The Unique Paths of Isaac Newton and G.W. Leibniz to the Calculus,
With Shared yet Underappreciated Influence from Thomas Hobbes
by Liz Rogawski
The Emory Undergraduate Research Journal (EURJ) is an annual print and online publication that accepts research manuscripts written by Emory undergraduates from all academic disciplines. EURJ provides a venue for students to showcase their high quality, original research while fostering interest in undergraduate research. Research can be submitted up until two years post-graduation. EURJ was founded through generous support by the Office of Undergraduate Education and continues to enjoy support from the Media Council, a division of the Student Government Association.

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Dear Reader,

I am pleased to present to you the Fall 2010 issue of the Emory Undergraduate Research Journal, an annual publication that seeks to bridge the gap between undergraduate student researchers and the task of locating a venue for publishing outstanding research. We at EURJ acknowledge the exceptional work that Emory undergraduate students accomplish through their quality research, and our journal seeks to gain recognition for these accomplishments by presenting your work to our fellow peers and the broader Emory community.

This issue features four full manuscripts, two extended abstracts, and three special features articles for your reading pleasure. Our feature article, “The Unique Paths of Isaac Newton and G.W. Leibniz to the Calculus, With Shared yet Underappreciated Influence from Thomas Hobbes,” offers readers an incisive look into the philosophical foundations of the mathematical field of calculus and the independent genius of two of history’s greatest thinkers. Our special features articles delve into such diverse topics as stem cell research, the psychology of happiness, and factors that determine career choices for students.

I hope that this issue of EURJ gives you a glimpse into the seemingly endless array of research opportunities and topics that are open to the inquisitive Emory undergraduate student. To continue our mission, we are constantly looking for new submissions from students in all subject areas. Every manuscript submitted to EURJ undergoes a blind peer review, and in that regard, we are always happy to welcome new faculty, post-doctorate fellows, and graduate students who can help out in this capacity.

Please be on the lookout for the submission deadline for the next issue of EURJ, coming this fall.

Warmest regards,

Carolyn Gulas
Critical Mass Representation in Uganda

Summary

Since the early 1990s, women’s rights activists have vociferously advocated the adoption of quotas that ensure critical mass representation of women in legislatures worldwide. This theory dates back to the 1970s and argues that the interests of women will not be addressed until a critical mass of 30 percent is achieved. Critical mass theory is predicated upon the assumption that female legislators will seek to guard the interests of women and improve women’s quality of life due to their shared gender. The adoption of quotas to achieve critical mass representation continues to grow in popularity amongst governments increasing from just four countries in 1985 to eighty-four countries in 2006. Despite the widespread support for critical mass representation, relatively little is known about the actual contribution of female legislators to the advancement of women’s human rights. Recognizing the importance of that missing knowledge, this research examines the influence of female members of parliament (MPs) on women’s land rights in Uganda. Research methods include: observation of study populations, unstructured interviews, questionnaires, and secondary data analysis. The study population was composed of the following: all former/current female members of parliament, male MPs of the 8th parliament (2006 – 2011), the directors of local NGOs, and reporters. Key informants were identified through purposive sampling. Individuals selected to participate in the research were those with knowledge on women’s rights and/or land rights in Uganda. Research methods include: observation of study populations, unstructured interviews, questionnaires, and access to primary resources, including government documents.

It was found that since 1995, women have been widely represented at all levels of the Ugandan political system. Despite their widespread presence, the political authority of female politicians is routinely challenged by popular perceptions of women’s roles that are steeped in patriarchy. In addition, the fact that women are unwilling to commit social and political suicide by forgoing their traditional role as wife and mother has immediate implications on their ability to successfully lobby for radical changes in land tenure policies. The female parliamentarians of the 6th parliament are credited with securing the land rights of women through the passage of the 1998 consent clause, which requires spousal consent for women’s land rights. Female parliamentarians of the 6th parliament are credited with securing the land rights of women through the passage of the 1998 consent clause, which requires spousal consent for their land rights. Research on women’s land rights in Uganda with the Foundation for Sustainable Development.

Critical Mass Representation - A theory that contends that women’s interests will only be addressed by governments when women represent a critical mass of at least 30 percent.

Critical Mass Representation in Uganda

Converting Personal Interests into Research Studies: What Factors Determine the Career Choices of Our Generation?

By Gabrielle Settellmire

Dr. Tracy Scott has been a lecturer in the Emory University Department of Sociology since 2004, and has a strong enthusiasm for research in addition to teaching. In this interview, Dr. Scott explains her most recent research study, which is particularly interesting because of its relevance to the lives of current Emory undergraduate students. Dr. Scott is currently looking at the career decisions of undergraduates and what factors influence such decisions. As a student of Dr. Scott’s, I witnessed genuine interest in what she does and this enthusiasm shines through in the words she spoke to me. I hope that this article will be an inspiration to Emory students to get involved in research, research that they genuinely enjoy.

Gabby: What has been your favorite research study you have completed so far in your career?

Dr. Scott: That’s a good question...that I’ve completed. Can I have two?

Yeah.

I actually really enjoyed my dissertation, which was about how religion influences people’s attitudes about work. And, I also looked at gender as well. So I looked at religion and gender together and how that influences people’s attitudes about work. I had a survey that my advisor had conducted that I analyzed and then I did fifty in-depth interviews to supplement that survey. So I was able to look at some broad results in a national U.S. population from the survey and then try to understand those survey results by talking to people in-depth about their views on faith and work. So, it was really fascinating and I love to talk to people so the interviews are fun to do. The second project that was a favorite was in an entirely different area, which is healthcare research. I did a study, another qualitative study, doing in-depth interviews with nurses and physicians about their interactions in the hospital. So I looked at two different hospitals in the Atlanta area and interviewed nurses and physicians who worked together on the same unit in the hospital. That was fascinating to get to talk to people and really understand things in-depth that they deal with in their work on a daily basis and having to interact with their coworkers.

