Rotman MRI Equipment List - Detailed

Below is a detailed summary of all of the equipment currently available for researchers at the Rotman MRI.

If you have any questions or requests please contact our MRI Specialist, Jacob Matthews, at jmatthews@research.baycrest.org.

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The Rotman MRI Suite	

	The Rotman MRI Facility completed an MRI scanner upgrade and suite renovations in 2021. Our facility now includes:
	• Brand new Siemens Prisma 3T MRI Scanner
	• Spacious, comfortable, wood-paneled scanner room
	• Isolated MR control area with fully connected research stimulus equipment
	• MRI Simulator (mock scanner) with scanner matched stimulus setup, and separate entrance for direct researcher access
	• Improved flow process for researchers and subjects
	   ○ Waiting area with seating in connecting Baycrest hallway
	   ○ Subject Interview room for verbal MRI screening
	   ○ Dedicated MRI Suite Bathroom including a subject shower
	   ○ Separate subject change room, with lockers to secure possessions
	• Isolated staff office with room for training sessions
	• Dedicated WiFi access points for strong connection in the suite

MRI Scanner and Equipment

Our MRI Scanner and ancillary equipment are fully configured to provide an optimal research experience with minimal setup required for each scan session.

Siemens 3T PrismaFit MRI Scanner

Newly installed at the Rotman in 2020, The Prisma is Siemens most powerful 3T research scanner, with stronger 80/200 gradient coils, improved higher order shimming, and an updated selection of coils. The new scanner is quiter with most sequences compared to the old Trio, and also features an undockable table (maximum subject weight 200kg/440lb) that is physically separated from the magnet for greatly reduced vibration with sequences like diffusion weighted imaging. Our scanner is currently running VE11E software. We have most research oriented sequence packages from Siemens and a variety of in-development and third-party sequences installed on the system.

Manufacturer Website

Head Coils

The Rotman MRI has three head coils available. There are also a variety of other "flex" and body coils available for non-brain scanning or brain studies with very specific requirements (e.g. completely open field of vision).

Siemens Head/Neck 20 Coil

The 20 channel head/neck coil is the most spacious and will accommodate the largest heads and/or additional research equipment in the head coil. Its SNR is lower than the other two, and the number of channels may be inappropriate for high levels of scan acceleration (i.e. GRAPPA/iPat, multi-band/sms). Note that of the 20 channels, 16 are positioned around the head and 4 around the neck (the latter would aid in c-spine imaging, but won't contribute to brain scanning).

Measurements:
Back-of-Head-to-Face: around head - 25cm, around neck - 24cm
Left-to-Right: around head - 22.5cm, around neck - 20.5cm
Neck-to-Top-of-Head: 34.5cm
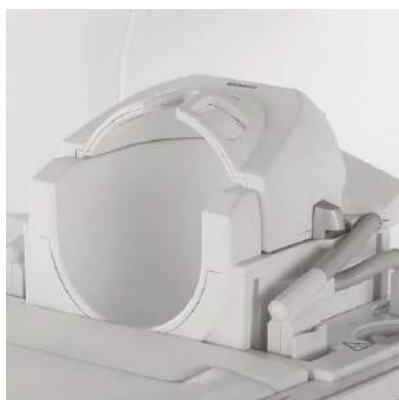
Siemens Head 32 Coil

The 32 channel head coil has the highest SNR in the brain of all three coils. The fit of this coil is the tightest, especially around the nose/brow. Some larger subjects may not fit in this coil, or will require very thin padding not suitable for longer protocols. All 32 channels are positioned around the head. Because there are no neck elements, this coil is the shortest and may better accommodate other equipment around the shoulders or neck area.

Measurements:
Back-of-Head-to-Face: 22.5cm
Left-to-Right: 19.5cm
Neck-to-Top-of-Head: 23.5cm

Manufacturer Website

Siemens Head/Neck 64 Coil

The 64 channel head/neck coil may be a good middle ground of size and SNR for many studies. It is similar in size to the 32Ch channel head coil around the head, but has additional space above the nose and brow which increases the number of subjects it can accommodate. It achieves slightly lower SNR than the 32 channel head coil in the brain, and can handle similar (or slightly higher) acceleration factors. Note that of the 64 channels, 55 are positioned around the head and 9 around the neck (the latter would aid in c-spine imaging, but won't contribute to brain scanning). Some reports have suggested that the lowest positioned of the 55 head channels are also mostly utilized for c-spine or neck imaging, and that the effective head channel count is lower (e.g. 48 head and 16 neck).

