There are 2 million head (TBI) injuries per year, per NIH. Often, people seem to recover completely. In addition, many mild head injuries occur without diagnosis. It could be a hit on the head, a loss of consciousness, as a result of anesthesia, or even illness.

LATER, Problems - seemingly unrelated to the incident start to show up. Even small injuries – something that jars the brain against the skull, can have a ripple effect. The frontal lobe plays a major role in attention. Problems show up in a variety of ways: as reduced drive or initiative; or, the competitive edge can be gone. They can become inappropriately jocular, emotionally volatile, irritable, fractious, and impulsive. The problem usually doesn't register as neurological impairment. Often, the injury magnifies personality tendencies. They are a subtle reflection of executive lobe function. CCAT and MRI can be normal. But the blood flow through SPECT scan and qEEG (or MEG) are abnormal. You can see slowed blood flow to the frontal lobe, or excessive slow EEG activity (or a lack of certain normal EEG activity).

The person may perform well on many psychological tests. However, goal directed processes can become severely impaired. If your client has hidden brain injuries, the problems and impairments can be subtle. It reduces inhibitory circuitry. The outcomes for an individual can LOOK quite different. These include:

<table>
<thead>
<tr>
<th>Indifference</th>
<th>A lack of inhibition</th>
<th>Lack of initiative</th>
<th>Anger, Rage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indecision</td>
<td>Hesitation</td>
<td>Need for instant gratification</td>
<td>Perseveration</td>
</tr>
<tr>
<td>Impulsivity</td>
<td>Extreme distractibility</td>
<td>Impaired attention (may look like ADD)</td>
<td>Volatility</td>
</tr>
<tr>
<td>Racing mind</td>
<td>Indifference</td>
<td>Unable to anticipate consequences</td>
<td>Chaotic</td>
</tr>
<tr>
<td>Asocial</td>
<td>Easily overwhelmed</td>
<td>Problems with being socially inappropriate</td>
<td>Depression</td>
</tr>
<tr>
<td>Poor planning</td>
<td>Chronically irrelevant</td>
<td>problems with social and ethical behavior</td>
<td>Poor planning</td>
</tr>
<tr>
<td>Poor memory</td>
<td>Panicky</td>
<td>Poor judgment/decisions</td>
<td></td>
</tr>
</tbody>
</table>

You can have huge "blind spots" – such as an inability to perceive one's inappropriateness. You can lack mental flexibility (rigidity of mind). There can be an Inability to monitor and control output (excessive, inappropriate comment).

At least 20% of your patients could have head injury, or abnormal EEGs. MANY are undetected. Many of the problems may look like personality problems. But they are instead - frontal lobe problems.

Switching easily from one idea or activity requires HEALTHY frontal lobes. One option - other than medications - is to exercise the thalamo-coritical loop, and stimulate activation or inhibition of the frontal lobe.

There are a variety of tests that can help assess frontal lobe impairment, including the Cognitive Bias Test (by Goldberg) and the Stroop test.

Information from the Executive Brain, Elkhonon Goldberg, PhD, Clinical professor of neurology at NYU School of Medicine and Dir of the Institute of Neuropsychology and Cognitive performance. www.elkhonongoldberg.com
Functions of the Prefrontal Cortex

- attention span
- perseverance
- planning
- judgment
- impulse control
- organization
- self-monitoring and supervision
- problem solving
- critical thinking
- forward thinking
- learning from experience and mistakes
- ability to feel and express emotions
- influences the limbic system
- empathy
- internal supervision

Problems Associated with the Prefrontal Cortex

- short attention span
- distractibility
- lack of perseverance
- impulse control problems
- hyperactivity
- chronic lateness, poor time management
- poor organization and planning
- procrastination
- unavailability of emotions
- misperceptions
- poor judgment
- trouble learning from experience
- short term memory problems
- social and test anxiety
- lying
- misperceptions
Problems of the PFC

Problems in the dorsal lateral prefrontal cortex often lead to decreased attention span, distractibility, impaired short term memory, decreased mental speed, apathy and decreased verbal expression. Problems in the inferior orbital cortex often lead to poor impulse control, mood control problems (due to its connects with the limbic system), decreased social skills and overall decreased control over behavior.

