CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Michael S. Brooks

Project Number
S1201

Project Title
Blood Proteins TRMP1 and Clusterin as Minimally Invasive Biomarkers of AR in Renal and Cardiac Transplants

Abstract

Objectives/Goals
My objective was to validate the ability of blood proteins TRMP1 and Clusterin to serve as minimally invasive biomarkers for diagnosis of Acute rejection in renal and cardiac transplant patients.

Methods/Materials
I tested previously collected samples from AR and stable patients using ELISA (Enzyme Linked Immunosorbent Assay)kits pre-coated with antibodies specific to the proteins I was testing for.
The results of the experiments were determined using a Microplate Reader and data graphing software.
There was much pipetting involved in transferring samples and chemical solutions from well to well on the ELISA plate.
An analytical Scale/Balance was also used in the preparation of solutions (often needed to be diluted)

Results
Blood Proteins TRMP1 and Clusterin increased in samples of patients experience acute transplant rejection VS samples of patients with stable transplant status.

Conclusions/Discussion
Through ELISA test validation, I found blood proteins TRMP1 and Clusterin able to:
1. Evaluate the health of a transplanted kidney or heart (compared to stable) semi invasively.
2. Identify acute rejection from stable grafts in renal or cardiac transplant patients can con therefore serve as acute rejection specific biomarkers.
3. Possibly diagnose opportunistic infections such as CMV (cytomegalovirus) in an immunocompromised patient- Clusterin and TRMP1 concentration were lower than the stable in infected patients.

Summary Statement
The ability of blood proteins TRMP1 and Clusterin to serve as minimally invasive biomarkers for acute transplant rejection diagnosis in renal and cardiac transplant patients.

Help Received
Used lab equipment at Stanford University under the supervision of Tara Sigdel; Participant in Stanford Institutes of Medicine Summer Research Program, Science Fair coach (Don Van Ness) had my board laminated.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)

Melissa Calvillo; Minerva Morales; Miriam Ramirez

Project Number

S1202

Project Title

Are Virtual Workout Partners Better than Standard Gym Exercises?

Abstract

Objectives/Goals

A virtual workout is a type of workout that helps people lose weight by just using a simple video game to play with. A standard gym exercise is a workout that also helps you lose weight by building up muscles in every sections of your body.

This study determines which type of workout helps you lose weight faster by having fun with the exercises and also by maintaining a steady diet. Is it the Nintendo Wii Fit; Xbox 360 Kinect; Playstation Move; Dance Revolution or the standard exercises in a gym? It also seeks to answer the question whether a virtual partner keep people on a daily exercise routine.

Methods/Materials

The procedure involved searching for volunteers to participate in this study, observing the data of their progress (whether they were losing weight or not), and find which of these exercises would produce the best results. We also conducted a survey by asking students what is the best way in keeping themselves fit, why do they want to exercise, and what do they think is an alternative way to keep you fit.

Results

The results showed that 83% of the volunteers lost weight by using the virtual workout partner exercises while only 16% lost weight by going to the gym and using traditional exercises. Obesity is the number one reason why gamers developed this system to get people involved into things that motivates them. Regarding question number 2, there are many ways in keeping ourselves fit, but around 70% of the students chose regular exercising as an answer. In order to create a visual representation of the results, bar graphs were made.

Conclusions/Discussion

In conclusion, our hypothesis was right. A virtual workout partner from a game system is more effective in losing weight than standard gym exercises.

Summary Statement

This study seeks to determine if virtual workout partners are better than standard gym exercises in helping you lose weight.

Help Received

Ms. Adriatico for guiding us through the process of conducting this research.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Patrick J. Chang

Project Number
S1203

Project Title
A Study of the Correlation between Eye Dominance and Hand Dominance

Abstract

Objectives/Goals
My objective was to determine if there was any possible correlation between eye dominance and hand dominance.

Methods/Materials
Subjects will be looking into a special box that was constructed in order to look at two objects set at a certain distance from each other. One object will be stationary while the other will be controlled by the test administrator (me). The moving object will be moved slowly towards the stationary object by the administrator until the subject believes the two objects are at the same level with each other and says stop. The process will be repeated times total, 3 times with the left eye and 3 times with the right eye. Subjects will also be crossing out as many circles as they can within 30 seconds with their dominant hand and then switching to their recessive hand and doing the same thing. They will alternate hands 6 times total, crossing out circles with each hand 3 times.