Measurements:
Back-of-Head-to-Face: around head - 22.5cm, around neck - 20.5cm
Left-to-Right: around head - 19.5cm, around neck - 17cm
Neck-to-Top-of-Head: 34.5cm

[Manufacturer Website](#)

Stimulus Presentation Computer

A fully configured and connected Stimulus Computer is available for researcher use which reduces setup time and avoids issues related to software versions. A bundle of KVM and hardware connected cables are available for researchers who wish to connect their own computers to our stimulus setup.

Dell Precision 5820

The Rotman provides its MRI users with a fully configured Stimulus PC. This PC is already wired to most of the equipment in this list, so that no hardware setup is needed before each session. We have most popular stimulus software (including E-Prime, Presentation, PsychoPy (python), PsychToolBox (matlab)), as well as software tools specific to our other hardware systems (VPixx, SR Research), already installed on this computer. We maintain consistent software versions on this PC and install new versions in parallel to maintain consistent software versions for every project. Other software can be configured upon request. If you have any questions or requests about the installed software or connected hardware for the Stimulus Computer, please reach out to Jacob Matthews.

Cables for Researcher Laptop/Device

If researchers prefer to use their own Laptop/Device, we provide a bundle of cables to connect to our hardware. This includes:
- two displayport video cables (one for a typical setup where the projector mirrors the laptop, and a second that can be used to extend the desktop from the laptop onto the projector for independent researcher and subject displays) with adapters for HDMI, mini Displayport, and USB-C device ports
- audio in/out cables for playing auditory stimulus to the subject and recording subject speech from the noise cancelling microphone
- a USB cable to connect the full size keyboard and mouse on the desk, receive scanner triggers and response box signals as keyboard presses, and allow control of connected VPixx hardware (DATAPixx and PROPixx)
- BNC and Parallel cables to receive analog trigger signals

Visual Stimulus Presentation System

A full visual system from VPixx is newly installed at the Rotman, allowing high resolution, fast refresh rate visual stimuli, and the ability to precision sync other stimuli to the visual refresh rate for microsecond precision. By default our projector mirrors the chosen stimulus display, but both our stimulus PC and KVM bundle include two separate video cables so that the stimulus display can be extended onto the projector display. This allows for separate researcher and subject displays, which can accommodate real time data validation, or stimulus scripts which maintain a consistent visual environment for the subject while stimulus software control is done only on the researcher display. Contact Jacob Matthews if you would like to test this type of setup.

VPixx PROPixx MRI

The VPixx PROPixx projector is a powerful LED projector which provides a high 1080p resolution at a fast 120Hz refresh rate. The specialized lens means the projector is permanently positioned in our equipment room and requires no adjustment or setup. The projector can be powered on remotely from the MRI Stimulus Computer using the PyPixx software.

Manufacturers Website

VPixx DATAPixx3 Controller

The VPixx DATAPixx Controller manages the visual signals being sent to the PROPixx projector and is also capable of managing other signals (audio, digital/analog). Using VPixx provided add-ons for most major stimulus software packages, these signals can be synchronized to the visual refresh rate with microsecond precision.

Manufacturers Website
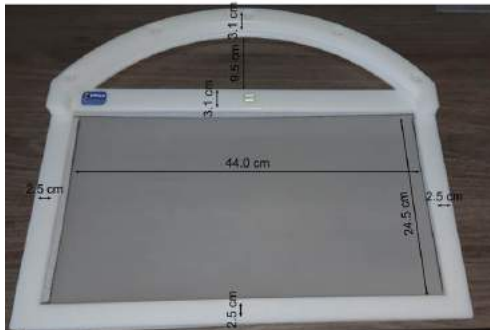
VPixx In-Bore Projection Screen

A custom in-bore screen from VPixx is used just inside the back of the bore. This allows for the greatest FOV while maintaining a full unclipped rectangular image. It is also shaped and positioned to allow simultaneous use of our other systems, including allowing line-of-sight for our eye-tracker camera and leaving room behind the head coil for our EEG amplifiers.

