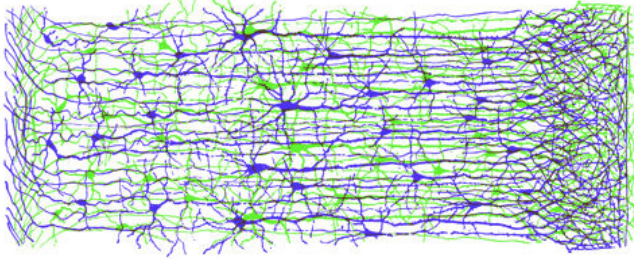


Neuralware



Neuralware is artificial neural networks that are added to the ego recording of a person and then made part of the brain when resleeved. Not quite bioware, not quite psychosurgery, it is expected to become a major market in enhancement.

The neat thing about neuralware implants is that they are essentially software that has been translated into a biological neural network. In principle any software could be inserted. In practice there are several strong constraints:

- 1) Neuralware is often much slower than software since it runs on biological neurons (or simulations of them), unless the software happens to be massively parallel in the first place.
- 2) Neuralware must "fit" inside the brain of a biomorph or synthmorph. Most models have fairly general bio/cyberbrains, but they still tends to assume a humanoid brain (especially the cheap ones). Users of advanced neuralware will find compatibility problems and might have to use morphs with more roomy brains (this is a common problem for cephalopod uplifts and AGIs too).
- 3) The neuralware needs to get inputs and outputs from somewhere. Normal software exists within some computational workspace where it can pick up data freely, but neuralware needs to be connected to other brain areas or external software to do anything.

Adding neuralware is done like other direct ego editing: the neural map is updated with the neuralware, and then the ego is put into a morph. A successful Psychosurgery roll will have inserted a fully functional network with a normal amount of stress. Less successful Psychosurgery may produce flawed neuralware (it only works partially, comes and goes, triggers disagreeable side effects etc) and of course more stress.

Neuralware is tricky to remove, since it becomes part of the wider neural network of the user. If the original brain state and edit information is available it can be removed with relatively low stress (1 SV) by editing the ego file, but if it has been inside for long enough it will require a serious psychosurgery effort spanning a week and with a -20 test modifier (SV cost 1d10/2). It is also possible to just disable the neuralware; this gives a +30 bonus to the psychosurgery but leaves the neural patterns behind. These might be a slight security risk, since they could accidentally reappear.

Neuralware is of particular interest to people who want to travel where their external selves will be scrutinized or where normal augmentation is banned (like the Jovian Republic). It is also quite a bit of effort to find neuralware if the network has been deliberately spread out across the brain: an investigator would have to run special-purpose neural topology software on a brain scan to detect that it is there.

Cognite has been a major developer of neuralware but is getting some stiff competition from ExoTech (who offer tempting package deals with their resleeving options). Meanwhile smaller cognotech design houses like Brent Brains of Extropia, Mindshot Enterprises and Toko Otak are gaining grounds in specialized areas of neuralware. Mindshot's expanding range of translatorware and beautware has many investors interested, especially since they are now developing translatorware to "natively" understand alien environments.

A few example neuralware applications:

Data: A neural network can store data, which becomes available to external software when the brain's owner gives a mental command or experiences some kind of cue. Note that the owner doesn't "know" the data themselves, they will just respond with it when needed. The most common use is to store long cryptographic keys, but it can be used to smuggle small pieces of software, recordings or data. The amount of data scales roughly with network size; a N neuron network can store about N kbytes (assuming ~1 bit per synapse, 8000 synapses per neuron). To hide a gigabyte requires about a million neurons, which is a needle in a haystack (especially since they are widely distributed in the brain). Unfortunately, hiding a terabyte starts to require noticeable numbers of neurons. Also, the standard design is read-only: the synaptic update rules of most brains are too low-fi to enable good computer data storage on the fly. Stress value: 1 for small stores, 1d10/2 for moderate stores (a gigabyte), 1d10 for larger stores. [Cost: Moderate]

Rolodex: An add-on to the fusiform face recognition area that acts a bit like Oracles or face recognition software. When run together with external software like a muse it connects the face-recognition perceptual system to a database of people, allowing it to bring up who's who information and point out people satisfying various importance criteria. It can even be provided with an emotional response, making the owner experience positive or negative responses to people in different groups. This information can be learned by the neuralware (takes about an hour of running a training loop) and then will be available even when there is no outside software. Stress value: 1d10 [Cost: Moderate]

