The Hen Hud Hub
Science Research Newsletter

Hendrick Hudson High School
2166 Albany Post Road,
Montrose, NY 10548.

Special points of interest:

- Social Sciences
- Cognitive Psychology
- Neuroscience
- Computer Science
- Educational Research
- Biology and Medicine

Inside this issue:

Introduction to the Program, by Dr. Christine Rogers

The research course is a three year elective in which students choose a topic and carry out an original research project on that topic. The student does ALL of what professional researchers do, from journal readings to finding a mentor, planning a project, and carrying it out to an appropriate research conclusion.

The evolution of a science research project is determined by the topic chosen. Failure to obtain publishable results is often the norm in science, even for seasoned scientists. The success of a project often depends as much on character as it depends on scientific results. In this program students are writing the textbook and exploring uncharted territories. The working environment, as well as the experience taken from working directly with scientists and being responsible for their own project are invaluable for young people, regardless of the particular success of the research.

As the work progresses, the student writes research papers, creates posters, and presents research findings at available competitions and symposia as determined by the instructor and depending on the advancements of the research project. During the student's junior and senior years, he or she may elect to take the course for college credit for a total of up to twelve credits at the State University of New York at Albany. Also during the junior and senior years, each student is required to enter available venues for competition as determined by the instructor. All students are welcome to apply regardless of past academic history. The only prerequisite is that the candidate be a self motivated, hard worker.

The papers presented in this edition are the midterm papers and introductory paragraph of research proposals, written by students, Juniors and Sophomores in the program.

Infant Recognition of Agents, by Allison Gofman

As infants develop, they gain the ability to differentiate between agents and nonagents by around 5 months of age. Originally, the distinction is one of causality: agents can move on their own and will actions to occur, while objects are stationary unless propelled by an agent or sequence of events.

However, while research has determined development of recognition of agents, little work has been done on a general preference for agents, unlike the research that has determined an inherent infant preference for human faces. This knowledge can determine the strength of the preference and determine whether infant differentiation can have an impact on their everyday interactions, or if it only manifests in controlled environments. I propose showing infants a series of videos with human agents, non-human agents, and objects, and compare looking times recorded

Infant Recognition of Agents (cont.)

on an eyetracker to determine a comparative average looking time. If infants look longer at the agents even when stationary, the hypothesis will be supported.

Infants begin developing a sense of agency around 5 months of age, learning to represent actions and actors in terms of causality and agentive roles. While most research focuses on visible human agents, this study will investigate the ability of 5-10 month old infants to infer the existence of unseen causal interaction between a morphologically unique non-human agent and a thrown inanimate object (a beanbag). Once shown an object with a unique morphology, which is typically very unusual acting as an agent through the use of independent motion, responsiveness and "speech" through beeps or flashes, the research will identify whether infants will be able to identify the location of the agent through the motion of an inanimate object (a beanbag). A different morphologically unique object will be used to offer the infants a choice between an agent and non-agent. If successful, the data will imply that preverbal infants expect an agent to be the cause of motion of inert objects, a skill that is in constant use in everyday interaction and considered by some to be severely affected by autism.

"Infants have a preference for human faces over non-human ones immediately after birth"

Just like the baby who gleefully watches a bird fly while ignoring the toy in front of him, people must distinguish through the multitudes of objects in their sight, and decide which are worth attention. The decision often takes into account agency . Agency is typically described as the assumed possession of mental states such as thoughts, emotions, or will (Johnson 2000). Mental states refer to the world and specific content by what would commonly be deemed a "mind" analyzing its surroundings. While objects remain constant in composition and action, human beings and other agents constantly change goals and personality, making recognition theoretically difficult. However, many characteristics have been attributed to characterization as an agent, including the action's effects (Biro & Leslie 2007), appearance of rationality (Gergely et al. 2002), self propulsion (Baron-Cohen 1995) or by the existence of goal-directed action, regardless of the actor (Csibra et al 1999).

Generally, past experiments have quantified recognition of agents through either eyesight or mimicry. Tracking is the process of following or monitoring both mentally and physically. Physical tracking implies that there is a reason for the item to be tracked: thus, for experimental purposes, physical tracking implies the existence of mental tracking as well. Mental tracking is more complex then physical tracking, as it can occur through time and space as well as through language, thought, and memory despite internal or external changes (Bullot & Rysiew 2005). Much research on infant expectations of causality and agency are predicated on the discovery that infants tend to look longer at novel or unexpected situations then at familiar and anticipated events.

Studies have shown that infants do not interpret all motions as intentional, but can distinguish between purposeful and accidental actions as early as five months, although not necessarily drawing conclusions about the nature of the actor at such a young age (Woodward 1999). By 6 or 7 months, however, infants are able to recognize self-moving and intentional agents from inert objects in the more sophisticated sense

(Leslie & Keeble, 1987; Kotovsky & Baillargeon, 2000; Pauen & Trauble, 2006; Woodward, 1998; Woodward, Sommerville, & Guajardo, 2001).

The present experiment hopes to connect two well-established sets of research in a novel way. The first is that discussed above, regarding the various cues that infants use to determine and attribute agency ((Biro & Leslie 2007, etc.) The second is that of face preference: infants have been found to be preferential to human faces over non-human faces from immediately after birth (Johnson *et al* 1991). This research is typically highly controlled, offering infants a choice between two stimuli, one face-like and the other not, either through reversal of feature organization or lack of polar contrast (Farroni *et al* 2005, Morton & Johnson 1991). A recent unpublished study, however, attempted to determine the practical functionality of this face preference: infants were presented with a naturalistic scenario (clips from Baby Einstein videos, which have been shown to keep infant attention) to establish whether the face-preference could override competing preferences present in real life, such as color, motion, etc. Preliminary analysis has shown that face preference does seem to be an over-riding preference in many cases from an early age.

Both proposed experiments make use of morphologically unique agents to eliminate several extraneous factors. Infants have a preference for human faces over non-human ones immediately after birth (Farroni *et al* 2005, Morton & Johnson 1991). This creates a problem in testing for agency, as many of the results may be based on the infant's learned expectation of people to be agents. Thus, recent studies have focused on

Infant Recognition of Agents (cont.)

infant reactions to non-human agents, typically "morphologically ambiguous objects" that the infant will have never seen before (Johnson 2003). These objects eliminate the innate predisposition to humans, and thus achieve more functional results. While most objects used are of odd shapes, experiments with different sets of characteristics have found that faces and eyes, self propulsion (Baron-Cohen 1995) and interaction, either physical or verbal interactions are important factors in identification as agents (Spelke et al 1995). S.C. Johnson found that 15-month-old infants can reenact inferred and unseen goals of non-human agents (in the study, a stuffed orangutan). Not only did the majority (52%) of infants imitate the action that the orangutan completed, but a large part (37%) completed an action that the orangutan had attempted but failed to do. To compare the effects of physical

characteristics, the same procedure was done with an object lacking a face or limbs: a common lamp. While it appeared to interact with the actor similarly to the orangutan, infants had significantly lower rates of return interaction and imitation (Johnson 2001).

The proposed research hopes to clear up the ability of infants to attribute agency to unseen agents by using agents that should have fewer extraneous factors (such as previous exposure and preconception) associated with them. Part B will investigate the strength of the sense describe in the literature: once a sense of agency is developed, infants have tended to look towards agents as compared to objects. I propose an experiment to begin exploring whether or not it is possible that infants could have a preference for agents as agents, rather then for the motion, complexity, etc that characterize them.

Baron-Cohen, S. (1995). Cambridge, MA: MIT Press.

Biro, S. & Leslie, A. M. *Developmental Science*.

Cohen, L. B., Amsel, G., Redford, M. A., & Casasola, M. (1998). (pp. 167–209). East Sussex, England: Psychology Press.

Csibra, G. (2003). *Philosophical Transactions of the Royal Society, London B, 358*, 447–458.

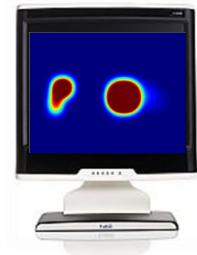Gergely, G., Bekkering, H., & Kiraly, I. (2002). *Nature, 415*, 755.

Kosugi, D., & Fujita, K. (2002). *Japanese Psychological Research, 44,* 66–78.

Leslie, A. M., & Keeble, S. (1987). *Cognition, 25,* 265–288.

Leslie, A. M. (1984). *British Journal of Developmental Psychology, 2,* 19–32.

Pauen, S., & Trauble, B. (2006). *Manuscript submitted for publication.*

Saxe R, Tzelnic T, Carey S. (2007)**.** *Developmental Psychology, 13*, 27-35.

Eyetracking data shown as a heat map. The data from all subjects or any subset can be superimposed to show the statistical clustering of gaze.

Molecular Mechanisms involved in Memory Consolidation , by Angela Licata

The study of memory has been traced to a few molecular events or processes. One of these is a phenomenon called long-term potentiation (LTP). LTP is the strengthening of synaptic connections in neurons and growth of new synapses, a form of plasticity which increases synaptic transmission. The cascade of activity from LTP leading to structural changes is observed after learning (Whitlock et al. 2006). The increase of the brain's efficiency in transmitting information is the initial formation of memory and the maintenance of this increased efficiency is retention.

Memories are initially formed in the hippocampus, an area of the brain which both aids in forming and processing memories. LTP is composed of several stages to reach the end product, protein synthesis. There is early and late-LTP. Early-LTP is the reception of a synaptic signal which triggers protein kinase activity. Late-LTP is subject to greater inquiries it is at this point that proteins are formed, many which are unidentified (Bailey et al. 2004). There are also more conceptual questions regarding LTP yet to be answered such as the ability for memories to be maintained over a lifetime and how they can be synapses specific yet

involve multiple sites in one neuron and multiple neurons.

One factor in the specificity of LTP is that there is strong evidence to suggest that the proteins are locally translated in the dendrites. The most compelling finding for this was done by severing the soma (cell body) and the dendrites, and testing the amounts of protein after synaptic stimulation.

It was found that sufficient LTP was produced and there was an equal amount of proteins, specifically dendritic elongation factor 1A (eEF1A) and phosphor-p70S6K (Tsokas et. al, 2005). Another paper entitled

"The study of memory has been traced to a few molecular events or processes"

Molecular Mechanisms involved in Memory Consolidation (cont.)

"Dynamic Visualization of Local Protein Synthesis in Hippocampal Neurons" additionally showed the ability of the dendrites to produce proteins without need for the nucleus (Aakalu et. al, 2001). Each study demonstrates that dendrites can create proteins without being physically attached to the cell body and synthesizes proteins at an increased rate from LTP stimulation though mechanism(s) that have not yet been uncovered.

The mammalian target of rapamycin (mTOR) pathway is implicated to this effect. The mTOR pathway results in the synthesis of phospho760S6 kinase and regulates other protein synthesis. The pathway targets terminal oligopyrimidine (TOP) mRNAs which translate proteins locally. It plays a role in the increase of translational machinery during L-LTP buy regulating translation elongation factors and ribosomal proteins.

It is also possible that RNA granules are present in the dendrites. These granules contain mRNAs and ribosomes as well other translational material. They are transported in this compacted granule form into the dendrites until there is something to cause the structure to unravel and activates the mRNAs to produce proteins (Martin and Zukin 2006). One study showed how this happens during depolarization, a condition which occurs after synaptic stimulation and also increases the shift of mRNAs to the polysomal fraction where they can produce proteins (Kirchevsky and Kosik 2001). As a result, the dendritic area is able to produce more proteins then in the repressed state. The exact mechanisms of specific depression of RNA granules are yet to be explored (Blitzer et al 2005).

It is possible that weak-HFS may be enough to start RNA granule depression and mTOR mediated increase in transla-tional capacity necessary to sustain LTP, yet it cannot do it alone. mRNAs must be de-repressed in a synapse-specific manner as well which is achieved through strong-HFS. These two factors are dependent on one another to create a long lasting LTP. The extra translational machinery must be present to translate specific mRNAs and similarly individual mRNAs must be de-repressed for the translational machinery to serve any purpose. However, the two can be induced at different times and at different synapses and LTP can still be obtained which is known as synaptic tagging/capture.

The basic hypothesis from the creators of the synaptic tagging hypothesis is stated as such; "We propose that LTP initiates the creation of a short-lasting protein-synthesis-independent 'synaptic tag' at the potentiated synapse which sequesters the relevant protein(s) to establish late LTP" (Frey and Morris 1997). Through this process synapses become associated with one another. An example homologous to this can be found in many people's memories when President John F. Kennedy was assassinated. They may recall where they were or what they were doing before they found out, usually uneventful activities, because of a significant event in close proximity. The parallel is in the two different levels of stimulation needed for synaptic capture to occur. The weak-HFS can be applied before or after the strong-HFS and will gain a lasting LTP as long as the strong-HFS train is delivered.

mTOR has been shown to be activated by a strong-HFS which can be applied within a significant time gap from the application of a weak-HFS. The synaptic capture which results is no weaker than if the time lapse was not present and therefore the amount time mTOR is active is significant. The sustained activity of mTOR must be maintained by a mechanism, primarily feed-back or feed-forward loops. This maintenance through a sequence of events on a molecular level should be further explored to determine how and why mTOR is active over a significant length of time and might further reveal the way it aids in the formation and maintenance of long-term memories (Martin and Kosik 2002 and Tsokas et. al 2005).