Results
Left handed people had a 3.3% deviation for the dominant hand (left) and a 4.0% deviation for the recessive hand (right). Right handed people had a 3.8% deviation for the dominant hand (right) and a 6.6 % deviation with the recessive hand (left). Left handed people had a 28% deviation with the dominant eye and a 21% deviation with the recessive eye. Right handed people had a 32% deviation with the dominant eye and a 27% deviation with the recessive eye. Left handed people had a hand dominance ratio of 1.6 while right handed people had a hand dominance ratio of 1.8. Left handed people had an eye dominance ratio of 0.78 while right handed people had an eye dominance ratio of 0.80. Pearson Coefficient was 0.19 for left handed people, 0.017 for right handed people, and 0.12 for overall

Conclusions/Discussion
Based on the data, the hypothesis that there would be no correlation between eye dominance and hand dominance was supported. On the Pearson Correlation Graph, there appeared to be no linear relationship between eye dominance and hand dominance and was more of a cluster of points. This may have been because both vision and handedness are both such major functions and function independently that they could not possibly rely on each other for if one should fail, the other would fail too. It may have also been because of the fact that eye dominance is not something many people are aware of and is such a small matter that it would not neither affect handedness nor be affected by handedness.

Summary Statement
My project mainly focuses on determining whether there is a possible relationship between eye dominance and hand dominance

Help Received
Mr. Antrim helped guide as to how experiment should be conducted; Dad helped construct box to test eye dominance; 60 people participated in the experiment

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Alexander Jow

Project Number
S1204

Project Title
ERK-Related Synaptic Deficits in a Mouse Model of Autism: Potential Therapeutic Solutions to an Epidemic

Abstract

Objectives/Goals
To interrogate whether ERK-related protein defects specific to synapses of the hippocampus are consistent across multiple mouse models of autism.

Methods/Materials
Hippocampal homogenates were made from subfield dissections of the bilateral hippocampi, while synaptoneurosomes were made from forebrains. Bands of Western blot analyses were visualized using ECL+ chemiluminescence (Amersham), quantified using ImageJ (NIH), and normalized to sample content. To make whole brain sections, brains were fast frozen and cryostat sectioned on the coronal plane at 20 micrometers. To conduct dual-labeled immunohistochemistry, primary and secondary antibodies were used and tissue was cover-slipped with VectaShield containing DAPI (#H-1200, Vector Labs). For hippocampal slice experiments and fast frozen brain sections, 3 to 4 tissue sections through each slice were used to acquire image z-stacks (0.2 micrometer steps). Images were processed for iterative deconvolution and automated in-house software was used to construct three-dimensional (3D) montages.

The experiment used Western blot analyses and dual-labeled immunohistochemistry to independently interrogate the protein levels of ERK, p-ERK, and p-CREB in both the total CA1 hippocampus and in only the CA1 hippocampus synapses of both C57/BL6 wild-type (WT) and BTBR T+tf/J mice.

Results
While synaptic levels of total ERK were shown to be normal in the BTBR hippocampus, synaptic p-ERK and p-CREB levels were both demonstrated to be significantly below wild-type levels.

Conclusions/Discussion
ERK-related protein defects specific to hippocampal synapses were shown to be consistent across multiple unrelated mouse models of autism and thus can potentially be used as a biomarker for diagnosing autism. In addition, these defects were shown to be synapse-specific, allowing for more focused future research. Lastly, BDNF defects can be tested for in the future and have been shown to be a potential drug target for curing autism.

Summary Statement
I discovered that ERK-related protein defects were synapse-specific and that these defects can potentially be used both as a biomarker for diagnosing autism and as a drug target for curing autism.

