.

Takagi and Kobayasi (1955) found that deep pressure applied bilaterally to a person's body results in a decrease in pulse rate, metabolic rate, and muscle tone. This finding, however, has not been replicated.

Krauss (1987) designed an air mattress apparatus, which applied pressure to large areas of the body. The apparatus consisted of two air mattresses surrounded by a canvas wrap connected to a pulley. A person laying between the two mattresses could control pressure applied by pulling on a rope, which tightened the canvas wrap. In this study, college students reported mild subjective reductions in anxiety and were found to have mildly increased heart rate, but neither finding reached statistical significance. However, this rope-operated apparatus applied considerably less pressure than the "squeeze machine" (Grandin 1984, Grandin and Scariano 1986).

THE SQUEEZE MACHINE

The squeeze machine device developed by the author consists of two padded side boards which are hinged at the bottom to form a V shape. The user steps into the machine and lies down on the inside in the V-shaped crevice like space. The inside surfaces of the device are completely lined with thick foam rubber. Deep touch pressure stimulation is applied along both sides of the person's body, with lateral pressure pushing inward onto the body . The V-shaped space supports the body fully from head to toe, so that the users can completely relax. The contoured padding provides an even pressure across the entire lateral aspects of the body without generating specific pressure points. The foam-padded headrest and padded neck opening are covered with soft fake fur. When the neck opening closes around the neck, it enhances the feeling of being surrounded and contained by the embrace of the deep touch pressure squeeze.

The user has complete control over the amount of pressure applied. A lever-operated pneumatic valve, which is connected to an air cylinder that pulls the side boards together, allows the user to self-regulate the amount of pressure applied. For adults, the air pressure on the 5 cm diameter air cylinder is set at 60 psi, which allows up to 43 kg (95 lbs.) of pressure to be exerted on each rope attached to the sides. For children under age 8-9 years, the pressure is set at 30 to 40 psi.

The user can enter and leave the machine at will, which confers a more complete, sense of self-control in the context of the machine. The squeeze machine and procedures for its use are more fully described elsewhere (Grandin 1984, Grandin and Scariano 1986).

The advantage of the squeeze machine over other forms of deep pressure stimulation, such as rolling in mats, is that the machine can apply greater amounts of pressure over larger areas of the body. The air cylinder power applies constant pressure, even when the user shifts position.

THE AUTHOR'S EXPERIENCE WITH SQUEEZE MACHINE

As a child, I craved to feel the comfort of being held, but I would pull away when people hugged me. When hugged, an overwhelming tidal wave of sensation flowed through me. At times, I preferred such intense stimulation to the point of pain, rather than accept ordinary hugs. On the Ayres Checklist for Tactile Defensiveness (1979), I had 9 out of 15 symptoms by age 10 years. Whenever anyone touched me, I stiffened, flinched, and pulled away. This approach-avoidance characteristic endured for years during my childhood.

At puberty, anxiety and nervousness made me feel as though I was constantly in a state of "stage fright." While the nature of this anxiety was not diagnosed at the time, they have been retrospectively diagnosed as panic attacks and would fulfill the *DSM -III-R* criteria.

At age 18, I constructed the squeeze machine to help calm down the anxiety and panic attacks. Using the machine for 15 minutes would reduce my anxiety for up to 45-60 minutes (Grandin and Scariano 1986). The relaxing effect was maximized if the machine was used twice a day.

Gradually, my tolerance of being held by the squeeze machine grew. Knowing that I could initiate the pressure and stop it if the stimulation became too intense, helped me to reduce the oversensitivity of my "nervous system." A once overwhelming stimulus was now a pleasurable experience.

Using the machine enabled me to learn to tolerate being touched by another person. By age 25, I was able to relax in the machine without pulling away from it. It also made me feel less aggressive and less tense. Soon I noted a change in our cat's reaction to me. The cat, who used to run away from me now would stay with me because I had learned to caress him with a gentler touch. I had to be comforted myself before I could give comfort to the cat.

As my "nervous system" calmed down, I required less squeeze pressure to produce a comforting feeling. Gradually, I could reduce the pressure regulator setting from 80 to 60 psi.

From my experiences, I learned that if pressure from the squeeze machine is applied at a steady pressure, habituation would occur and discomfort would begin within 10 to 15 minutes. Instead, if the pressure is increased and decreased slowly, the soothing effect could be maintained for up to one and a half hours. Very slow movement of the squeeze sides was most soothing. Sudden jerky movements caused me to jump and become aroused. On most occasions, a 5-15 minute period in the machine was sufficient to get a good response.