This exploration of the mTOR feedback/forward loops will be the subject of research which will provide data through a series of experiments using electrophysiology and western blots by observing mTOR activity from its downstream targets. The extracellular signal-regulated kinase/ mitogen-activated protein kinase (ERK/MAPK) pathway is a possible factor (Tsokas et al. 2007). Overall the experimentation will aid in the understanding of memory association.

Image from: Citri , Ami, & Melenka , Robert C. (2008). Synaptic plasticity: Multiple forms, functions and mechanisms. Neuro-psychopharmacology. 33, 18-41.

Aakalu, Girish, Smith, W. Bryan, Nguyen, Nhien, Jiang, Changan, & Schuman, Erin M. (2001). *Neuron*. *30*, 489-502.

Bailey, C.H. , Kandel, E.R., & Si, K. (2004). Neuron. 44, 49 -57.

Blitzer, Robert D. (2005). *Science's stke*. 1-3.

Bozon, Kelly, A. , Josselyn B, S.A., Silva, A.J., Davis, S., & Laroche, S. (2003). The Royal Society 358, 805 - 814.

Frey, Uwe, & Morris, Richard G. M. (1997). *Nature*. *385*, 533-536.

Kiebler, Micheal A. , & Bassell, Gary J. (2006). *Neuron*. *51*, 685-690.

Krichevsky, Anna M., & Kosik, Kenneth S. (2001). *Neuron*. *32*, 683-696.

Martin, Kelsey C., & Kosik, Kenneth S. (2002). *Nature Reviews: Neuro-science*. *3*, 813-820.

Martin, Kelsey C., & Zukin, R. Suzanne (2006). *The Journal of Neuro-science*. *26*, 7131-7134.

Sajikumar, Sreedharan, Navakkode, Sheeja, & Frey, Julietta U. (2007). *The Journal of Neuroscience*. *27*, 5068-5080.

Schuman, Erin M., Dynes, Joseph L. , & Steward, Oswald (2006). *The Journal of Neuroscience*. *26*, 7143-7146.
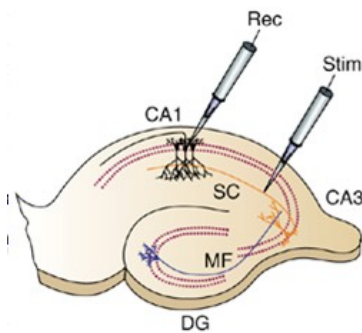
Tsokas, Panayiotis, Grace, Elizabeth

A., Chan, PokMan, Ma, Tao, Seal-fon , Stuart C., Iyengar, Ravi, Lan-dau, Emmanuel M., & Blitzer, Robert D.(2005). *25*, 5833-5843. Tsokas, Panayiotis, Ma, Tao, Iyen-gar, Ravi, Landau, Emmanuel M., & Blitzer, Robert D. (2007). *The Journal of Neuroscience*. *27*, 5885-5894.

Whitlock, Johnathan R. , Heynen, Arnold J., Shuler, Marshall G., & Bear, Mark F. (2006). *Science*, *313*, 1093-1097.

A Preliminary Study in Corporate Communication, by David Eisenberg

Communication is an essential component when dealing with large corporations due to the need for quick access of information. As internal and external networks are the basis for most communication today, it is necessary to formulate a methodology to optimize how information is organized. If achieved, not only can this re-design increase collaboration and inter-user communication but will harbor future advancements dealing with integration and service architectures.

How can we draw users to access information?

How can we efficiently display information in a way that is accessible and productive to a large number of widespread users?

What statistics and metrics must be retrieved and analyzed to formulate conclusions?

Adapting internet technologies into an enterprise is a field of research that has been explored by many scientists in the past (Molina et al, 2007) The ability for enterprises to be integrated with each other in a streamlined, accessible fashion can allow companies and corporations increase productivity and expand their horizons.

Having a sound architecture behind any corporate enterprise is a necessity to allow a business on a large scale function efficiently. Communication must be established and maintained to prevent disjointed business practices and advancements. The ability to share knowledge on a widespread basis not only will increase the productivity of the enterprise by collaboration, but can improve intra and extra communication between business partners and customers. Businesses which operate on many platforms and work with various operating systems require that some level of architecture is present to allow these separate entities work well with one another. (Soto-Acosta & Merono-Cerdan, 2007) A functional corporate intranet is a vital step in applying and utilizing enterprise architecture to improve performance of the corporation. Solely using messaging and email services are not adequate in conveying information across a company with individual departments and a large number of employees. Besides the high cost of doing so, the ability to find and seek out individuals or groups to achieve certain tasks cannot be expressed. As a result, intra-nets that invoke user participation and collaboration are most effective (Lai, 2001). Intranets themselves have a wide variety of applications, ranging from a high accuracy of information to increased teamwork and lower costs (Baptista et al, 2006).

Networking technologies have many applications within an enterprise beyond the ability for systems to operate efficiently. In fact, many businesses have integrated systems and have developed streamlined architectures to achieve tasks such as improving supply chains, helping production, and large scale monitoring and maintenance (Fang et al, 2008). The application of interoperability is the result of a breakthrough in architecture design – instead of an integrated enterprise system, in which one, cohesive unit is created as a result of the combination of various smaller entities, architecture is now interoperable, in which smaller units act independently from each other. This allows the models of the enterprise to become decentralized, allowing for optimization.

On the micro level we see the importance of human-computer interaction. This involves direct contact between the user and the machine and is now the forefront of improving the performance and proficiency of a corporate environment. In order for the services and components of interoperable systems to be effected on an end-user level, they must be designed in an efficient manner to allow users to fully comprehend and be capable of utilizing the architecture to its full potential. As our knowledge and technological proficiency of computers increase, the importance of having a viable user interface becomes increasingly significant. For example, if one was to create a program that was to document the illnesses of various patients, it would be extremely important for the user to be able to navigate and easily access all the information that is stored.

By using specific values and metrics, researchers and designers can formulate the easiest and most efficient methods of displaying information (Bradley & Lang 1994) (Takatalo et al, 2008). Little research has been conducted focusing the impact that HCI improvements have on interoperable architectures and the resulting productivity.

When testing human computer interaction, previous research has stressed the importance of evaluating and creating an experiment based on a framework of usability. According to Erik

"A functional corporate intranet is a vital step in applying and utilizing enterprise architecture to improve performance of the corporation"

A Preliminary Study in Corporate Communication (cont.)

Frøkjær, Morten Hertzum, and Kasper Hornbæk,[1] it is vital that experiments of this nature are measured on a scale of usability (Frøkjær et al, 2000). They apply the ISO's (International Organization for Standardization) definition of the term that is comprised of three unrelated factors:

Effectiveness: The accuracy and completeness with which users achieve certain goals

Efficiency: The relation between the accuracy and completeness with which users achieve certain goals and the resources expended in achieving them. (ie: completion and learning time)

Satisfaction: The users' comfort with and positive attitudes towards the use of the system.

It would seem that in a corporate environment, effectiveness and efficiency would be the only important factors when designing interfaces. However, if these complex architectures are to well-received and reused within the enterprise, all of the criteria must be satisfied. Effectiveness and efficiency are qualities that can be measured quantitatively and can be gathered with proper tools. Satisfaction, however, is a much more complex concept.

Gitte Lindgaard and Cathy Dudek illustrate how user satisfaction often stems by comparison with previous experiences with a particular system (Lindgaard et al, 2003). As a user is exposed to a system as it progresses, the user is able to determine whether or not he/she is "satisfied" with the alterations. Thus, the measurements pertaining to user opinions can be justly boiled down to simple, point scale questions:

Do you feel that the tools were effective to find the information that you needed?

Do you feel that the amount of time it took to achieve your task was adequate?

Are you satisfied with the improvements made to the services?

Each one of the questions deals with effectiveness, efficiency, and satisfaction, respectively. The reasoning behind the wording of question two (as opposed to a simple question inquiring how long it took to find information) allows users to express universal opinions about the service, regardless of what he or

she was originally seeking. Definitions of some of the terms within the questions (satisfaction, effective) should be defined for the user, but this allows non-intrusive data to be collected that can be gathered quickly without disturbing normal operation. These questions, backed up with quantitative metrics, should be enough to validate findings.

Baptista, J, Backhouse, J, & Canhoto, A (2006). *Social, Behavioral, and Organizational Aspects of Information Systems*. 1-16.

Bradley and Lang, 1994 M.M. Bradley and P.J. Lang, *Journal of Behavior Therapy and Experimental Psychiatry 25,* (1994), pp. 49–59.

Fang, Y, Ling, B, Chou, T, Lin, Y, & Lieng, J (2008). *Expert Systems with Applications*. *26*, 5784-5792.

Lai, V., 2001. Communications of the ACM 44 (7), 95–100.

Molina A., Panetto H., Chen D., Whitman L., Chapurlat V., Vernadat F.B. (2007). 16/4. December, Informatics and Control Publications. ISSN 1220-1766

Takatalo, J, Nyman, G, & Laaksonen, L (2008) *Computers in Human Behavior 24,*1-15.

Soto-Acosta, P, & Merono-Cerdan, A (2007). *Telematics and Informatics*. *26*, 211-221.

Synesthesia, by Naimah Hakim
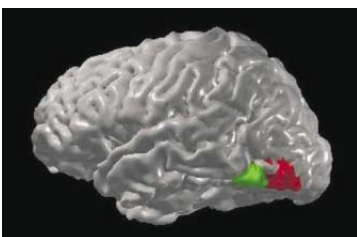
Visual area 4 in red, number grapheme area in green. Image from: V.S. Ramachandran and E.M. Hubbart in Journal of Consciousness Studies, 8, No. 12, 2001, pp. 3–34

In the words of Ramachandran and Hubbard, "Imagine a world in which the number '2' is pink, the word 'computer' tastes of jellybeans, and F# has a conical shape" (Ward and Mattingley, 2006). For a person with living with synaesthesia, these seemingly far-fetched experiences become an astonishing reality. Synaesthesia is often described as a psychophysical condition in which a person experiences sensations in one modality due to the simultaneous stimulation of a second modality (Ramachandran and Hubbard, 2001). Modalities refer to any of the five senses, sight, smell, taste, hearing, and

touch. Thus, synaesthesia results from a connection existing between two senses that normally function separately. In fact, the word "synaesthesia" derives from Greek roots, "syn," meaning union, and "aesthesis," meaning sensation (Asher, et al., 2006).

As there are five known senses and various sub-categories within these modalities, it is no wonder that synaesthesia comes in a variety of forms. The most common and widely studied form is known as grapheme-color synaesthesia. A grapheme is any kind of typed symbol, from a numeral to any of the

letters of the alphabet. Synaesthetes with this condition experience induced colors upon reading symbols, typically letters, or viewing words. For this reason, this form of synaesthesia is also sometimes referred to as linguistic-color (Barnett et. al., 2007). Although many believe that there is a general, universal mechanism on a neurological level that causes the occurrence of synaesthesia, the personal experiences resulting from the latter can vary tremendously between synaesthetes (Barnett et. al., 2007). While some experience synaethetic colors upon viewing entire

Synesthesia (cont.)

words, others see individual letters with a distinct induced color. The means by which a person sees these colors can also vary between people. Some, known as "projector" synaesthetes, express perceiving the colors in "external space." Others with "associator" synaesthesia report the colors existing more in the "mind's eye" (Barnett et. al., 2007). Even the elicited colors are relative to the individual synaesthete. For one synaesthete, the letter "Q" may render as yellow, whereas the same symbol may render as purple to a different person with grapheme-color synaesthesia. Many synaesthetes are subject to idiosyncracies when a word's elicitation does not correlate with its meaning, an occurrence known as "alien-color-effect" (ACE) (Wardand Mattingly, 2006). For example, this might occur if the word "blue" induces a red synaesthetic color, despite premeditated logistics. Although there is a variety of differences by which synaesthesia is expressed, synaesthets are united by a few inalienable traits. As alien-color-effect would support, synaesthesia is a "conscious perceptual" experience that is automatic, obligatory, and consistent over the years (Ward and Mattingley, 2006). Despite their individual differences, the fact that synaesthetes have constant experiences over time makes their unique condition testable.

Today, many studies on synaesthesia are being conducted on many faces of the planet. However, synaesthesia has not always been regarded in this manner. In fact, some people initially refused to believe that synaesthesia even existed. Synaesthesia was first coherently documented by Galton in 1880, who observed that synaesthesia usually ran in families. Since then many scientists have dismissed synaesthetic allegations as mere "romantic neurology"

and that the claimers were just seeking attention or being metaphorical (Humphrey 1990). Others blamed drug usage and pursued the field no further (Ramachandran and Hubbard, 2001). However, none of these hypotheses address the many factors that do support synaesthesia's scientific legitimacy or necessarily prove anything. It is from here that many synaesthetic experiments began to bloom.

Initially, most experiments of the past have aimed to take various forms of synaesthesia and prove their scientific legitimacy. In other words, scientists want to find evidence that supports that synaesthesia is a genuine perceptual condition. During the last thirty years, the most common form of methodology has been to develop a type of test that is given to a sample of synaesthetes and non-synaesthetes, the control group. The test is usually designed to give synaesthetes an inherit advantage to accomplishing the task due to their condition over the controls. Thus, it is reasoned that if synaesthetes are able to better perform the task, their synaesthesia must be perceivable. This concept was perhaps most famously first applied by Baron-Cohen in 1987, in which a synaesthete was asked to describe the elicited colors experienced by 103 words and sounds, unaware that they were to be later retested. A nonk-synaesthete was also tested, but asked to memorize the word list, aware of a later examination. Upon being asked to recall the word list two weeks later, the control subject showed a 17% consistency while the synaesthete showed a 100% consistency after two weeks, and maintained that percentile after ten weeks as well. This procedure, known as the Test of Genuineness (TOG) has become a "golden standard" in terms of synaesthetic diagnostic tests (Asher, et. al,

2006).

