# Stroke Savvy

Vol. 8 | EXCITE Program Monthly Newsletter

Welcome to another of the ***Stroke Savvy*** newsletter for participants in the EXCITE research study. This issue is dedicated to the organ responsible for almost everything you do, the brain. We're exploring how adaptable the brain is to injury. Comments or suggestions for the newsletter can be sent to Carol Giuliani at carol_giuliani@med.unc.edu or (919) 966-9796.



## Neuroplasticity

### The Brain Is A Very Adaptable Organ

Brain growth and nerve cell change is not limited only to childhood. Nerve cell connections and functions of different areas of the brain change throughout our lifetimes, depending on the situations and needs of the brain. A good example is learning new information. Older individuals can learn new skills, such as learning a language, learning how to play the piano, or finding the way around in a new town. Although these examples may seem common, each requires new activity in groups of neurons. Physical and mental activities that have already been acquired can also be improved. A good example might be better performance while singing a song, or perfecting a tennis serve.

All types of learning, whether it involves motor activities, or intellectual tasks, can occur at any age. Although learning may be more challenging for some older people, it is still possible, except in those with severe dementia. As we age, there is a gradual loss of neurons, but there is evidence that those that remain are more complex than those in younger individuals, and capable of excellent function.

### Response to Injury

In addition to the changes that the nervous system takes while learning a new task or reacting to the environment, we have learned that he nervous system can adapt in response to injury to a remarkable degree. The changes and adaptations in response to injury is sometimes called "plasticity". The term conveys the dynamic nature of neural change, somewhat akin to the "flexibility" of a piece of soft plastic. The brain actually changes activity levels of neurons to compensate for the injury. Scientists have discovered when a nerve is injured, or a person has an amputation, the areas of the brain responsible for movement and sensation of the injured part start to change.

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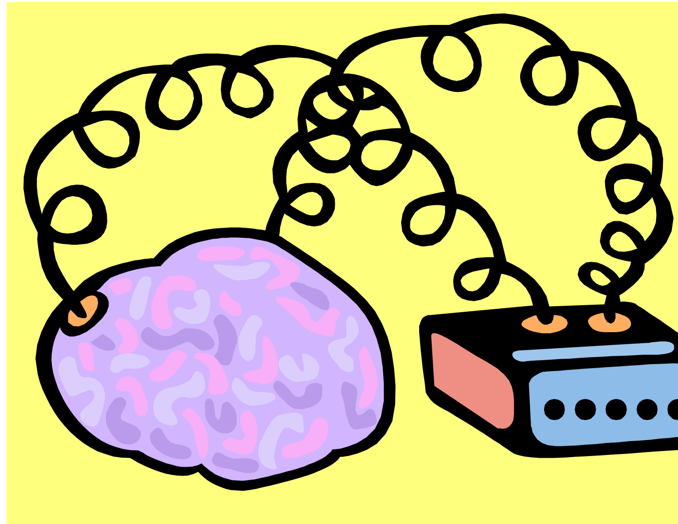
Editors' Note: Please don't forget to send in the quiz after you've completed the newsletter!!

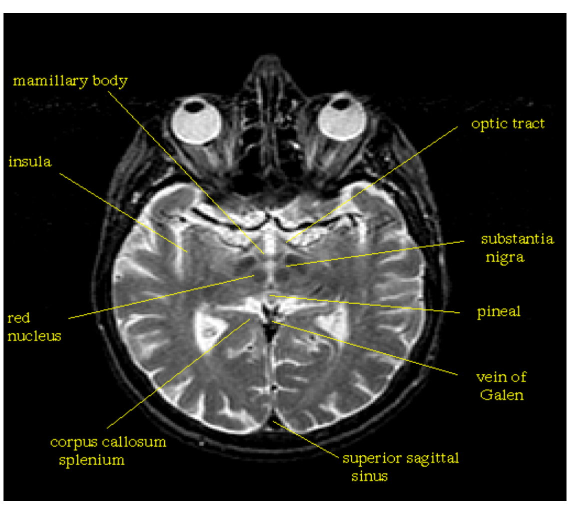
## Response to Injury (cont.)

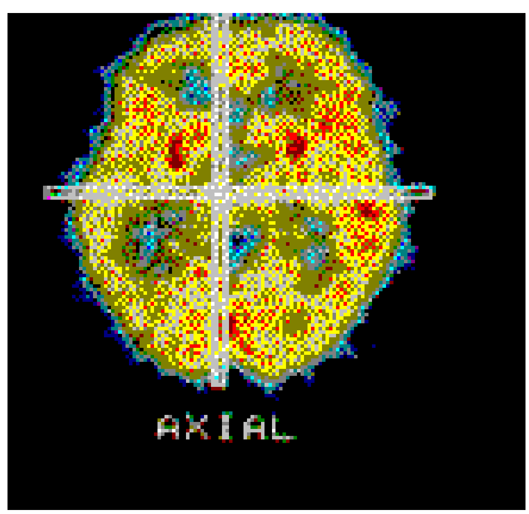


The area of the brain responsible for the injured body part begins to help with the function of parts of the body next to the damaged area. In a blind person who becomes proficient in Braille, portions of the brain responsible for finger movement and sensation in the dominant hand expand considerably, when compared to the non- dominant hand, which is not involved in Braille reading. These and many other examples suggest that the brain "remodels" itself in response to injury.

