*Surgery and Animal Care:* Six animals were used in this study. Each animal was trained, under food restriction (15 g/animal/day, standard hard chow), on a simple lever-press-and-hold task until performance stabilized and then taken in for surgery. Animal behavior was not analyzed for the preparation of this manuscript and, where applicable, electrophysiological data was selected from inactive (intertrial) time periods during each recording session.

Each animal was implanted with four different silicon microelectrodes (NeuroNexus Technologies; Ann Arbor, MI; custom design). Each electrode contains up to 16 independent recording sites, with variations in device footprint and recording site position. Four devices in each animal were implanted into one of four implant positions bilaterally, in the forelimb region of the primary or supplementary motor cortex (+2.0 mm AP, +2.0 mm ML; +3.0 mm AP, +1.0 mm ML; +3.0 mm AP, -1.0 mm ML; +2.0 mm AP, -2.0 mm ML; all coordinates with respect to bregma.) Efforts were taken to ensure that the implant procedure for each device was as consistent as possible. Surgery was standardized by the use of the same surgeon for all implants. The surgery protocol included the use of an automated insertion motor which allowed fine positioning and alignment of the device prior to implantation, in addition to a controlled implant speed of 0.5 mm/sec (Physik Instrumente; Eschbach, Germany; item no. XXXX). All animal procedures were performed in accordance with the National Institutes of Health Guide for the Care and Use of Laboratory Animals and approved by the University of Michigan Animal Care and Use Committee.

Following surgery each animal was administered an analgesic, ketoprofin (XXXX; XXXX; XXXX), the following day the animal initiated a schedule of daily electrophysiological recordings, one hour in duration, conducted in a high walled observation chamber under freely-behaving conditions. Following recording, each animal was anesthetized for 45 minutes using isoflurane (XXXX; XXXX; XXXX) in order to take complex impedance spectra measurements (data presented in another manuscript, in preparation). This recording schedule continued for seven days as animals recovered from surgery. Upon completion of the seven day recovery period, each animal was returned to a restricted feeding schedule, recording were now conducted in a modified operant testing chamber and the recording schedule was shifted, beginning on the ninth day past surgery, repeating every other day until the completion of the experiment at one month following surgery.

*Electrophysiology*: Electrophysiological data was collected using a custom recording rig assembled from off-the-shelf components. Each animal is connected to the rig by a recording cable terminating in a Zif-Clip, low insertion force connector with an integrated unity gain headstage amplifier, modified from standard cable components (Tucker-Davis Technologies (TDT); Alachua, FL; 2 x ZC32), so that the cable is lengthened to 7’ using Teflon coated, stranded copper wire (Cooner Wire; Chatsworth, CA; Item no. CZ1187). The cable connects directly to a 64 channel amplifier (Plexon Inc.; Dallas TX; PBX Preamplifier) using adaptors available from Plexon, for use with TDT style cables. The amplifier is configured for wideband recording, with hardware band-pass filtering from 0.07 Hz to 8 kHz, and 1000x gain. Analog, amplified signal are digitized at 16 bits and sampled synchronously across 64 channels at 31250 Hz, using a data acquisition system (National Instruments; Austin, TX; chassis: PXIe-1073, DAQ: 4 x PXIe-6363) controlled by custom LabVIEW software. Digitized data is collected at a range of -10V, +10V and scaled to 16-bit (signed) integers and multiplexed for storage and further analysis. With each file 64 channel file four blocks of 16 channels represent recordings from each of four implanted devices.