The partnership of Ramachandran and Hubbard has also made great strides in probing that synaesthesia is a true perceptual experience and not "bogus." Their main method is through the use of a visual search task. Visual search tests also bias synaesthetes by giving them an advantage, for it allows them to use they synaesthesia to perform a perceptual task that normal people would find nearly impossible. One of the first experiments Ramachandran and Hubbard created was a paradigm modeled as a matrix that was filled with various shapes that were similar in form (eg. 5's and 2's) in which one of the shapes created a hidden, underlying shape amidst the second shape. The task was simple; within a given relatively short time-frame, identify the underlying shape. The controls struggled, whereas the synaesthetes excelled, as predicted (Ramachandran and Hubbard, 2006). One might better understand the reasoning behind the synaesthete's success through an anecdote. If colorblind men were asked to identify the colors of a pile of assorted socks, one would imagine that they would have great difficulty. This is because the blind men do not have the means of perceiving the criteria by which to differentiate between the socks. In Ramachandran and Hubbard's experiment, the controls are like the colorblind men. The controls are not perceptually well equipped to determine the underlying shape. However, the experiment proves that synaesthesia is a genuine experience that gives people a perceptual advantage.

I first learned about synaesthesia a number of years ago, when a friend mentioned reading a book about a character that "smelled colors" and "tasted sounds." Upon hearing of such a bizarre, unique condi-

"Imagine a world in which the number '2' is pink, the word 'computer' tastes of jellybeans, and F# has a conical shape"

Synesthesia (Cont.)

tion, I never quite forgot the spark of curiosity that it ignited in me. Shortly afterward, I recalled my sister's odd mannerisms of dressing herself, in which she reserved pink outfits for Mondays and blue articles for Tuesdays. By connecting the dots, my curiosity returned, recognizing the synaesthetic tendencies that my sister expressed. It was from there that I began my research on synaesthesia. Since my initial gathering of information, I have gone on to propose and develop ideas of my own pertaining to synaesthesia. For example, I often note how, in several articles, it must be difficult to conduct experiments with large, accurate sample sizes when scientists must often rely heavily on the sole personal, varying perceptual descriptions of the synaesthete. It is true that scientists can only do their best in selecting trusted subjects to question. However, each subject may describe given circumstances in different ways, information that can throw off results. In addition, the term "synaesthesia" is becoming overly-used and encompasses such a wide array of concepts that its meaning is becoming vague and loose (Barnett et. al., 2008). For these reasons, I hypothesize that a standardized classification system must be developed to categorize the different synaesthetes by the kind of synaesthesia they have, the type of experience is elic-

> *"...a higher percentage of synaesthetes tend to be artists, poets, novelists, and professions of the like."*

ited, the area if the brain affected, etc. This would help to reduce some of the error in experiments and create more accurate data with which to compare the independent and dependent variables of the experiments.

Another topic that has interested me is the development of synaesthesia. As I have personally experienced through my relations with my sister, not all people have synaesthesia, but most do have subliminal synaesthetic tendencies, whether they be expressed through metaphor development or clothing choice. Thus, I hypothesize that all children are born with some form of synaesthesia, but that the condition is lost due to neurological pruning and differentiation. It would be my goal in the future to test this hypothesis out by questioning children.

Thirdly, it greatly interests me that a higher percentage of synaesthetes tend to be artists, poets, novelists, and professions of the like. I would think that most people go into a professional field because they are talented in their "art." As Ramachandran and Hubbard's tests demonstrate, many synaesthetes have an inherit perceptual edge over others. Thus, perhaps it is because of this perceptual advantage that synaesthetes that are drawn to the arts, a profession that emphasizes original perception. Thus, on a neurological level,

the cross-wiring of sections V4 and V8, the theorized neural basis of synaesthesia, may cause superior artistic talents in humans (Ramachandran and Hubbard, 2001). However, what about other professions? Why are some people drawn toward art, while others are inclined to sports or academics? Why do others excel in more than one? From my studies on synaesthesia, I would reason that athletes must have some type of different cross-wiring in different parts of the brain that allows them to have an athletic advantage. Moreover, superior intellectuals must have more cross-activation in areas of the brain that emphasize higher cognitive thought. People who find themselves with a variety of talents must have cross-activation occurring at multiple levels.

Asher, J. E., Aitken, M. R., Farooqi, N., Kurman, S., & Baron-Cohen, S. (2006). *Cortex*, 137-146.

Barnett, K. J., Finucane, C., Asher, J. E., Bargary, G., Corvin, A. P., Newell, F. N., et al. (2008). *Cognition*. (106) 2 871-893

Hubbard, E. M., & Ramachandran, V. S. (2005, October 10). *Neuron, 48*(3), 509-520.

Ramachandran, V. S., & Hubbard, E. M. (n.d.). *The Royal Society*.

Ramachandran, V. S., & Hubbard, E. M. (2001, November 12). *Journal of Consciousness Studies*, 3-34.

Ward, J., & Mattingley, J. B. (2006). *Cortex*, 129-136.

The Biomechanics of Pitching and the Maintenance and Reconstruction of the Elbow, by Daniel Briggi

The overhand throwing motion is one of the most unnatural in all of sports. The motion causes repeated stress to the tendons and ligaments of the elbow, causing microtears, and, over time, complete tears. These problems caused by overhand throwing can be solved through surgery, but no surgical

method stands out as the best, and none comes close to producing a strength equal to that of the intact ligament. By perfecting the techniques used to rebuild the elbow and finding new ways to prevent injury, professional baseball will be able to keep its best players on the field, maintaining the high-

est levels of competition and saving teams from losing millions of dollars in investments. Most often, the Ulnar Collateral Ligament of the elbow is the area most affected by throwing. This ligament connects the humerus of the upper arm to the ulna of the forearm. Injuries to this soft tissue, including

The Biomechanics of Pitching and the Maintenance and Reconstruction of the Elbow (Cont.)

the tendons connecting the ligament to the bones, take a great deal of time to heal and, if severe enough, remove the possibility of competition. However, these injuries do not bring about problems in daily life, as household chores are not made more difficult. This supports the concept that this injury causing activity is unnatural. Injuries to the elbow, specifically, but really any part of the body, can be classified as acute or chronic. Acute injuries are those that have rapid onset, while chronic injuries occur over a long period time. Most of the injuries caused by the throwing motion are chronic, as pitching places repeated stress on the elbow. Two junctions, or points where different tissues are connected, are sites for the injuries caused by the throwing motion. The first is the Musculotendinous Junction, or MTJ. At this site, the muscle and tendon are connected. Because muscle can withstand much less stress than the tendon, this interface is the most vulnerable to injury. Another junction critical to the elbow's stability is the Osteotendinous junction, also known as the OTJ. At this point of connection, the bone and tendon meet (Lin, 2003). Many methods of reconstruction are performed by inserting the tendon into the bone tunnel, which has been shown to heal inward (Rodeo, 1993).

For the athlete, injuries to the tendon seemingly take forever to heal. Right after the injury occurs, the area around the tendon becomes inflamed as the surrounding blood vessels burst and clot, forming a hematoma. New chemicals, proteins, and fluids are then introduced to the injury site. The next step in the lengthy healing process is proliferation. During this stage, type III collagen levels peak, and a great deal of protein collects in the area, in an attempt to replace the torn soft tissue.

Finally, the remodeling and maturation stage takes place, in which type I collagen returns and the previously red scar becomes lighter in color and connects the two sides. This entire healing process can take upwards of a year. Even as months and years pass, however, the tendon will never regain the strength or resilience it had before the injury (Lin, 2003).

The debate regarding whether the body heals intrinsically or extrinsically has become a stalemate in recent years (Lin, 2003). Intrinsic healing suggests that the injured area heals from within, as the tendon covering rapidly produces new tissue to heal the injured tendon. Intrinsic healing requires an internal blood supply, and does not allow for the formation of adhesions, or scar tissue (Mass and Tuel, 1991). On the other hand, the theory of extrinsic healing suggests that the tendon can not heal on its own. An outside blood supply supports the formation of scar tissue, and the infiltration of inflammatory cells and fibroblasts is required for the tendon to properly heal (Potenza, 1969). Despite both arguments having credibility, neither is clearly correct. It is probable that a combination of the two exists to heal the tendon, depending on location, severity, tendon mobility, and the availability of a blood supply. If this balance were to become better understood in the future, surgeons could make improvements to procedures improve treatment, optimize strength, and reduce time of recovery (Lin, 2003).

Soft tissue, such as that holding the humerus and ulna together in the elbow, is composed of collagen. As the smallest structure that a tendon is composed of, collagen is a fibrous protein that makes up eighty-six percent of the dry weight of a hu-

man's collective tendons. It must be noted, however, that water makes up between sixty and eighty percent of the tendon's total weight (Woo, 2000b).

Prolotherapy is a procedure designed to induce the proliferation of new cells through local irritation. Investigated as a treatment for various sources of pain, including arthritis and tendinitis, it involves a series of injections, mainly composed of dextrose. In a small study of subjects with lateral epicondylosis, or tennis elbow, it was shown that prolotherapy greatly reduces pain while improving strength substantially. Despite the need for a larger study, there is potential for prolotherapy to stabilize the throwing elbow because of the similarity between medial epicondylosis and Ulnar Collateral Ligament tears (Regence, 1997). As the injections stimulate the local production of collagen, the elbow could be more fibrous and therefore have greater strength. Because the injections also reduce pain in the affected area, pitchers will be able to withstand more activity than if they went without.

Different procedures have been tested on patients to mend a tear of the Ulnar Collateral Ligament in the Elbow. After an athlete has been injured, the surgery is intended to replace as much of the original strength as possible while minimizing the time needed to rehabilitate and recover. The surgery involves an import of tissue, known as a graft. The imported tendon replaces the injured one, and often has more collagen than the tendon before injury. Of the many problems associated with the repair of the elbow, joint gapping of more than two inches is considered to be incompetent (Field) and sutures, the surgical thread holding the graft together and often connecting it to bone,

"...the Ulnar Collateral Ligament of the elbow is the area most affected by throwing"

The Biomechanics of Pitching and the Maintenance and Reconstruction of the Elbow (Cont.)

have a tendency to pull out. Another problem associated with elbow reconstruction is the transportation of the Ulnar Nerve. By utilizing the muscle splitting approach, which involves cutting the tendon lengthwise, the average twenty-one percent of patients facing symptoms due to Ulnar Nerve complication is reduced. This also allows for a higher percentage of athletes to return to their previous level of competition.

Post surgery, rehabilitation includes over a year of work, including weeks of immobilization and only gradual improvement. Only after sixteen weeks can a patient begin to throw a baseball again (USA Today, 2003). Various techniques have been tested in order to find the optimal method of reconstruction and least time required for rehabilitation.

Historically, the Jobe technique has been the method of elbow reconstruction. Its origins are with the pitcher Tommy John, who was in desperate need of help after a complete tear and found that help during a visit with Dr. Frank Jobe, who gave him very poor odds of recovery. However, after the surgery, he returned to the majors and was arguably better than before. Different studies have boasted different statistics, but the traditional Jobe technique allows sixty-eight percent of athletes to return to the previous level of competition (Conway, 1992) while the muscle splitting approach improves that to eighty-two percent (Thompson, 2001). Today, this method of surgery is known as the figure eight reconstruction.

This reconstructive technique uses the Palmaris tendon from the inside of the wrist. The figure eight procedure uses two strands, cut lengthwise and connected at the repair site. Tunnels are drilled in the humerus and the ulna, one across

"With advances in the prevention, treatment, and surgical techniques in this field, individuals may be able to compete at a higher level for a longer time"

the width of the ulna and two drilled almost parallel lengthwise in the humerus. The graft is then inserted into the drill holes, forming a continuous loop crossing at the joint. Though used most often, this method has been shown to allow for a great deal of joint gapping and displays little strength compared to the other methods tested and the intact ligament (Armstrong, 2005).

Another method for elbow reconstruction that has been employed is the Docking procedure. This is a single strand reconstruction, using sutures to hold the tendon to the humerus. In the ulna, a hole is drilled similarly to that of the figure eight procedure, but there is only one large drill hole in the humerus, with two of minimal size above for suture fixation. The graft was threaded through the hole in the ulna and both ends were inserted into the humeral tunnel. The main cause of failure for this method had to do with the suture pulling out of its drill holes. Despite being one of the strongest reconstructions tested, it could not provide the same strength and stability to the elbow that the intact ligament could (Armstrong, 2005).

The third surgical procedure done in the study included the use of the interference screw for fixation. This is also a single strand reconstruction, as only one graft is used to stabilize the elbow. Two holes were drilled lengthwise, one in the humerus and one in the ulna. The end inserted into the ulna was folded and held in place with an interference screw, which was also forced into the drill hole. At the humeral attachment site, the ends were attached with sutures. This method also produces relatively successful results, but could not compare to the strength of the intact ligament. The most glaring prob-

lem with this technique is the harshness of the edges of the interference screw. When inserted into the ulna with the graft, it damaged the tissue. However, if a screw with softer edges is created, this method holds promise (Armstrong, 2005).