EFFECTS OF THE SQUEEZE MACHINE ON NORMAL ADULTS

Deep pressure applied to a wide area of the body, administered by the squeeze machine, has a relaxing effect on normal adults. In the present study, college students were found to feel relaxed after use of the squeeze machine. College students (18-25 years old) were not informed of the purpose of the squeeze machine, and simply were told that it was part of a sensory perception experiment. The operation of the machine was described to each student, and the author got into the machine to demonstrate its use. Each student was tested individually to prevent students from influencing each other's response. After 5-10 minutes, 45%(18/40)of the subjects employed words such as "relaxing" or "sleep" to describe their reactions. Four students (10%) used the words "floating," "weightless," or "flight" to describe the sensation. Relaxation was physically evident in some subjects. After being in the machine for a few minutes, the squeeze sides could be pulled closer together without increasing the pressure setting.

Two people (5%) had a claustrophobic reaction to the machine and could not complete the experiment. For 40% of subjects, the machine appeared to have no relaxing effect.

Of the entire group, 25 students were asked, "If you could buy this machine in a store, what could it you use it for?" "Relaxer" or "tension reliever" was the response of 17 students. One student, who did not feel relaxation after using the machine, suggested that it could be used as an isometric exerciser.

In a subgroup of 18 students, the squeeze machine was operated in three arbitrarily selected ways: (1) stationary pressure, (2) fast rhythmic pulsation of 50 cycles per minute, and (3) slow rhythmic pulsation of 15 cycles per minute. At the stationary setting, the tension on the ropes to the squeeze sides was 40 kg, a setting that most adults find tight but comfortable. During the two pulsation modes, the pressure was reduced until the top of the squeeze sides moved 1 cm on each side. After 5 minutes in the machine, each student was instructed to rate their state of relaxation on a scale from 1 ("almost asleep") to 10 ("very excited").

The data in Table 1 indicate that the stationary mode and the slow pulsation mode were more relaxing than the last mode.

I also have conducted some preliminary experiments that suggest that the squeeze machine may have an effect on auditory threshold (Grandin 1970). This possibility was investigated in view of the findings that cerebellar mechanisms might modify sensory inputs involving sound as well as touch.

USE OF THE SQUEEZE MACHINE IN TREATMENT OF CHILDREN

For the last 10 years, several occupational therapists and psychologists have used this squeeze machine with autistic and hyperactive children. Six machines currently are being used for sensory integrative therapy, and beneficial effects are being described anecdotally. Lorna King, Director of the Center for Neurodevelopmental Studies in Phoenix (Arizona) reports that the squeeze machine is useful for children with autistic disorder, attention-deficit hyperactivity disorder, or learning disabilities, Margaret Creedon at the Michael Reese Hospital in Chicago reports that children with pervasive developmental disorder (PDD) and children with Tourette's disorder like to use the machine and that it calms them; it is claimed to help to inhibit tantrums and reduce stereotypes. However, there is a severe lack of formal research data pertaining to the clinical treatment of children.

TABLE 1. RELAXATION RATING SCORES REPORTED BY COLLEGE STUDENTS IN THE SQUEEZE MACHINE

	Stationary pressure	***Slow pulsation***	***Fast pulsation***
Rating (mean)	4,1 ± 1.3	4,3 ± 2-2	7.3 ± 1.6*
Range	2-7	2-9	5-10
Number of subjects	is	18	18
Number of subjects with rating below 6		16	13
Percentage of subjects with rating below 6		89%	72%

The squeeze machine was employed by 18 subjects using three arbitrarily selected modes: stationary pressure, slow rhythmic pulsation of 15 cycles per minute, and fast rhythmic pulsation of 50 cycles per minute. Each subject experienced all three settings, for 3 minutes in each mode, in random order during a 15-minute session. After experiencing each mode, subjects rated their state of relaxation on a scale of 1 (almost asleep) to 10 (very excited). An analysis of variance on the entire sampling resulted in an F value - 19.33 ($p < 0.0001$).

*To assess differences among the three modes, a Duncan's multiple range test was applied, using **u -** 0.05, A statistically significant difference was noted for relaxation ratings for Fast Pulsation, compared with ratings for either Slow Pulsation or Stationary Pressure; these latter two modes were not different from one another.

