

The Arlin M. Adams Center  
FOR LAW AND SOCIETY  
Susquehanna University

ARLIN M. ADAMS CENTER FOR LAW AND SOCIETY

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1:30 P.M.

STRESS, AGING AND MEMORY

PARTICIPANTS:  
Kathleen Bailey, Professor  
Susquehanna University  
Robert Drugan, '79, Professor  
University of New Hampshire  
Chris Gipe, '66

Before: Sarah C. Thomas, RMR  
Reporter-Notary Public

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MS. BAILEY: I would like to say good afternoon to everyone who has been able to get to this event. I would like to extend a special welcome to all of the Susquehanna University alumni, the faculty and students, friends, family, community members as we continue this incredible celebration at Susquehanna University's sesquicentennial.

My name is Kathleen Bailey. I am an assistant professor in the psychology department here at Susquehanna. I will serve as our moderator today.

This event is sponsored by the Arlin Adams Center for Law and Society here at Susquehanna. One of the goals of the Adams Center is to provide a forum for examining issues affecting human rights and social responsibility through the lens of science and technology.

We are very pleased today to welcome back to Susquehanna University two distinguished Susquehanna alumni, Christopher Gipe and Professor Robert Drugan. Christopher Gipe is a licensed clinical psychologist who is in private practice in Harrisburg, Pennsylvania and graduated in the class of '66. Professor Robert Drugan, class of '79, is from Durham, New Hampshire and he graduated in the class of '79. They are here today to offer their expertise and insight into a topic that has received a considerable amount of attention in the popular press lately. That is the aspect of successful aging.

It's not surprising that there is focus on maintaining health, successful aging, cognitive and physical abilities well into the twilight years considering the record number of Americans, part of the baby boom generation, nearing retirement age. Although as a group they are often described as more physically active and healthier than past generations, this group is also facing additional stressors brought about by our recent upheaval in our financial markets. In addition, as the population of Americans over 60 increases, we are seeing a parallel increase in the number of individuals coping with a variety of diagnoses and disorders that directly affect memory function.

It seems particularly relevant this year with our University theme topic of memory and the fact that homecoming weekend falls just prior to midterm grade reports for current students and baby boomers are experiencing some distress over recent financial downturns that our discussion this afternoon will examine stress, aging, and memory from both a neurological and a clinical perspective.

So without further ado, it is my pleasure to introduce our guest speakers so that we might begin this interactive presentation and discussion. Our first speaker this afternoon is Professor Robert Drugan, who joins us from the psychology department at the University of New Hampshire. As I mentioned, Dr. Drugan graduated magna cum laude in 1979, from Susquehanna university with a B.A. in psychology. He obtained his Master's degree and Ph.D. in experimental psychology from the University of Colorado at Boulder. Following his graduate studies he received a National Research Service Award for postdoctoral fellowship at the National Institute of Mental Health. Upon completion of his postdoctoral work, he was an assistant professor in the department of psychology at Brown University from 1988 until 1995, and in 1995, he moved to the department of psychology at the University of New Hampshire.

Over the past 30 years Dr. Drugan's research has focused on the neurobiology of stress and coping and its impact on learning, memory, drug reactivity, and the immune system. Dr. Drugan's presentation will focus on the neurobiology of stress and its effect on memory function.

Please, we want you to feel free during this forum to address any questions you might have to the speakers as they are presenting. We will try to keep things sort of on target, but we want this to be a very interactive opportunity for you. So do feel free to address your questions to the speakers. There are some aisle mics, but I think probably if you speak up and you are having a hard time getting through the isle and by people, we will probably be able to hear you.

I would also like to present our second speaker this afternoon, who is Christopher Gipe. Mr. Gipe received his Bachelor's degree from Susquehanna University in psychology in 1966, and his Master's degree in counseling education from Scranton University in 1972.

He is a licensed clinical psychologist, earning his license in 1977, and has been in private practice since 1981, with Guidance Associates of Pennsylvania. He also enjoyed as a 38-year career with State Civil Service in his capacity as a psychologist. Chris has also served as a consultant to the Alzheimer's Association for over 20 years. In his private practice he specializes in stress and anger management, as well as physical, emotional wellness. Mr. Gipe would be offering specific strategies for regaining, strengthening, and preserving memory, as well as preventing memory loss.

Please join me this afternoon in a warm welcome for Dr. Robert Drugan and clinical psychologist Christopher Gipe.

DR. DRUGAN: I am going to try and present my talk and carry this microphone around with me because I don't like standing in front of a podium when I lecture. And so it's just a habit of mine. I hope you will bear with me on that.

First, before I start, I want to thank several people and the Arlin Adams Center for Law and Society for inviting me to come back. It's a great privilege and a pleasure to come back to Susquehanna. Dr. Misanin had invited me back 20 years ago to give a talk, so it's been 20 years since I've been here and it's a wonderful feeling coming back to this.

I also want to thank Allan Sobel, the director of the Arlin Adams Center, and Michelle Arcuri, the administrative assistant, for her help in arranging this, and last, but not least, Dr. Kathleen Bailey, who has been so helpful in all this.

The start of my talk -- I always like to give an agenda as to what I am going to talk about so you know what to expect. I am going to talk about definitions. All of us know what the words stress, aging, and memory mean, but I want to define them to you so we have an appreciation for what we mean when we are talking.

I will then talk about how we get memories, how they encode into our brain and how we retrieve them, and then talk about some different types of memory. Then where in the brain do memories reside? We will talk about that. The neural correlates of stress and memory, how stressful events affect our ability to remember things in either a positive way or a negative way.

And then how does aging affect memory? I will talk to you about some literature that's coming out now, very exciting literature that helps us to understand how these changes occur. Then, finally, my discussion will be a more positive aspect in how can we help slow down or even reverse some of these age-related deficits of memory, and the Chris Gipe will take that along into a more clinical aspect.

The first thing I want to start off with talking about is emotional memories. This is something, given that I am back in town

after being away for 20 years, I want to show you some things that came to mind as I drove into Selinsgrove.

This is circa 1978 and this is Bruce Wagenseller, who was my cross country coach at Susquehanna, and this is me. So I look a lot younger and I had a lot more hair back then, but this is a very fond memory for me. I went through the Lanthorne and picked this out. Each one of these individuals, I still remember their names and I still remember what they were like. So it's a very rich memory for me. I spent many hours running the streets of Selinsgrove, down to the Isle of Que, around all the horse farms, so I still remember a lot about the area.

This is me in 1978, running the Boston Marathon, representing Susquehanna, and I raise money -- every time I run a marathon I raise money for multiple sclerosis. So, again, this is a very strong memory for me because right here, where I'm passing Wellesley College, I had a stress fracture in my left toe. So I thought I had a rock in my shoe when I actually had a stress fracture, so I was in some pain and pain produces some memories, as well.

My last memory, this is the Senior Scholar Day program and I have highlighted -- you can't see the bottom of this, but it tells you what I was talking about. The more important thing is, I was sponsored by my advisor, Dr. Jim Misanin, who is in the audience with us here today. This is my last memory. I presented this in 1979, on the other side of the campus center. This was my first public presentation, so there is a lot of emotional memories there.