Help Received
I want to thank Dr. Christine Gall and graduate student Ronald Seese for their invaluable guidance and editing of my project. I also want to thank my parents and my science teachers, Mr. Knight and Ms. Bunch, for their continued support of my science education.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Kevin K. Lee

Project Number
S1205

Project Title
Utility of the Spatial Peaks QRS-T Angle in Distinguishing Left Ventricular Hypertrophy from Athletic Heart Syndrome

Abstract

Objectives/Goals
This project proposes the spatial peaks QRS-T angle as a new method of distinguishing left ventricular hypertrophy (LVH) from athletic heart syndrome (AHS). These two very different conditions (one indicates high risk for sudden death, the other an athlete in good shape) appear identical on the standard 12-lead EKG, implying the need for a more accurate method of diagnosis.

Methods/Materials
Double blind tests were conducted on athlete and LVH groups using traditional techniques (Sokolow-Lyon and Cornell indices) the spatial peaks QRS-T angle. After computing the parameters, diagnoses were made by comparing the respective values of the calculated parameters to the normal limits, then sensitivities and specificities were computed and compared to determine the relative utilities of the two methods.

Results
The ranges of angles for the LVH and athlete sets were clearly distinct, with the angles in the LVH group significantly larger. For the traditional methods, the ranges for the two data sets presented significant overlap and ambiguity. Both sensitivity and specificity were higher for the spatial peaks QRS-T angle than for the traditional parameters.

Conclusions/Discussion
The spatial peaks QRS-T demonstrated superior utility over traditional methods in distinguishing LVH from AHS. Also, it resolved ambiguity from the traditional methods explicitly. The angle not only holds great potential to detect cases of LVH that may have previously gone unnoticed, but it also reduces the need for expensive subsequent testing by virtue of its increased specificity. Additionally, it would be inexpensive to implement in clinics since no new hardware is required.

Summary Statement
My project devises an improved method for screening athletes by expanding the electrocardiogram to three dimensions in order to reveal potentially important insight.

Help Received
Dr. Cortez helped clarify explanations in justification of procedure, supervised use of EKG machine, and provided several data sets; Mr. Smay helped revise report and gave advice on display and presentation.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)

Samir Malhotra

Project Number

S1206

Project Title

Mild Carbon Monoxide Exposure as a Therapeutic Agent in the Mouse Inner Ear

Abstract

Objectives/Goals

We tested the hypothesis that low levels of CO exposure upregulates deense mechanisms that ameliorate oxidative stress which contributes to inner ear deterioration in the MRI/lpr mouse model. The MRL/lpr mouse strain is one of the best studied models of spontaneous systemic lupus erythematosus (SLE). In autoimmunie diseases there is an attenuation of defense mechanism against oxidative stress. SLE in humans is a chronic, inflammatory, autoimmune disorder that may affect the skin, joints, kidneys, and other organs such as the inner ear. Carbon monoxide (CO) produced endogenously has emerged as a signaling molecule involved in the physiology of the nervous, cardiovascular, renal, and gastroenterological systems. Therapeutic upregulation of CO tissue levels can be achieved via exogenous application of CO, for instance by direct inhalation of CO gas. To date there are no studies on the expression of oxidative stress markers or functional and structural proteins after mild CO exposure in the MRL/lpr mouse inner ear. The mechanisms that account for inner ear protection by CO exposure were investigated in this project.

Methods/Materials

MRL/lpr mouse pups were exposed to CO (25 ppm) or air (control) from post-natal day 5 to 20. The concentrations of CO we tested were below the upper levels set by most regulatory agencies. It was hypothesized that mild CO exposure could result in prevention of the deterioration of the cochlea of the MRL/lpr mice after CO exposure, when compared with MRL/lpr mice exposed to air. Changes in the MRL/lpr cochlea were studied by the application of immunocytochemistry, and supported with the use of mRNA expression and tandem mass spectroscopy applied to proteomics.

Results

By immunocytochemistry we detected an upregulation in several protective proteins including heme oxygenase-1 (HO-1) and antioxidant enzymes, superoxide dismutase (SOD-1 and SOD-2). There was also upregulation at the mRNA genes related to oxidative stress using specific gene assays. By proteomics we detected the expression of proteins involved in protein degradation (Ubiquitin system).

