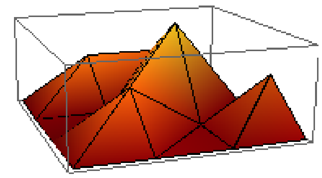
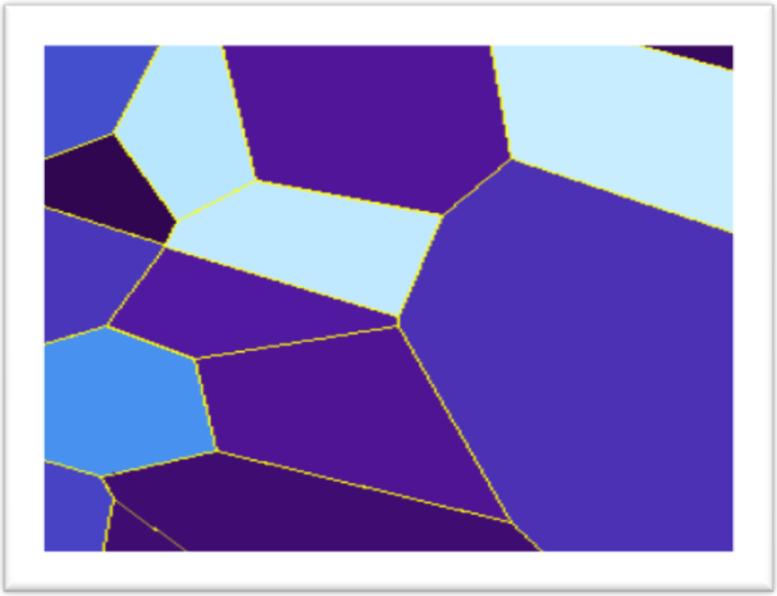
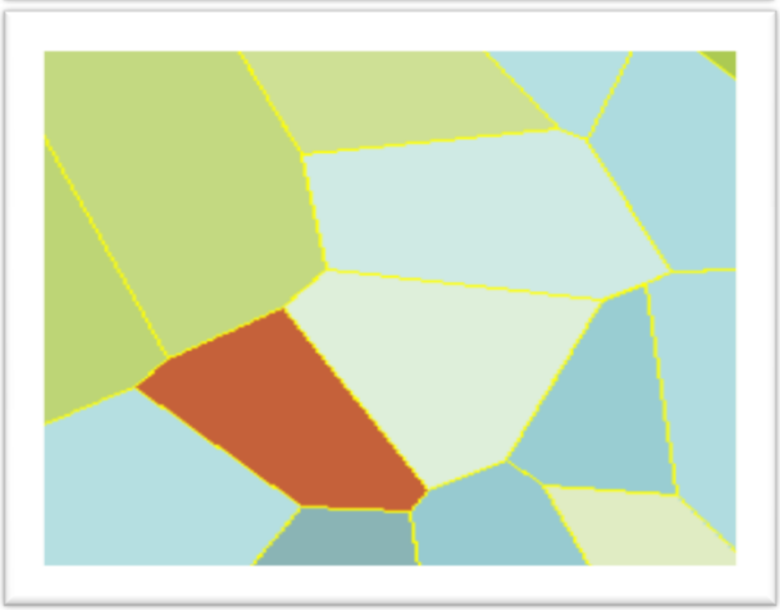
MATYCONN NEWS
Spring 2009







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Mathematical Association of Two – Year Colleges of Connecticut

2008 – 2009

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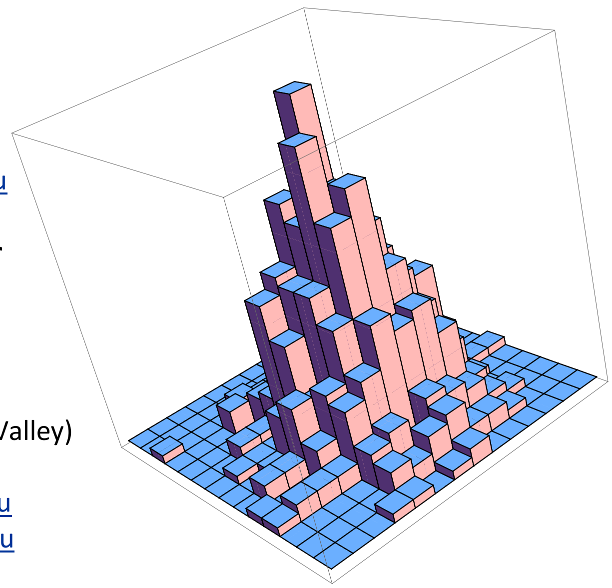

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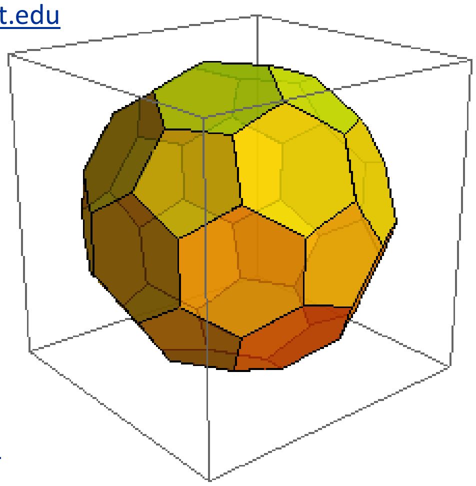

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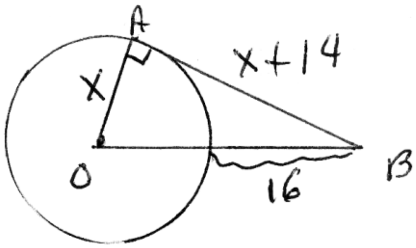
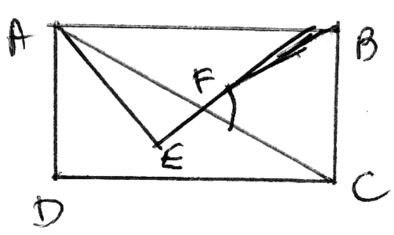
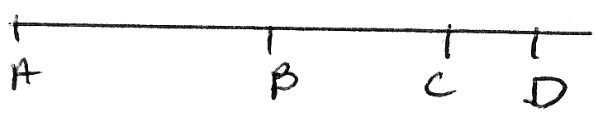
19th ANNUAL MATH CONTEST

The 19th Annual Math Contest took place between Wednesday, April 1, 2009 and Saturday, April 5, 2009 across the Connecticut Community College system.