The projection surface measures 44cm x 24.5cm. The projected image is just slightly smaller than that at 43.5cm x 24cm. With slight drift in the projector position/angle over time, it's possible to have the extreme edges of the image cut off by the frame. Although we check for this regularly, it's safest to avoid using the extreme edges of the display for stimuli (about 10 voxels or 2mm).

The eye-to-screen distance is approximately 98cm. This will vary depending on subject head size, which will impact:
a) how close to the top of the coil (z-direction) the subject's eyes are and the corresponding mirror position, resulting in a mirror-to-screen distance between 86 to 90cm (approximately 88cm on average).
b) how high up in the coil (y-direction) the subject's eyes are and the corresponding required padding, resulting in an eye-to-mirror distance between 8cm and 12cm (approximately 10cm on average).
At the edges of the display the vertical FOV is approximately 14.5 degrees and the horizontal FOV is 25.8 degrees.

Auditory Stimulus Presentation System

Four audio systems are available at the Rotman. As of 2021-10-19, the built-in Siemens system is available, we are awaiting the delivery of the OptoAcoustics system, and the Avotec and MR-Confon systems are available for use with advanced notice.

OptoAcoustics OptoActive II ANC Headphone

The OptoActive system provides slim stereo headphones which fit all of our head coils, and uses optical signal transmission directly to the headphones which isn't degraded by an air tube. The system can be trained on specific MRI sequences and subsequently provide active noise cancellation (ANC), reducing scanner noise substantially (OA claims EPI noise can be reduced by up to 95%). This is excellent for studies where the frequency content of auditory stimuli is important, and you need to reduce the impact of background scanner noise. This system includes a FOMRI-III™ noise cancelling microphone, which can record accurate subject vocals even while the scanner is running. The system includes a control room console which facilitates subject communication, allows audio in/out levels to be balanced, controls ANC setup and activation, and also allows for the various audio input and microphone signals to be monitored by the researcher.

Manufacturers Website

Siemens Built-In Audio

The Siemens Prisma scanner has three audio options built-in by default.

Headset - A traditional mono headset is available to play audio directly to the subjects. This headset only fits in the 20Ch head coil. The audio is piped through an air tube to the headset, so the quality is not as good as our third party audio systems. It is suitable for subject communication, auditory cues in stimuli, but not high fidelity auditory stimuli.

In-ear - Siemens provides a set up air tubes ending with in-ear foam tips. We have found these to be inconsistent and uncomfortable, both with fit and audio quality, for many subjects and do not generally recommend them. These should work with any head coil, but can require finicky foam setup to avoid pressure on the subject's ears. If you feel you want in ear audio for your project, contact Jacob Matthews.

Loud-Speakers - We are able to send audio to the rooms loudspeakers. This can be heard through ear plugs and foam padding, but is typically only suitable for subject communication and not auditory stimuli.

	## Avotec Silent Scan The Avotec Silent Scan system provides two sets of mono headphones with built in subject microphones, at least one of which fits in each of our three head coils. This system also uses an air tube for sound delivery, but has a very detailed EQ system which has been calibrated for our setup. This corrects some of the frequency output characteristics imposed by the air tube. The resulting sound quality is better than most air tube systems, but not as good as the optical and electrical headsets. The system's maximum volume is also not the loudest, and may require adjustment of stimulus audio files. The system includes a control room console which facilitates subject communication, and allows for control of various audio in/out levels. Manufacturers Website
	## MR Confon The MR Confon system provides two sets of stereo headphones, at least one of which fits in each of our three head coils. The headphones are electrodynamic, using the magnetic field of the MRI scanner to drive their transducers. The resulting sound quality is more accurate than the air tube systems. We have also found the max volume of this system to be relatively low, specifically with the headset used for the 32Ch and 64Ch head coils, and it may require adjustment of audio stimulus files. While the frequency response is accurate, there is also a very subtle "grainy-ness" to this system. The system includes a control room console which facilitates subject communication (when used in conjunction with an Optoacoustics Fomri microphone), and allows for control of various audio in/out levels. Manufacturer Website

Subject Response System

An updated response system from Current Designs was installed in 2018. This includes a new ergonomic button box style in addition to our classic boxes. Signals from this system are sent to the Stimulus PC and researcher device cable bundle via USB. They are sent as keyboard key presses using numbers corresponding to the number row above the keyboard (some software distinguishes these signals from the number pad to the right of the keyboard). The right hand button boxes send numbers "1" to "4" from index to pinky, and the left hand button boxes send numbers "6" to "9" from index to pinky. Scanner trigger signals are sent by the scanner every TR for EPI and DWI sequences and are converted and sent as a keyboard press "5". Additional button box styles and signal cables are available from Current Designs. Please contact Jacob Matthews if you are interested in something not listed below.