Conclusions/Discussion

Our results suggest that mild CO exposure could be used to prevent cochlear deterioration after noise-induced hearing loss and ototoxic treatments with antibiotics or cisplatin in which oxidative stress is present.

Summary Statement

Current project investigates the correlation between low levels of CO exposure and upregulation of defense mechanisms in the inner ear of MRL/lpr mouse model.

Help Received

Dr. Lopez taught lab techniques (Immunohistochemical staining and fluorescence microscopy), guided and mentored this project; let me use all lab supplies. Work done in the Department of Head and Neck Surgery, David Geffen School of Medicine, UCLA.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Alexandra Maloof

Project Number
S1207

Project Title
The Accuracy of Genetic Testing in Diagnosing Common Metabolic and Heart Diseases

Abstract

Objectives/Goals
The objective of this project was to discover the accuracy and usefulness of genetic testing to be used in private medical offices.

Methods/Materials
Ten individuals were selected from a private internal medicine practice to be genetically tested for twenty-five diseases. The researcher made comparisons between the patients# past medical histories and the genetic test results to determine the accuracy of the genetic tests. The second part of the experiment involved performing conventional testing on the patients to rule out the diseases that were not found in their past medical histories but were above the average lifetime risk in their genetic test results. Then, patients were provided with personalized protocols to prevent their likelihood for obtaining diseases. Some of the materials utilized in this project were genetic test kits, lancets, alcohol swabs, EKG machine, exercise treadmill machine, thallium stress test machine, echo stress test machine, Sequenom massarray chip, Sequenom massarray machine, thermalcycler, and a nanodispenser.

Results
In the final analysis, macular degeneration resulted in being a disease that was most accurate, 100%, with aneurysm following, 90%. Type 2 diabetes and peripheral vascular disease were both 80% accurate, and in both diseases the genetic test was inaccurate in identifying the controls. Then, osteoarthritis and migraine were both 70% accurate. Type 1 diabetes was 70% accurate, failing to identify all the cases, while obesity, which was 60% accurate, failed to identify some of the controls. Lastly, coronary heart disease was the least accurate, 20%.

Conclusions/Discussion
Genetic testing was not 100% accurate in distinguishing the cases and controls for some diseases; however, genetic testing can be utilized as a tool to aid physicians in the diagnosis of diseases, the determination of the patients# conditions, and the prevention of future diseases. We are entering an era of personal genome testing at the nucleotide level. By using the clinician#s armamentarium, personal genome testing will change the field of medicine in a propitious way, allowing physicians to pinpoint their patients# diseases.

Summary Statement
This study involved discovering the accuracy of genetic testing in distinguishing the cases and controls of common metabolic and heart diseases, as well as finding the benefits of utilizing genetic testing in private medical offices.

Help Received
Joseph Nadeau PhD. for project direction; George John M. Jr. M.D. FACP for supervising genetic testing; DNA Specialist Dan Slowinski (GTL Lab.) for analyzing blood samples; Vashaspathi Palakodeti M.D. (IV Cardiology) for performing heart examinations and teaching me the procedures.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Lyndsey J. Marsh

Project Number
S1208

Project Title
Treasured Memories: A Test of Horse Cognitive Memory

Abstract

Objectives/Goals
There were four horses in both groups. I designed the experiment with three buckets identical to each other. Carrots were placed in one of the buckets. One horse was tested at a time and every horse was tested each day. In the control group, I took each horse and lead them to the corral. I turned the horse facing away from the buckets. From there it turned to face three black buckets. The horse then walked up to one of the buckets and the choice was recorded. In the experimental group, I lead the horse to the correct bucket and allowed them to recognize the contents and investigate. From there I faced the horse away from the buckets. I allowed this experimental group to choose a bucket and recorded their choice.

Methods/Materials
Basic Procedure: Set up three black buckets evenly spaced apart from one another. Place cut up carrots (enough carrots to cover the bottom of the bucket) in one bucket at random (left, middle, or right). Lead horse into corral/lunging arena and turn them facing away from buckets. Remove lead rope. Record bucket chosen. Test Procedure: Set up three black buckets evenly spaced apart from one another. Place cut up carrots (enough buckets to cover bottom of bucket)in one bucket at random (left, middle, or right). Lead horse into corral/lunging arena and walk them to correct bucket. Allow horse to eat a few carrots before turning them away from buckets. Remove lead rope. Record bucket chosen.

