<table>
<thead>
<tr>
<th>Technique</th>
<th>Subject State</th>
<th>Technology</th>
<th>Costs</th>
<th>Temporal Resolution</th>
<th>Spatial Resolution</th>
<th>Functional</th>
<th>Example</th>
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</thead>
<tbody>
<tr>
<td><strong>ANATOMICAL EXAMS:</strong></td>
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<tr>
<td>Lesions</td>
<td>Alive or post-mortem. Brain damaged, naturally or experimentally.</td>
<td>Observe behavior before/after ablation surgery, or process brain tissue to examine (especially naturally occurring) damage.</td>
<td>Can include damaging subjects</td>
<td>GOOD, per damaged area.</td>
<td>YES, per deficits</td>
<td>Phineas Gage, H.M.</td>
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<tr>
<td>Electrical Stimulation</td>
<td>Alive. Electrical probe on surface or inserted in brain. Local (scalp) anesthetic.</td>
<td>Micro-electrode probe (stimulation) &amp; map of (e.g. Brodmann) brain areas.</td>
<td>Invasive</td>
<td>GOOD, per stimulation site.</td>
<td>YES, per awake subject reactions, descriptions</td>
<td>Penfield Map</td>
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<tr>
<td><strong>RECORDINGS OF ENDOGENOUS EM RADIATION:</strong></td>
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<tr>
<td>Single Cell Recording</td>
<td>Alive. Recording probe inserted in brain. Local (scalp) anesthetic. Engaged in task.</td>
<td>Micro-electrode probe (stimulation) &amp; map of (e.g. Brodmann) brain areas.</td>
<td>Invasive</td>
<td>GOOD, for target cell, but highly localized</td>
<td>GOOD, per recording site.</td>
<td>YES, per associated activity, subject report</td>
<td>Face cells, Mirror cells</td>
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<tr>
<td>EEG (Electro-Encephalogram)</td>
<td>Alive. Record from external array of sensors, worn on scalp.</td>
<td>Wear cap of electrodes, record electric dipoles, perpendicular to brain surface (from Gyri), generated by changes of potential in thousands of cells. Trace oscilloscope output over time.</td>
<td>Relatively inexpensive technology</td>
<td>GOOD, per realtime (ongoing) brain activity</td>
<td>POOR, dipole an overall effect of activity in many cells</td>
<td>Weak, per associated activity</td>
<td>Stages of sleep</td>
</tr>
<tr>
<td>ERP (Event-Related Potential)</td>
<td>As above. Engaged in task.</td>
<td>Same equip as above. Examine average of the EEG responses that are time-locked to stimulus/task exposure, over repeated trials.</td>
<td>As above.</td>
<td>GOOD, for particular moment re: onset of task task</td>
<td>POOR, from mean differences across areas</td>
<td>YES, per associated activity</td>
<td>N400 in language processing, P200 in visual attention</td>
</tr>
<tr>
<td>MEG (Magneto-Encephalogram)</td>
<td>Alive. Head fixed in large apparatus.</td>
<td>Apparatus records magnetic fields, parallel to brain surface (from Sulci), generated by changes of potential in thousands of cells. Requires super-conducting materials to detect subtle fields.</td>
<td>More expensive magnetic detectors (&quot;SQUIDs&quot;)</td>
<td>GOOD, per realtime (ongoing) brain activity</td>
<td>GOOD, the field an overall effect of activity in many cells</td>
<td>Weak, per associated activity</td>
<td>Cortical activity</td>
</tr>
<tr>
<td><strong>IMAGES PRODUCED BY PERTUOATION OF SYSTEM:</strong></td>
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<tr>
<td>MRI (Magnetic Resonance Imaging)</td>
<td>Alive. Lying in large, loud drum.</td>
<td>Magnetically align proton spin in hydrogen atoms (in water) using magnet &amp; radio waves, then release. Use energy released by return to natural alignment to expose image. Differentiate structures, tumors, myelin, lesions, etc.</td>
<td>Expensive, loud</td>
<td>BEST, high resolution</td>
<td>No.</td>
<td>Detailed brain images, cortical and sub; Detection of disease Multiple Sclerosis (MS)</td>
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<tr>
<td>fMRI (Functional MRI)</td>
<td>Alive. Lying in large, loud drum. Engage in sensory or cognitive task.</td>
<td>Like above, but BOLD records ratio between oxygenated- and deoxygenated hemoglobin in blood, at active sites. Images color-coded per differences during task relative to baseline.</td>
<td>Expensive, loud</td>
<td>POOR, few seconds</td>
<td>VERY GOOD, high resolution</td>
<td>YES, per associated activity</td>
<td>Listen to music, examine faces, imagine objects, etc.</td>
</tr>
<tr>
<td>PET (Positron Emission Tomography)</td>
<td>Alive. Head fixed in apparatus. Engage in sensory or cognitive task.</td>
<td>Gamma Rays from decay of injected radioactive fluid absorbed w/glucose (at active sites). Images color-coded per differences during task relative to baseline.</td>
<td>Radioactive materials, expensive</td>
<td>POOR, ~ 30 seconds</td>
<td>GOOD</td>
<td>YES, per associated activity</td>
<td>Listen to music, examine faces, imagine objects, etc.</td>
</tr>
<tr>
<td>CAT (Computed Axial Tomography)</td>
<td>Alive or post-mortem. Head in apparatus.</td>
<td>X-Rays. Tissues vary in penetration /shade of image. Build up 3D from 2D images.</td>
<td>X-Ray exposure, less expnsv</td>
<td>None</td>
<td>OK, less resolution</td>
<td>No</td>
<td>Anatomy of brain and other structures</td>
</tr>
</tbody>
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