Interface - Current Designs 932 Interface & Power Supply

The Current Designs 932 Interface box takes in signals from the subject response boxes, and the scanner triggers, and outputs them to our Stimuli Computer as keyboard key presses over USB. The box is positioned below the Stimulus Computer and has LED lights that display incoming signals, so researchers can monitor subject inputs in real time without referencing anything on the Stimulus Computer.

Manufacturer Website

Button Box - Current Designs Pyka 8 Button Bimanual - Thumbs Disabled

The latest button boxes from Current Designs, the Pyka, are a slightly more ergonomic shape than our other boxes, with a more naturally shaped box and the buttons along the side. This means pressing the buttons is more of a squeezing motion instead of a pressing motion. Subjects with arthritis or other hand issues may prefer this design. The boxes can also be held by the subject without being taped in place, which can be more comfortable and sometimes reduce the frequency of subjects losing their finger position on the box. Although the boxes appear to have ten buttons, the fiber bundles support only 8 buttons. The thumb buttons on our units are disabled. The right hand box sends keyboard presses "1" to "4" and the left hand box "6" to "9" from index to pinky. Our units have been labelled to avoid mix ups. We now use these boxes by default.

Manufacturer Website

	Button Box - Current Designs 8 Button Bimanual Curved Lines A new set of classic button boxes from Current Designs, with four colored buttons for each hand in a slight curve to align with the length of each finger. We often tape the box in place so it doesn't slide out from under the subject's hand. The right hand box sends keyboard presses "1" to "4" and the left hand box "6" to "9" from index to pinky. Our units have been labelled to avoid mix ups. Available for projects upon request. Manufacturer Website
	Scanner Triggers Scanner Triggers are outputted from the scanner optically for every volume (TR) of EPI based sequences, and can be used to synchronize experiment timings, physiological recordings, or other independent stimuli/recordings. The optical signal from the scanner is converted with custom hardware to an analog signal available via BNC or parallel connections. It is also passed to the Current Designs Interface Box, and is then outputted as a keyboard key press signal sent over USB. The USB triggers are sent as a keyboard press "5". These signals are also fed back to the scanner and can be used for physiological gated sequences, or outputted with Siemens physio recordings and used to accurately sync physio and fMRI data.

Simultaneous Eye-Tracking Recording

	SR Research EyeLink 1000 Plus A brand new SR Research EyeLink 1000 Plus was installed with the new scanner. We have moved the camera from an in-bore tray mount to an external stand to avoid scanner vibrations from shaking the camera and affecting pupil tracking. We have also switched from battery packs to a permanent power solution. This means the eye-tracker is permanently set up, eliminating the need for camera placement and adjustments every session. Simply boot up the dedicated Host computer in the control room, which is already wired to the provided Stimulus Computer (SR software is already installed). Manufacturer Website

Simultaneous EEG Recording

Two systems are available at the Rotman for simultaneous MRI-EEG recording. The new EGI system uses 256 electrode saline-sponge caps which require 5-10 minutes of setup and are suitable for most scanning up to 1.5-2 hours. The Brain Products system uses 128 electrode gel caps which require 45-60 minutes of setup and are suitable for any length of scanning, including scanning above 1.5-2 hours such as MR sleep studies.

Both systems are set up on mobile carts. This allows for the subject to be set up in another room (our simulator space is able to be reserved for this purpose) and moved into the MRI space at the time of scanner reservation. The long range optical and signal wiring are permanently installed in the MRI. Setup requires the researcher to place some hardware in/near the scanner, and make several cable connections in both the control room and the scanner room. Please contact Jacob Matthews to arrange for setup training with this system.
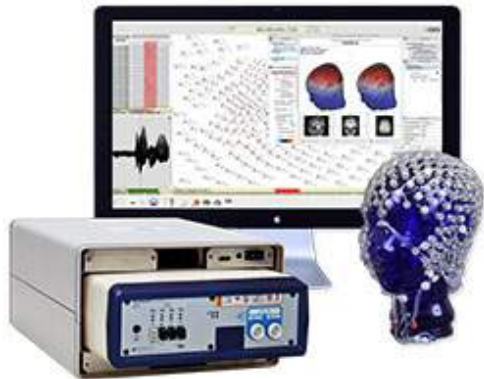
EGI MR-compatible Geodesic EEG System 400