The EndoButton was originally created for surgical use in the femur. It is a small device with a plastic end intended to stay outside of the tunnel and a loop of thread intended to hold the graft inside the tunnel. The procedure was done with a single strand and utilized one drill hole in the ulna and another in the humerus. The EndoButton was threaded with the graft and held the imported tissue inside the drill hole in the ulna. Similar to the Docking and Interference Screw procedures, this reconstruction also connected the graft to the humerus with sutures. Despite the device being too large, this technique showed promise as the point of failure was often at the humeral attachment. In these cases, if the sutures could better attach tendon to bone, the repaired elbow may be able to withstand loads similar to those of the intact ligament (Armstrong, 2005).

With advances in the prevention, treatment, and surgical techniques in this field, individuals may be able to compete at a higher level for a longer time, saving money for the team because they will have to deal with fewer injured players, competitive baseball will be able to maintain a higher performance level, and the athlete will have the opportunity to extend his career without being permanently derailed by injury.

Armstrong, A.D., Dunning, C.E., Ferreira, L.M., Faber, K.J., Johnson, J.A., King, G.J.W., 2005. Journal of Shoulder and Elbow Surgery, 14, 2, pp. 207-215.

J.E. Conway, F.W. Jobe, R.E. Glous-

The Biomechanics of Pitching and the Maintenance and Reconstruction of the Elbow (Cont.)

man and M. Pink, *J Bone Joint Surg Am* 74 (1992), pp. 67–83.

Dodd, Mike. (29 July, 2003). USA Today

L.D. Field and D.W. Altchek, *Am J Sports Med* 24 (1996), pp. 177–181.

Lin, T.W., Cardenas, L., Soslowsky, L.J., 2003. Journal of Biomechanics 37, 865-877.

Mass, D.P., Tuel, R.J., 1991. Journal of Hand Surgery-American Volume 16, 24-30.

Potenza, A., 1969. Mechanisms of healing of digital flexor tendons. Hand 1, 40-41.

Rodeo, S.A., Arnoczky, S.P., Torzilli, P.A., Hidaka, C., Warren, R.F., 1993. Journal of Bone and Joint Surgery-American Volume 75, 1795-1803.

W.H. Thompson, F.W. Jobe, L.A.

Yocum and M.M. Pink, *J Shoulder Elbow Surg* 10 (2001), pp. 152–157.

Woo, S.L., Debski, R.E., Zeminski, J., Abramowitch, S.D., Saw, S.S., Fenwick, J.A., 2000b. Annual Review of Biomedical Engineering 2, 83-118.

1997. Medicine Section-Prolotherapy. Regence. Retrieved January 11, 2009

Possible Uses of Phytochemicals to Prevent Cancer from Spreading through Mitosis, by Danielle Astarita

Breast cancer, the most widespread among women, is currently on the increase as the baby-boom generation continues to increase the population. There are many different forms of cancer. They all originate from the cells that line the skin in the breast lobules or the ducts (Goldman, I.L., 2003). Non-invasive carcinoma remains within the breast and is called "in situ" (Goldman, I.L., 2003). DCIS (ductal carcinoma in situ) and LCIS (lobular carcinoma in situ) are both examples of "in situ" (non-invasive) carcinomas (Symptoms & Diagnosis). The other main group of cancer is invasive. Invasive, or infiltrating carcinoma, can spread via bloodstream and lymph nodes into other areas of the body (Symptoms & Diagnosis). Invasive carcinomas can also occur in the duct or lobules (IDC or ILC) (Symptoms & Diagnosis). It has been shown that the two most common ways invasive cancer presents itself is through papal masses, which are typically 2.4 cm in diameter and have 58% lymph node metastases, and through mammographic densities, typically 1.1 cm with only a 14% lymph node metastasis (Kumar, Abbas, Fausto et.al ;). Calcifications are

the most common cause of DCIS; however papal masses are more commonly the cause of LCIS (Kumar, Abbas, Fausto et.al ;). The risk for developing invasive breast carcinoma (based on a one to ten scale with ten at the highest) ranks non-proliferative changes at none-low risk (around 1), followed by proliferative disease without atypia (atypical increase in cells) at a 1.5-2.0. When atypia does occur, the risk increases to 4.0-5.0. The highest risk is attributed to carcinoma in situ (8.0-10.0) (Kumar, Abbas, Fausto et.al ;). Two hereditary and highly dominant genes, BRCA1 and BRCA2 are attributed to carcinoma, typically associated with a mutation in p53 (Kumar, Abbas, Fausto et.al ;) (The Cell Cycle). Tumors are caused when the rate of proliferation increases, but apoptosis remains at the same rate (The Cell Cycle). One of the treatments for breast cancer is to remove papal masses/ tumors, which is made much easier if the carcinoma is in situ. Undergoing chemotherapy or radiation treatment is another option for cancer patients of all varieties (Kumar, Abbas, Fausto et.al ;). However, a new treatment, phytochemicals, has a

history that goes back in time.

Phytochemicals are plant derived substances that have been used for medicinal purposes reaching as far back in history as we can (Goldman, I.L., 2003). Nutritional science has come to humans in several different stages, the first was called the naturalistic era in which homeopathic medicines were considered supernatural because we did not understand the laws of science that made these medicines function. The next era we phase into is the chemical-analytical era, in which the analysis of food (as well as everything else) became very chemical, since we were (at that time) learning about atoms and molecules, we could now think of ways to make medicine better for ourselves (Goldman, I.L., 2003). The last phase is a more advanced throwback of the naturalistic era scientists' call the biological era. We have recently recognized the incredible purpose of fruits and vegetable and have now tried to work them back into our diets and lifestyles (What are Phytochemicals). A vast majority of phytochemicals have been discovered and classified, including saponin, which

"Phytochemicals are plant derived substances that have been used for medicinal purposes reaching as far back in history as we can."

Possible Uses of Phytochemicals to Prevent Cancer from Spreading Through Mitosis (cont.)

control the DNA replication, making them able to stop the proliferation of cancer cells (What are Phytochemicals). Others, like capsaicin, protect the DNA from carcinogens (What are Phytochemicals).

Many studies have been done to show this correlation. Two of which written by Dr. J.M. Wu have observed reservatrol, and one more specifically, its effect on p53 production (Wu et.al, 2005). Reservatrol, a grape derived extract, allowed for a significant increase in p53 expression (Wu et.al, 2005). Another article written by Dr. J.M.

Wu et.al; showed the way ponicidin and oridonin (different types of diterpenoids) have an effect on the cell cycle, proliferation, and protein expression with cell line MDA-MB-231, MCF-7, and MCF-10A (Wu et.al, 2005).

Dixon, Michael. J Breast Cancer. Net Doctor, from http://www.netdoctor.co.uk/diseases/facts/breastcancer.htm

Goldman, I.L. (April-June 2003). Horttechnology 13(2) 252-258,

Kumar, Abbas, Fausto et.al;, Pathological Basis of Disease. Symptoms and Diagnosis. 11/11/08. breast-cancer.org, from

http://www.breastcancer.org/symptoms/

The Cell Cycle. Retrieved 11/20/08, Web site: http://users.rcn.com/jkimball.ma.ultranes/BiologyPages/C/CellCycle.html

What are Phytochemicals?. Retrieved 2008, Web site: http://www.phytochemicals.info/

Wu Et.al;, Joseph M (05/9/15). Biochemical and Biophysical Communications, (337) 224-231

Wu Et.al;, Joseph M (05/6/27). Biochemical and Biophysical Communications (334) 223-230

An Exploration of Congenital Insensitivity to Pain with Anhidrosis (CIPA), by Sophie Ruff.

Congenital Insensitivity to Pain with Anhidrosis (CIPA) is an extremely rare disease affecting less than 200 patients worldwide. CIPA is congenital, meaning it is not developed, but rather is present at birth. CIPA causes a loss of response to painful stimuli and inability to regulate body temperature through sweating. Although it is difficult for the unaffected human to understand, pain is actually an important factor for a regular human life. Imagine a world in which you fall down and break a leg. But there is no indication in your brain of any pain. You get up and continue with your life for days, maybe weeks, possibly with a slightly awkward feeling, but without pain, your body's indication that something is wrong, what may start out as a minor break will continue to fester. This is a normal occurrence for a CIPA patient. Many patients, when teething as a toddler, chew off fingers and toes, unaware that they are damaging their bodies. Blood is not a sign of injury to them, but a strange side effect

of chewing on their fingers and lips, never mentally linked to pain. They must be taught that blood is bad and that they must be careful, which can be very difficult for young babies that do not speak clearly yet. Overheating and high fevers are also a major problem in CIPA patients, as their bodies do not monitor their temperatures. A majority of CIPA patients die before reaching adulthood because of this overheating. Needing to go to the bathroom is actually a form of pain, and therefore CIPA patients often need a timer to tell them when to go to the bathroom. Mental retardation is also a common symptom in CIPA patients. It is not a life free of pain and difficulties, but a harsh existence with problems unfathomable to the average mind (Benson, 2007).

For a long time, CIPA was diagnosed based on clinical symptoms, such as frequent overheating, unknown injuries, and sometimes slight mental retardation. Now, with more re-

search done on the genetic causes of CIPA, CIPA could be diagnosed as early as birth through genetic testing. The following articles performed groundbreaking experiments to further genetic diagnosis of CIPA.

Yasuhiro Indo led a groundbreaking study to identify the genetic cause of CIPA. He hypothesized that CIPA is caused by a genetic mutation in the TRKA gene. He used a background research that discovered that mice with characteristics similar to humans with CIPA have mutations in the TRKA gene, causing him to perform this experiment. He first tested the genes of 100 non-CIPA patients as a control to ensure that non-CIPA patients do not possess this gene mutation. He then gathered nine CIPA patients from seven different families, noting that five of these families were made from consanguineous parents. All of the CIPA patients showed the classic symptoms including loss of response to painful stimuli and

An Exploration of Congenital Insensitivity to Pain with Anhidrosis (CIPA), (cont.)

inability to sweat. The TRKA genes of the patients were amplified in vectors and then scanned for mutations using exon trap analysis. All patients showed significant mutations in the TRKA gene, but they were a variety of different types of mutations, including novel, missense, nonsense, frameshift, and splice-site. Obviously the results were conclusive that CIPA patients possess mutations in the TRKA gene, but the small testing pool with only nine patients left the experiment needing further confirmation in future experiments for solid results (Indo et al, 1999). More recently, in February 2008, Kathrin Huehne led an experiment furthering Indo's findings on TRKA mutations associated with CIPA. She discusses hereditary sensory and autonomic neuropathies (HSAN), the broader category of pain insensitive diseases. But, she focuses on HSAN IV, more commonly known as CIPA. Knowing that the TRKA gene contributes to the transduction of nerve growth factor, which maintains the survival and growth of sensory neurons, she also uses the previous testings on mice to hypothesize that mutations in the TRKA gene may lead to CIPA. She had a pool of five unrelated CIPA patients and one patient with hereditary motor and sensory neuropathy as well as impairment of the autonomic nervous system, another type of HSAN. Seventeen exons of the TRKA gene were amplified using polymerase chain reaction (PCR). Distinct novel missense mutations were found within the CIPA patients, But, one of the CIPA patients and the other non-CIPA HSAN patient were found with no mutations in the TRKA gene. Notably, these patients were also found to have otherwise normal mental development, and since mental retardation is considered a normally prevalent symptom in CIPA, it is likely that these patients have

something slightly different than CIPA after all. The article concludes that CIPA's defective neural crest differentiation is likely due to a mutation in the TRKA gene, but that not all patients with CIPA-like symptoms, ie. insensitivity to pain and anhidrosis, will necessarily possess this mutation, making further studies important (Huehne et al, 2007).

Later in 2008, an experiment was conducted not having to do with the actual insensitivity to pain caused by the TRKA mutations, but other things that nerve growth factor effects in CIPA patient. Avraham Beigelman led an experiment designed to further explore the ineffective function of nerve growth factor in CIPA patients. But, the experiment acknowledges and was dependent on the mutation in the TRKA gene causing the ineffective transduction of nerve growth factor (NGF). NGF is a 120 amino acid neurotrophin that maintains the survival and growth of sensory neurons, causing the insensitivity to pain present in CIPA patients, but it also has immunologic effects. Beigelman sets out to explain the high rate of infection in some CIPA patients, hypothesizing that chemotaxis will be impaired in CIPA patients due to the abnormal transduction of nerve growth factor. Chemotaxis is the attraction of cells to some other substance, ie. sperm attraction to egg, bacteria fleeing from poison or bacteria migrating towards nutrition, and is the most basic of instincts. Chemotaxis in this study is referring to the gathering of bacteria around a wound to start healing. Thirteen CIPA patients' chemotaxis was assessed and compared to one hundred control non-CIPA patients. The result was severely impaired chemotaxis in the CIPA patients that possessed infections, but a higher rate of chemotaxis in the more healthily healing CIPA patients. Then,

NGF was found to not actually be the cause of this chemotaxis. Instead, results showed that fMLP, a strong chemoattractant, was increasing chemotaxis. Chemotaxis was then performed on the control in the presence of NGF, and this showed that NGF did significantly effect the migration of bacteria to the fMLP. Contrarily, NGF did not have this effect in the CIPA patients. The experiment concluded that although NGF did not have a direct effect on chemotaxis, it did have an enhancing effect on the chemotaxis migration to fMLP. For this reason, the high rate of infection and impaired chemotaxis in CIPA patients is probably due to the genetic mutation in the TRKA gene causing a flawed transduction of NGF (Beigelman et al, 2008).