And this allows me to thank Dr. Misanin in a public venue, which I have wanted to do many years, for launching my scientific career. And so thank you, Dr. Misanin, too, for helping me launch my scientific career.

So let's talk about the topic at hand; stress, aging, and memory. What do these mean?

Stress is any situation or experience that takes you away from your homeostasis, or your normal state of being. If some of you told me I just won the lottery, I would be experiencing stress. It's a good kind of stress. What am I going to do with all that money? But that's still stress. That's what is called eustress.

The other side is someone who came up to me and would say, Rob, someone in your family has been in a car accident. I would experience distress, which creates a very negative aspect. Eustress and distress causes memories to be indelibly marked in our brains.

Aging is, in my mind, just the accumulation of years. As we get older, our brains change. Our memories change. The memory is the ability to store and retrieve information.

So these are what I mean by these terms. Now, Chris may have different terms that he will talk about, but for me, this is what I like to refer to things.

How does this process occur? We have many different sensory systems in our body that bring information into our brain that is now encoded in what is called short-term memory. If those memories are there for a long enough time they get consolidated into long-term memory.

Now, our goal, as I told you when I drove into town, trying to figure out how I get to the University from 11 and 15, I am trying to retrieve memories from long-term storage into short-term storage, where I can remember it and hopefully not lose it; okay? So these are the basic processes that we are talking about.

What I want to do today is to focus on just this left-hand side, declarative memories, which are broken out into two forms. Declarative memories are things that you can tell others. They are either episodic, remembering events in your life, or they are semantic, knowing certain facts; okay?

Now we ask the question, where in the brain do memories reside? How can we understand that? Well, nature's experiments give us great insight. What I mean by "nature's experiments" are case studies in the field of neurology and psychology and medicine where people have lost certain parts of their brain and we are able to understand by the memories they've lost where these memories may reside.

There was a very famous patient called HM back in the 1950's, who had a very severe seizure disorder that wasn't responding to any kind of medicine, and the doctors had to go in and surgically remove part of his medial temporal lobe. When I say, "medial," I mean in towards the center of your brain. Temporal means by your temples.

This is MRI looking from the bottom up. You can see the area of the brain that was lesioned to try and help reverse his seizure disorder.

It was very helpful in stopping his seizures, but he lost some memories. He had memory loss of certain types of things that I will show you very shortly.

The interesting thing is there is another patient, which is a similar situation, where they lost this medial temporal area, but they lost it due to viral encephalitis. This is what happens when a virus gets into the brain. It can have neurotoxic, or nerve damaging, effects in the brain.

The interesting thing is this patient had the same type of memory loss as did HM. And so these areas of the brain, the hippocampus and the amygdala, which you will hear a lot about today, appear to be very important in memory.

So several types of memory -- HM had these losses -- retrograde is looking back. So if an event happens and you tried to remember what happened before that event and you can't, that's retrograde amnesia. That's what HM suffered. He had trouble remembering things that happened ten years before.

Anterograde, moving forward in future, HM had the inability to form new memories. He could remember things for a very short period of time, but then he would lose those memories.

However, he could still remember to do things. He could still remember to play an instrument that he had played for a long time. He could still drive a car. So these were procedural memories, like riding a bicycle that we all know how to do that he was still able to do.

So it's a really unique situation. It separates out one type of memory versus another.

A new study that just came out in Science magazine -- and Kathy helped me try and blow some of these pictures up for you -- is, again, in 2008, September 5<sup>th</sup> edition of Science, they were working with seizure patients and had electrodes placed in the brain of seizures patients who were unresponsive to treatment, and they were trying to find where the seizures started. Lo and behold, they had those electrodes placed in the hippocampus.

What these individuals did in this experiment is they actually looked at the activity of brain cells in these patients and were able to show that the same cells that were active during viewing of audiovisual sequences -- I'll show you some of those clips -- were

again active when they asked them to recall what they had just seen. It's a remarkable study and it's the first that suggests that these cells are active during the recall of an event that's happened.

So I apologize for the cloudiness of this. What the individuals were viewing was film clips of individuals. Here you have a person, a woman in a skirt. Here you have an episode of the Simpsons. So they watched the Simpsons for 45 seconds. Then they watched a view of some individual speaking, and then a building, and then the Simpsons again.

Look at this. One cell that they are recording from shows you increased activity only during the Simpsons. So the Simpsons -- they recorded from a number of different cells in the hippocampus. This one cell was the Simpson cell; okay? So every time they saw that clip of the Simpsons, the cell would get active.

Now they asked the individuals after that to recall what they have had viewed. Tell me what you saw on those video clips. And now the individuals are just sitting there freely recalling. And what you see here -- you can't see the words down here, but they are saying, This is a Hollywood picture. This is a picture of someone dancing. And right here they say, Ah, the Simpsons. I saw the Simpsons.

The Simpsons is not in front of them. They are recalling that Simpsons episode and the same cell is firing.

So what they have -- what they gathered from this study is that there are cells in the brain that are sensitive to something that we are seeing and those same cells get active when we recall what they are. They are in the hippocampus.

It's a very -- and on medial temporal lobe. A very exciting study. Just came out a few weeks ago.

That's not to say the hippocampus is the only place. There are other areas of the brain that are activated. For example, when you are looking at individuals being read stories of their past, which is autobiographical, or the stories of someone else's life, your brain lights up differently.

So looking at a PET scan -- PET scans measure the uptake of radioactively tagged glucose, or basically sugar, which is brain food. Our brain runs on sugar, a carbohydrate. When a cell gets active, the brain cells draws glucose into that area so they can remain active and maintain their activity.

In this study what they looked at was individuals being read their own life story. So a family member would give them a clip of their life.

So, for example, Rob Drugan, do you remember running down the Isle of Que? I would say, Yes, I remember running the Isle of Que. If that was the case, this area of the brain would light up. Again, we see the medial temporal lobe, but now the outer areas, called the cortex, light up.

Now, if you tell me about, for example, Chris Gipe's memory of Susquehanna, I might have some areas light up, but it's nowhere near as much as when you tell your own story or you are being told your own story. So this really tells you that the brain is lighting up in these areas when people hear their own story versus others.

So if you were to ask me, how do you summarize this? What are the brain areas involved in long-term memory, I have to say it depends on the type of memory.

So, again, going to long-term memory, we have declarative memory. We have episodic, which is something that's stored in cortex and in the temporal lobes. This is something that's happened in the past, an episode of your life.

Versus facts. What is the capital of France? That might be stored in a slightly different place in the cortex, but also perhaps in the temporal lobe.

Now we come to the question of how does stress influence memory? All of us know these situations. If you have had a near miss car accident or you've had a very stressful life event, you can remember that event very well. So now the question is, what are the neural correlates of emotional memory, as it's called; stress, emotional memory?

Well, this is the part of the brain that we just mentioned. The hippocampus is right here. So, again, episodic memory is found in the hippocampus. That, again, is the center that's involved in emotional memory, as is the amygdala, this structure right next to it.

James McGaugh and his colleagues out at the University of California-Irvine tested this hypothesis by having subjects read a story and then injecting them with adrenaline. When we are stressed out there is adrenaline released. And he found that those individuals remembered the story better when they got adrenaline injections right afterwards. He claims that it's important for the amygdala and the hippocampus. There, again, are neural brain structures involved in emotional memory.