Questions	***Answers***
EACH OF THE FOLLOWING PROBLEMS, 1 THROUGH 6, ARE WORTH ONE (1) POINT.	
1. THE RATIO OF THE RADII OF TWO CIRCLES IS 2 TO 1. WHAT IS THE RATIO OF THE LARGER AREA TO THE SMALLER AREA?	1. 4:1
2. JETER HIT 9 LESS THAN TWICE AS MANY HOME RUNS AS PEDROIA. PEDROIA HIT 8 FEWER HOME RUNS THAN JETER. HOW MANY HOME RUNS DID JETER HIT?	2. 25 HR
3. IF A(B – C) = 37, FIND A IF B IS 1 MORE THAN C.	3. A = 37
4. MEG COMPLETED 30% OF HER WORKOUT ON HER TREADMILL, WITH 35 MINUTES REMAINING ON THE TIME KEEPER. HOW MUCH TIME HAD SHE ALREADY SPENT ON THE TREADMILL?	4. 15 Minutes
5. A MULTIPLE OF 11 I BE. NOT ODD, BUT EVEN YOU SEE. MY DIGITS A PAIR, WHEN MULTIPLIED THERE, MAKE A CUBE AND A SQUARE OUT OF ME! WHO AM I?	5. 88
6. X IS A POSITIVE INTEGER LESS THAN 100. FOR HOW MANY VALUES OF X WILL $\sqrt{1+2+3+4+X}$ BE AN INTEGER?	6. 7 Values
EACH OF THE FOLLOWING PROBLEMS, 7 THROUGH 14, ARE WORTH TWO (2) POINTS.	
7. STARTING AT THE TOWN OF EULER AND TRAVELLING 40 MILES TO THE TOWN OF PYTHAGORAS, RALPH TRAVELS AT THE RATE OF 2 MILES EVERY 15 MINUTES. RETURNING FROM PYTHAGORAS TO EULER, HE TRAVELS 2 MILES EVERY 3 MINUTES. WHAT WAS RALPH'S OVERALL AVERAGE SPEED, IN MILES PER HOUR, FOR THE ENTIRE TRIP?	7. 13 1/3 Mph

8. FIND THE VALUE OF k FOR WHICH $kx^2 - 5x - 12 = 0$ HAS SOLUTIONS $x = 3$ AND $x = -\frac{4}{3}$.	8. K = 3
9. A TRAIN 2 KM LONG IS PASSING THROUGH A TUNNEL 3 KM LONG AND TRAVELS 30 KM PER HOUR. THE TRAIN BEGINS TO ENTER THE TUNNEL AT 9:30 AM. AT WHAT TIME IN THE MORNING DOES THE TRAIN COMPLETELY CLEAR THE TUNNEL?	9. 9:40 AM
10. DEFINE $(x\Delta y)$ TO MEAN $2x - 3y$. EVALUATE $((4\Delta 3)\Delta(5\Delta 3))$.	10. – 5
11. IN THE FOLLOWING DIAGRAM, SOLVE FOR X. 	11. X = 10
12. A IS 6 MORE THAN B, AND B IS 6 MORE THAN C. COMPUTE THE VALUE OF: (A – B)*(B – C)*(A – C)	12. 432
13. A CLASS HAS AN EQUAL # OF BOYS AND GIRLS. IF 8 GIRLS LEAVE, THEN THERE ARE TWICE AS MANY BOYS AS GIRLS. HOW MANY TOTAL STUDENTS WERE ORIGINALLY IN THE CLASS?	13. 32 Students
14. IN THE FOLLOWING DIAGRAM, ABCD IS A SQUARE, AND ABE IS AN EQUILATERAL TRIANGLE. FIND THE DEGREE MEASURE OF ANGLE BFC. 	14. 105 Degrees

EACH OF THE FOLLOWING PROBLEMS, 15 THROUGH 20, ARE WORTH THREE (3) POINTS	
15. A TRAPEZOID HAS COORDINATES (- 4, 0), (4, 10), (4, 30), AND (- 4, 40). WHAT IS THE RATIO OF ITS AREA IN THE FIRST QUADRANT TO ITS AREA IN THE SECOND QUADRANT?	15. 13:15
16. A FARMER HAD A DAUGHTER WHO SPOKE IN RIDDLES. ONE DAY THE CHILD WAS ASKED TO COUNT THE NUMBER OF GOATS AND THE NUMBER OF DUCKS IN THE BARNYARD. SHE RETURNED AND SAID, “TWICE THE NUMBER OF HEADS IS 76 LESS THAN THE NUMBER OF LEGS.” HOW MANY GOATS WERE IN THE BARNYARD?	16. 38 Goats
17. AN I-POD’S PRICE WAS DISCOUNTED 10%, AND THEN AGAIN BY 20%. WHAT IS THE OVERALL % DISCOUNT?	17. 28 %
18. THE QUADRATIC EQUATION $X^2 + BX + C = 0$ HAS ONE SOLUTION R. FIND THE RATIO OF B TO C, IN TERMS OF R.	18. $-2 / R$
19. ON THE FOLLOWING NUMBER LINE, AB = 3 BC, AND BC = 2 CD. FIND THE RATIO OF BD TO AD. 	19. 183
20. LINE 1 HAS A SLOPE OF M, AND Y INT OF (0, 2). LINE 2 HAS A SLOPE OF 2, AND A Y INTERCEPT OF (0, M). FIND THE COORDINATES OF THE POINT OF INTERSECTION.	20. (1, M + 2)

What is Education?