In November of 2008, Elin Larsson piloted an experiment not involving HSAN IV(CIPA) patients, but HSANV, a less severe but related disease. In the experiment, Larsson uses this information to investigate the functional consequences of mutated NGF's inability to induce the differentiation of PC12 cells. PC12 cells are cancerous cells obtained from a rat that normally upon being treated with NGF will stop dividing and differentiate. To test the effect of the mutant NGF on PC12 cells, PC12 cells were obtained and then treated with either empty vectors (negative control), normal human NGF (positive control), or HSANV (variable). The PC12 cells were then left to sit and grow for forty eight hours. The PC12 cells were analyzed using a variety of different methods, including western blot, protease cleavage, in vitro transcription and translation, pulse chase study, secretion studies, immunocytochemical staining, and microscopy. The results of the study showed that there was not only a decrease in the secretion of NGF, but NGF had defective

"CIPA causes a loss of response to painful stimuli and inability to regulate body temperature through sweating."

An Exploration of Congenital Insensitivity to Pain with Anhidrosis (CIPA), (cont.)

transduction with its receptors and therefore was unable to induce PC12 differentiation. In fact, the mutated NGF was secreted thirty times less than the normal human's NGF in PC12 cell lines. It is noted that future studies will include the purification of the mutated NGF so as not to affect the testing of the receptor binder affinities (Larsson et al, 2008).

Regarding the research about mutations causing CIPA, we need to explore the cause of pain insensitivity in patients without mental retardation who lack the TRKA mutation. The

research done to find the cause of and find out more about CIPA has various important applications. Diagnosing CIPA concretely and early on with a genetic test prevents the self mutilation and unknown injuries that often happens early in a CIPA patient's life. The more that is known about CIPA, the closer we are to finding a cure.

Beigelman, A., Levy, J., Hadad, N., Pinsk, V., Haim, A., Fruchtman, Y., et al. (2008). Clinical Immunology, (130) 365-372

Benson, B. (n.d.). The Facts About Congenital Insensitivity to Pain with Anhidrosis. In Associated Content.

Retrieved August 7, 2007, www.associatedcontent.com/article/336594/the_facts_about_congenital_insensitivity.html

Huehne, K., Zweier, C., Raab, K., Odent, S., Bonnaure-Mallet, M., Sixou, J.-I., et al. (2007). Neuromuscular disorders (18) 159-166

Indo, Y., Mardy, S., Miura, Y., Matsuda, I., Sztriha, L., Frossard, P., et al. (1999). Am. J. Human Genetics (64) 1570-1579

Larsson, E., Kuma, R., Norberg, A., Minde, J., & Holmberg, M. (2008). Neurobiology of Disease (33) 221-228

Implementation of Technology in the Classroom: Towards an Improvement of Students ' Scores and Student/Teacher Relationships, by Shannon Kenny

Society has reached an advanced stage of technological development, and there are new and improved ways to convey information, especially to children whose minds are still open to fresh ideas and concepts (Wang 2008; Eteokleous 2008). Society has also begun to examine the human mind more in depth, and analyze new ways to appeal to the emotions/human bonds while learning (Newberry and Davis 2008). Research findings in both of these areas allow for better intellectual growth, and create higher prospects for the future. It is proven that technology, by using visual learning, helps in the use of brain based learning, and also that relationships/emotions are key factors in the use of brain based learning (Dunman 2007; Cole and Palmer 2008). Brain based learning helps the mind function at a higher level, and helps with student progress (Dunman 2007). Technology is frequently being used in the outside world now as well (Eteokleous 2008), and students should get use to using it so they will be ready for what awaits them in life. For

further experimentation, studies are going to be made on how children and teachers react to these technological tools being used in the classroom, and to the implementation of different styles of teaching in order to examine the affect on the students, teachers, and their bonds. By doing so it is hoped that a new style of classroom dynamic will be introduced, and assist teachers and students in creating a better environment for learning.

Many different scientists have been studying the affect of technology being used in the classroom and the reaction of the students and teachers who were involved in these studies. Learning technologies have been integrated into the classroom, which have created many questions on whether technology truly works in helping both students and teachers. One study demonstrated how technology creates an interactive learning environment where content is more meaningful, real, and relevant (Wang 2008). For example, technology allows students to explore the outside

world, and also introduces them to skills that they will need in the future, since technological skills are becoming more needed in the workforce. Technology also allows students to share their own perspectives, because by using technology they can glean more information than just what the teachers know (Wang 2008). This does not only benefit the student. Teachers can access information they were previously not privy to, and incorporate it into their lessons (Wang 2008). Although technology is a valuable tool for educational uses, it is not used to its full potential. One would think, especially here in the United States where the people are privy to such a vast amount of technology, that technological devices would be used frequently in the classroom. Yet, the US Department of Commerce revealed that education is ranked as the least technology-intensive enterprise among fifty-five sectors (Lowther 2008). It was also found that seventy percent of students are not experiencing the full benefits of effective technology integration (Lowther

The Senteo

Implementation of Technology in the Classroom, (cont.)

2008). This makes further research in the department of technology integration all the more important. Researchers should analyze improved ways to incorporate technology in the classroom in a way that will benefit both student and teacher. Technology has already been proven to be an effective asset to the classroom environment as a tool to increase learning (Lowther 2008). Technology is known to increase student achievement and teacher performance (Lowther 2008). It is also proven that technology promotes critical thinking and problem solving, and that participation of students increases with the use of technology (Wang 2008). Technology is also being used frequently in the outside world (Eteokleous 2008), so it is best if students can gain knowledge about these advanced devices before they are thrown into a world where they will need this important information.

In the research on technology, one study analyzed the reactions of teachers and students using personal and thorough way. They did this by using interviews and questionnaires (Eteokleous 2008). The observer asked the teacher about different sections of the research, such as their personal feelings on computer technology in schools, factors that affected the integration of technology into their classroom, and an open ended question in order to draw out more comments (Eteokleous 2008). The scientist also questioned about how they viewed their students using the equipment for many purposed, such as instructional, personal, and organized (Eteokleous 2008). Students were asked similar questions in a simpler format (Eteokleous 2008). With the interviews, questions were asked about why teachers/students answered in a certain way (Eteokleous 2008). By using

these techniques, the scientist was better able to understand the perceptions of the students/teachers as individuals, and take in all of their commentary. The group was able to express their feelings about the experimentation, and illustrate what they liked, disliked, and what could be changed in the future in an organized way. The scientist then took this data and searched for common themes, which they would then analyze and incorporate in future experimentation (Eteokleous 2008).

Though integrating technology into a classroom seems simple, there are key components that need to be incorporated in order for the transition to go smoothly (Wang 2008). One of these is using the correct teaching strategies, or pedagogy (Wang 2008). These need to be concrete before the transition can commence. Although it would be wonderful if one could define exactly what is necessary for teachers to run a classroom efficiently, it is not so. All that this study states is that teachers need to use the resources given to them wisely, such as technological equipment, and cater to each students' individual needs (Wang 2008). In another study, there are a few suggestions for what would be helpful to a teacher in a technological environment. This study states that teachers need to have good leadership skills and cooperation in the use of technology in the classroom (Eteokleous 2008). The school as whole needs to be an active participant in this process as well (Eteokleous 2008). They need to support the program and provide adequate technological resources (Eteokleous 2008). It is also states that in order to be able to use the technology properly, teachers need extensive training with the device they are using, which is, again, the schools responsibility, but also requires diligence

on the part of the teacher (Eteokleous 2008). Content used during the lesson must be meaningful and relevant to the students, and the student should be able to put in their own perspectives instead of only listening to what the teacher is saying (Wang 2008). This requires the teachers who participate to have an open mind and be perceptive to new ideas (Eteokleous 2008). Students must also work collaboratively, and the content and technology must be easy/simple for them to understand (Wang 2008). Teachers have to be able to easily access information from the technology, which must be "kid friendly", in order to motivate and encourage students, as well (Wang 2008).

Another key component that needs to be included is social interaction and the development of social bonds, especially between teacher and student (Wang 2008). It is scientifically proven that the relationships that children make when they are young, particularly with their educators, affect their behavior in later years (Davis and Newberry 2008). Teachers must be attentive to all students, and attempt to connect with all of them on a personal level (Davis and Newberry 2008). Teachers with a "teacher's pet" are proven to have low closeness level with their students (Davis and Newberry 2008). It is also proven that students need stability, such as being in the same environment every day, in order to form a bond (Davis and Newberry 2008). Teachers may change the location of their class once and a while and there will still be relative stability, but other than that students need to be able to fall into a comfortable routine in order to open up to other, particularly to those who are older and unfamiliar (Davis and Newberry 2008). Teacher and student must also have the same objective, that is, they must both be

"...that a new style of classroom dynamic will be introduced, and assist teachers and students in creating a better environment for learning"

Implementation of Technology in the Classroom, (cont.)

on the same page and both reaching for the same goal (Davis and Newberry 2008). This usually entails that both teacher and student wish for the student to excel in the classroom (Newberry and Davis 2008). Basically, teachers need to watch out for what their students need, and make sure they act as good role models and friends to the children so they can connect and improve. In one study, many teachers were gathered together to analyze their relationships with their students (Davis and Newberry 2008). If there was pressure to form a relationship, it was more difficult to do so (Davis and Newberry 2008). It was also found that if teachers shared the similar qualities to the student they were working with, it was easier to form a bond (Davis and Newberry 2008). Teachers who helped students through challenges were able to connect with them more as well (Davis and Newberry 2008). Yet, some teachers were afraid of feeling vulnerable and receiving rejection, so they acted professional or casual with their students, which pushed them away (Davis and Newberry 2008). These observations are valuable, for now they can be used in later studies. For example, since teachers with similar personalities can connect more with their students, teachers can attempt to relate aspects of their life to aspects of their students' lives in order to show the student that they are not all that different from them. In turn, the student will be able to talk to the teachers about their problems and what they need assist with, creating a stronger bond and allowing the student to excel.

For this experimentation with student/teacher relationships, one study also used interviews in order to understand the response of teachers, just as Eteokleous did. Teachers were

"Researchers are saying how the best style of teaching, in order for the brain to learn on a higher level, is for teachers to teach to each students' individual differences"

asked about who they thought they were in the eyes of their students, the impact of the relationships they made with students, and how they managed their student, either creating closeness or distance (Newberry and Davis 2008). The study also asked how the persona that the teacher showed to their students affected student progress (Newberry and Davis 2008). For example, some teachers act as a guardian/protector to their students, others as friends, and still others as disciplinarians (Newberry and Davis 2008). Teachers were also asked what they understood teacher/student connection to be, and how they judged the relationships they created with their students (Newberry and Davis 2008). The categories that were asked in these interviews can be useful to future researchers, for now they can add to this study and create a greater understand of teacher/student closeness and how to improve it.

In today's society, scientists are studying the brain and how it functions and learns (Dunman 2007), which could be an enormous help in the educational process. Researchers are saying how the best style of teaching, in order for the brain to learn on a higher level, is for teachers to teach to each students' individual differences (Dunman 2007). In a classroom, if a teacher were to have one on one time with each student, it could help in raising the performance of each student. The brain also is a product of its environment, so it locates resources in order to elevate its performance level (Dunman 2007). One of these resources could be technology, and because the brain was in an environment where technology was used, it could be stimulated, allowing for a stronger learning process. The brain needs enrichment as well, and one of the

ways in which it is enriched is visual learning (Dunman 2007). Technology is a wonderful source for visual information, making it ideal for brain based learning to commence.

Scientists have learned from the brain that learning is based on emotions, and is strongly influenced by emotional factors (Dunman 2007). Another study has found that emotions have a significant impact on cognition (Clore and Palmer 2008). Depending on whether a person is in a good or bad mood/situation, they will be able to focus and perform at different levels (Clore and Palmer 2008). Bad moods/situations are characterized by fear or anger, while good moods/situations are characterized by happiness and contentment (Clore and Palmer). A study was done with people participating in activities while in intensive emotional states, and the results found that people in negative moods/situations tended to not be focused on the task at hand (Clore and Palmer 2008). Therefore, good moods/situations are preferable to be in, since cognition is at its highest during those times (Clore and Palmer 2008). This could help with teacher/student relationships, so teachers can know to be emotionally attentive and cater to the child's emotional needs in order assist them in learning.

With all of the technology being used nowadays, sometimes one cannot know which device is best to incorporate into a classroom environment. Yet, there is a technological device that is made to be easy and enjoyable for students to use, and helpful for teachers to assess student progress (Senteo). This device is the Senteo Interactive Response System. The Senteo consists of a board much like a smart board where questions can be posted and students can answer them with individual

Implementation of Technology in the Classroom, (cont.)

remotes (Senteo). The Senteo is helpful for student participation and brain based learning, for it used visual learning, such as pictures and graphics, in order to assist in teaching students (Dunman 2007; Senteo). This device also helps in telling teachers how their students are progressing by showing them the amount of questions each student answered correctly (Senteo). This will allow the teacher to understand what each student needs help on and cater to their individual needs, which is important in forming a relationship (Newberry and Davis 2008). All

in all, the Senteo is perfect for a classroom environment, and should be utilized in order for students to receive a full and enriched education.