This is his slide, which I won't bore you with a lot of the details. Here is the blood-brain barrier. Adrenaline is released into our blood stream when we are stressed. It goes to the brain and affects receptors in our amygdala, so it's well characterized how a blood-borne substance like adrenaline can get into the brain and influence the brain.

There is also another hormone called cortisol that is involved in stress and memory. This is a pictorial diagram of the brain signaling stress. So we all experience stress and one of the most powerful stressors for humans is if I were to come into the audience right now and say to one of you, Could you come up on stage here and tell people how you are doing?

Public speaking is an incredible stressor and they use this in a lot of studies. It produces very much high levels cortisol release and cortisol release is a system that's regulated by the brain, causing the adrenal gland to squirt out cortisol so it allows us to fight or flee. It's a very old system that allowed us to run away from predators.

Well, we don't have predators anymore. Well, we do, perhaps, if you think of a snake or something like that that you really don't want to be around. That's a scary animal. That releases cortisol. But life events that aren't life threatening can also cause us to release cortisol and cortisol affects our memory.

So a number of investigators -- again, McGaugh and colleagues -- have done studies with cortisol. They looked at the stress hormone released by the adrenal gland. It's preparing us to fight or flee, but we can be sitting, taking an exam, for the students in the audience, or the other folks in the audience, you can be preparing yourself for a job talk or for a meeting with some important people. This hormone is released when we are under times of stress. It affects our memory.

So two of McGaugh's students actually had healthy men and women receive what is called cold pressor stress. They would have a bucket of cold water that they would put their arm in. Very unpleasant, but it causes an increase in cortisol. And they demonstrated that when they read a story and then they put their arm in cold versus warm water, a week later they asked them to remember what they read. If you had your arm placed in cold water, you recalled more items. Men have a much

greater effect than do women, but compared to warm water your memory is enhanced.

So you read the story, stick your hand in ice water. You get stress. You remember better a week later than if you weren't stressed like that.

So stress can change our memory, but it depends on when the stress occurs. This happened right after we read the story; right? What happens -- before I get there, they showed an inverted U. This is -- on the X axis here is the amount of cortisol released. So if you have a low amount of cortisol, if you are looking at how many items they recall, not so good. If you are in the middle, you remember more. If you have too much, you don't remember as much.

So there is this inverted U function. Very interesting. So this is what happens if you are stressed right after an event that you want to remember. What happens when you are trying to recall the event? I just told you about the conclusions.

What happens when it's experienced during recall? A very different thing happens. In this study -- again, very recent study -- they found that the memory was actually impaired when individuals were stressed right before they were asked to recall something. So they were learning ten neutral words, ten negative words, and ten positive words in a laboratory setting. Twenty-four hours later they are exposed to a stress or not-- and I'll tell you about this stress situation -- and then they are asked to recall.

This is what is called the Trier Social Stress Test. It was developed by Dirk Hellhammer and his colleagues in the University of Trier in West Germany, and it's probably for humans one of the most effective stressors.

Imagine yourself in this situation. You are asked to give a five-minute speech in front of an audience and you are not allowed to prepare much for this. So imagine if you were to argue with someone that you are good at being a tire sales person. You are being interviewed for this in front of an audience. That's very stressful.

Or -- and I can imagine myself being very stressed by this -- in front of all of you I've got to tell you what the number is in steps of 17 if I subtract from 2,043. I don't know if I could tell you the first one right now and I'd be very stressed. That's what they do. You produce a huge stress response.

The control condition is that they are asked to do this, but they do it in a quiet room with no one else around, so it's the mental challenge. Pretend you are giving a speech, but nobody is there, compared to the stress condition when there are people there you don't know. It's very stressful, but now you got a control.

Look what happens. The stress right before you are recalling the information interferes with memory of emotionally charged words, but not neutral words.

So if you were to ask me what does stress do to memory, I would say it depends. It depends on when it occurs.

So here is the summary of where we are so far. Acute stress, or stress that happens at a single point in time, does activate cortisol and given immediately after the event enhances memory. Stressful events just prior to recall actually interfere with memory.

Chronic stress, as Chris will talk about later on, actually is deleterious or interferes with memory. That story is very well established. So it's not a good idea for us to live chronically stressed lives because it interferes with memories.

Now let's talk about aging -- and see where I am in terms of my time. How does aging affect memory?

Well, human and animal studies provide changes and potential therapies that are very exciting. What I want to tell you about is the animal work that I'll show you shows you unequivocally that the aging and the stress changes, or whatever I'm talking about, cause the change in memory. It can be nothing else. So that's why the animal observations are so critical.

In human studies there is a lot of things that you can't control -- genetics, prior experiences -- but in the animals you know everything, so you just manipulate one thing so you can say that caused this.

If you look at the types of learning that are affected during aging, they see declarative memories being lost in those that require organizational effects. And Kathy asked me to give an example of that.

Memories that require organization are things that you have to sit down and think about what came before what, so you have to organize or categorize the memory. That's the type of memory that shows deficits typically with aging, although other memories tend to be rather well established and stay the same.

Here are, again, PET scans that are looking at encoding, and the yellow and red scores represent levels of high activation, medium and high activation in young individuals that are encoding compared to older individuals, so you can see there is a lot less activation in older individuals compared to the young. The same is true when you look at recognition both young compared to old, so the activity levels in the brain are changing.

So now is the question of, how can we enhance our memories? The bottom line is, enrich our environments and exercise, two very easily accessible capabilities. And the animal studies that use this use what I term the rat Disneyland situation, where they have a lot of balls and tunnels to run in and they have running wheels so they can exercise.

This is something I have on my office door at work at the University of New Hampshire. I am an avid runner, so I say there is a lot of benefit from running. Environment -- environmental enrichment changes the actual structure of neurons in our brain. Neurons are the single cells that make up our brain. We have between 100 and 150 billion neurons in our brain.

If you enrich an environment, you change the architecture, what is called the dendrites here, the parts of the neuron that are getting information from other neurons. The ears of the neuron, if you will. Environment enrichment enhances those dendrites.

So does exercise. So if you are looking at the dendritic tree, if we go back here and we look at how many branches there are in these trees of single cells, which you can do in animals, and you have animals that are running, that are exercising in the black versus sedentary animals, in every instance in several areas of the hippocampus you see an increase in those dendritic spines. So exercise is causing a proliferation of these branches in the nerve cells.

It's also producing new cells or what is called neurogenesis. Even in adulthood if an animal exercises, you will see an increase in the number. These numbers really -- or this graft really drives it home. Each one of these black dots represents a cell, a new cell. Here are the control animals. You don't have to use statistics. You can see it with your own eye. Here is an animal that's been running. Here is an animal that has an enriched environment. Look at how many more cells there are compared to an animal who had neither in the hippocampus.

Changing the brain.

So to summarize, the enriched environment and exercise both increase the dendritic branching I told you about and the number of neurons and it's in this area of the brain that we have seen in human studies that show this important involvement in memory. Those were adult animals.