Submitted by:
Patton Duncan, Instructor of Physics
Capital Community College
April 2009

We are facing a crisis of truly historic proportions in education. This is a problem of national scope and Hartford is not exempt. Yet in the discussion of potential solutions we may be trying to reinvent the proverbial wheel. Human civilization by some estimates began approximately 7,000 years ago on the banks of the Nile River in the northern part of the continent of Africa. The foundations of education across the globe have their beginnings in the Egyptian Mysteries System taught in the famous Per Aungk (The House of Life). This designation is very instructive because the aim of education is only attained when the student is raised from their undeveloped potential to that of a well rounded, creative, intelligent and skilled member of society. This goal is not simply utilitarian but involves the actualization of the mental, artistic and spiritual dimensions of the human being.

When we look beyond the rhetoric of some of our leaders we can see that we have fallen very far in our practice from these ideals. In order to make the visions of educators like Imhotep, Socrates, Mary Mcloud Bethune, and others a reality we must resurrect the ancient foundations of holistic knowledge systems. Thinking must be emphasized rather than a market driven reduction of knowledge to mere “outcomes based learning”.

A holistic knowledge system attempts to integrate the fundamental components of learning into an organic, open and multimodal whole. There have been many such systems in the history of education. Examples include those of the Egyptian cosmology, Pythagorean harmonics, and the Liebnizian cosmological synthesis. These systems avoid overspecialization. They instead embrace the unified view of a human being, recognizing the student as a result of, and a conscious agent in, the evolutionary development of a living, spiritually meaningful cosmos.

There are essentially nine components to a holistic education system as developed in the western tradition: religious studies, philosophy, dietetics, calisthenics/martial arts, physical science, mathematics, technology, arts and political economy. The purpose of these diverse studies is to gradually build in the diligent student an awareness of the history and complexity of human culture, and to foster the moral and cognitive skills that will empower the student to become an active participant in building and defending their community. As the student of these studies advances they are challenged to move through three fundamental stages of knowledge mastery:

I. Listening and the art of concentration for information acquisition
II. Reflection and critical analysis of the logic and systems of thought
III. Identification and creative manipulation of knowledge/information systems

We can learn a lot from studying our past, for the ancestors have much to teach. Computers are indispensable for information storage, retrieval and manipulation, but true thinking is a reality of a different order. When we bring together the wisdom of our past and combine this with the best of modern science and technology, I believe that the crisis we now face will be the inspiration for creative work, resulting in *the building of a new world*.

AMATYC Project ACCCESS

Submitted by:
Teresa Foley, Instructor of Mathematics
Asnuntuck Community College
March 2009

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*******************FOR RELEASE ON or AFTER, XXXXX, 2008***************

Teresa Foley, Asnuntuck Community College,
Chosen as AMATYC ACCCESS Fellow

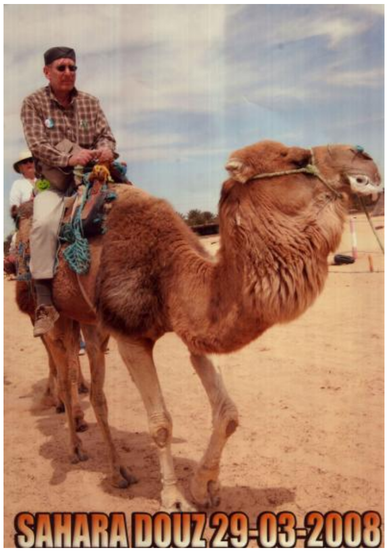
The American Mathematical Association of Two-Year Colleges (AMATYC) is pleased to announce the fellows selected for the fifth cohort of AMATYC Project ACCCESS (Advancing Community College Careers: Education, Scholarship and Service). Founded in 1974, the AMATYC is dedicated to the improvement of the teaching and learning of mathematics in the first two years of college. AMATYC addresses the concerns of the 20,000 full- and part-time mathematics faculty who teach in two-year colleges. In North America, more than 1,200 community colleges enroll some 10.4 million students. AMATYC serves professional two-year college mathematics faculty from the United States and Canada with approximately 2,500 individual members and over 100 institutional members.

AMATYC Project ACCCESS is a mentoring and professional development initiative for two-year college mathematics faculty. The project's goal is to provide experiences that will help new faculty become more effective teachers and active members of the broader mathematical community. The project began with its' first cohort in the fall of 2004. With the addition of the fifth cohort, the project has provided opportunities for 131 fellows. The fellows attend special sessions at the annual AMATYC conference each fall and are networked with each other as well as with consulting colleagues who have vast experience as teachers at two-year institutions. AMATYC Project ACCCESS is just one of the many programs offered through AMATYC. AMATYC provides professional development opportunities for educators interested in the first two years of collegiate mathematics instruction through an annual conference, summer institutes, traveling workshops, publications and projects.

For more information about AMATYC or AMATYC Project ACCCESS, visit the website at www.amatyc.org.

Steve Krevisky's Numerous Adventures

Submitted by:
Steve Krevisky, Professor of Mathematics
Middlesex Community College
December 2008



Since the summer of 2008, I got to visit some interesting places. My annual baseball conference, the meeting of SABR (Society for American Baseball Research), took place in Cleveland, Ohio in late June. There, I did a poster presentation on a pitcher named George Uhle, who won exactly 200 games in his career. 27 of those wins came in 1926, when he led the Indians to an exciting finish, just missing the pennant that year. I used something called the Pythagorean Projection to use the team runs scored and runs allowed, so as to see how many wins the Indians should have gotten, vs. how many they actually got.

I also visited the Kent State University campus, the Rock and Roll Hall of Fame, and the area where famous pitcher Cy Young was born. My next stop was Monterrey, Mexico, where the International Congress on Math Education (ICME) took place. This event occurs every 4 years, in different continents, and this was my 5th congress! I gave a math and baseball paper, as an example of a best practices application in our classes, to Discussion Group 23, on Two Year Colleges and other Tertiary Institutions. This was a continuation of discussions which took place at the previous ICME'S in Denmark and Japan. We had a lot of good discussions, and we hope this will continue at the next ICME in 2012 in Korea.

I have kept people informed about various international math conferences through my chairing the AMATYC A-NET special interest group on international math education. I have long wanted AMATYC to move more in this direction! After the conference, I asked AMATYC President Rikki Blair to have a more official position in this realm. As a result of discussion back and forth, I was asked to co-chair an International Math Education sub-committee of the Division/Department issues AMATYC committee. We met at the November annual AMATYC conference in DC, and we came up with some good ideas for keeping the momentum going!