Results
Muddy only choose the correct bucket once. Poznan chose the correct bucket twice. Otter chose the correct bucket twice. Maka was the oldest horse in the experiment and was wrong every time. Tantine chose the correct bucket all twenty times. Tux chose the correct bucket every time. Jack chose the correct bucket eighteen times. Annie chose the correct bucket seventeen times. She made no hesitation in choosing a bucket, and if incorrect would quickly inspect the next closest bucket.

Conclusions/Discussion
I found during testing that when the horses were shown what the correct bucket was, they would choose the correct bucket. I also discovered during testing that the brain capabilities of the different aged horses seemed to be different. In conclusion, the experimental group showed a higher level of accuracy when shown the correct bucket. The horses shown the correct bucket chose the correct choice and proved that they have cognitive memory.

Summary Statement
The project is about finding evidence as to if horses show they have cognitive memory.

Help Received
Mother helped with board; Dr. Malhotra helped revise; Horse owners lent horses; Laura Day lent property

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Daniel C. Moon

Project Number
S1209

Project Title
Spectral-Temporal Analysis of Dog Barks

Abstract

Objectives/Goals
The objective of this experiment is to determine whether dogs bark differently in response to different stimuli.

Methods/Materials
Barks were recorded various times in response to three stimuli. These were in response to a stranger, when we were going outside, and when it wanted attention. These recordings were analyzed to view their spectra of frequencies and the amount of time between consecutive barks.

Results
The results show that barking towards strangers have more low frequencies, barking for attention have more mid-range frequencies, and the barking when going outside have more high range frequencies. Barking at a stranger had an average interval of .295 seconds, barking for attention had an average interval of .358 seconds, and barking when going out had an average interval of .412 seconds.

Conclusions/Discussion
My hypothesis was correct because dogs do have different barks according to their spectra and intervals.

Summary Statement
Evaluating spectrums and intervals of dog barks to see if they have different barks.

Help Received
Father introduced me to the computer software

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)

Apoorva Mylavarapu

Project Number

S1210

Project Title

Role of the Basal Forebrain in Mediating Selective Attention

Abstract

Objectives/Goals

The objective of this project was to determine the role of neurons in the basal forebrain in a learning-dependent behavioral task and the influence of spatial probability distributions on basal forebrain neuronal firing rates.

Methods/Materials

Rats were placed in a circular arena with 36 manually operated LED lights on the perimeter, and rewarded based on successful identification of flashed lights. Neuronal firing data was acquired from two electrodes inserted in the basal forebrain. I analyzed all data in MATLAB by writing code to compare neuronal and performance data. I determined the significance of firing rate modulations at various stages of the task using randomized t-tests between successful and failed trials.

Results

The performance of all rodents closely followed the spatial distribution of stimulus probability. Of the 718 neurons recorded in the substantia innominata and ventral pallidum, 655 could be separated into 6 distinct categories based on firing rate patterns across task phase. 331 of these 655 neurons fell into the task phase associated with attention and memory. Differential firing patterns were observed between successful and failure trials even prior to choice of light and knowledge of outcome via receipt or absence of reward. Approximately 3% of neurons were significantly different in successful and failed trials at take-off, 15% immediately prior to reward, and 44% after the reward phase.

Conclusions/Discussion

Preliminary results suggest that rodents adapt their attention to variable distributions of stimuli, and that many neurons in the basal forebrain have differential event-based firing patterns consistent with a role in intelligent adaptation of attention across task stages. This research also reveals that outcome-specific firing patterns evolve over time and largely depend on spatial distribution of stimuli. Applications of studying this subset of basal forebrain neurons include understanding Alzheimer's and other neurodegenerative diseases and creating effective, targeted treatments for memory and learning-related disorders.

Summary Statement

My project analyzes the role of the basal forebrain in controlling different aspects of selective attention and the influence of various spatial probability distributions on attentional behavior and neuron firing rates in rats.