Overall, when there are problems in the PFC the organization of daily life becomes difficult and internal supervision goes awry. People with PFC problems often do things they later regret, exhibiting problems with impulse control. They also experience problems with attention span, distractibility, procrastination, poor judgment and problems expressing themselves. Test anxiety along with social anxiety also may be hallmarks of problems in the PFC. Situations that require concentration, impulse control and quick reactions are often hampered by PFC problems. Tests require concentration and the retrieval of information. Many people with PFC problems experience difficulties in test situations because they have trouble activating this part of the brain under stress, even if they have adequately prepared for the test. In a similar way, social situations require concentration, impulse control and dealing with uncertainty. Pfc deactivation often cause a person's mind to "go blank" in conversation which lead to being uncomfortable in social situations.

When men have problems in this part of the brain, their emotions are often unavailable to them and their partners complain that they do not share their feelings. This can cause serious problems in a relationship because of how other people interpret the lack of expression of feeling. Many women, for example, blame their male partners for being cold or unfeeling, when it is really a problem in the PFC that causes a lack of being "tuned in" to the feelings of the moment.
Per Amen:

**Dominant Side (usually the left)**

- Perception of words
- Process language related sounds
- Sequential analysis
- Increased blood flow during speech perception
- Process details, individual units
- Intermediate term memory
- Long term memory
- Auditory learning
- Retrieval of words
- Complex memories
- Visual and auditory processing

**Dominant Temporal Lobe (usually left) Problems**

- Decreased verbal memory (words, lists, stories)
- Difficulty placing words or pictures into discreet categories
- Trouble understanding the context of words
- Aggression, internally or externally driven
- Dark or violent thoughts
- Sensitivity to sights, mild paranoia
- Word finding problems
- Auditory processing problems
- Reading difficulties
- Emotional instability

**Non-dominant Side Functions (usually the right)**

- Perception of melodies
- Pitch/prosody
- Social cues
- Reading facial expression
- Increased blood flow during tonal memory
- Decoding vocal intonation
- Rhythm
- Visual learning

**Non-dominant Temporal Lobe (usually right) Problems**

- Difficulty recognizing facial expression
- Difficulty decoding vocal intonation
- Implicated in social skill struggles
- Trouble processing music
- Decreased social cues/context
- Poor visual imagery
- Decreased selective attention to visual input
- Decreased recall of nonverbal items - shapes, faces, tunes

**Either or Both Temporal Lobe Problems**

- memory problems, amnesia
- headaches or abdominal pain without a clear explanation
- anxiety or fear for no particular reason
- abnormal sensory perceptions, visual or auditory distortions
- feelings of déjà vu or jamais vu
- periods of spaciness or confusion
- religious or moral preoccupation
- hypergraphia, excessive writing
- seizures

**Temporal Lobe Personality**

- proneness to aggressive outbursts
- overemphasis on trivia
- pedantic speech
- egocentric
- preoccupation with religion
<table>
<thead>
<tr>
<th>Tests showing right ear advantage</th>
<th>Tests showing left ear advantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Digits</td>
<td>• Melodies</td>
</tr>
<tr>
<td>• Words</td>
<td>• Musical chords</td>
</tr>
<tr>
<td>• Backward speech</td>
<td>• Environmental sounds</td>
</tr>
<tr>
<td>• Morse code</td>
<td>• Emotional sounds and hummed melodies</td>
</tr>
<tr>
<td>• Difficult rhythms</td>
<td>• Complex pitch perception</td>
</tr>
<tr>
<td>• Ordering information</td>
<td></td>
</tr>
</tbody>
</table>

Kolb & Wishaw (1990) have identified eight principle symptoms of temporal lobe damage:

1) disturbance of auditory sensation and perception,
2) disturbance of selective attention of auditory and visual input,
3) disorders of visual perception,
4) impaired organization and categorization of verbal material,
5) disturbance of language comprehension,
6) impaired long-term memory,
7) altered personality and affective behavior,
8) altered sexual behavior.

- Inability to perceive or remember events
- Damage to the inferior aspect of the temporal lobe - decreased memory (conscious recall of information, in proportion to tissue damaged)

There may be disturbance of visual and auditory input selection. This presents as impairment of short term memory, also called working memory and judgment about the recency of events.

Other temporal lobe symptoms - Agitation, irritability, childish behavior. There is a temporal lobe personality. There is an emphasis on trivia and the small details of daily life. There is egocentricity, pedantic speech, perseveration of speech, paranoia, religious preoccupations and a tendency to aggressive outbursts, especially after right temporal lobectomy. Perseveration is when there is a continuous but futile attempt to produce a word or perform an action long after others would have given up or tried a different approach.

Temporal lobe lesions may be associated with true hypersexuality, transvestite and transsexual behaviour. Stroke normally reduces libido but temporal lobe lesions can increase it. ³

Selective attention to visual or auditory input is common with damage to the temporal lobes (Milner, 1968).