After the ICME, I spent some time in Texas, especially enjoying the friendliness and scenery of the Texas Hill country, centered in Fredericksburg! Come August, I gave a math and baseball paper at the AMTNYS NY state math teacher's conference in Syracuse, NY. I had not been back to the 'cuse since I finished my Masters degree in '73, so this was a trip down memory lane. Due to construction, I hardly recognized anything, though a few things were familiar. I was glad that I did this!

I then did some touring in upstate NY, seeing 3 minor league baseball games. I visited the Woodstock site in Bethel, NY, which was a real treat! I visited an Iroquois museum, which had an exhibit on Native American baseball players! Howe Caverns was a treat, and of course, I spent 3 days at the Baseball Hall of Fame in Cooperstown, NY. I did some baseball research, stocked up on memorabilia, and enjoyed this. I also visited a former colleague who is now in upstate NY, who was a tour guide at the Woodstock museum!

I also continue to be active as President of the CT SABR Smoky Joe Wood chapter, and we have regular meetings and activities for us baseball junkies. Spring training, anyone?

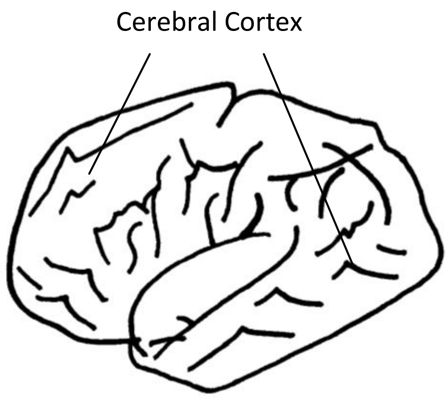
Anatomical Brain Differences between Genders

Submitted by:
Elizabeth Raver, Instructor of Mathematics
Housatonic Community College
September 2008

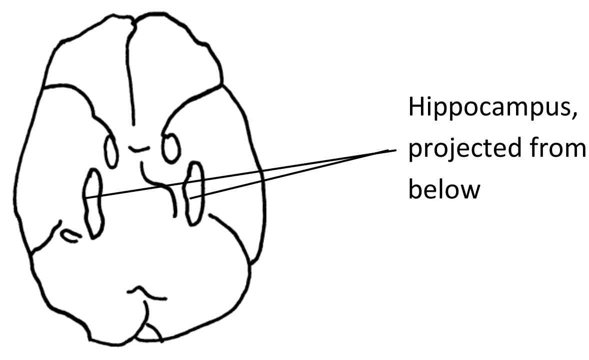
Recent advances in brain imaging have allowed the comparison of male and female brains. Significant anatomical differences between the genders have been revealed. These differences can be found in multiple areas of the brain, including the hippocampus, the amygdala and the corpus callosum. First, differences in the hippocampus that may explain gender differences in spatial versus landmark navigation skills as well as gender differences in chronic stress versus acute stress, will be addressed. Next, gender differences in the amygdala involving serotonin's role in stress, and emotional memory will be discussed. Third, there will be a discussion regarding anatomical gender differences in the corpus callosum. Finally, the outdated belief in a correlation between brain size and intelligence will be debunked.

<u>Hippocampus and Spatial Ability</u>

The hippocampus is associated with emotion, learning and memory formation. As a percentage of total brain size, it is larger in females than in males (Cahill, 2006, p.2). According to Leonard Sax, the hippocampus is developmentally more primitive than other brain areas (Sax, p. 101, 2005). It is that part of the brain used by males for spatial navigation. Females, on the other hand, rely more on the cerebral cortex for spatial navigation. The cerebral cortex is a more phylogenetically evolved part of the brain (Ranpura, n.d., p3). It is the convoluted surface of the brain known as gray matter (Hendelman, 1994, p.3). During the 1970s, experimentation by John O'Keefe and Lynn Nadel revealed hippocampus neurons that became active when rats were in specific areas of a maze. These neurons were called "place cells" because they responded to physical "places and not to smells, sounds, or other features of the environment" (Ranpura, n.d., p3). The phenomenon of place cells has also been described as when a rat moves "across a large environment, one can readily correlate dramatic increases in a place cell's firing rate when the rat arrives at a particular location" (Eichenbaum, 1999, p. 211). Because of this observed behavior of place cells, the hippocampus has been cited as having the ability to function like a cognitive map because it responds to movements in spatial geometry (Sax, 2005, p. 101). In other research, magnetic resonance imaging (MRI) scans recorded brain activity while male and female subjects played a video game requiring players to work their way out of a maze. The researchers found that females used their cerebral cortex to navigate out of the maze and males used their hippocampus (Cahill, 2005, p. 100-101).



Human Brain,
dorsolateral view



Human Brain,
ventral view

In 1999, Doreen Kimura reported gender differences in hippocampus size among laboratory animals, but could not confirm these differences in humans. She theorized that this may in part be because the hippocampus appears to be more directly associated with generalized memory than it is to specific spatial memory (Kimura, 1999, pp. 131-132). However, more recent studies utilizing positron-emission tomography (PET) and MRI scans have revealed gender related hippocampus size variations in humans. Louann Brizendine also reports that the female hippocampus is larger in women than in men without adjusting for total size of brain (Brizendine, 2006, p. 5). Melissa Hines writes that within the human brain the hippocampus is unusual in that it is capable of producing new neurons in adults. In humans and other mammals, hormones can affect the production and survivability of these new neurons as well as "dendritic growth, synapse formation, and other growth processes" (Hines, 2004, p. 196.) In this way, the relative volume of specific brain regions can fluctuate throughout life in humans. This, in turn, would affect brain anatomy as reflected by brain imaging.