Clore, G. L., & Palmer, J. (2009). Cognitive Systems Research. (10)1 21-30

Dunman, B. (2007). Online Submission, Paper presented at the International Educational Technology (IETC) Conference (7th, Nicosia, Turkish Republic of Northern Cyprus.

Eteokleous, N. (2008). Computers and Education. (51) 669-686

Lowther, D. L., Inan, F. A., Strahl, D. J., & Ross, S. M. (2008, September). Does Technology Integration "Work" when Key Barriers Are Removed? Educational Media International. (45)3 195-213

Newberry, M., & Davis, H. A. (2008). Teaching and Teacher Education, 24(8) 1965-1985

Senteo Interactive Response System. (n.d.). SMART. Retrieved January 26, 2009, from http://www2.smarttech.com//US///

Wang, Q. (2008). Innovations in Educational and Teaching International. (45) 411-419

Music and Hedonic Contrast, by Zack Struver

As a species, we have a psychological fascination with music. Every year, humans around the world spend billions of dollars on music, be it in the form of music downloaded from the internet or tickets to the New York Philharmonic, and we listen to or at least hear music every day of our lives. Under the information theory, music acts as a form of communication. The sender, or performer, makes use of a medium, air, in order to send information, the sonic patterns of music, to the receiver, or listener (Cross, 2005; citing Shannon and Weaver, 1949). Basically, music is the vibration of molecules which humans can discern from other noises; we have the cognitive ability to distinguish the sound of a car engine starting and the sound of a Mozart violin concerto. Humans have the ability to categorize music and create opinions about music, the ability to rate music based on personal preference, whereas music has the ability to affect our brain and body. The brain and the body both respond to musical stimuli. The physical effects of music are seen in the form of increased blood pressure and respiration

when listening to happy music, while sad music does the opposite, relaxing individuals (Khalfa, et al. 2007). The same study also found that the rhythm and tempo alone, without music, had none of the effects that the complete piece itself had. Clearly, music in itself has an effect on the human body. We see this every day, when, for example, a person involuntarily taps their feet or forms a facial expression when a song comes on the radio. Music even provokes seizures in some individuals, forcing them to run from a place or plug their ears when they hear music (Sacks 2008). Sometimes, an individual may suddenly become obsessed with music, or an individual may hear one catchy jingle over and over again in the course of many days (Sacks 2008). Music affects both the brain and the body.

Musical compositions are meant to influence listeners aesthetically, or artistically, and hedonically, or pleasurably. How we respond to music may be influenced by recently heard stimuli. The theory of hedonic

contrast encompasses this idea; that stimuli can affect how we perceive other stimuli. Researches verify hedonic contrast by asking subjects to rate two consecutive stimuli, and have found that hedonic contrast occurs in two ways. The principle of positive contrast states that the ratings of hedonically ordinary, or weakly positive, stimuli is enhanced when followed by hedonically negative stimuli. Negative contrast, the converse of positive contrast, occurs when subjects hear hedonically positive stimuli, reducing the rating of negative or mediocre stimuli. Studies have shown that hedonic contrast not only occurs with music, but with food and drink (taste), photographs (sight), and smell (Parker, et al. 2008).

Categorization of musical stimuli reduces positive and negative contrast. The theory is that when music or other stimuli are categorized, for example, into Bach and Mozart, that contrast will be reduced. If I were to play a hedonically negative Bach piece, and then proceed to play a hedonically ordinary Mozart piece, and I were to tell the test subjects that I was doing so,

"Cognitively, music has the ability to affect pain Perception"

Source: Mediaeconomist.com

Music and Hedonic Contrast, (cont.)

although positive contrast would be observed, the distance between the ratings of the two pieces would be significantly closer because the two pieces are distinguished from one another (Zellner, Kern, & Parker, 2002). This phenomenon has been observed with the tastes of gourmet coffee and ordinary, canned coffee. Contrast was reduced when subjects in the study believed that gourmet and canned coffee were in two different categories, while those who believed that they were in the same category rated them with increased contrast.

Cognitively, music has the ability to affect pain perception. Patients who received forty-five minutes of music therapy felt less pain than those who received forty-five minutes of rest, after undergoing heart surgery (Chan, 2007). A study by Mitchell, MacDonald, & Knussen (2007) found that, "Preferred music was found to significantly increase tolerance and perceived control over the painful stimulus and to decrease anxiety compared with both the visual distraction and silence conditions." Conditions like aphasia, or the inability to produce and understand speech because of brain damage due to injury or disease, such as autism or Parkinson's, have been treated with music therapy. Individuals with extreme speech problems can sing perfectly (Sacks, 2008). Autistic children who usually

require a question to be repeated over and over again before they even comprehend its meaning can perfectly understand questions posed to them in the form of music, and they are able to respond almost instantly when they sing the answer back (Sacks 2008). A manmade creation which serves to communicate emotion and convey complex ideas in the form of sonic waves has the amazing and unintended side-effect of actually helping us to live and survive. The future applications of music therapy are endless. Music therapy can be used to reduce stress, as found by Lesiuk on a study of air traffic controllers (2008). Listening to preferred music has a positive affect on professionals in the workplace as well; it can be used to facilitate conversation and decrease stress (Ullmann, et al. 2008). Music at different tempos may have different effects on these factors as well (Khalfa, et al. 2008). Listening to music has endless benefits for humanity.

Our fixation with music exemplifies itself through the psychological effects that it has on us. Our pain perception is affected by musical stimuli, and preferred music can have other physiological affects, such as increased blood pressure and respiration rate. Music as a form of therapy is currently used in conjunction with other forms of therapy for pain, stress, and other psychological conditions. In conjunction with

music therapy, studies have been done to see whether music affects concentration or other skills. Further research will verify the extent to which music affects our perceptions of pain and stress. Applications of music therapy in different settings may also find future use by professionals.

Chan, M. F., CStat. (2007, November 13). Heart & Lung: The Journal of Acute and Critical Care, 36(6), 431-439.

Cross, I. (2005, January 9). In D. Miell, R. A. R. MacDonald, & D. J. Hargreaves, Musical Communication (p. 29). New York: Oxford University Press.

Khalfa, S., Roy, M., Rainville, P., Bella, S. D., & Peretz, I. (2007, December 27). International Journal of Psychophysiology, 68(1), 17-26.

Lesiuk, T. (2008). The Arts in Psychotherapy, 35(1), 1-10.

Mitchell, L. A., MacDonald, R. A. R., & Knussen, C. (2008, August). Psychology of Aesthetics, Creativity, and the Arts, 2(3), 162-170.

Parker, S., Bascom, J., Rabinovitz, B., & Zellner, D. (2008, August). Psychology of Aesthetics, Creativity, and the Arts, 2(3), 171-174.

Sacks, O. (2008). Musicophilia (Revised and Expanded ed.). New York: Vintage Books.

Ullmann, Y., Fodor, L., Schwarzberg, I., Carmi, N., Ullman, A., & Ramon, Y. (2008). Injury, 39(5), 592-7.

Zellner, D. A., Kern, B. B., & Parker, S. (2002, July 24). Appetite, 38(3), 175-180.

Modeling Life, by Miranda Kephart.

The field of artificial life dates back to the early 1980s, when it was defined as a new area of computer science. This field views life as a property of organization, rather than of matter, attempting to outwardly simulate life without being ex-

actly the same. One of the earliest programs to do so was John Conway's cellular automaton game of LIFE. By using simple rules to turn cells on and off, Conway was able to create both evolving and self-replicating structures. Another

example is the "Boids", which follow a few very simple rules, yet appear to act exactly like real birds.

One of the first models for experimental evolution was created by Packard. He utilized a two-dimensional world filled

Modeling Life, by Miranda Kephart.

with "bugs", each of which needed a certain amount of food each time step in order to remain alive. This food was available at each lattice point in varying amounts. He found that the population fluctuated greatly when food was added randomly and minorly when food was added regularly. Complexity increased with greater population fluctuations.

The question of how computers will act – and how close it will be to human action – is an important one. While computers cannot literally "feel", it is possible to program a mobile device such that it acts in the same manner as a human or animal would, if faced with the same situation. For example, if an animal sees that it is nearing a cliff, it will be afraid, causing it to move away from the place that causes this unpleasant sensation. A robot might use radar to sense the drop, then back up and turn in a different direction, repeating this sequence until it found level ground. While the algorithms for these actions are different, an outside observer would see essentially the same thing in each. Interestingly, computers now appear far less intelligent than they did when they were first created. This is because they were originally used merely for calculation, a task which they are well suited to, and do efficiently. When called upon to preform tasks that humans have evolved to do efficiently, such as recognize faces, however, computers tend to fall short.

Slightly further along the road to artificial life, Dawkins created a program that started from a random collection of points and changed each time period, keeping pixels that brought the picture closer to what was desired and continuing to alter those that did not. He also created a program that " bred" a selection, one of which was chosen by a human and then

rebred. This was closer to a true Darwinian model of evolution. The advantage of the first method, however, was that the computer was in some sense thinking for itself, creating order out of chaos. This organization is, as stated above, the main property of life, especially when applied to computer or artificial life.

At around the same time, Epstein and Axtell ran several increasingly complex simulations, to find if complex societies could be formed using a small set of simple rules to govern behavior. The most basic is similar to Packard's "bugs". It involves agents, which inhabit a landscape filled with varying amounts of food. Each agent has two variables, each with randomly generated degree: vision (how far the agent can see in the four cardinal directions) and metabolism (how quickly it uses up food). Food, or "sugar", is placed in gradients on the landscape in the northeast and southwest and is replenished at a certain rate every time period. A carrying capacity for the environment is quicly found, and there is selection pressure for agents with high vision and low metabolism. When sexual reproduction is introduced, deriving the offspring's attributes from a random combination of the parents', selection occurs at an even greater rate. They then created a tag of 0s and 1s for each agent, denoting a culture (Red or Blue). Upon meeting another agent, it could flip one of the numbers, possibly changing the culture. This resulted in one culture eventually domination the landscape. The next introduction to the landscape was spice, another commodity. In order to survive, and agent had to have some amount of both sugar and spice at all times. By allowing agents to trade, they were able to form an economic simulation of free market prices – a surprising result for a system that was

made up of simple strings and algorithms. They also created immunity strings and diseases, with an adaptability that allowed the agents to fight even unknown diseases. They found that they could simulate real-world epidemics with a high degree of accuracy. Overall, Epstein and Axtell were able to create surprisingly complex and accurate societies using very simple rules.

In 2007, Hays and Efros explored how a computer can fill in unwanted areas of pictures. For example, it can erase a face or a car from a scene. It does this by filling in the area with a background image. Previous systems simply continued the textures and contours of surrounding areas, or copy-and-paste from a different part of the picture. However, the new system scans other pictures for similar areas, and then grafts on the new piece. This technology preformed significantly better in tests with real people than earlier ones.

Around the same time, Shao and Terzopoulos created a system which simulates pedestrian movement. Instead of using typical crowd simulation technology which focuses on the movement of the crowd as a whole, each person moves, acts, and "thinks" on its own. A person is given command, such as "buy a ticket". It then joins a line and navigates to its train. Acting independently, the pedestrians move to avoid collisions, both with other people and with inanimate objects. The authors achieved an effective simulation of many crowd-like situations and areas.

Terzopoulos also worked with a simulation of fish, along with Grzeszezuk and Tu. They created realistic simulations, which moved much like real fish do. This was achieved using springs and other constructs as physics-based counterparts for muscles and other parts of biology.

"The question of how computers will act — and how close it will be to human action — is an important one"

Modeling Life, (cont.)

They then gave the fish sets of simple rules, such as how to act in the presence of food, predators, or a possible mate, as well as the ability to perceive and process details about their environment. They found that the fish could simulate real fish almost exactly, behaving in the same ways as they would. With this simulation, they took several steps forward in the world of realistic computer simulations.

Another type of crowd simulation was created by Pelechano and Malkawi, who explored building evacuations. There are two main ways that a crowd can be simulated: social forces models and cellular automata models. Social forces models treat the space as continuous, while cellular automata models treat it as discrete. Rule-based models (similar to the very basic "Boids") are also used. Psychological factors, such as not knowing all exits, can affect behavior, as can stress. This particular simulation involved each person moving as quickly as possible to the next target point. A drawback of the simulation is that using the same decision process for each person results in clogging, ultimately increasing the total evacuation time. The authors recommended that unforeseen scenarios, such as the elderly stopping to rest or pushing, be considered in simulations, as should communication between agents.

Terzopoulos discussed how artificial life computers can be used to create better simulations of living things. Instead of just using geometric or physics-based approaches, a program must incorporate things like birth, growth, learning, and intelligence. These methods have been used in many movies, including *Star Wars* and *Batman Returns*. One specific area is simulating the human face. Another is simulating intelligence. For example, a computer game allows users to

Virtual Stunman,
Faloutos, et at (2001)

interact with non-playing characters, which are controlled by neural networks. This article also references the artificial fish in an in another of Terzopoulos' articles. Instead of individually animating each object, animators are now able to program objects to animate themselves.