One study (Imamura et al. 1990) examined behavioral effects of the squeeze machine on 9 children, aged 3-7 years, with autistic disorder or PDD. Hyperactivity was found reduced in 4 subjects, and the machine had no effect on 5 children. One child first began to hug the therapist after using the machine. The parents of a 7-year-old, high-functioning autistic boy reported that they could tell the days on which he had used the machine by observing his calmness. When the squeeze machine was not available to him, this boy learned to roll up in a quilt and then roll on the floor for 15 to 45 minutes every day to obtain adequate pressure stimulation.

Sessions with the machine were relatively unstructured, and usage usually was less than two minutes daily. There appeared to be a relationship between longer duration of squeeze machine usage and beneficial effects. Some children in their studies appear to have failed to use the squeeze machine long enough to have an effect. Imamura et al. (1990) concluded that a more structured approach, designed to encourage greater use of the machine, probably would result in increased beneficial effects.

ANIMAL OBSERVATIONS

The author initially conceived of the idea for the squeeze machine from her observations in animal science. Cattle being held in a squeeze chute, while waiting in line for veterinary attention, often appeared somewhat agitated during the waiting ; some of the animals, however, seemed to relax once pressure was applied to large areas of their bodies.

Deep pressure stimulation of diverse forms have been reported to have calming effects in a variety of animals. For example, stroking and scratching the flank of a pig has long been known to induce inactivity (Marcuse and Moore 1944), and pigs spontaneously seek body contact against a solid surface (Hartsock 1979). Pressure applied to both sides of a pig in a padded

V-shaped trough will induce sleep and relaxation (Grandin et al. 1989). In rabbits, gentle but firm pinching of the skin with padded clips will lead initially to arousal, followed by relaxed muscle tone, drowsiness, and deactivation of electroencephalogram (EEG) patterns (Kumazawa 1963). Likewise, a "squeeze machine" for chicks, constructed from hollowed-out foam rubber blocks, reduces separation distress (Jack Panksepp, Bowling Green University, personal communication). In cats, rubbing and gentle pinching of a paw will decrease tonic activity in the dorsal column nuclei and somatosensory cortex (Melzack et al. 1969).

In infant animals (and brain-damaged humans), pressure exerted on the face by an elastic bandage wrapped around the head will override the vestibular system and cause the head to fall back (Teitlebaum 1977). Wrapping a bandage around the torso of a cat causes the hind quarters to topple (Teitlebaum 1982).

The reactions of cattle to being restrained in a sqeeze-restraining device are very similar to people in the squeeze machine. Strong pressure initially causes cattle to relax, but will lead to struggling and discomfort when the animal habituates. Habituation occurs more quickly in cattle being held against unpadded metal surfaces. Pressure must be decreased if the animal is held in a chute for more than two minutes.

Recently I operated a cattle-restraining chute that was fitted with hydraulic controls; these provide more precise control over the amount of pressure and the speed of movement of the apparatus. Any sudden jerky movement caused animals to jump and become agitated. If pressure was applied slowly, many animals would remain passive and not resist. Squeezing in a smooth steady motion, required less pressure to keep the animal still. This chute was equipped also with a head restraint yoke, which would rise up under the animal's chin after the body was restrained. Some cattle would fight the chin yoke by keeping their heads in a crooked position, which made it impossible to restrain them fully. Sudden bumping often caused the animal to resist. By gently pressing the yoke against them, I found that wild cattle would straighten their necks and place their chin in the curved part of the yoke. When the animal moved into position, the pressure could be increased, and the head was brought up into the restrained position with very little pressure. None of these animals pulled their head out of the yoke or even tried. At all times, pressure was applied firmly.

A wild horse may flinch and pull away from being touched by a human, similar to the reactions of some autistic children to touch. In the process of taming a wild animal, animal trainers have learned that a firm touch calms and a very light touch tends to excite, again similar to the clinical observations of occupational therapists.

The two main methods used to tame wild horses are forced holding and gradual taming. Forced holding is quicker and more stressful than the somewhat slower gradual taming process.

Forced holding is similar to holding therapy for autistic children (Welch 1983). Gentler methods of holding therapy are also effective for increasing eye contact and interest in humans (Powers and Thorworth 1985).