Our new MR-compatible Geodesic EEG System 400 from Magstim EGI allows simultaneous recording of EEG data inside the MRI. Our setup includes three sizes of 256 electrode nets, small (54-56cm), medium (56-58cm), and large (58-61cm). Our setup also includes the FICS

Manufacturer Website

Brain Products BrainAmp-MR EEG System

Our Brain Products MRI compatible EEG system allows simultaneous recording of EEG data inside the MRI. Our setup includes two different sizes of 64 electrode caps (BrainCap MR), small (54cm), and large (58cm). Our setup also includes the MR-conditional amplifiers (BrainAmp MR plus) and power supplies (PowerPack) which are positioned in the scanner. An additional amp (BrainAmp ExG MR) allows for recording of e.g. EOG, EMG, ECG, GSR signals (please check with Jacob Matthews for available transducers).

Manufacturer Website

Physiological Recording
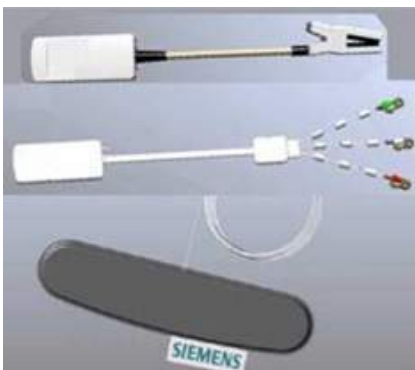
Siemens

The Siemens Prisma MRI Scanner includes three physiological transducers. A respiration belt to measure breathing, a finger cuff to measure a delayed heart rate, and a three electrode ECG array to measure a more accurate heart rate. These signals can be recorded for each functional scan and exported for use in post processing. These signals can also be used as gating signals for certain sequences on the scanner.

	Biopac
	A Biopac MP150 system and a variety of MRI compatible modules are available to researchers at the Rotman MRI. These signal recordings are much higher quality than those recorded with the Siemens transducers. This system is recommended if you need high quality raw physio data or are planning to use it for correction of MRI data (e.g. retroicor). Modules are available to measure: ● breathing with a pressure respiration belt ● pulse (blood volume pulse) with a finger cuff (photoplethysmograph) ● pulse (R-wave) with a three-electrode ECG ● skin conductance (SCL and SCR) with two-electrode EDA ● exhaled O2 and CO2 concentrations with a nasal cannula ● blood pressure with a finger cuff Additional modules are available from Biopac for other measurement types. Please speak to Jacob if you are interested. The biopac system is set up on a mobile cart, including a dedicated computer, for use in or out of the MRI. It requires 5-10 minutes of setup time depending on the number of modules being used. Manufacturer Website

Patient Monitoring Camera System

	MRC 12M Cameras
	Two in-bore cameras from MRC Systems are installed in the Rotman MRI. One at the front entrance of the bore providing a full view of the subject and allowing body motion and hand position on the response boxes to be monitored, and a second above the head coil position at isocentre allowing head motion and eye open/closed status to be monitored. These camera feeds are fed to a monitor in the control room, and can also be recorded on the Stimulus Computer with advanced notice. Manufacturer Website

MR Safe Prescription Glasses

	Wardray Premise Mediglasses
	MR Safe glasses with interchangeable corrective lenses. The lens inserts are easily changed based on the needs of your subject. The kit includes 24 sets of prescription lenses (+6.00 to -6.00 sphere) in 1/2 dioptre increments, as well as 0.0 planar and opaque lenses. Since the lenses are interchangeable, different prescriptions can be used for each eye. An eye chart is available on site, set up at a viewing distance matching our scanner, for testing subjects who don't know their prescription. Manufacturer Website

Mock (0T) MRI Simulator and Equipment

We maintain a mock (0T) MRI environment for use by Rotman MRI Users, free of charge. We try to keep the setup here as similar as possible to our actual MRI setup. We have similar audio/visual presentation equipment, matching response boxes, and even the ability to play recorded MRI scanner noise over the bore speakers to simulate a real MRI scan.