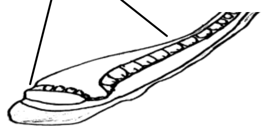
Ashish Ranpura reports that the hippocampus plays an important role in spatial memory (Ranpura, n.d., p. 3). Gender differences in hippocampus size may partly explain how men and women navigate differently. Men are far more likely to navigate using spatial geometry, i.e., "dead reckoning." Women are more likely to utilize landmarks (Cahill, 2005, p. 44). In one experiment, a psychologist assigned two different student groups to locate a point on campus. The directions for one group emphasized landmarks, i.e., "Go straight down this road until you get to the house with the green door. Then turn right…" (Sax, 2005, p. 98). The directions for the second group emphasized spatial geometry, i.e., "Go north one block, then turn east and walk two blocks…" (Sax, 2005, p. 98). Results were different for men and women. Women did much better using the landmark method and men did much better using the spatial geometry method (Sax, 2005, p. 98).

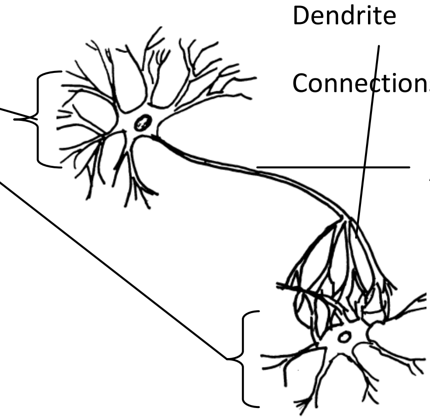
Similar differences in navigational abilities have also been demonstrated in rats. Female rats are more likely to navigate mazes using landmarks while male rats are more likely to use spatial methods. However, according to Cahill, "Investigators have yet to demonstrate,…,that male rats are less likely to ask for directions" (Cahill, 2005, p. 44).

Hippocampus and Stress

Differences between male and female reactions to stress can also be seen in the hippocampus. Research suggests that males may be better at handling acute stress and females may be better equipped to handle chronic stress. Larry Cahill reports that hippocampus damage from chronic stress has been shown to be greater in male rats and monkeys than in females, if in fact it produces any damage at all in females (Cahill, 2006, p. 3).

In one experiment by Juraska, et al, rats were placed in a nurturing environment with toys and other rats for socialization. After this exposure, dendrites in the dentate gyrus were examined (Juraska, 1985, p. 73). The dentate gyrus is one of three main areas of the hippocampus: others include the hippocampus proper and the subiculum. The dentate gyrus has a serrated surface that looks like teeth (Hendelman, 1994, p. 188). Dentate means "notched; toothed; cogged" (Stedmans's Medical Dictionary, 2006). Dendritic connections are associated with memory formations. Dendrites look like the branches of a tree coming out of a neuron. These branches receive signals from other neurons. Exposure to a nurturing environment increased dendritic connections in female rats to a greater extent than it did in male rats. Female rats in the control group (not exposed to a nurturing environment) did not display an increase in dendritic connections (Juraska, 1985, p. 73). This increased connectivity may help explain the observation that females seem to respond better to chronic stress.





In another experiment, rats were given brief electric shocks to their tails in order to create an acute stress experience. The electric exposure benefited male rats, enhancing their ability to perform tasks while increasing the number of their dendrite connections. But the shock treatment had the opposite effect on female rats, in that both task abilities and number of dendrite connections decreased (Cahill, 2005, p. 44).

Recent data "add to an accumulating literature suggesting that there are significant gender differences in stress and emotion" (Jackson et al., 2006, p. 517). In 2005, Jackson, et al. performed an experiment on human subjects measuring skin conductance responses (SCR) to Pavlovian conditioning. Males and females exposed to psychological stressors i.e., males faces and a female scream, demonstrated gender differences in Pavlovian conditioning performances. Male subjects demonstrated significantly greater stress-induced conditioning enhancement than did female subjects (Jackson, 2005, pp. 516-522). In other words, stress exposure in males increased Pavlovian response through fear. But in women, stress exposure had no significant effect.

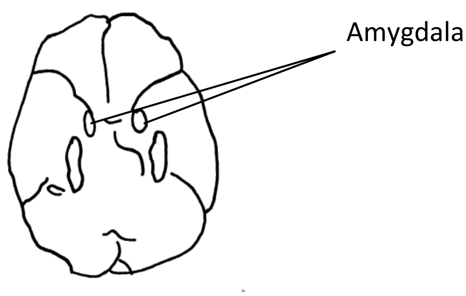
In a separate experiment involving rats, females demonstrated greater resilience to chronic stress. Experimenters stressed rats by restraining them in a cage for six hours. The rats were then given a neurotoxin which is known to kill hippocampus cells. Male hippocampus neurons were killed off at a greater rate than were female hippocampus neurons. Sex hormones are thought to play a role in hippocampus neuronal resiliency (Cahill, 2005. pp.44-45).

Gender differences in reactions to stress have important educational implications. There is now enough evidence that supports the idea that males respond better to acute stress while females respond better to chronic stress. Knowing this, mathematical educators could benefit from understanding if and how gender differences in reactions to stress affect student mathematics performance. For example, different reactions to stress may affect exam scores on timed versus un-timed tests, and multiple choice tests versus no multiple choice tests.

Teaching styles may also need to be adjusted to optimize learning of both sexes. Female students may do better studying together and/or completing group assignments, than do male students. In *Why Gender Matters,* Leonard Sax writes that sometimes males perform better academically when aggressive teaching styles including confrontation are utilized. In fact, it can energize young males who do not see it as threatening but as motivational. Females, on the other hand, would likely react poorly to such aggressive teaching styles. “Teachers report more success with girls when they use a supportive, non-confrontational approach” (Sax, 2005, p. 89). An example of a confrontational teaching style in a community college, might be aggressively calling on students by name in class to answer a mathematical question. In many students this may encourage better preparation for classes. But for other students, this may have the opposite affect. No matter how prepared they are, when aggressively called on to answer a question, their minds may “freeze”.

<u>Amygdala and Stress</u>

Sexual dimorphism in the amygdala may also contribute to differences in how males and females react to stress (Cahill, 2006, p. 4). Like the hippocampus, the amygdala is a phylogenetically primitive area of the brain (Sax, 2005, p. 29). It is associated with instinctual behaviors or “the wild beast within” (Brizendine, 2006, p. xiii). It plays a quintessential role in remembering emotional experiences, getting “the heart pumping and the adrenaline flowing” (Cahill, 2005, p.42) The amygdala is larger in males than in females (Hines, p. 198, 2004) suggesting gender differences may exist in ways emotions are processed.