We see similar adaptations of the brain in stroke. Several new techniques have been developed to nerve damage caused by stroke. Two such techniques are positron emission tomography (PET) and functional magnetic resonance imaging (fMRI). Both of these techniques use a special type of scanner to evaluate small changes in blood flow that occur when nerve cells are active. Another technique is transcranial magnetic stimulation (TMS) which involves the use of a small magnetic current placed over the scalp. The current stimulates activity in nerve cells immediately under the scalp, causing slight movement of specific muscles in the opposite side of the body. In this way, parts of the brain responsible for movement of various areas can be "mapped". Examples of pictures obtained using these techniques in normal volunteers are shown in the figures. All these techniques are painless and each takes about one hour to perform.

In people who have had strokes, all of these techniques have shown alterations in nerve cell activity. For example, immediately after a stroke, the response to magnetic stimulation by TMS over the side of the brain that has suffered the stroke is decreased, or even absent. When the person attempts to use their weak hand, other parts of the brain not normally responsible for the hand movement become active as measured by fMRI or PET. This suggests that the brain is trying to compensate for the weakness by using these other regions of the brain. Another interesting observation is that as a person recovers from stroke, the areas of the brain responsible for motor movement also change. For example, TMS "maps" of nerve cells involved with movement of the recovering hand enlarge, suggesting that areas around the stroke damaged area, which were not previously involved in moving the weak hand, are now becoming active. These PET and fMRI changes in brain activity correlate with improved function.



## Can Therapy Change Brain Plasticity?

Recently, there has been exciting evidence that intensive training results in changes in brain activity correlated with recovery. Several studies using tiny electrodes to map parts of the brain that control movement have been performed in monkeys who have had a stroke. These studies have shown that if the stroke occurs in the part of the monkey's brain that controls finger and hand activity, a training program forcing the monkey to use its weak hand causes brain reorganization. The portions of the brain previously responsible for moving the elbow and shoulder become active when the monkey is moving its hand, and this seems to correlate with improvement in use of the hand. Studies performed in Germany on people who have had a stroke show a similar pattern. In these studies, transcranial magnetic stimulation in persons who have undergone constraint-induced movement therapy (the same type of therapy used in the EXCITE study) show an expansion of the hand area, suggesting that brain cells previously involved in the other functions can now be retrained to move the hand. This study is the first to show that intensive therapy in people with stroke actually causes brain plasticity. This exciting information gives us hope that carefully designed therapy programs might be even more effective in the future.

We know that medications affect our brain function in many different conditions. It is likely that the changes in neuron activity following stroke recovery could also be affected by medicine. Studies are now addressing the effects of medicine known to improve learning, in the hopes that combining a medicine and a training session will be even more beneficial than the training session alone. It is certainly possible that in the future every person receiving stroke rehabilitation could receive a combination of pill and a special training program specifically designed to enhance their recovery.

## Summary

Changes in brain cell function occur throughout lifetime, both in association with learning experiences, and in response to nervous system injury, including stroke. We know certain patterns of change of brain activity are correlated with recovery of function, and these changes can be influenced by intensive therapy programs, similar to the type used in the EXCITE study. As more is learned about what causes the brain to reorganize (undergo plasticity) we hope that even better techniques of therapy can be developed, and that medications might also be developed that will enhance recovery.

## Complete your Newsletter Quiz
## and mail it back to your site to receive credit for the month.

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| Vol. 8 | EXCITE Program Quiz |
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Please answer the following questions using the information provided and return this portion of the document. Good Luck! Complete and return to:______________________________________________________

1. You can't teach an old dog new tricks! True or False?

2. As people age they __________ neurons; but the remaining neurons can be more complex / less complex than those seen in younger adults

3. The term "plasticity" refers to:
    a. The brain's ability to bounce.
    b. The brain's ability to adapt and remodel itself.
    c. New techniques used to measure brain function.

4. What changes do we see in the brain of blind people who learn Braille?

5. PET and fMRI are two technologies used to measure changes in the brain. True or False?

6. The process of using electrical stimulation under the surface of the skin to cause small muscle contractions allows us to _______________ the brain.

7. Which country first proved that human brains have the ability to re-organize when there is an injury? _________________

8. Certain medications are known to improve learning. True or False?

9. What is the next step for research in this area?
    a. Determining the effect of certain medications on neuronal activity to facilitate recovery.
    b. Determining which types of training sessions are the most effective to create change.
    c. Determining which combination of medications and training is the most effective.
    d. All of the above.

10. By participating in the EXCITE study, I am contributing to this exciting body of research.
    True or False?