Left side lesions result in
1) decreased recall of verbal and visual content, including speech perception.
2) disturb recognition of words
3) impaired memory for verbal material.

Right side lesions result in
1) decreased recognition of tonal sequences and many musical abilities.
2) can effect recognition of visual content (e.g. recall of faces).
3) loss of inhibition of talking
4) impaired non-verbal material, such as music and drawings.

There may be difficulty using contextual information, in extracting information from the environment and using visual and social cues. (thought of as Right side lesions, but unclear in reading)

Temporal lobe epilepsy can cause perseverative speech, paranoia and aggressive rage

Brain redundancy – mirror function for language, other functions

In healthy brains, language functions are carried out by a network of mirror image brain areas in the left and right side of the brain, with one side, usually the left, being dominant. The subordinate side, usually the right, may spend most of its lifetime playing an understudy role, as well as developing its own specializations.

But if a stroke or some other neurological damage disables one of the network components on the dominant side, the corresponding left side component rapidly and spontaneously emerges from its understudy role, and starts to activate to a normally high level during language processing.

The rapid recovery of the ability to use language after stroke damage to the language network was previously attributed to tissue healing functions, like reduction of swelling in the brain.

Seizures:
Simple Partial Seizures (SPS) involve small areas of the temporal lobe and do not affect consciousness. These are seizures which primarily cause sensations. These sensations may be mnestic such as *déjà vu* (a feeling of familiarity), *jamais vu* (a feeling of unfamiliarity), a specific single or set of memories, or amnesia. The sensations may be auditory such as a sound or tune, or gustatory such as a taste, or olfactory such as a smell that is not truly present. Sensations can also be visual or involve feelings on the skin or in the internal organs. The latter feelings may seem to move over the body. Dysphoric or euphoric feelings, fear, anger, and other sensations can also occur during SPS. Complex Partial Seizures (CPS) by definition are seizures which impair consciousness to some extent. Signs may include motionless staring, automatic movements of the hands or mouth, inability to respond to others, unusual speech, or unusual behaviors. Occasionally, such patients have personality changes, characterized by humorlessness, philosophic religiosity, and obsessiveness; in men, libido may be decreased.

Seizures which begin in the temporal lobe but then spread to the whole brain are known as Secondarily Generalized Tonic-Clonic Seizures (SGTCS). These begin with an SPS or CPS phase initially, but then the arms, trunk and legs stiffen in either a flexed or extended position.
Motor Cortex

The motor cortex is located in the rear portion of the frontal lobe, just before the central sulcus (furrow) that separates the frontal lobe from the parietal lobe. The motor cortex is divided into two main areas, Area 4 and Area 6. Area 4, also known as the primary motor cortex, forms a thin band along the central sulcus. Area 6 lies immediately forward of Area 4. Area 6 is wider and is further subdivided into two distinct sub-areas.

To carry out goal-directed movements, your motor cortex must first receive various kinds of information from the various lobes of the brain: information about the body's position in space, from the the parietal lobe; about the goal to be attained and an appropriate strategy for attaining it, from the anterior portion of the frontal lobe; about memories of past strategies, from the temporal lobe; and so on.

The motor cortex can be divided into five main areas:

- the primary motor cortex (or M1), responsible for generating the neural impulses controlling execution of movement
- and the secondary motor cortices, including
  - the posterior parietal cortex, responsible for transforming visual information into motor commands
  - the premotor cortex, responsible for motor guidance of movement and control of proximal and trunk muscles of the body
  - and the supplementary motor area (or SMA), responsible for planning and coordination of complex movements such as those requiring two hands.

Other brain regions outside the cortex are also of great importance to motor function, most notably the cerebellum and subcortical motor nuclei.

Planning for any given movement is done mainly in the forward portion of the frontal lobe. This part of the cortex receives information about the individual's current position from several other parts. Then, like the ship's captain, it issues its commands, to Area 6. Area 6 acts like the ship's lieutenants. It decides which set of muscles to contract to achieve the required movement, then issues the corresponding orders to the "rowers"—the primary motor cortex, also known as Area 4. This area in turn activates specific muscles or groups of muscles via the motor neurons in the spinal cord.

Even for a movement as simple as picking up a glass of water, one can scarcely imagine trying to consciously specify the sequence, force, amplitude, and speed of the contractions of every muscle concerned. And yet, if we are healthy, we all make such movements all the time without
even thinking of them.