Human Brain, ventral view

The cerebral cortex is considered the most highly evolved area of the human brain and is associated with cognitive abilities as well as with speech. (Sax, 2005, p. 29). In adolescent girls and in women, the cerebral cortex tends to process negative emotions more than it does than in males. Male cognitive processing of negative emotions appears to be confined to the amygdala. This may explain the observation that it is easier for females to express their feelings of sadness, anger, etc. than it is for males (Sax, 2005, p. 29-30).

Degu pups are rodents from South America that are similar to North American prairie dogs. In one experiment by Ziabreva, et.al, researchers separated a litter of degu pups from its mother (Cahill, 2005, p. 44). There were three experimental groups of degu pups:

Group One: $N_{female} = 6$; $N_{male} = 5$. These pups were systemically separated from family by placing them in an unfamiliar environment, several times a day, for ten days. After the tenth day, the pups remained undisturbed until day 14.

Group Two: N $_{female}$ = 6; N $_{male}$ = 6. In addition to separating these pups from family by placing them in an unfamiliar environment several times a day, this group was also subjected to the maternal calls of a lactating female degu pup, via loudspeakers. This occurred for ten days, after which the pups were left undisturbed with their families until day fourteen.

Group Three: N $_{female}$ = 8; N $_{male}$ = 5. This was the control group. They remained with their family until day 14 (Ziabreva, 2003, p. 5330).

On day 14, the animals were killed and their brains prepared to be examined and analyzed. In groups one and three, there were not any significant changes in the number of serotonin receptor sites in either gender. In group two, (the group subjected to the maternal vocalization), the number of serotonin receptor sites in male pups significantly increased when compared to the control group. Conversely, maternal calls reduced the number of serotonin receptor sites in female pups, when compared to the control group (Ziabreva, et. al., 2003, pp. 5331 - 5334).

"Serotonin is a neurotransmitter (signal-carrying) molecule that is key for mediating emotional behavior" (Cahill, 2005, p.44). The sample size of this study is relatively small, but its results are striking. Since serotonin availability is linked to how well humans handle emotional or physical strain, this finding supports the idea that males and females react differently to stress. In fact, some anti-depressant/anti-anxiety medications are serotonin reuptake inhibitors that increase the amount of serotonin available at synapses. (Celexa, 2007).

Not only can separation-induced changes in the amygdala affect emotional behavior, stress may also alter cognitive functions such as "spatial learning" (Ziabreva, et., al., 2003, p. 5334). The limbic system of the brain is those "parts of the brain associated with emotional behavior" (Hendelman, 1994, p.213). Its areas include the amygdala and the hippocampus (Hendelman, 1994, pp. 175 – 182). Curiously, the limbic areas of the degu pup brain in which receptor densities can be altered by maternal calls are the same areas in which a human mother's brain responds to her baby's cries (Ziabreva, et. al., 2003, p. 5334). Such responses may have long term consequences altering "cognitive and socio-emotional capabilities at later stages in life" (Ziabreva, et. al., 2003, p. 5329).

Gender differences in the amygdala's ability to utilize serotonin in stressful situations suggest that male and female college students may handle stress differently. It could be helpful for mathematics instructors to remember this when trying to optimize the mathematical learning of both genders. Community college mathematics instructors may try a variety of techniques to lessen the effects of stress. This could include the simple act of being available for help when asked. Another example may be encouraging students to develop their own study groups. This would give students who know the material well a chance to reinforce their skills by helping others. Those students with a poor grasp of the material will have an opportunity to receive one-on-one help from peers. It is possible this kind of activity would help students to feel part of a community thereby increasing confidence in doing mathematics. Such group endeavors could further be encouraged by instructors giving a small number of "group quizzes". Such quizzes might not weight heavily when final grade averages are computed but may greatly encourage students. Finally, allowing a certain amount of food and drink such as coffee, orange juice and donuts during a test may also help to alleviate the effects of stress by creating a more relaxed atmosphere.

Amygdala and Emotional Memory

In another amygdala study, Larry Cahill and a team of researchers recorded brain activity using PET scans while female and male subjects watched a violent and disturbing film clip. A few weeks later, subjects' memories were tested to see what they remembered. Researchers found two results, of which the first is somewhat expected, i.e., that the amount of recall is directly related to the amount of brain activity for each subject during the PET scan. The greater the brain activity, the more of the film clips the subject could remember. The second result is more surprising: in females only the *left* amygdala was active during the film. Conversely, PET scans recorded only *right* amygdala activity in males during film clip viewing (Cahill, p. 45, 2005). Three additional studies have confirmed these results (Cahill, p. 45, 2005).

Beta blockers are a class drugs best known for the treatment of heart related conditions such as hypertension, angina and irregular heartbeat. Beta blockers can also be prescribed for anxiety (Beta Blockers, p. 1, 2008). For example, musicians may be prescribed beta blockers as the drugs will lower heart rate, reduce stage fright and improve "technical-motor performance" (Neftel, p. 461, 1982). Propranolol is a type of beta blocker that also suppresses the brain's ability to process emotions (Stegeren, p. 305, 1998). It also influences the amygdala by making it more difficult for subjects to remember emotional experiences (Cahill, p. 44-45, 2005).

To further test the idea that male and female amygdala-related cognitive processes differ, Cahill administered the drug propranolol to a group of subjects. Immediately after administering propranolol, subjects viewed a film about a bad accident involving a boy and his mother. Subjects' memories were tested one week later. Results showed males were less likely to remember the main idea of the story; that a boy had been involved in a terrible car accident. On the other hand, females were less likely to remember the finer details of the film such as the fact the boy had been carrying a ball (Cahill, p. 44-45, 2005). When not exposed to chemicals that alter amygdala processing, males are more likely to remember the gist of an emotional experience while females are more likely to remember its details. These findings support the idea that left hemispheric areas of the brain are more connected with processing the particulars of an experience, while the right hemispheric areas of the brain are more involved in processing the main facts of an event.