Help Received

Undergraduate and graduate students at UCSD Dept of Cognitive Science, Nitz Lab helped with data collection; used software at UCSD under the supervision of Professor Douglas A. Nitz

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Lauren A. Pell

Project Number
S1211

Project Title
The Effect of Hair Type on the Prevalence of Melanomas in Horses

Abstract

Objectives/Goals
The purpose of this research experiment was to learn more about the factors that predispose horses to getting melanomas. This is currently an important field of study because it could help prevent unwanted melanomas and because it is linked to skin cancer in humans. Although equine melanomas can be classified similarly to those in people, it is much more uncommon for horses to develop malignant melanomas, so scientists are investigating why horses get melanomas more often than people do while still rarely experiencing negative health effects.

Methods/Materials
The hypothesis for this project was that when gray horses older than six years old are tested for melanomas at random, more horses with frizzy, course hair texture will have melanomas than those with silken, fine hair textures. Horses were only included in the study if their individual owners provided information regarding possible previous melanomas, and only gray horses above the age of six were chosen, because this particular group of horses has significantly increased risks of contracting melanomas.Each horse selected was placed into a group based on hair type and the presence of melanomas to determine the link between hair type and melanomas.

Results
After each horse was classified into groups, the study found that 80% of the gray horses with frizzy hair had been diagnosed and treated for multiple melanomas (though not all melanomas had been diagnosed as malignant), while only 8% of the horses with silky hair had ever been diagnosed with a melanoma.

Conclusions/Discussion
This evidence overwhelmingly supports the hypothesis, so the result of this study is that there is a positive correlation between tail hair texture and the likelihood of contracting melanomas in gray horses.

Summary Statement
This project determined that frizzy haired gray horses are more likely to develop melanomas than silken haired gray horses.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Kalani S. Ratnasiri

Project Number
S1212

Project Title
Trends in Hospital Admissions: The Epidemic of Diabetes Mellitus and its Comorbidities in California, 2000-2010

Abstract

Objectives/Goals
The objective of this study was to determine trends in prevalence and comorbidities of diabetes mellitus (Type 1 & 2) by employing hospital admissions (episodes) in California from 2000 to 2010. The hypothesis was that the prevalence and comorbidities of diabetes mellitus would increase from 2000 to 2010.

Methods/Materials
Diagnoses of more than 32.2 million hospital admissions from 2000 to 2010 in California, compiled by OSHPD, were screened by employing ICD9CM codes specific to diabetes to identify episodes in diabetes. Trends were evaluated using simple linear regressions.

Results
Approximately 6.3 million hospital admissions where diabetes was a principal diagnosis or subsequent diagnosis were identified during 2000-2010. Compared to year 2000 (16.1%), the prevalence of diabetes-associated episodes increased significantly by 41% in 2010 (22.8%), demonstrating that the epidemic is increasing with a positive trend ($p<0.0001$). In 2010, among all hospitalizations, excluding newborns and length of stay more than 30 days, the most prevalent comorbidities were essential hypertension (48%), disorders of lipid metabolism (46%), and coronary atherosclerosis and other heart disease (34%). Significant trends ($p<0.0001$) were observed from year 2000 to 2010 for chronic renal failure (4.5 times), acute and unspecified renal failure (2.3 times), and disorders of lipid metabolism (1.9 times). Costs to diabetics were almost $45 billion in 2010, compared to $14 billion in 2000, representing a 229% increase ($p<0.0001$).

Conclusions/Discussion
The hypothesis was supported. This study reveals increasing trends in prevalence, deadly consequences, and ever-increasing hospital costs to pay for California's diabetes epidemic. The financial burden on the public is increasing every year. It cost $45 billion in 2010, posing a grave threat to an already vulnerable economy in California. By increasing awareness and education, regular exercise, changing life styles, and proper medical monitoring and care, we can keep diabetes from engulfing our state and the nation.

Summary Statement
This project describes the increasing trends in diabetes, diabetes-related hospitalizations, deadly health consequences, and financial burden to the society.

Help Received
Ms. Marilu Carter edited my writing. My dad helped me to access the data and to write the SAS programs.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Michelle C. Stanley

Project Number
S1213

Project Title
Can "Dr. Beat" Cause Damage to the Ear?