The latest work in the field of has to do with controllers, used for simulations of the human body. Faloutsos, van de Panne, and Terzopoulos provided a way to properly simulate human movement, as well as allowing integration of movement controllers from various sources into one main program. The authors define a suitable controller as one which is able to take a character from its current state to a goal state, as well as determine whether it is operating nominally, has succeeded, or has failed. These suitable controllers can be added to a pool of controllers, which itself is controlled by a supervisor controller that can choose between them. The base program used is DANCE. The character contains anthropometric data consistent with an average male. The exact movements will not be the same for identical disturbances, since environmental factors will have changed. In this system, all possible controllers are polled to find if they can take the character from the current state to the desired state. The first such controller is activated, and remains so until it has succeeded, failed, or the desired state changes. Controllers can either be entirely separate or grouped together (running, walking, etc.). Each controller is responsible for knowing its own pre-conditions, post-conditions, and expected performance. The first two are the input and output. The last allows the controller to detect its own failure. Using the DANCE program, each controller has full access to all data, as well as several sensors. These include the state of the center of mass, the

support polygon, the position of the center of mass relative to the support polygon, the contact with the ground, and the position of the body relative to the hip.

The same authors studied how a simulated human learns to move. Specifically, the authors wanted to create a simulation that could do stunts like those often seen in movies. A program finds certain values (such as information on the center of mass and pelvic center of mass, and orientation) before movement is made. The program tries to react as a real human would. For example, if it falls it will attempt to absorb most of the impact with its hands. When rising, it sits up before raising itself with its hands. The program can recognize that it may fall and rebalance. If this fails, it moves into a fall recovery routine. They have not yet been able to write a sufficiently general program for walking, due to the large number of variables involved (including the terrain and different gaits). Two main areas of further research are the high-level planning of motor actions and the intelligent integration of controllers which affect only parts of motion and can be executed at the same time.

Artificial life, especially as it pertains to simulations, has been a constantly changing field since its beginning. Its nature is such that there are always new opportunities for research. Of these, the main area is currently simulations of the human body. These are best achieved when biology is properly simulated, preferably with physics-based constructs. In addition, the agent or character should be allowed to choose for itself which action to take, out of a wide range of options. The realism of the simulation increases with the number of controllers involved, since a real human has an extremely wide such range. The proper area of focus in this field is therefore

Modeling Life, (cont.)

the development of more suitable controllers.

Dawkins, R. (1996). The Evolution of Evolvability. Adaptive Individuals in Evolving Populations: Models and Algorithms, XXVI, 201-220.

Epstein, J. M., & Axtell, R. (1996). Growing Artificial Societies: Social Science from the Bottom Up. Washington, D.C.: Brookings Institution.

Faloutos, P., Panne, M. V. D., & Terzopoulos, D. (n.d.). Composable Controllers for a Virtual Stuntman [Brochure]. Retrieved from University of Toronto, Dept. of Computer Science Web site: http://www.dgp.toronto.edu/papers /pfaloutsos_SIGGRAPH2001.pdf

Faloutsos, P., Panne, M. V. D., & Terzopoulos, D. (2001). Computers and Graphics, 25(6), 933-953.

Hays, J., & Efros, A. A. (2006, ACM Transactions on Graphics (SIGGRAPH 2007), 6, no. 3.

Langton, C. G. (1996). Adaptive Individuals in Evolving Populations: Models and Algorithms, XXVI, 1-47.

Moravec, H. (1996). Adaptive Individuals in Evolving Populations: Models and Algorithms, XXVI, 167-199.

Packard, N. H. (1996). Adaptive Individuals in Evolving Populations: Models and Algorithms, XXVI, 141-155.

Pelechano, N., & Malkawi, Automation in Construction, 17(4), 377-385.

Shao, W., & Terzopoulos, D. (2007). Autonomous Pedestrians. Graphical Models, 69(5-6), 246-274.

Terzopoulos, D. (1999). Communications of the ACM, 42(8), 32-42.

Terzopoulos, D., Tu, X., & Grzeszezuk, R. (1994). Behavior, and Learning in a Simulated Physical World. Artificial Life, 4, 327-351.

Should Voting Age be Lowered? A Social Study Research, by Anna Walsh

In 1993, Paul Peterson injected a bubble of an idea into the ocean of journalistic science; perhaps, with precautions, children could be given the right to vote in the United States. It's title, "An immodest proposal" belies his parallel to Jonathan Swift's "A Modest Proposal," which told the 16th century Irish to solve their problems through infant-gobbling. Although the parallelism was meant to draw perpendicular conclusions, the youth of America are given the same skepticism when their right to vote is mentioned. This idea should expand from its bubble, for as a young, silenced citizen said, " "Any time you have a limited amount of people involved, you'll have a limited amount of opinions and ideas. To have as many people as possible makes a much bigger pool of ideas." There exists a normative view that every democracy should give each of its citizens an equal say; to do this, we look to the possibility of expanding voting rights.

I. Voting Age Should Not be Lowered "For some reason, with youth comes unreliability," Michael Rubinoff, an ASU professor said. "It's fatal for anyone who is banking on young people to come through ... I'm not saying no young people vote, but you can't assume that they'll all go to vote en masse." (Natekar, 2008) Since G. Hall proposed the idea in 1904, the theory of 'Adolescent Storm and Stress' has been considered, and significantly studied. While developmental psychologists quickly rejected the idea that adolescence reflected a tumultuous time in evolutionary development, the teenage years have a volatile stigma for a reason. At a rate of approximately two conflicts every three days, a recent meta-analysis by Laursen et. al. (1998) concluded that conflict frequency is highest in early adolescence and conflict intensity is highest in mid-adolescence. (Arnett, 1999). The "beeper method", or 'Experience Sampling Method' (ESM) shows that adolescents experience greater extremes and more frequent changes in mood. ESM requires the carrier to report on various aspects of their emotions each time their mobile beeper sounds throughout the day. Gardner and Steinberg (2005)

found that peer influence on a teenager's behaviors was statistically significant, more so when risky behaviors were introduced, and especially in comparison to their pre-pubescent and adult counterparts. An overwhelming majority of teenagers will participate in at least one kind of risky behavior at some point, regardless of behavioral problems in childhood, which have been linked.

If peers influence on teens is as drastic as shown, and emotions leave decisions erratic (Steinberg 2005), lowering the voting age even two years would lower the quality of voting, which should run in line with both the Smallest Distance Hypothesis (SDH) and the Incumbent Approval Heuristic (IAH) (Powell, 2000). Voting as a cult movement does not allow for issues-based campaign, and only requires candidates to appeal in materialistic, aesthetic ways. As Rubinoff continued, "The shift in civic thinking does not occur until students are independent, beyond their parent's aid, and supporting themselves." Further, the fact that citizens do not vote would not serve to statistically change

"There exists a normative view that every democracy should give each of its citizens an equal say; to do this, we look to the possibility of expanding voting rights"

Should Voting Age be Lowered? (cont.)

numerous elections result, but perhaps 1.75% (Ebner 2004). As proven in numerous peer-reviewed articles, low turnout does not impact elections to any statistically significant point; the little it does is balanced out by the positive correlation between lower turnout and increased voting by SDH and IAH principles. Further, age and turnout are positively correlated, meaning less eighteen-year olds vote than those in their fifties; the generation cannot be forced into civic duty, especially when results could be negatively affected. Beyond peer pressures, pressure by parents also critically impacts the possible quality of the vote. At one of the twenty-four public schools that held mock-elections for their students, many voted in accordance with their parents, especially as age decreased. Lily, skipping out after casting a vote for John McCain and Governor Sarah Palin explained, "because Mom and Dad do." (Sostek, 2008: *More statistical analysis needed, mock elections for children are extremely rare in the United States and have never been analyzed beyond the tally count*). If small children are voting in accordance with their parents, teenagers may vote for the opposing party just to be rebellious (Scott, 2007). An examination by campaigns like "Rock the Vote" and "Declare Yourself" use images echoed by the adolescent community, youthful insubordination (one advertisement pictured angry teens with their mouths covered in tape). "Today's youth-oriented efforts tend to present voting as self-interested and adversarial, a demonstration of rebellion against those running the state and against one's overbearing, parent-like compatriots." (Rampell, 2008) Overall, teenagers at least are given enough influence in society; grassroots campaigns on the internet often include teenagers, 15 to 25 year olds volun-

Source: millerelections.com

teer more than do people of any other generation (Delli Carpini & Keeter, 1997), and beyond voting, the same avenues of political critique are open to all.

II. Voting Age Should be Lowered "Youth organizations worry that young people see themselves less and less as stakeholders in public life, take a decreasing responsibility for their communities, and possess a diminished ability to lead and work with others toward common interests (Delli Carpini, 2000; Flanagan, 2004; Lerner, 2004)." (Cassell 2006). While they may volunteer the most, and be highly recognizable in their ability to manipulate social networking, interest itself is minimized. Numerous articles have negatively correlated age with low turnout (Rosema 2004), the generation constantly referred to in reference to hope and potential usually brings about 13.5% of its eligible voters to the ballot. However, this does not mean the low turnout can be blamed on teenage rebellion or 'storm and stress.' First, research strongly indicates that the outdated idea of 'storm and stress' is far from inevitable for every teenager; while teenagers experience more stress and high emotion during the labeled years, there are substantial individual differences. In fact, scholars try to minimize the 'storm and stress theory,' because too much enunciation could lead to parents adopting authoritarian techniques to try and thwart the system. (Holmbeck, 1996). Numerous studies conclude that parental conflict does not belie an enduring breach, and may actually be beneficial to teens (Steinburg, 1989) to develop a sense of individualism. "Most adolescents take pleasure in many aspects of their lives, are satisfied with most of their relationships most of the time, and are hopeful about the future (Offer & Schonert-Reichl, 1992). G. S.

Hall (1904) saw adolescence as stormy and stressful, but also as "the birthday of the imagination" (Vol. 1, p. 313) and "the best decade of life" (Vol. 1, p. xviii), when "the life of feeling has its prime" (Vol. 1, p. 59)." (Arnett 1999).

Hall even went so far as to postulate that 'storm and stress' symptoms were caused by failures of state, schools, families, and church to adapt to the specific needs of adolescents. Unlike his other theories, this has been backed by more recent studies (e.g., Eccles et al., 1993; Simmons & Blythe, 1987). Adolescents are far from hopeless, developmental psychologists have found that community-based activities increase many positive, 'anti-storm' qualities, including social trust, solidarity, emotional and practical skills, and social networking. They show a more positive attitude toward others, with a decreased risk of substance abuse and less antisocial behavior (Larson, 2000). Community-participation can be as simple as direct outreach from politicians. CIRCLE analyzed polling data and found encouraging proportional increases in voting turnout during the 2004 and 2008 elections, though especially the latter. In 18-29 year olds, turnout was 25% overall, 11% to 15% (in Maryland, other statistics similar), while those over 30 only inched one percentage point, from 28% to 29%. Barack Obama, by repeatedly bridging the age-gap with first person plural-filled speeches and direct references to student issues, like college tuition, was responsible for mobilizing a large part of that group (Perez 2008).

If more teenagers are given the right to vote, the participation level will assuredly rise. And in the 2006 midterm elections, national exit polls showed youth voters chose Democrats over Republicans by 58 percent to 37 percent. The youth vote will be incredibly lobbied and an-

Should Voting Age be Lowered? (cont.)

gled for, because an active youth would be able to pull a few percentage points, those under 18 composing 24.1% of our population (according to 2010 census projection) (United States Census Bureau). More lobbying will increase votes, while will have a positive impact upon the teenagers suffering from the above symptoms. Further, when politicians talk about more issues that matter directly to teenagers, votes will be cast in greater accordance with SDH and IAH; increased issue discussion will also increase the likelihood of a higher turnout.

A larger youth base will increase SDH and IAH because of the differences in voting logistics between younger students and adults. Subconsciously, adults are strongly affected by both appearance and style (decisions which do not fall in place with the SDH), and even intrinsic characteristics like gender. Women are less likely to be voted to public office than men because they are immediately correlated with kindness, altruism, and community-mindedness, while the characteristics attributed to leaders are assertiveness, power, and competency (Blais 1990; Cassel, 2006). However, a study by Cassel on an online community called "Junior Summit" found much different results in children. Although the study has yet to be repeated, and does not take into account the difference between online reactions and person-to-person decisions, it sets a remarkable microcosm for the adult world. All over the world, children were selected based on their acumen and political participation for *Junior Summit*, an extensive and nine-month-long forum that pinnacles when certain elected delegates travel to Boston to present their group's study to the rest of the world. Adult moderators were only in place to answer questions about the program.

After delegates were selected, Cassel analyzed to see how the children had chosen. The hypothesis predicted much the same as adults, unequal gender skew (*Junior Summit* was composed of 45% male and 55% female students). However, with 56% female delegates and 44% male, they defied expectations. Further, students were said to base their decision on (in descending order): 1) Hard work/ Lots of forum posts 2) Their potential ability to represent the group eloquently, 3) The quality of their ideas, and 4) The amount their opinions corresponded with their own (Cassel 2006). While the fourth option could have been higher on the list to correspond with SDH, their was no evidence of bias, and the qualities named are a solid mandate for any future candidate.

Voting establishes a habit one pursues later in life, and learning about politics is educational. To maximize education, we apply constraints and rules. In an experiment involving a 4H animal-training study with a group of children, the control group had no limits and the test group had a constraint about weight and organization. The control group's experience was compared to 'like those of a child who raises a family pet: a good experience, but an experience of much different educational quality than that of the other 4H members in this study (Emo, 2008). Teaching current events and politics would be much the same. By voting, teachers can give rules and guidelines that will enhance the learning process.