The forced holding procedure is done quietly and gently, and care is taken to avoid excitement. The horse is securely tied or held in a livestock restraint device. The horse is held tightly and is unable to kick or thrash. During the restraint period, the trainer strokes and pets all parts of the animal's body and talks to it gently. Deep touching of every part of the animal's body is the key component of the taming procedure. The animal is released once it is nonresisting. Sessions seldom last more than one hour. Good horse trainers use forced holding only on very young animals. A significant disadvantage of this procedure is that forced restraint is stressful.

The taming approach is conducted more gradually. Horse trainers have found that nervous horses become easier to handle if they are rubbed and brushed over all parts of their bodies (Tellington-Jones and Burns 1985). The horse may flinch at first, but gradually will start to relax when stroked. Similar to the autistic child who is initially aversive to touching and then finds that touching becomes pleasurable, a horse will show a behavioral change such that a stimulus that was once actively avoided is now actively sought.

In animals, taming can proceed to the point of allowing the use of a deep touch pressure machine. Sheep can be trained to enter a device similar to the squeeze machine repeatedly and voluntarily for pharmacological studies (Grandin 1989). As with humans, the sheep were introduced gradually to the device. At first, the sheep just stood in it, and subsequently pressure could be applied for increasing amounts of time.

SUGGESTIONS FOR THERAPISTS

In working with children, we have found that 5 minutes of sustained use of the squeeze machine is the minimum typically required to obtain a readily detectable calming effect.

We would suggest that use of the machine should never be forced, though strong encouragement is needed to overcome the approach-avoidance features associated with tactual defensiveness. Therapists who work with tactually defensive children find that they are better able to tolerate touching that they have initiated (Key 1989). At times, it is useful to encourage such a child to use the machine for at least the minimal 5 minutes in order to ensure a noticeable effect. We have observed two basic ways that children and adults approach the machine. The pressure-seeking type immediately will start using the machine, and use it readily with little encouragement. Children with attention-deficit hyperactivity disorder typically fit in this category. In contrast, some autistic children have a high degree of tactual defensiveness, so that it is difficult for them to overcome their initial aversion to touch; they will require more encouragement. Use of the machine should never be forced, but the therapist must be "gently insistent" to coax a tactually defensive client to use it.

Clients should be discouraged from sudden jerking of the pressure on and off in rapid sequence. Some people may want to increase and decrease the pressure slowly, which may help them to remain in the machine for longer periods of time. The use of slowly varying deep touch pressure should be allowed.

Margaret Creedon (personal communication 1989) has suggested that users show two patterns: sustained squeezers, and intermittent squeezers who continually squeeze it up and release it. It is possible that the intermittent squeezers may have greater tactual defensiveness than sustained squeezers, and may need encouragement to learn to tolerate the pressure.

In teaching new users to operate the machine, it is important that the therapist who demonstrates the machine really like to get in the machine. If he or she is uncomfortable or claustrophobic, the fear will be communicated to the child. I often have induced a tactually defensive child to use the machine, even after attempts by others had failed, because they could see that I enjoy it. For tactually defensive children, the therapist may need to demonstrate use of the machine repeatedly, so that they can see that it will not cause them harm. After the child becomes accustomed to the machine, he or she usually can use it voluntarily without further demonstration by the therapist.

It is essential that the machine is adjusted to properly fit the child. The side boards must be adjusted so that the V-shape supports the body, but there still must be enough space for the child's knees. Proper adjustment will enhance the effect of the machine because the pressure will be applied more evenly.

Although the squeeze machine can be used for younger children, there are many easy methods for applying deep pressure stimulation to children under the age of 5: rolling up in gym mats, "mat sandwiches, " and resting under a pile of beanbag chairs. It is simply impossible to hold older children securely using these alternative methods. Two holding therapy successes have been reported by parents, and both involved young children (Randall and Randall, Stribling 1989).

The squeeze machine may be most useful for older children or adults. In older children and adults, the squeeze machine can apply considerable amounts of pressure. The device is also available for use at any time. Older children and adults often feel embarrassed playing "children's games" with the therapist and prefer to use the squeeze machine in privacy.

Children with ADHD are often strongly attracted to the machine. There are suggestions that the use of the machine may allow reduction in the dose of psychostimulant required to treat these children.

CONCLUSIONS

It appears that the squeeze machine may be beneficial to some children with autistic disorder or attention- deficit hyperactivity disorder, and is of little value to others. Serious side effects appear to be minimal.