What do we do about aging? Can you find studies in the literature that show aging is affected by these two properties, as well?

And the good news is yes, there is. There is evidence. In aging individuals you see three changes; the change in the volume of certain structures of the brain, the activity levels that I've already told you about, and the development of neuropathology.

Some of you may have heard about beta amyloid plaques and neurofibrillary tangles in Alzheimer's disease. These are part of the pathological changes in the brain that are associated with Alzheimer's.

Interestingly enough, this hippocampus structure that we have been talking about all along tends to shrink when we age. It's the only brain structure that shows a correlation with loss of memory, the shrinking of the hippocampus.

The activity of the brain in Alzheimer's disease, again, scans that look at metabolic function in the brain show the Alzheimer's brain. Again, in this temporal area is much less than in an individual who does not have Alzheimer's disease. These are age-matched individuals.

Finally, the neuropathologic changes, these black areas, are beta amyloid plaques that become imbedded in the tissue and displace neurons, and these neurofibrillary tangles are also non-neuronal tissue that develops in aging.

Well, here is the good news. Even in an aging animal you can see environmental enrichment affecting learning. And I will show you the results of this test. And exercise does the same thing.

So that it's not a fait accompli. We are not getting old and we can't help ourselves. We can help ourselves. If you expose yourself to an enriched environment and exercise, you can stave off these changes. These animal studies demonstrate that unequivocally.

And work by Fricks, et al. shows that in a Morris water maze task that measure hippocampus function in animals that these exposures to environmental enrichment can improve memory.

Now, here is another enriched environment for you. I want to get a couple of slides. They have colored tubes to crawl through. They have a nice, big running wheel. That's the enriched environment.

Here is the Morris water maze task. The animal is placed in this pool at various locations and there is a platform just under the water, and the animal used cues outside of the pool to find that location of the platform.

It's very similar to you going to a new city, parking your car, and now trying to find your way back to your car. It's called navigational memory. Where in the world did I park? That's why we all put those little balls on top of our antennas; right? Of course, nowadays you can push the alarm button on the car and have it go off. But if we didn't have those we would have to rely on navigational memory.

Now, you can ask, how well does that animal remember where that platform is? Well, look at this. These animals were given an

enrichment environment when they were aged and it still helped. You are looking at how close are they to that platform.

This is the animals that are middle aged. Middle aged rats that were given no treatment. They are worse off. They are swimming farther away from where the platform was compared to this adult control.

So this is a young adult. There is a middle aged animal. This is the animal that was given an enriched environment. It's back down to when it was young, a young adult.

So it remembers where that platform was better just by being in an enriched environment when it was middle aged. So there is hope.

This is males. For the women in the audience, the same holds true. If we are exposing ourselves to enriched environments, we can reverse this memory loss. Really exciting.

So this suggests that mice that had already experienced degeneration and memory loss, when you put them in an enriched environment they regain that capacity. So that it's not as if you have to exercise when you are young to help yourself when you are old. You can do it when you are older and it still has that benefit.

As someone who just passed the 50-year mark a couple of years ago, I'm delighted to hear about this data. Even though I have a lot of the tip-of-the-tongue problems, people ask me things, I say, "What is that? It's coming." I run every day, so I feel like I'm helping my brain. I'm helping remember things better than if I didn't.

You don't have to be a runner. You can go out and take a vigorous walk. Exercise and an enriched environment are very important.

How else can we -- I sort of beat myself to the punch. How else can we, as Kathy said, age optimally? Mind and body we can exercise. It's been well known that exercise is good for your heart. It's good for lowering bad cholesterol and increasing good cholesterol. Now there is evidence that it actually helps your brain.

I showed you the animal studies where the new brain cells are forming in the area of the hippocampus that's involved in learning and memory. These studies are even more exciting because they are using aged animals and you are seeing reversal of these effects in aged animals.

So what they used is a voluntary exercise situation. They have animals with running wheels in their cage and that animal can choose to run when it wants to.

When I was at Brown I had this same setup and I had animals running three miles a night in a running wheel. Little rats running three miles. That's probably equal to a human running a marathon every night. These animals are this big running three miles a night, but they love to do it. They do it by themselves without anybody telling them to do it, so it's called voluntary exercise.

And what they use, they exploited our understanding of molecular biology. These animals had a hyper expression of a gene that codes for beta amyloid, the substance that makes up those plaques in Alzheimer's. So these animals were hyper expressing beta amyloid plaques.

And you ask the question, does this animal who has this propensity to show you early Alzheimer's disease, can exercise help? So what they looked at is voluntary exercise for one or six months and compare it to a sedentary control. I call these the couch potato rats; the ones that don't have a wheel, but just sit in their cage and they eat. That's all they do.

We got an animal that has a hyper expression of these beta amyloid plaques, which also influences neurofibrillary tangles that produces this dementia.

So we are exploiting an animal model because that now has a fast forward in the aging process and we are asking can exercise help.

I wouldn't be leading you down this pathway if it didn't work. It works and it's remarkable. You can see it on a photomicrograph when each one of these stars represents a beta amyloid plaque. You and I can just sit here and count them, one, two, three, four, five, six, seven, eight, nine, ten, whatever. There is a lot there.

Look at the exercise animal. One, two, three really. There is fewer plaques in that exercising animal.

And the graph shows you -- these are the normalized reactivity to beta amyloid plaques -- exercise reduces in several areas of the brain; cortex, hippocampus, other areas of the brain. It all reduces this beta amyloid plaque.

They also perform better in that Morris water maze. Here is the sedentary animals. How quickly do they find that platform? Not very well compared to the exercised animals. They are doing much better. Not only is their brain changing, but their memory and learning is showing you enhancement.

And this is where I'm wrapping up. How do you put all this information to knowledge? This is my handout to all of you. This is a way to put all this into knowledge so that we can do something to help ourselves. We know that it will. We know that exercise can help us.

You have to aspire, make a goal, and make it realistic. I am going to get up and I am going to walk each morning for 15 minutes. You don't have to run a marathon right away. You can just get up and walk.

Talk to the doctors, obviously. Get yourself checked out before you engage in an exercise program. This is my disclaimer so no one comes after me with a lawsuit if they have a problem. See your doctor first. I told you, please. But that's reasonable.

Patience. Be patient. It takes time. Make it part of your life.

Reveille. I run every morning. Do it first thing in the morning. Then nothing gets in your way and you've got your workout done.

Strategy. This top one here is variety. Walk one day. Go for a swim in the pool the second day. Ride your bicycle the third day. Add variety.

Strategy. Increase your activity.

Options. Make sure you can do it.

Self-abrogation. If not for yourself, do it for your family.

And that's the end of my talk. Thank you for your patience.

MS. BAILEY: If anyone has any questions they would like to direct to Dr. Drugan before we move onto the presentation, I would like to give you that opportunity.

VOICE: If you went back to that slide of the difference in, I think, it was learning between children and the aged, completely different areas of the brain involved, but is that because they actually need to use that part differently or that the aged already have so much information that they are not learning something completely new and cold, as a child might? You know what I mean?

Old people are safer drivers because of their years of experience. Kids that have quick reflexes and good vision are horrible risks for insurance companies. So what --

DR. DRUGAN: The partial answer to your question is it was my fault for not better describing the study, so I apologize. They used young adults versus older adults. I didn't describe that to you appropriately.