Gender-specific hemispheric reactions to emotional experiences can be measured almost immediately. Electroencephalography is a medical technique used to measure brain activity such as perception, memory and language processing. Neural activity produces small fluctuations in voltage on the scalp which are then analyzed. Recordings of activity take place within milliseconds (ERP, p. 1, 1995). In Italy, Gasbarri, et. al, analyzed electrical neuronal activity on the scalp of subjects using electroencephalography. By graphing the electrical scalp activity, brain wave spikes were higher in the left hemispheres of women than of men and brain wave spikes were higher in the right hemispheres of men than of women (Gasbarri, et. al, 2006, pp.

177-184). Since responses measure brain activity occurring within milliseconds, cognitive processes occur long before subjects have had time to consciously interpret what they experienced (Cahill, 2005, p. 46).

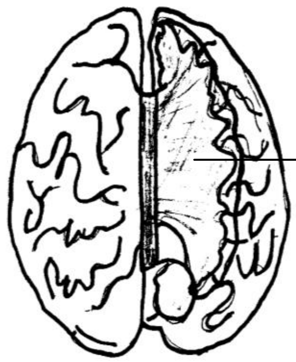
Other research has demonstrated additional amygdala specific functioning. While recording lateralized amygdala activity with MRI scans, Killgore, et al, measured brain activity of human subjects that were being shown happy faces. Males produced greater right amygdala activity, than did females (Killgore, 2001, p. 2543). Another research team, Kilpatrick, et al, recorded amygdala activity in human subjects who were resting. These subjects were not subjected to films, pictures, or any other kind of stimulus. Researchers found that *female left side amygdalas* demonstrated greater activity than male left side amygdalas. Conversely, *male right side amygdalas* demonstrated greater activity than in female right side amygdalas (Kilpatrick, 2006, p. 452).

Hemispheric gender differences in the amygdala do not suggest that one sex holds intelligence or emotional superiority over the other. Instead, it implies that the genders process the world around them differently. These cognitive processing differences are likely to be at least partly based on gender differences in brain structure.

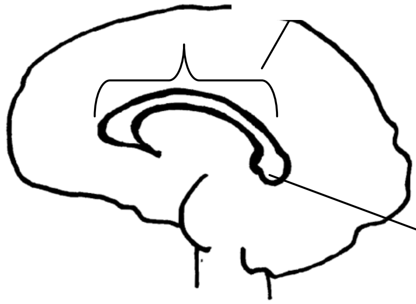
<u>The Corpus Callosum</u>

Between the two hemispheres of the brain there is a deep fissure, the floor of which is formed by the corpus callosum. The corpus callosum consists of white matter, which is basically composed of myelinated axons. Its function is to connect together the two hemispheres of the human brain allowing them to communicate with each other (Hendleman, 1987, p. 16). It is involved in movement, perception, language and spatial abilities. Sex differences in the corpus callosum include size and shape. It has been hypothesized that such differences provide a neuronal basis for gender differences in cognitive processes. For example, it is hypothesized that females' corpus callosums allows for better communication than males' between the hemispheres of the brain, which in turn results in better language skills (Hines, 2004, p. 191-192).

The common belief that females have better language skills than males probably stems from differences in children. On average, girls have a larger vocabulary, are better spellers, are better readers, and generally better at articulating (Kimura, p. 91, 1999). However, this may not hold true for adults. Adult females do not have a larger vocabulary (Kimura, p. 101, 1999) nor do they on average score higher on the IQ Wechsler Adult Intelligence Scale (WAIS) (Kimura, pp 94-95). Nonetheless, adult females reportedly appear to be better spellers, and have a small amount of higher verbal fluency (Kimura, p. 101, 1999). Further, adult females perform better than adult males on memory tasks involving the ability to recall unrelated and related word lists (Kimura, p. 101, 1999).



The size and shape of corpus callosums varies among individuals. Using MRI scans, Allen, et al, was able to detect significant sex differences in the shape of some areas of the corpus callosum in 122 age-matched adults. In the same study, MRI scans used to examine 24 age-matched children, showed no statistically significant differences between genders, in these same areas of the corpus callosum. In the adults, the area of the corpus callosum called the splenium was more bulbous shaped in females and more tubular-shaped in males (Allen, et.al, 1990, p. 933). The splenium is found at the posterior end of the corpus callosum. Its functions include the transmission of visual and other types of information, between left and right occipital lobes (Hines, 2004, p. 248).



Mid sagital view of human brain

Brain imaging has shown different patterns of brain activity in males versus females participating in various cognitive assignments (Halpern, 1997, p. 1097). The "theory that female brains are more bilaterally organized in their representation of cognitive functions" (Halpern, 1997, p. 1097) is supported by the fact that the splenium is more bulbous in females (Halpern, 1997, p. 1097). The theory is based on the assumption that gender differences in the corpus callosum lead to a greater ability for the female brain to communicate between the brain's two hemispheres. Supposedly, a greater hemispheric communication ability results "in a greater relative fluency of thought and speech" for females (Bland, 1998, p. 5). However, the number of axons in the corpus callosum has never been counted (Bland, 1998, p. 5). Greater bulbousness may not necessarily reflect more axons or better connectivity between axons.

It is speculated that gender differences in the corpus callosum could affect the way the genders approach problem solving. For example, if asked to solve certain non-verbal word problems involving certain spatial tasks, a person with better brain connectivity may attempt to solve the problem through word usage. On the other hand, skills requiring a high degree of focus on just one side of the brain in a specific area may be hindered by greater hemispheric connectivity (Kimura, 2000, p. 134).

Brain Size

Gender differences in overall brain size have been studied since at least the 19th century. Generally, the assumption has been that because male brains as a percent of body size are on average larger than female brains, males are more intelligent than females (Hines, 2004, 183-186). German physician Paul Julius Mobius wrote in a popular 19th century book that women are "physiologically weak-minded" (Sax, 2005, p. 31). He based his conclusion on human skull measurements showing that when height is accounted for, cranial capacity is always greater in males (Sax, 2005, p. 31).