Further, this early process encourages later participation. ""Once people start voting, they don't stop," says Director Peter Levine of the Center for Information and Research on Civic Learning and Engagement. "It's a habit, and there's a lot of statistics supporting that."" Civic organizations encourage parents to bring their children to

the polls so as to teach them about the process, else it can seem intimidating. "In his research, Plutzer points out that most young people's peers have never voted. "Their friends cannot assure them that voting has been easy, enjoyable, or satisfying," he writes. And bringing someone to the polls as a child--or a young adult--can make the process look less daunting." (Schwab, 2007)

Lowering the voting age will have two final benefits. First, it will lessen 'storm and stress' conflicts to an even smaller degree by making parents talk to their children about politics. In the 24 major mock elections that children participated in this year, parents and children reported a new flow in communication, an educational one that had not existed before. "Just that morning, Mr. Gorman said, he had been trying to explain a basic version of the electoral college to his kids over the breakfast table."(Sostek, 2008). "'Why don't you ever talk about these guys?" (a young Matthew) asked his dad, pointing to pictures of Bob Barr and Ralph Nader. "What's an independent? What's a" -- he paused before sounding out the word -- "libertarian?'" (Sostek, 2008).

To vote, one must be able to analyze the beliefs of a candidate, or have a vote equivalent to the casting of a dice. Children under five should never have the vote, because they haven't developed the 'decoding false belief' technique. All are presented with a 'false belief' situation: Sally puts her ball away into a green box, then walks away. Ned comes in and takes the ball out of the green box and into a purple basket. Most over five, barring autistic and Asberger complications, know that Sally will come back and look in the green box for her ball. But four year olds and younger pick the purple basket. Since they do not realize their sense of reality

"Women are less likely to be voted to public office than men because they are immediately correlated with kindness, altruism, and community-mindedness"

Should Voting Age be Lowered? (cont.)

differs from those around them, they cannot vote, for they would not know the consequences of their action. However, we let people with Asberger syndrome and autism vote. Every single negative impact, including peer pressure and anxiety, also applies to adults. We need a wider discrepancy before denying younger teenagers the benefits that come with voting. Many teens have jobs and pay taxes just like their parents, and all of these are the ones with opinions on politics.

III. Further Research, Questions, and Proposals

There is no such thing as a perfect age discrepancy. There will be always be at least one more qualified sixteen year old than a forty year old. And even if not, the boy who cannot vote because his birthday is three days after the cut-off date is penalized unfairly.

Still, the idea proposed by Alex Koroknay-Palicz, executive director of the National Youth Rights Association, falls flat too. He says that any age restriction can be replaced by a competency test, a few instructional lessens and standardized testing. However, to allow people to vote based on intelligence or maturity crosses unprecedented lines in bio-ethics, giving people rights based on their genetic code.

However, his idea of ageism rings true, and the numerous benefits stressed in the second section of this paper make the possibility of a lower voting age worthwhile. However, much research has to be done before.

A) The idea of peer pressure and its influence on teenagers, especially in regards to voting
b) A widely analyzed and much larger mock-election for grade students, probably 6-12. Surveys should be answered, questioning each motivation, logical reasoning, research prepared, and affect of the status quo's candidate pick.

c) Effect of parent's political preference on child's future preference

d) "Storm and stress": Whether risk-taking activities activate the same part of the brain as voting

e) What aspects of media influence political view, and does it change between children and adults?

f) If low turnout ineffectiveness on influencing democracy could be changed if younger teenagers were introduced, and how much participation it would take.

g) What could alter the low turnout of 18-29 year olds beside the decrease of the voting age

h) The ethics of a cut-off date

i) A general assessment of a teenager's political knowledge as compared to the average adult's j) The need for political knowledge in regards to voting

Allen, A. W. (2008, April 17). *McClatchy- Tribune Business News*. Retrieved from Proquest database.

Arnett, J. J. (1999, May). Adolescent Storm and Stress, Reconsidered . *American Psychologist , 54*(5), p.317-p.326

Cassell, J., Huffaker, D., Ferriman, K., & Tversky, D. (2006). *Developmental Psychology, 42*(3), p.2-p.14.

Kids catch ballot fever at the polls. *McClatchy- Tribune Business News*. Retrieved January 7, 2009, from Proquest database.

D'Attilo, S., & Tangowski, S. (2007, September 3). *Scholastic Scope*, pp. p. 17. Retrieved January 13, 2009, from Proquest database. Ebner, J., & Herring, L. (2003, January 9). In *American Sociological Association* [Journal Article].

Emo, K. (2008). *The Journal of Experiential Education, 31*(2), p. 152- p.168.

Gardner, M., & Steinberg, L. (2005). *Developmental Psychology , 41*(4), p. 625-635.

Interim Projections: Population

Under Age 18 and 65 and Older: 2000, 2010, and 2030. (n.d.). *United States Census Bureau* [Chart]. Retrieved January 24, 2009, from www.census.gov///.xls

Levine, P. (n.d.). Civic Renewal and the Commons . In *Center for Information and Research on Civic Learning and Engagement* [Political Essay]. Retrieved December 24, 2009, from http://www.ncl.org///-3/.pdf

Lutz, G., & Marsh, M. (2007). *Electoral Studies, 26*(1), p. 539-547.

Natekar, A. (2008, August 24). Group, politicians encourage teens to vote: People ages 18-25 have the lowest turnout rate. *McClatchy- Tribune Business News*.

Newman, G. H. (2008, October 1). Children Shall Lead Way To Ballot Box. *McClatchy- Tribune Business News*.

Perez, E. (2008, February 21). 25% of young voters turn out. *McClatchy-Tribune Business News*.

Peterson, P. E. (1993, Winter). *The Brookings Review, 11*(1), p. 18-24.

Rampell, C. (2008, March 30). Why Obama Rocks the Vote. *The Washington Post*, p. B7.

Rosema, M. (2007). *Electoral Studies, 26*(1), p. 612-623.

Saxe, R. (2008, February). Reading Your Mind: How our brains help us understand other people. *Boston Review*, pp. p.39-41.

Schwab, N. (2007, December 31). Teach Your Children How to Vote. *U.S. News & World Report*, pp. p. 60.

Sostek, A. (2008, October 19). Museum gives kids a chance to vote. *Pittsburgh Post- Gazette*, p. B1.

Music Therapy and Autism, by Victoria Lee

My field of research is in neurological and developmental disorders like autism. Autism is a spectrum disorder that affects a person's way of communicating with the people around them. It is neurological and lasts an entire lifetime. There is no cure, but there are ways of helping autistic children, such as music and physical therapy. There are also many medicines that could help the symptoms produced by autism, which include digestion. Along with no cure for autism, there is no known single cause of autism. Autism is thought to be caused by an abnormality during the development of the brain when inside the mother's uterus due to the environment the mother is in or the substances the mother has digested. Autism is also thought to be a genetic disorder because it seems to run in the family. Detecting whether a child has autism is fairly simple. Those children show noticeable symptoms in the first three years of their lives. Children with autism usually are delayed in speaking language or display repetitive behaviors like hand-flapping and jumping up and down. I picked this field of research because some of my personal life has to do with autism. When my brother was about one or two years old, his doctors diagnosed him with a very mild form of autism. However the doctors were wrong and my brother soon became very smart. He has an amazing memory and he soaks information in like a sponge. He even knows what two states are shaped like rectangles! However he still displays some symptoms of very, very mild autism. He jumps up and down and flaps his hands. So I have some connections with my field of research. There is a lot more to study and learn about autism, so scientists are still running experiments and tests to see discover the unknown about the disorder.

Since autism is a spectrum disorder, there are many different symptoms for each of the patients who have it. A lot of autistic patients display behavior problems that are organized into three categories. Self-injurious behavior is one of the categories. Symptoms in this category include hitting, biting, and scratching themselves. Another category is named aggressive destructive behavior. Symptoms that show aggression include hitting and biting others. Stereotypic behavior is the last of the three categories. Screaming, hand flapping, and jumping up and down are some of the symptoms of stereotypic behavior. Autistic people may also display relationship and social interaction problems like the lack of interest in sharing feelings and company with other people. Verbal and non-verbal communication is another problem displayed in autistic people. Usually a child that has autism has delays in speaking or never learns how to speak. Stereotypic behavior also ties into this because autistic children repeat the phrases the other person is saying and that is called echolalia. The symptoms of this disorder can be decreased from therapy or medications, but the entire disorder can not be cured.

Music is thought to be a way of life. People listen to music for many different reasons. Those reasons include dancing, singing, thinking, writing, and relaxing. Well, music can also help the development of an autistic child's physical and listening skills. This is where music therapy comes in. I read an article about how vibroacoustic music can help an autistic person help control their self-injurious, aggressive destructive, and stereotypic behaviors by Lars-Olov Lundqvist, Gunilla Andersson, and Jane Viding. About 20 people with autism or other developmental disorders were tested in this experiment. Each participant had to sit in the vibroacoustic chair with accompanying music for about twenty minutes. Each participant had ten sessions in total. While the sessions went on the assistant in the room would fill out rating forms. These rating forms were filled out on things like sense of security, how many occurrences happen in the session, or how severe the occurrences were. For the results, most of the participants had improved their control of their behaviors. Autism is also treatable through drugs for problems like digestion. Some people with autism have problems digesting foods with certain chemicals or nutrients inside them, so scientists have come up with a medicine that could help those autistic people digest those chemicals or nutrients completely. Scientists are still trying to come up with a treatment that will completely cure autism instead of temporarily decreasing the symptoms of autism. I read an article that examines the result of music therapy on individuals with autism. This article by Robert Accordino, Ronald Comer, and Wendy B. Heller. has a lot of research of music therapy tests on autistic children From Wimpory, Chadwick, and Nash in 1995, they used musical interaction therapy to try to increase a three year old girl's social interaction and eye contact with her mother. They got her involved in twenty minute sessions of music therapy two times a week for seven months in her own home. During those sessions, the mother's motions were happening at the same time as the therapist's playing of the harp and the mother also imitated all the actions of the autistic child. The therapist also videotaped the sessions, and after all of that music therapy, the tapes showed some changes in the way the child interacted and the way the child got involved with her mother. Music therapy could also be involved with rhythm. In Keats' study in 1973, a forty year old man with severe autism, severe hearing

"...music can also help the development of an autistic child's physical and listening skills".

Music Therapy and Autism, (cont.)

problems, and visual problems. The therapist set up four music stations with different percussive instruments to make rhythmic patterns with basic words and phrases to help the autistic person understand. The first station was called "Hello" and consisted of an alto xylophone, melodic cowbells, a triangle, a conga drum, and temple blocks. All of the session with the autistic man started at station one with a musical conversation with him. "How are you today?" was the second station which consisted of drums, a cowbell, and a cymbal. Their playing described the man's emotions with dynamics and accents. "What's new?" was station three which consisted of a basic drum set that the therapist taught the man to play with rhythm. "Let's Jam" was the fourth station which the client just played solos on the drums and enjoyed himself. The outcome showed that he got involved with sharing and interacting with the therapist but lacked information out of therapy. One of the authors of this article, Robert Accordino, is involved in a program called "Music for Autism." The program is about a group of people who have a lot of musical experience that goes around the world to see schools or hospitals with people with autism or other developmental disabilities. The group plays music for the children and interacts with

Istockphoto.com

them so they could increase their interaction with other people. This is basically music therapy. Along with finding the cure of autism, scientists are also trying to find the single unknown cause of autism as well.

Scientists are trying to track down the cause of this disorder. They came up with a couple possible causes for autism. Autism seems to be a genetic disorder. In a family with an autistic person in it, there is a chance that a future family member will also have autism. Other scientists came up with the idea that maybe when the fetus was developing in the mother's uterus, the mother may have unknowingly disrupted the fetus's development. The disruption might have been a substance the mother might have digested like alcohol or a chemical. The pregnant mother also might have been exposed to certain environments that are not healthy to herself or her baby. Those unhealthy environments include nuclear power plants, radioactive factories, or gas stations. This field of research is far from being fully researched so there are still very important questions being asked about this topic.

Autism is not fully researched and they still have a lot more to find out. There are many questions to ask about autism. I wonder about questions like: How does music get into the

brain of a normal person? An autistic person?, Where in the brain does the abnormality of the development of autism start and why?, and How can autism be prevented? There are many more questions to ask, but the ones I listed here are important.

Accordino, R., Comer, R., & Heller, W. B. (2006). Research in Austism Spectrum Disorders (1)1 101-115

Barstow, D. G., RN., & Odle, T. G. (n.d.). *Pervasive Developmental Disorders*. Retrieved Fall, 2008, from Gale Virtual Reference Library database

Cairns, C., Accordino, R., & Lubbock, J. (n.d.). *Music for Autism*. Retrieved Fall, 2008, from www.musicforautism.org/

Frey, R. J., PhD. (n.d.). *Pervasive Developmental Disorder*. Retrieved Fall, 2008, from Gale Virtual Reference Library database

Lundqvist, L.-O., Andersson, G., & Viding, J. (n.d). Research in Autism Spectrum Disorders (3) 390-400

Odle, T. G., & Paradox, P. (n.d.). *Autism*. Retrieved Fall, 2008, from Gale Virtual Reference Library database

Turkington, C. A. (n.d.). *Autism*. Retrieved Fall, 2008, from Gale Virtual Reference Library database.

Notes

Notes