So you are right. The amount of experience that we accumulate in our lives is obviously very important in terms of what we need to call up to solve something or to remember something.

VOICE: Or to learn because you correlate it with so much stuff that you already are familiar with.

DR. DRUGAN: It's called association cortex in the brain that's collecting information from various areas. You're right. There may be a lot more of the association areas that are activated. Yet there are specific hot spots in the brain that you see in a young adult that are lighting up much more in the young adult than in the older adult. You may see a switching from a hot spot to a more global response. As you are suggesting, calling in a lot of different information.

But the people that are doing these studies still say that there is something fundamentally different about the activity of the brain during encoding. They are using the subject words they had never heard before. They are taking them lab and teaching them to learn, for example, nonsense syllables to try and get at that problem that you are addressing.

So there is no prior experience, hopefully. There may be. There is no way you can protect against that. But they are trying to get away from that increased experience being part of the noise, if you will.

So your point is well taken, but they try to prevent that from happening.

VOICE: If you go into a nursing home and you see the environment, the enriched environment that these poor people endure, is there little wonder that they just go downhill? What would you do if you were running a nursing home and you wanted to get those people that were on kind of a downhill slide reversed around and back home? What would you do you differently in a nursing home?

DR. DRUGAN: I'm sure Chris is going to talk about this more. I can tell you from my reading of the literature, Judith Rodin, who was at Yale, who is now president at Penn, did something in nursing homes that turned people around, actually had more people more invigorated and they lived longer in nursing homes by giving them control over the situation.

They were responsible for picking speakers who would come in during cultural events. They were in charge of setting up activities. They weren't just told, You were doing this tomorrow. They became more integrated in that environment. By taking control, they were empowered and they are more intellectually vigorous. They lived longer, on average 18 months longer, than people who were not involved.

This was back in 1976. It's slow to occur across the country, but her findings are undeniable that that makes a difference.

I would also engage them in much more activities where they are participating and not just spectators. They are actively involved. I want to leave enough time for Chris, because I think Chris will talk about this.

MR. GIPE: One comment. Many nursing home facilities, long-term facilities across the country have a doctrine called the Eden Experiment, in which they brought plants and animals basically into a nursing home. They had like garden areas, animal-assisted therapy, cats, dogs. They had birds in the nursing home. That really triggered the interactive environment and made them healthier, as Robert said.

Also, intergenerational programs. I know down in Harrisburg, Messiah Village, where they pair the elderly with the children. They have a real affinity for each other and the children have what they call like adopted grandparents, foster grandparents, and the elderly have special children. They interact sometimes on a daily basis.

Now, those types of programs really simulate the elderly. Again, they are healthier. They are happier. They tend to live longer in an environment.

DR. DRUGAN: Chris, why don't you --

VOICE: I would like to talk to that gentleman afterwards. I am a retired nursing home activity director. He hasn't gotten the right nursing home.

DR. DRUGAN: Like I said, it's coming around.

VOICE: I am going to Penn State tomorrow to the State Activity Convention for four days. You will find a lot of things going on. Much, much improved.

VOICE: I have a question for you, sir. How you encode will affect how you will recall. Is there any method that can work better than any other so that you can recall all that information that you have buried somewhere in the brain so that later you can bring it back?

DR. DRUGAN: When I teach biological psychology and they have to remember all these facts, I give a strategy for them. I say, "You have to hang it on a hook." There has to be a hook to hang it on. It can't just be something that's not related to anything.

So, for example, it's the cocktail phenomenon. You go to a cocktail party and someone says, Hi. My name is Fred. I have a terrible memory for people's names. So when I shake that person's hand, I look at them and I have to say something to myself that will help me remember who they are.

Perhaps -- and I will make fun of myself. My name is Rob. So if I were trying to remember my name, I would look at them and, Rob is a runt. Rob is short. He is a runt. Rob runt. Rob runt. So I put that together -- or Rob the runt. So now you've got it tied with something. It's not just up floating around, but it means something. It has context.

So I think that's very important. You obviously have to be focusing on something to remember it and repetition helps. So when you are trying to remember a phone number -- you know how it is. When you look at a phone number -- now you have the cell phones. You don't have to worry about that. Reciting it a few times will help it stay in

short-term memory. You have to do more to get it into long-term memory. You have to tie it something.

Then when you are trying to recall it, if you can try to put yourself in the same state when you learned it. I tell all my students, if you study with coffee or tea, bring coffee or tea to the exam. It's called state dependent learning. So you learn and you remember a lot better when you are in a similar state.

That's why people with PTSD when they are excited they have a flashback because they are all jazzed up. You are at a 4th of July parade and you hear a firecracker go off and it scares you, they are back in that state again when they were on the battlefield. That's called state dependent memory and learning connection.

MS. BAILEY: I think we will move it along, but there will be time at the end, too, to ask questions of both Rob and Chris. Give me a little round there for Chris.

MR. GIPE: This time situation reminds me of a story I heard. It is about a professor at Penn State was supposed to give a speech at a women's club about sex. And the moderator kept leaning over to him during dinner and saying, "Our time is getting short, so keep your remarks brief." So when she introduced him, she said, "Here is the professor. He is going to speak on sex." He got up and he said, "It gives me great pleasure. Thank you very much."

I am going to speak a little longer than that. I think you will be able to hear me whether I am in front of the microphone or not because I like to move around. This is the first time of me doing a presentation like this. My cortisol adrenaline level is kind of high.

Unfortunately, I don't have any slides or photographs of when I attended here because when I attended Susquehanna photography hadn't been invented yet.

Now, we are talking about memory today, so I always like to have audience involvement. I don't like talking at people. I like their interaction.

So I am going to give you all a little memory test. I am going to say three words. I want you to repeat them. Airplane, yellow, and spinach. Repeat them. I want you to remember those three words because in a few minutes I am going to ask somebody to repeat them.

Now, as Robert said, my part of the presentation is the clinical aspects of memory, so let's talk about memory. What I have in my slides I have experienced myself. You have trouble remembering names. I'm terrible, too. I know why. The key there is usually when you meet somebody new you are thinking about what you are going to say to that person next instead of listening to what they are saying, listening to their name. So five minutes later, what was that person's name?

Toward the end of my presentation I am going to give you little tricks of the trade how to remember those.

Another common thing is you walk into a room and say, Why did I come in here? When is that appointment? You've got a lot of company thinking those things. There is a lot of people that share these little memory blank-outs and a lot of people worrying -- as you get older, worrying about the beginning of Alzheimer's disease. I will talk about that sort of at the end, when we get to aging and memory.

Most of these memory lapses are a normal part of living. Not aging; living. We may be preoccupied with some perplexing thoughts. Maybe we forgot our ginkgo biloba that morning or maybe we just blank out.

Memory itself is much more than simple recollection of particular events from the past. Memory itself is connected to the emotional state we experienced at the time of the event that Robert is talking about and that emotion is always present as a part of that memory.

Particularly, an example he just gave a few minutes ago about people who experience PTSD. There is so much emotion involved in the event that triggered that disorder that that emotion is always there.