Simulator

Psychology Software Tools MRI Simulator

Our MRI Simulator has several features to mimic a real MRI Scanner. There is a working table (maximum subject weight: 135kg / 300lb) that can be operated from a control panel or with a remote control. There are lights and fans inside the bore as in our real scanner. There are also loudspeakers in the bore that we can play real recorded MRI Scanner noise over to simulate the noise made in the real scanner. Table and head coil specific padding are included, and we have added a pillow for under the subject's knees for lower back support. There are sheets and pillow cases stored nearby which researchers are responsible for switching out in between every subject. Please contact Jacob Matthews if you would like to arrange a training visit to the simulator.

[Manufacturer Website](#)

Stimulus Presentation Computer

A fully configured and connected Stimulus Computer is available for researcher use which reduces setup time and avoids issues related to software versions. A bundle of KVM and hardware connected cables are available for researchers who wish to connect their own computers to our stimulus setup.

Dell Precision 5820

The Rotman provides its MRI users with a fully configured Stimulus PC. This PC is already wired to most of the simulator equipment in this list, so that no hardware setup is needed before each session. We have most popular stimulus software (including E-Prime, Presentation, PsychoPy (python), PsychToolBox (matlab)) already installed on this computer. We maintain consistent software versions on this PC and install new versions in parallel to maintain consistent software versions for every project. Other software can be configured upon request. If you have any questions or requests about the installed software or connected hardware for the Stimulus Computer, please reach out to Jacob Matthews.

	## Cables for Researcher Laptop/Device If researchers prefer to use their own Laptop/Device, we provide a bundle of cables to connect to our hardware. This includes: ● two displayport video cables (one for a typical setup where the projector mirrors the laptop, and a second that can be used to extend the desktop from the laptop onto the projector for independent researcher and subject displays) with adapters for HDMI, mini Displayport, and USB-C device ports ● audio in/out cables for playing auditory stimulus to the subject and recording subject speech from the subject microphone ● a USB cable to connect the full size keyboard and mouse on the desk, and receive response box signals as keyboard presses.

Visual Presentation System

	A new projector is currently being sourced for the MRI Simulator. It will be 1080p and 120Hz to match the MRI VPixx system. It will not have the VPixx specific stimulus synchronization options. This document will be updated when more specific information is available. Please contact Jacob Matthews for more information.

Audio Presentation System

	OptoAcoustics is providing a custom non-MR version of their audio system for our simulator. It will not feature optical connections or Active Noise Cancelation. It should provide our researchers and subjects with an overall similar audio and communication experience as in our real scanner. This document will be updated when more specific information is available. Please contact Jacob Matthews for more information.

Subject Response System

Updated "trainer" response boxes from Current Designs were installed in 2018. This includes a new ergonomic button box style in addition to our classic boxes. Signals from this system are sent to the Stimulus PC and researcher device cable bundle via USB. They are sent as keyboard key presses using numbers corresponding to the number row above the keyboard (some software distinguishes these signals from the number pad to the right of the keyboard). The right hand button boxes send numbers "1" to "4" from index to pinky, and the left hand button boxes send numbers "6" to "9" from index to pinky.

	## Button Box - Trainer Pyka x 2 The latest button box style from Current Designs, the Pyka, are a slightly more ergonomic shape than our other classic boxes, with a more naturally shaped box and the buttons along the side. This means pressing the buttons is more of a squeezing motion instead of a pressing motion. Subjects with arthritis or other hand issues may prefer this design. The boxes can also be held by the subject without being taped in place, which can be more comfortable and sometimes reduce the frequency of subjects losing their finger position on the box. Although the boxes appear to have ten buttons, the fiber bundles of the MRI version support only 8 buttons. The thumb buttons on our units are disabled. The right hand box sends keyboard presses "1" to "4" and the left hand box "6" to "9" from index to pinky. Our units have been labelled to avoid mix ups. Manufacturer Website
	## Button Box - Trainer 4 Button Curve Right/Left A new set of classic button boxes from Current Designs, with four colored buttons for each hand in a slight curve to align with the length of each finger. You may need to tape the box in place so it doesn't slide out from under the subject's hand. The right hand box sends keyboard presses "1" to "4" and the left hand box "6" to "9" from index to pinky. Our units have been labelled to avoid mix ups. Manufacturer Website