In treatment of children with autism, a very heterogeneous disorder, it is well-known that a treatment that works for one individual may be useless for another, It is possible that the squeeze machine will be most beneficial to those autistic people who have problems with oversensitivity to sensory stimulation. These problems are perhaps due to an abnormality in the modulation of sensory inputs in several sensory modalities, and may be related to structural abnormalities in lobules V, VI, and VII of the vermis of the cerebellum observed in patients with autism. Some individuals with autism, who have greater cognitive problems and relatively few sensory problems, may be less likely to benefit.

The possibility that use of the squeeze machine might allow dose reductions of psychostimulants, or conceivably, other medications, is intriguing, but awaits formal demonstration.
At present, the squeeze machine should be considered a novel treatment that has not been subjected to careful evaluation of clinical efficacy or safety. Preliminary observations in humans are encouraging, but the data are inadequate to recommend routine use in clinical care. However, a calming response to deep touch stimulation appears to be characteristic of a diversity of animals, and may represent a relatively "physiological" approach to sedation that has been overlooked by psychiatry researchers.

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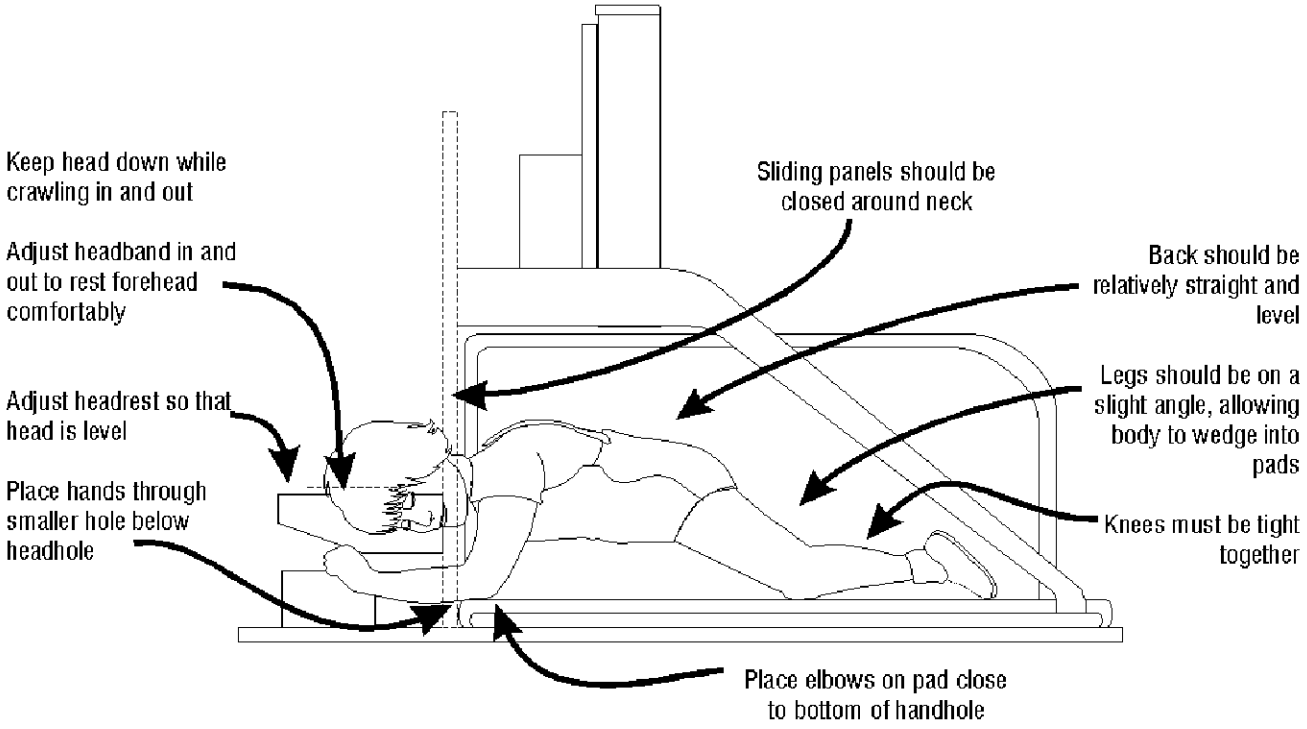
CORRECT BODY POSITION WHEN USING THE SQUEEZE MACHINE



CORRECT POSITION

INCORRECT POSITION

Rear View