Memory is also affected by stress and the aging process, but also factors such as disease, sensory loss, and dementia. I am going to be stressing that; okay?

Forgetting is not a normal part of aging. I am getting ahead of myself. I'm going to be stressing that throughout my talk. Forgetting is not a normal part of aging. I will talk about other things that cause that.

Memory storage. I believe personally that everything that we experience in life is somewhere in our memory bank. There is in the September 22nd issue of "Newsweek," which was just out a week ago, there is an article called Mysteries of Memory on page 64 by Matthew Wilson of MIT, who states storage and retrieval of memory is concentrated in the same cells. Everything that we experience gets into our memory. It may not necessarily stay there or if it's there, it can be way in the back; okay?

Those memories with strong emotional sensory tags are easier to recall. Even distant memories that we have had that contain little emotional tags for us are normal place.

I want to give you an example of this that you may experience. How many of you have been with friends sitting around dinner, having a few cocktails, when suddenly you remember something that you had forgotten? I believe that with the right trigger you can recall just about any memory.

This has happened to me. I have some friends I've grown up with since I was little. Sometimes we get together and talk about things we did back in high school. All of a sudden I will remember something I had forgotten for years and years.

Memory retrieval. There are three primary forms of memory retrieval. One is instantaneous. Most of us have played dodge ball in gym. Somebody throws a ball at you, you get out of the way. You don't have to think about it. You don't have to remember. Here comes the ball. I have to move out of the way. It's instantaneous. It's there. It's something you don't have to force to the front of your brain.

Another type of retrieval is called willed memory. This involves, again, trying to remember somebody's name that you are meeting. You think it's like on the tip of your tongue. You can't think of it. You can't think of it. It won't come to mind, so you stop thinking about it. But then an hour or so later the name comes to your mind. Because what happened is even though you stopped thinking, that retrieval process was still going on in your brain and finally comes to the forefront.

So the key there is if you stop thinking about or trying to remember that person's name or something, stop worrying about it, think about something else, and you will be surprised that it will pop in your memory then.

Now, the third type of memory retrieval I call automatic. This is engaging in an activity without having to think or remember the activity. For example, driving from point A to point B, not

remembering the journey, or brushing your teeth, but not remembering doing it.

Now, the thing that personally I have experienced is whenever I put gas in my car and I pull away from the gas pump, I always check my side view mirror to see if I closed the gas cap. I always do. But when I am in the act of pumping gas and closing it, my mind is somewhere else, so I don't remember doing it. I have to think about it, did I really do that?

Excuse me. I lost my place.

We are on automatic pilot, which happens to all of us. That's okay, but too much of that is not okay, because when we, again, blank out, our brain isn't on.

I recommend a book to you, which isn't on here. It's called Time Shifting by Stephan Rechtschaffen. Big name. It's a book about being in the present; okay? He says in the book that when you are doing mundane things around the house like washing the dishes or brushing your teeth, focus on doing the dishes and brushing your teeth instead of thinking about what happened today or what is going to happen the next day. Focus on the present and that will help you keep your brain switched on.

Okay. Let's see here. Young lady with the Susquehanna shirt, what were those three words that I asked you to remember?

VOICE: Airplane, yellow, spinach.

MR. GIPE: Very good. Your memory is intact. Maybe one person didn't know and somebody else knew.

Now, let's talk about memory and stress. Stress is both positive and negative. Positive part of stress, when we talk about brain chemistry, is that it releases norepinephrine, which improves the mood and encourages creative thinking. Stress is also negative.

And Rob was talking about the positive effects of cortisol. When cortisol level is raised you tend to remember better. However, if your cortisol level remains raised too long or oversecretion of it, that can adversely affect memory because it damages the hippocampus.

So we think of -- a lot of people think of the word stress as a negative thing, but it's also positive because stress is what motivates us to do better and motivates us to study for a test, motivates us to do things of life that we need to do.

Years ago somebody established a priority stress list of things that are most stressful in our lives and some of the top ten are positive things. Getting married, getting a job promotion, winning the lottery are all positive things in our life, but they create stress. So stress can be good and bad.

One of the keys is how you handle stress and appropriate response to stress is a healthy and necessary part of life. Stress management is a key; not stress elimination.

Now, there is a handout you might have picked up on the way in which lists the stress relievers. I suggest that you look over that. I think there is 101 things. I suggest you look over that list and find things on there -- and I'm sure there is a lot of things that you already do in your life that are on the list, but you don't think of those as stress relievers. Look over the list and check off the ones that you think make sense to you and feel free to add to the list. The key there is to engage in a stress-relieving activity every day.

Now, I agree with Rob that the best stress reliever is exercise. Between the two of us, we have run 15 marathons, but I won't suggest you run a marathon as a stress reliever. It's too much. Exercise is a big one for both of us. Feel free to look through that list and, if it's helpful to you, great.

Now, let me get to memory and aging, which is a big area for me. As Kathy said, I've been consulting with Alzheimer's Association for about 25 years.

Now, when it comes to memory, forgetting may be almost as important as your memory, when the brain selects what will and what won't become long-term memory. If you think of the brain as a hard drive in a computer, there's only so much room, storage facility. As we get older, I don't think it's so much a matter of forgetting, but we become more selective in what we remember. We tend to become more selective of the things that are more important to us.

This may not be the best example that just came to mind. When you are going through school, go through high school, in high school it's called banking. The teacher gives you information and you bank it. When you get to college, you start using -- you become more critical, more analytic. The professor says, Okay. I want you to take this information and apply it.

Now, what happens I found -- again, from my own experience -- I went back to school as an adult. After Susquehanna I went in the military for four years and went back to school. What I had learned as an adult in school became more important to me than what I remembered in high school. Because it was important to me, I remembered it better. It may have supplemented some information I learned about that topic earlier, but, more importantly, it was more immediate, because I needed that education maybe for my career.

Now, remembering and forgetting are also influenced by several variables, including emotional states, stress levels, environments, stressed environments, previous memories, biases, perceptions, and illness. Biases and perceptions is interesting. There have been experiments done about this.

What we see is based on our own previous experience. For example, three people could witness a car accident. Each one of those three people has a different reaction. One person may have been involved in a car accident and they freeze. They panic because of what happened to them. The second person might want to jump in, run in and say, Somebody may be hurt. I've got to help out. The third person may have more of a neutral response, saying, Hum, boy, it's going to take a lot to repair that car.

So your own personal history, your own perception helps create the memory and influences what you remember and what you forget.

Now, a healthy brain can create new memories throughout as we age. It may just take longer to learn as we age. Our capacity to learn is still there in a healthy brain.

As Robert was talking about the biology, the hippocampus shrinks over time. It's still there. You can still remember. It may take a little bit more of an effort.

Now, when you talk about a failing memory, I still want to stress this -- use the word stress a lot -- a failing memory is not a normal part of aging. It's an indication of a serious problem that needs attention.

We were talking before the presentation about what we were going to say. I was talking about the fact with Alzheimer's disease -- most of us, I think, have been affected by Alzheimer's, either we know

somebody in our own family or we know a friend -- it's so important to have a correct diagnosis of dementia, because there are so many different things, other variables that can look like dementia, a reversal form of dementia, such as depression, vitamin B12 deficiency, sleep deprivation, side effect of medication.