Mobius's presumption was not an unusual viewpoint for his time period or even now. In fact, most early researchers assumed that larger cranial areas will result in superior intelligence. For example, Gustave Le Bon, who was one of the founding fathers of social psychology, wrote the following in 1879:

In the most intelligent races, as among the Parisians, there are a large number of women whose brains are closer in size to those of gorillas than to the most developed male brains. This inferiority is so obvious that no one can contest it for a moment; only its degree is worth discussion. All psychologists who have studied the intelligence of women, as well as poets and novelists, recognize today that they represent the most inferior forms of human evolution and that they are closer to children and savages than to an adult, civilized man. They excel in fickleness, inconstancy, absence of thought and logic, and incapacity to reason. Without doubt there exist some distinguished women, very superior to the average man, but they are as exceptional as the birth of any monstrosity, as, for example, of a gorilla with two heads; consequently, we may neglect them entirely (quoted in Hines, 2004, p. 186).

Such archaic views have likewise been used to explain supposed differences in intelligence amongst the races. For example, the Germans thought they had larger brains than the French and therefore were more intelligent (Hines, 2004, p. 186). Amazingly, such views still exist today. Richard Lynn, Professor Emeritus University of Ulster, has published recent writings (20th and 21st century) that insist that the larger the brain size, the greater the intelligence. He maintains that this explains differences in IQ scores amongst races and genders (Lynn, n.d., p. 1-2). Given twenty-first century brain imaging technology, this view seems very simplistic and warrants healthy skepticism.

Depending on what kinds of statistical adjustments are made for gender differences in body size, reported gender differences in brain size vary. Some methods calculate male brains to be larger, while other methods indicate no such variance exists (Hines, 2004, p. 187). Further, statistical gender differences in body height are greater than statistical gender differences in brain weight. "d" is a statistical measure of differences in standard deviation units (Hines, 2004, p. 235). Standard deviation "is a measure of variation of values about the mean" (Triola, 2004, p. 75). d is the mean of a group minus the mean of a second group, divided by the mean of the standard deviation:

$$d = \frac{\text{(mean group 1)} - \text{(mean group 2)}}{\text{mean standard deviation}}$$

d > 0.8 is a large difference, d = 0.5 is a moderate difference, and d = 0.2 a small difference (Hines, 2004, p. 235). Calculated gender differences in height have been calculated as d = 2.0, and calculated gender differences in brain weight have been calculated as d = 1.05 (Hines, 2004, p. 187). Thus, it appears that gender differences in body size are greater than they need to be to explain gender differences in brain size.

Calculated brain sizes have been reported, showing females' brains to be "8 to 10 percent smaller than the man's" (Sax, 2005, p. 31). Another source reports that male's brains are, on average, about 100-grams heavier than female's. In other words, given a male and a female of the same body size, the male's brain would be about 100 grams heavier (Kimura, 2000, p. 128). However, in some areas of the brain, neuronal density is greater in females than in males making the total number of neurons in both genders equal. Also, females have a greater amount of gray matter (Hines, 2004, p. 187) and it is the gray matter where neuronal cell bodies are found (Hendelman, 1994, p.1).

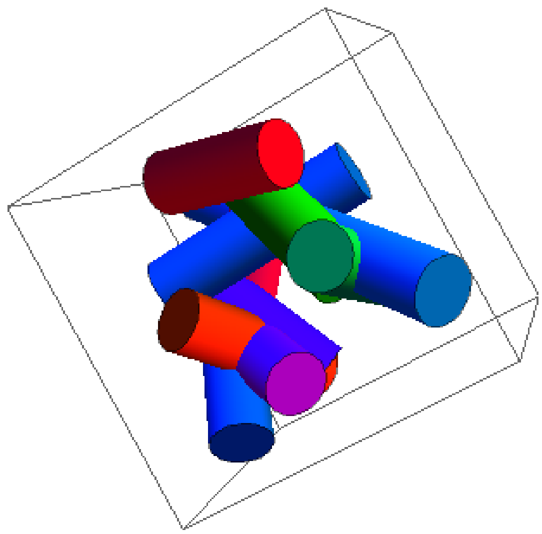
Reportedly, brain blood flow is higher "per gram of tissue" in female brain tissues than in male brain tissues (Sax, 2005, p. 31). A neuronal unit is "a motor or sensory neuron, including its axon and axonal branches" (Kuypers, 1995, p.1). In a study by Rabinowicz, et al., autopsies were performed in 6 males and 5 females aged 12 to 24 years old. In the cerebral cortex, male brains showed "more numerous, smaller neuronal units" (Rabinowicz, 2002, p. 46) and female brains showed fewer but larger neuronal units (Rabinowicz, 2002, p. 46). Female left hemispheres showed larger "neuronal soma size" than male left hemispheres (Rabinowicz, 2002, p. 46). These gender differences may in part explain reported gender differences in language and spatial abilities.

Females' reported larger brain cells are capable of receiving more input (Cahill, 2005, p. 31). However, this does not necessarily mean that the entire female brain receives more input. Finally, brain imaging scans showed women using the cerebral cortex and men using the amygdala and hippocampus, while each sex performed the same mental tasks. As mentioned earlier, the cerebral cortex is considered to be a more advanced area of the brain than is the amygdala or hippocampus (Sax, 2005, p. 31).

Summary

Clearly, gender differences in the structure of the human brain provide evidence that females and males may experience the world differently. It is as though the two sexes have two distinct sets of reality. Spatial abilities, stress, emotional memories and cognitive functions are processed differently and correlate with gender differences in brain structures. The idea that brain size alone accounts for differences in intelligence can no longer be taken seriously. From a physiological point of view, it is not so much a matter of superior versus inferior intelligence as it is a matter of *differences in cognitive processing* that are reflected in intelligence. It is an example of different routes leading to the same destinations.

In educational settings, such differences are real and can make a big impact in how to optimize learning for each gender. Students may experience the teaching styles and testing practices of instructors very differently, depending on the student's gender. Since stress is a big issue for many students, it is also important for instructors to be aware of gender differences in reactions to stress. As most community colleges offer coeducational classes, it would be best for mathematics instructors to be knowledgeable about gender differences in their student's cognitive processing and stress experiences. In this way instructors can work *with* their students' minds. Likewise, instructors would be better equipped to enable students to optimize their educational experience.



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