Hallucinospace: Simspace software that can start a pre-defined simspace inside the head of the user. When activated they simply appear to fall asleep as they go into the simspace. While the complexity and size of the simspace is limited it is a convenient way of avoiding an unpleasant outside world. Stress value: 1d10 [Cost: Moderate]

Apparitions: Like AR overlays, but visual or auditory hallucinations controlled either by external software or other neuralware. Stress value: 1 [Cost: Low]

Fake EEG: Neuralware that produces apparent brainwave activity corresponding to pre-set states, such as being deep asleep, dreaming, being awake and alert, attending to a certain stimuli or being in an epileptic fit. It can be programmed to fake recognition responses (useful when subjected to brain fingerprinting interviews). This only works in biomorph brains and against

simple (or remote) brainwave measurement devices that do not actually check the true internal state. Stress value: 1d10/2 [Cost: High]

Neuroskillware: just like skillware, but implemented as a neural network rather than a cybernetic implant. On the plus-side, this makes it always available. On the minus-side, unless the skillsoft is externally available it must also be compiled into the neuroware when the system is set up and cannot be changed afterwards. Stacking neuroskillware and skillware is possible but problematic: the different systems will be interfering with each other and cause stress: every time the user shifts from using neuroware to skillware or back they need to roll a WILx3 or get one stress point. Stress value: 1d10 [Cost: High]

Translatorware: Neuroware that takes information from some senses and runs some form of encryption/decryption on it. A user may for example view a barcode, a page of apparently random letters or a piece of music, actually experiencing the translated information hidden inside. Conversely, translatorware can also allow the user to produce messages with encrypted or steganographic information, e.g. writing a response in the form of random letters or singing with messages encoded in microvibrato. Standard translatorware comes with pre-set keys at build time. Stress value: 1d10/2 [Cost: Moderate]

Beautyware: Artificial neural networks for recognizing certain high-dimensional patterns or symmetries that normally would not stand out. While the network doesn't help to understand them, it allows the user to notice them. For example, a network to find supersymmetric patterns in data might be helpful for a physicist. The name comes from the experience of "beauty" or recognition when the patterns are "seen". Some people get beautyware intended to help comprehend certain forms of extremely complex art. Stress value: 1d10/2 [Cost: Moderate]

Exploits: A trick among certain criminals is to encode exploit software in their neural network and then attack code that interfaces with their brains such as simulspaces. Also useful for carrying contraband software such as scorches into secure installations. The exploit software gives a -20 modifier due to its neural slowdown. Stress value: 1d10/2 [Cost: Moderate] or software price, whichever is highest.

Blank: For the paranoid, a cortical suicide pill. This extensive neural network will trigger a massive epileptic fit at the same time it maximizes synaptic plasticity. The result is an endless fit that gradually erases memories and everything else. A scan of the brain will likely at best produce a gamma fork. Stress value: 1d10+3 [Cost: Moderate]

Firewall: For the utterly paranoid, security software that runs *inside* the brain. While much less capable than a software firewall, it might be the extra surprise needed to escape egonapping or enemy capture. The firewall has -20 on Infosec tests due to its slowed down reactions, but acts as a filter against exploits entering through neural access jacks, the stack, endos, cyberware and the senses. Some Firewall teams are experimenting with hardening their brains against basilisk hacks this way. Stress value: 1d10 [Cost: High]

Daemons: Simple AIs can be compiled into neural networks and run inside the brain. The exact relationship between the daemon and the owner depends significantly on how the setup is implemented. The most basic version keeps the daemon in an entirely separate network and allows it access to the outside through normal cybernetic enhancements; it is as if it was just

carried along. A more common approach is to give the AI access to sensory channels and a few limited output channels (overlays in the visual or auditory fields are most common): the owner can speak with the daemon and it can talk back, but it cannot do anything more than advice. A more full integration gives the daemon motor control, allowing true multitasking (assuming both can agree on what to do - alien hand syndrome is not too uncommon). The most full integration gives the daemon read access to the owner's memories and emotions (the converse is normally not possible due to the differences in internal representation, but Cognite is working hard on fixing that). Obviously, the owner and daemon better have compatible personalities or they are going to drive each other mad. Stress value: 2d10 [Cost: High].