The decision to pick up a glass of water is accompanied by increased electrical activity in the frontal region of the cortex. The neurons in the frontal cortex then send impulses down their axons to activate the motor cortex itself. Using the information supplied by the visual cortex, the motor cortex plans the ideal path for the hand to follow to reach the glass. The motor cortex then calls on other parts of the brain, such as the central grey nuclei and the cerebellum, which help to initiate and co-ordinate the activation of the muscles in sequence.

The axons of the neurons of the primary motor cortex descend all the way into the spinal cord, where they make the final relay of information to the motor neurons of the spinal cord. These neurons are connected directly to the muscles and cause them to contract. Finally, by contracting and by thus pulling on the bones of the arm and hand, the muscles execute the movement that enables the glass to be picked up.

In addition, to ensure that all of these movements are fast, precise, and co-ordinated, the nervous system must constantly receive sensory information from the outside world and use this information to adjust and correct the hand's trajectory. The nervous system achieves these adjustments chiefly by means of the cerebellum, which receives information about the positions in space of the joints and the body from the proprioceptors.

**Sensory Cortex**

The sensory cortex is an umbrella term for the primary and secondary cortices of the different senses: the visual cortex on the occipital lobes, the auditory cortex on the temporal lobes, the somatosensory cortex on the postcentral gyrus, the olfactory cortex on the entorhinal and pyriform cortices, and the gustatory cortex laterally on the postcentral gyrus.

All sensory areas are located behind the lateral and central fissure, that is, more at the back of the brain.

Note that the central sulcus (or fissure) divides the primary motor cortex (in the precentral gyrus) from the sensory cortex (in the postcentral gyrus).

The posterior parietal cortex (somatosensory cortex) is involved in somatic sensation, visual stimuli, and movement planning.
Function of parietal lobes involves sensation and perception and the other is concerned with integrating sensory input, primarily with the visual system. The first function integrates sensory information to form a single perception (cognition). The second function constructs a spatial coordinate system to represent the world around us. Individuals with damage to the parietal lobes often show striking deficits, such as abnormalities in body image and spatial relations (Kandel, Schwartz & Jessel, 1991).

Controls Proprioception - awareness of the position of body parts

Damage to the left parietal lobe can result in:

- right-left confusion,
- difficulty with writing (agraphia) and difficulty with mathematics (acalculia) - left parietal plays a big role in knowledge of numbers and their relations
- disorders of language (aphasia): severe word finding and confrontive naming difficulty. These individuals have difficulty naming objects, describing, pictures, inability to perceive objects normally (agnosia).

Damage to the right parietal lobe can result in:

- neglecting part of the body or space (contralateral neglect), which can impair many self-care skills such as dressing and washing.
- difficulty in making things (constructional apraxia),
- denial of deficits (anosagnosia) deficit in drawing ability.

Because the inferior parietal lobule also acts as a relay center where information from Wernickes region can be transmitted, via the arcuate fasciculus, to Broca's area (for expression) destructive lesions, particulary to the supramarginal gyrus of the left cerebral hemisphere can result in conduction aphasia (see chapter 11). Although comprehension would be intact and a patient would know what she wanted to say, she would be unable to say it. Nor would she be able to repeat simple statements, read out loud, or write to dictation. This is because Broca's area is disconnected from the posterior language zones.
Bi-lateral damage (large lesions to both sides) can cause

visual attention and motor syndrome, characterized by the inability to control the gaze
inability to integrate components of a visual scene
inability to accurately reach for an object with visual guidance (optic ataxia)

Damage to area between the parietal and temporal lobes can create special deficits (primarily to memory and personality)

Left parietal-temporal lesions:

Verbal memory and the ability to recall strings of digits

Right parietal-temporal lobe is concerned with non-verbal memory.
Right parietal-temporal lesions can produce significant changes in personality.

Gerstmann syndrome is a cluster of neurological symptoms that includes difficulty writing (dysgraphia or agraphia), difficulty with arithmetic (dyscalculia or acalculia), an inability to distinguish left from right, and difficulty identifying fingers (finger agnosia).

Cause - Gerstmann syndrome may be acquired when bleeding into the brain during a stroke or after a traumatic head injury occurs in an area of the left parietal lobe. This disorder is often associated with brain lesions in the dominant (usually left) side.

This sits at the junction of the temporal, parietal, and occipital lobes, the angular gyrus and supramarginal gyri near the temporal and parietal lobe junction.