Both -- for two reasons. As we get older we tend to become more sensitive to the medication we are on and, also, there is a tendency to engage in college pharmacy as we get older, maybe both the patient and the doctor. The doctors have this idea addition instead of subtraction. If you are on so many medications and you tell the doctor you have this other problem, instead of looking at the combination the patient is on, they will say, Let's give you this other medication.

Medication can be tricky. The effects you feel from medication might look like dementia. Also, alcoholism and pain.

So there are so many things that can look like dementia that are either reversible or correctable, so it's so important to have a correct diagnosis.

I was involved with speaking to Alzheimer's support groups for years and I stressed that issue. I heard many stories from the caregivers of the people with Alzheimer's that were very sad because either the doctor missed a diagnosis or the person wasn't on the right medication. So it's very important.

Let's talk about strengthening memory and preventing memory loss. I have some ideas from your earlier question. It's been said -- and you have probably heard it -- that if you take care of your body when you are younger, it will take care of you when you get older. Same thing with your memory. If you take care of your memory, it will pay dividends when you get older.

Again, I recommend the book Time Shifting.

One way to stimulate your memory is through word games, crossword puzzles, cryptograms. My current favorite is Sodoku, which is challenging and frustrating because I can get so far along a difficulty level and then I get stuck.

Another way to strengthen your memory is through pneumonics. A strange word. I guess it's Greek. Acronyms. I remember when I was in school -- and maybe the students in the audience have done this, too -- to help you remember lists, for example, you come up with an acronym. Maybe you have a list of ten things you have to remember, so you come up with a ten-letter acronym to help you remember. Like ASAP, as soon as possible, and zip code.

Does nobody remember what the letters Z-I-P actually stand for? See, after so much time the acronym gained a life of its own. Zone improvement plan. Back when the Post Office decided a better way to help the mailman get the mail to your house is to come up with a zone improvement plan, which became the zip code. If you don't remember anything else from the presentation, remember that.

Now, association. A way to remember people's names, as Robert talked about himself, Rob runt. Another way to do that, you meet somebody whose name is Bob. Bob has bright red hair, a very distinguishing feature. The one way to help you remember his name when you meet him again, you picture a bright red wig with the name Bob written on it. So, oh, red hair, wig, Bob.

One of the -- one of my running routes around my house is a development called White Hall Terrace. For so long I couldn't remember it. So what I do now, I picture in my mind a long hall in a building painted white with terrace steps at the end. I still do this. I think, What is the name of this place I am running through? I picture

that in my mind. There is White Hall Terrace. That's a good way to help you remember things.

Train your mind to be flexible, another way to keep it exercised. Try new things. Try new foods, new music. Take different routes to work. Some of you may have to go one way. Students, walk a different way to get to class.

When you do your normal stuff, like brush your teeth or comb your hair or eat your meal, use your nondominant hand to do that. I read somewhere -- and I don't remember where -- if you use your nondominant hand you've got to think more for all the activity and fine motor skills you have to do and that stimulates your brain to be flexible.

The other handout I gave you is called Keeping Memory Sharp. I think I read through that. I found it on the internet. I Googled memory and that came out.

I think, again, you exercise your brain just like you exercise your body. If you continue to exercise your brain, that's going to really pay dividends as you get older.

And my caveat, which is why I have it in blocks down here, learn for a living. I was taking some doctoral courses in a program called adult education. I really want to stress how important that is, to really keep your mind healthy, learn for a living. And I end on that.

MS. BAILEY: So do we have any questions?

VOICE: I have two questions and they are unrelated. The first one is kind of rhetorical because I am a college teacher and I am always mystified that on a list of things that are good for improving learning and memory we have good sleeping habits, we have adequate healthy exercise, we have excellent nutrition, and elimination of chronic stress. College, by definition, includes none of those. I think it's good for us to address that and, as educated people, what are we doing?

MR. GIPE: Let me make a comment on that. I stress this with my private clients. I believe -- and I am not as scientific. I believe that 90 percent of stress you experience comes from within you; okay? Take like the job air traffic controller, probably one of the most stressful jobs you could have. Some people thrive on that risk and they do fine. Other people would fall apart within five minutes.

It's not the job. It's not the activity. It's not the event that happens around you. It's your reaction to that event that causes you stress.

VOICE: Absolutely. But I think we do have to admit, when we look at the college environment, there are a lot of things that are set up to make it tough in those ways, with kids that are on their own, learning to be adults, learning to figure out how to manage their own stress. I think it's just something that might be worth thinking about at the campus wide level.

We have this wonderful knowledge -- I just totally enjoyed this program this afternoon -- that we know how things work in the brain in ways we never knew before. We know that nutrition has an impact on learning. We know that sleep has an impact on learning, lots of things which our students tend to not be very good at.

DR. DRUGAN: I agree with you. Can I just comment real quickly? I think we have to change our culture. That's one of the problems.

The second problem is, one of my colleagues when I was at Brown, Mary Carskadon, studied circadian rhythms. And she told me we shouldn't have any classes before 10:00 in the morning. But then I say, We don't have the classroom space and if we start at 10:00 we have to end at 8:00, and then the whole staff and faculties' lives goes by the way side because of the kids.

But your point is well taken. She suggested that and obviously not many people who are responsible for scheduling classes really heard that because of the problem of schedulers.

VOICE: My second question is not really related to that. As we say, all of us are or will be impacted by someone with memory problems with aging, which in my case is my mother. One of the things that we all face is when we have to make a decision to take away a liberty from a person because they are not able to do that anymore; in particular, driving.

So when I am looking at your list of things there is the kind of memory that is engaging the ability to put the key in the ignition, to accelerate the car, and steer it, and has nothing to do with the fact that the person behind the wheel has no idea where he or she is going, what they get when they are there, and what the logical activities are once they are at that destination.

What we have found actually in this area, in the state police system, is a person can maintain a driver's license if they have memory A even if they don't have memory B. And at what point will this knowledge, this learning, this research go out into the legal system when we start to evaluate who is not a safe driver?

MR. GIPE: Well, a couple answers to that. It is really in the local system because if you can get the family there to write a letter saying that the person can no longer drive, then the --

VOICE: I will talk to you afterwards. You have done this. I think this is something that's not really recognized and the onus is on the family, which is possibly appropriate. But legally going through the system is not as straight and clear as you might say in all situations.

MR. GIPE: Another way, Mary Lasero, who used to be the CEO of Manor Care Nursing Home, she always talked about creative lying. When you have -- some of you are taking care of somebody with Alzheimer's, and they want to continue to drive and they can't. What you do is when it is an appropriate time to take the car and take it somewhere else, you tell them, The car is in the shop, so you can't drive it.

I had one person whose husband refused to take a bath, so she got a prescription and the doctor said he had to take a bath with special water, which was food coloring, and she got him to take a bath. Creative lying.

One point I wanted to make about Alzheimer's to kind of reassure some of you is that sometimes we leave our car keys somewhere, but you eventually find them. But when you get to the point where you don't know what the car key is for, then there is a problem. That's the difference between normal forgetting and Alzheimer's.