Abstract

Objectives/Goals

I play in the marching band where we use a Dr Beat when we rehearse our field shows. A Dr Beat is a loud speaker that is connected to a metronome. The beats from the metronome are amplified so that band members can hear the sound over the entire area of the football field. After practices, I have experienced ringing in my ears, clogged sinuses, the feeling of a swollen right eye, and finally, throbbing headaches. Based on this, I believe a Dr Beat can cause damage to the ear.

Methods/Materials

I set up the Dr Beat beside the football field in the same location and same manner as we do in practices. I arranged 24 orange pylon cones at different intervals on the football field to measure and record the decibel levels using a decibel meter. I tested the decibel level coming from Dr Beat at each pylon location three times. I then averaged the data and compared the results with a conversion table of intensity to decibel levels. I compared these results with materials from my research on hearing loss.

I then made an appointment to have my hearing checked with an ear, nose, and throat specialist to discuss my symptoms after rehearsals.

Results

I found that 89 was the highest decibels produced by the Dr Beat. 42 decibels was the lowest. 60 was the average decibels produced.

Dr. Rabinov (the specialist) conducted a physical examination of my ears. I also had a hearing test. The doctor determined that I experience temporary threshold shifts during practices which results in tinnitus and the symptoms I suffer.

Conclusions/Discussion

60 decibels is not enough to immediately cause hearing damage. Anything over 85 can kill hair cells in the cochlea of the middle ear, and I did have a reading of 89 decibels.

Dr. Rabinov advised me that repeated loud exposure will cause damage to my ears. We discussed a type of ear plug worn by many musicians.

So, while Dr Beat does not cause immediate damage to the ear, long term exposure could cause damage to unprotected ears.

Summary Statement

My project is about whether or not a Dr Beat can cause damage to the ear.

Help Received

I received help from the music and athletic departments at my school. My dad rented the pylons.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)

James J. Thomas

Project Number

S1214

Project Title

A Predictive Bayesian Network Model of Alcohol Dependence Based on Genetic and Demographic Factors

Abstract

Objectives/Goals

We sought to develop the first predictive model of alcohol dependence and analyze the model to pinpoint the biological mechanisms that underlie the onset of the disease.

Methods/Materials

We began with a dataset containing demographic and genetic information for 3,776 individuals, about half of whom were alcoholics. We invented a generalizable approach based on linkage disequilibrium to eliminate redundant and uninformative genetic factors from the dataset. A Bayesian network-based predictive model was learned from the reduced dataset using the Java-based WEKA machine learning library. We also invented a method to analyze any Bayesian network model of a disease to identify genes and high-level biological concepts (e.g. pathways) that are likely to be associated with the disease. We implemented this method as a Java software package and, on a supercomputer, applied it to our Bayesian network for alcoholism.

Results

The area under the receiver operating characteristic curve (AUROC), a measure of predictive power, is a very high 92% for our model. Many of the genes and biological concepts that were deemed likely to play a role in the onset of alcoholism have already been tied in some way to the disease in the literature, validating both our novel method for model analysis and the model itself. Other findings do not seem to have been documented previously in the literature and are excellent candidates for further research.

Conclusions/Discussion

We have developed a highly accurate model to determine the probability that a patient will develop alcohol dependence given his or her genetic and demographic information. Examination of the model's network structure indicates that a major reason for the model's success is a synergy between demographic and genetic factors -- the presence of certain demographic factors increases the likelihood that certain genetic factors will cause alcoholism. We have determined several new links between genes and biological concepts and the onset of alcoholism, many of which may aid in the development of preventative treatments for the disease (drugs that target certain pathways, gene therapy measures, etc.). Finally, all of our methods, including our novel algorithms for genetic feature selection and analysis of Bayesian network models of diseases, have been validated by the success of our model and can be used in the future to construct and analyze models of other diseases.

Summary Statement

Using Bayesian statistics, we developed the first model that can predict the onset of alcoholism in individuals and analyzed it to better characterize the biological mechanisms of the disease.