- dysgraphia or agraphia: an inability or impairment in the ability to express oneself through the written word.
- dyscalculia or acalculia: an inability to perform basic calculations.
- left-right confusion: difficulty identifying the left or right of one's body or of other objects.

the angular gyrus is at least partially responsible for understanding metaphors. Right-handed patients who had damage to their left angular gyrus and whose speaking and comprehending English was seemingly unaffected, could not grasp the dual nature of metaphor. (More at: http://brainmind.com/AngularGyrus.html)

Adults with Gerstmann syndrome may also display some degree of aphasia, which is an impaired ability to communicate verbally, to understand verbal communication, and to understand written language. Children with developmental Gerstmann syndrome may also exhibit poor handwriting, difficulty spelling, reading problems, and difficulty copying simple drawings (called constructional apraxia).
Like a spotlight that illuminates an otherwise dark scene, attention brings to mind specific details of our environment while shutting others out. A new study by researchers at the Salk Institute for Biological Studies shows that the superior colliculus, a brain structure that primarily had been known for its role in the control of eye and head movements, is crucial for moving the mind's spotlight.

Their findings, published in the Dec. 20, 2009, issue of the journal *Nature Neuroscience*, add new insight to our understanding of how attention is controlled by the brain. The results are closely related to a neurological disorder known as the neglect syndrome, and they may also shed light on the origins of other disorders associated with chronic attention problems, such as autism or attention deficit disorder.

"Our ability to survive in the world depends critically on our ability to respond to relevant pieces of information and ignore others," explains graduate student and first author Lee Lovejoy, who conducted the study together with Richard Krauzlis, Ph.D., an associate professor in the Salk's Systems Neurobiology Laboratory. "Our work shows that the superior colliculus is involved in the selection of things we will respond to, either by looking at them or by thinking about them."

As we focus on specific details in our environment, we usually shift our gaze along with our attention.

"We often look directly at attended objects and the superior colliculus is a major component of the motor circuits that control how we orient our eyes and head toward something seen or heard," says Krauzlis.

But humans and other primates are particularly adept at looking at one thing while paying attention to another. As social beings, they very often have to process visual information without looking directly at each other, which could be interpreted as a threat. This requires the ability to attend covertly.

It had been known that the superior colliculus plays a role in deciding how to orient the eyes and head to interesting objects in the environment. But it was not clear whether it also had a say in covert attention.

In their current study, the Salk researchers specifically asked whether the superior colliculus is necessary for covert attention. To tease out the superior colliculus' role in covert attention, they
designed a motion discrimination task that distinguished between control of gaze and control of attention.

The superior colliculus contains a topographic map of the visual space around us, just as conventional maps mirror geographical areas. Lovejoy and Krauzlis exploited this property to temporarily inactivate the part of the superior colliculus corresponding to the location of the cued stimulus on the computer screen. No longer aware of the relevant information right in front of them the subjects instead based all of their decision about the stimulus' movement on irrelevant information found elsewhere on the screen.

"The result is very similar to what happens in patients with neglect syndrome," explains Lovejoy, who is also a student in the Medical Scientist Training Program at UC San Diego. "Up to a half of acute right-hemisphere stroke patients demonstrate signs of spatial neglect, failing to be aware of objects or people to their left in extra-personal space."

"Our results show that deciding what to attend to and what to ignore is not just accomplished with the neocortex and thalamus, but also depends on phylogenetically older structures in the brainstem," says Krauzlis. "Understanding how these newer and older parts of the circuit interact may be crucial for understanding what goes wrong in disorders of attention."

Note: This story has been adapted from a news release

Wikipedia. The optic tectum or simply tectum is a paired structure that forms a major component of the vertebrate midbrain. In mammals this structure is more commonly called the superior colliculus (Latin, higher hill), but even in mammals, the adjective tectal is commonly used.

The general function of the tectal system is to direct behavioral responses toward specific points in egocentric ("body-centered") space. Each layer of the tectum contains a topographic map of the surrounding world in retinotopic coordinates, and activation of neurons at a particular point in the map evokes a response directed toward the corresponding point in space. In primates, the tectum ("superior colliculus") has been studied mainly with respect to its role in directing eye
movements. Visual input from the retina, or "command" input from the cerebral cortex, create a "bump" of activity in the tectal map, which if strong enough induces a saccadic eye movement. Even in primates, however, the tectum is also involved in generating spatially directed head turns, arm-reaching movements, and shifts in attention that do not involve any overt movements. In other species, the tectum is involved in a wide range of responses, including whole-body turns in walking rats, swimming fishes, or flying birds; tongue-strikes toward prey in frogs; fang-strikes in snakes; etc.

In some non-mammal species, including fish and birds, the tectum is one of the largest components of the brain. In mammals, and especially primates, the massive expansion of the cerebral cortex reduces the tectum ("superior colliculus") to a much smaller fraction of the whole brain. Even there, though, it remains functionally very important as the primary integrating center for eye movements.