Others questions?

VOICE: My question would be to Dr. Drugan, please, if you don't mind. Is there any similarity between some of the research that's going on in the field of autism and the fragile X protein, the gene protein, and

Alzheimer's? Is there any similarity in this as it relates to the synapses in the brain?

DR. DRUGAN: The field is still evolving in terms of what causes these types of deficits. Fragile X and autism are referred to as nerve developmental disorders. In other words, there is an exposure to perhaps a virus early on in life that causes a miswiring of the brain in these individuals such that autistic and fragile X individuals have a hypersensitive response to environment and they also have difficulty with focusing on things around them.

I think your question is a very important one because now you ask later on in their life are they going to be more vulnerable to developing memory deficits and things like that. I don't think those studies have been carried out at this point in time, but I think they will be done because it's so important to try and understand the trajectory of something that happens early on and then what happens later on.

I can assure you that people who do animal work are working on this feverishly. And the benefit of animal research is an old rat or mouse is three years old, whereas a human is 80. We are going to find that answer out in three years rather than waiting 80. So I think that's the benefit of doing animal research, is you have this time warp of aging that will allow us to go in.

You saw the data I presented. The rat and mouse data are remarkably similar to the human data. The difference is we have a larger cortex, but they still have a hippocampus. We have a hippocampus. Our hippocampus is involved in much more elaborate memory, but we have similarities. I think we can understand from those models and try and help the human condition from that.

I don't know if I answered your question, but I think people are investigating it and that they are trying to understand where that trajectory is going to take them now.

My wife works in special education and she has told me that working with autistic children in a very supportive environment has now caused changes and advances in those children like they have never seen before. When I was at Susquehanna I worked at the Selinsgrove State Hospital in my internship and I saw those autistic children. I was heart broken. That's why I didn't go into clinical work. I said, Rob, this is not for you.

But nowadays, rather than saying those individuals have to be separated, they are mainstreamed. My wife is working with autistic children that have special education programs, individual education, IEPs, to help them be in the classroom and work with them so they are more socialized. You are seeing a greater improvement in those people, which I think will help them later on in life.

VOICE: Aside from these wonderful ideas for memory, is there anything extra that would particularly help someone with a brain problem who has lost a spouse? I'm being a little bit funny here --

DR. DRUGAN: That's a very well-characterized phenomena. Chris can probably talk more to this. My reading is they are now including exercise in treatment of psychotherapy for post -- what they call post-bereavement depression. There are some people who more susceptible to post-bereavement depression than others.

If you think about it, it's more than just losing your spouse, but you are now responsible for doing things you never had to do

before. Plus you've lost your life-long companion. So the burden that you are feeling, the stress that you are feeling compounds that loss.

MR. GIPE: I did some work in my private practice. Again, one of the things that I stress with my -- I have to stop using the word stress -- one of the things I emphasize with my clients is to help you deal with your grief and to eventually resolve it and go on with your life is to involve yourself in helping others who are basically less fortunate than you.

I have had people -- for example, a lot of my clients get very depressed around the holidays. I suggest they get involved with Toys for Tots or other charities helping with children. When you sort of open yourself up to help other people, I believe it helps us.

No, there isn't -- well, yeah. Depression is part of it, but there isn't a pill in a sense. For example, it might be helpful to take an antidepressant for a brief period of time until they get over the crisis period. I don't push medication, but sometimes it's necessary.

VOICE: Help you have a good time.

PROFESSOR DRUGAN: Humor is actually very helpful. There are studies out there that show humor can boost the immune system. So your point is very well taken, even though you didn't mean to make that point. A very healthy thing.

MR. GIPE: This is just slightly a bit off topic. We live in a fast food society. We want everything right away. I have a problem. Give me a pill for it.

Some things don't happen quickly. One of the things that doesn't happen quickly is getting over the loss of a loved one. It's a process. Everybody takes their own amount of time to grieve over the loss of someone in order to move on with their life.

VOICE: Can you comment on music as an -- would it be a bump for your long-term memory that you hear different kinds of music, baroque, even? Is it known to be effective?

DR. DRUGAN: Mihaly -- I think I'm saying his name correctly -- is a psychologist out in California who talks about a phenomenon called flow. I don't know if any of you have heard of the word flow. He sees it in people that are artists. He sees it in people that are rock climbers. He sees it in people that are totally immersed in something for the moment and they forget about everything else in their life.

So it's a time-out to relieve yourself from the stress of life. People who do yoga or do meditation find this.

There is good evidence that flow helps the mind, helps energize the individual, and helps to provide them with a grounding -- a sense of grounding that really helps them to move on.

I am a musician even though I never made any lifetime commitment or was famous for it, but I love music. When I play the guitar and I sing, I can't think of anything else. If I did, it falls all apart. So in an effort to try and rid yourself of worry, if you engage in an activity where all you can see is what you are doing, it's extremely helpful.

I think Chris hit the nail on the head. We live in a fast food society where we are so busy all the time. I'm embarrassed to tell all

of you that I don't have a cell phone. I am a dinosaur. My students don't call me on the weekends or e-mail. I tell them, Don't try. I won't answer because I need time out. I need to be a father and a husband, and I need to get away. I think our society doesn't let us do that.

Flow, doing music -- your point is terrific -- that, I think, is so healthy. Chris mentioned take up a new instrument. Do something different. That's a wonderful thing to do not only in terms of stress release, but studies have actually shown different brain activity in people who play piano versus those that don't. There is a greater representation in motor cortex for areas of the fingers in pianists than non-pianists. Now, these people started early on in life when they played the piano, but it changes the brain. So I would think it's good for a number of reasons.

VOICE: Well, i was thinking more of the rats swimming around looking for a place to land with the enriched environment versus the couch potatoes and an improvement shown there even in aged rats. Suppose your nursing home population is -- is there -- does it have an impact positively?

MR. GIPE: Very much so. The person who works there can help you more, I think. When you go to a nursing home and you talk to some of the folks, they can't tell you what they had for breakfast that morning, but they can sing every word to the songs that they grew up.

Music stimulates your brain. Music stimulates your emotion, brings passion into your life.

One thing that I do if I am on my way to a race, I will listen to a particular type of music to kind of stir me up, so I have cranked up my adrenaline so I am ready to go when I get there.

I think everybody should have music in their life. Stir your passion, stir your emotions, stir your memory.

DR. DRUGAN: Stirring the memory is terrific. Hassinger Hall, when I used to have to do track and field at Susquehanna, they played Dire Straits' Sultans of Swing when I was a freshman. Every time I hear that song I think of Hassinger Hall. Takes me right back.

Music also gets tied to memories. I ever seen this in a variety of people. It brings you back. Maybe that's the way we ought to go about probing memory in individuals is using music to try and bring them back. I think it's a very powerful tool.

MR. GIPE: How many of you have cried at a certain song on the radio that reminded you of a relationship that went bad?

MS. BAILEY: Are there any additional questions for either Chris or Rob? I think we are about out of time.

I would just like to thank everyone for their participation, and we really enjoyed this forum and an opportunity to speak to you all.

So enjoy the rest of the alumni weekend.

(Whereupon, the presentation concluded at 3:12 p.m.)