Help Received

Project was conducted under the guidance of Dr. Amin Zollanvari, Research Fellow, Children's Hospital Informatics Program

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Adam Villalpando

Project Number
S1215

Project Title
Investigating the Effects of Concussion on Memory and Concentration

Abstract

Objectives/Goals
The term concussion or MTBI, mild traumatic brain injury is defined as a head injury with temporary loss of brain function which can cause a variety of long term symptoms, emotional and physical, to the victim. I chose to study the effect of concussions as a student athlete since I am concerned and want to examine the risks associated when playing American football.
Furthermore, this study interests me because millions of people gather on February, Sunday afternoon, to see their favorite sport being played at its peak unknowingly watching their favorite players risks their lives on that field. The study explores the risks high-school student athletes face while chasing the dream of winning a scholarship. My fellow classmates who have experienced concussions were carefully studied. I observed these students and analyzed how much this has affected their academics and ability to concentrate in the classroom.

Methods/Materials
The procedure is quite simple. I had to find 8 student-athletes who have experienced concussions and are willing to participate in the study. I analyzed the significance of their concussions by giving them a spelling quiz; observed their attention span in the classroom setting when given a 30- minute lecture to see how long it would take them to refer to their electronic gadgets and stop paying attention to the speaker. I compared the results to the other 8 regular student participants who have not experienced a concussion.

Results
The results showed that on average the regular students performed 12.5% better than student-athletes (who have experienced concussions) when given a spelling test. Likewise, the average attention span of student-athletes is 15% less than regular students.

Conclusions/Discussion
These data proved that students who have concussions have short term memory loss and a tendency to have shorter attention spans than students who haven't had a concussion. Should this be considered a tragedy or a cost for American entertainment?

Summary Statement
This research seeks to investigate if concussions acquired through sports can affect a student-athletes' performance in the classroom.

Help Received
Ms. Adriatico for her guidance and support.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)

Kevin C. Yang

Project Number

S1216

Project Title

Testing for Simulated Sinusitis in Phantoms Using Near Infrared Radiation Transillumination

Abstract

Objectives/Goals

Sinusitis is one of the most common disease in the United States, affecting 31 million people. A preliminary study at UCI indicated that NIR transillumination seems to be a promising tool for the rapid diagnosis of sinusitis. To further study NIR sinus imaging, I intend to construct a phantom which has the geometrical and optical properties of the human head. Furthermore, I intend to investigate whether simulated sinusitis can be detected in this phantom using NIR transillumination.

Methods/Materials

Materials and Methods: A phantom was constructed by combining an upper and a lower part. Each made using silicone (polydimethylsiloxane) base, silicone activator, titanium oxide as scattering agent and nigrosin dye as the absorbing agent. The ingredients were mixed together, degassed and solidified. The mold used to make the upper portion simulates the sinuses and was constructed so that two 11ml containers were suspended in a box. The mold to make the lower portion of the phantom was based off of an upper palate impression received from a local dentist. An array of NIR light emitting diodes was placed on the palate-simulating phantom. Images of the transillumination pattern were captured using a NIR camera and archived on a laptop.

Results

A phantom was constructed that simulated both the maxillary sinuses as well as the palate optically and geometrically. Tests were run after leaving the sinus cavities of the phantom empty, filling only one, or filling both with water. When both simulated sinuses in phantom were empty, NIR light emitting from both cavities was symmetrical and bright, indicating the sinuses were completely aerated. When one of the sinus cavities in the phantom was filled with water, the NIR light emitted from the filled cavity was reduced. When both sinus cavities were filled with water, the intensity of the light emitted from both of the sinus cavities was reduced. These results indicated that NIR transillumination can detect simulated sinusitis in this phantom.

Conclusions/Discussion

A phantom that has the key features of the human skull with maxillary sinusitis was successfully constructed. NIR can clearly distinguish between air filled spaces (healthy) and fluid filled spaces (diseased) in this phantom. This phantom was then used by Praxis Biosciences, LLC for testing using different NIR probes.

Summary Statement

A phantom which has the key optical and geometrical features of the human head with maxillary sinuses was successfully constructed and simulated sinusitis in this phantom was detected using NIR transillumination.

Help Received

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