That sounds really interesting. What has influenced you to perform your own research studies and what satisfaction have you gotten out of it?

Dr. Scott: What factors determine the career choices of our generation? My first career interest was business, then I thought about going to law school. I actually applied and got in but didn’t go. Then I realized I wanted to teach at the college level, but I originally thought I would do a PhD in religion. While get...
Gabrielle Settlemire is a junior and plans to major in Mathematics and Economics. She is a resident of Edmond, Oklahoma and hopes to go to medical school after graduating from Emory.

Can you summarize the goals of your current research? Certainly, I did a stint in healthcare research for about seven or eight years and now I’ve come back to more purely sociological research – wanting to get back into the field of career interests and work values. I’m now looking at undergraduates and how they think about their future careers, how they’re trying to make decisions. I have left the religion influence, but I still want to focus on gender, now adding in race and ethnicity, to see how different social backgrounds of people influence how they think about work, how they think about this large aspect of their life, and how they try to make decisions about it. So, I’ve done a pilot project with a SIRE student last summer. I conducted four pilot interviews and she conducted another nine for me. So we did thirteen interviews of undergrads with men, women, African Americans, and whites trying to see if there are some differences in how people from different racial-ethnic backgrounds and men and women are thinking about these things.

And have you found that there are so far? We think there are, yes. Again, because it’s early stages it is kind of suggestive but it does seem like there might be some differences, yeah.

Where did you find the idea for that research? Part of it came from my dissertation because it’s kind of connected. And part of it actually came—a big motivation simply from talking to the undergraduates that I teach. Many of them come in with questions about what they should do and so just in conversation it was so interesting to me to hear how different people were thinking about this. But again, I thought I’d like to do this more systematically and try to understand what’s going on with this generation in terms of major influences in the career path.

Can you offer any advice for undergraduate students wishing to conduct research? Yes, for undergrads wishing to conduct research, always pick a topic that you’ve got some kind of interest in because you are going to spend a lot of time with this topic. You want something you aren’t going to get bored with. Again, try to look and see how something you’re personally interested in could be approached from a more academic, objective perspective in whatever discipline you are looking at. And I think oftentimes that makes for the most interesting research.

Frances Nicholas is an economics major with a minor in global health, culture and economics major with a minor. For the past year she has been involved in volunteering around campus, as well as being a member of Kappa Kappa Gamma and on the equestrian team. She plans to go to public health school in the future.

Sarah Rattan is a junior from Providence, Rhode Island majoring in Theater Studies. She has enjoyed her first year at Emory participating in Ad Hoc Theatre's production of “You're A Good Man, Charlie Brown,” playing tennis for Emory’s club team, and volunteering on campus.

Rebecca Lipman is a junior from Houston, Texas, Sarah is an economics major, Spanish minor. For the past year at Emory she has worked with Hand in Hand, PAWS, served as Miss Black & Gold for Alpha Phi Alpha, and is the cheer captain of Emory’s newborn cheerleading team.

Matthew Campbell is a Living Links postdoctoral fellow and an ORDER teacher-scholar for 08-09. He is working with Professor Frans de Waal and studying empathy in chimpanzees at the Yerkes National Primate Research Center. He received his Ph.D. in psychology at the University of Wisconsin-Madison in 2006, and graduated from Emory College in 1999 majoring in Neuroscience and Behavioral Biology.

Dolly Krishnaswamy is a Biology and Journalism major at the College. She volunteers at a research lab at Emory and works as an intern at a law firm in Atlanta. She hopes to go to law school in the future.
Introduction
As the fairly new millennium progresses, issues concerning the need for alternative energy to sustain our environment have become more pressing. Many students are conscious that their actions are not limitless: from the popularization of the term “living green” in new fashion trends to the potential use of algae for fuel in cars. It is becoming evident that everyone has a part in using or discovering alternative energy. At Emory University, the resources available to promote green living are plentiful. There is no reason for students to be “environmentally unaware”.

Our next comparison was of energy usage in New Turman while the posters were on display and the period of time right after they came down. The hypothesis was that energy usage would decrease and would rise again after we took the posters down. Without the posters to continuously remind them, students would return to their previous energy consuming habits. Since most students were not aware of the green screen, we predicted that the all systems usage while the posters were up versus after they came down, we found a statistically significant drop in overall energy use. The results were contrary to our hypothesis, but after speaking with Dolly, a New Turman resident, she told us that the posters had been noticed and brought up in a ResLife meeting, and ResLife had independently decided to continue encouraging the green movement in New Turman, which would explain the continued decrease in resource use even after our posters were taken down.

We also compared the data from New Turman to the data from Few. We hypothesized that the energy usage in New Turman would be greater than Few for the period before the posters were up because Few has posters encouraging the green movement. We found that the data supported our hypothesis and showed a statistically significant difference in all systems energy usage for the period before the posters were up. With the posters up, Few’s energy usage would decrease and would rise again after we took the posters down. This increase, however, was not statistically significant. The environmentally friendly posters in Few did not seem to be affecting the residents’ electricity usage. However, there is a statistically significant difference in chilled water consumption and steamed water consumption between the two dorms. New Turman used more chilled water than Few in this period, which supports our hypothesis that the energy usage in New Turman is significantly lower than Few’s. It is possible that since the Few residents had been exposed to the posters since the beginning of the school year, they had become accustomed to the posters and stopped noticing them as much. In contrast, the posters were newly put up in New Turman, and perhaps, the residents took more notice of the posters and drastically decreased their energy consumption.

Overall, the statistically significant drop in energy usage between New Turman before the posters and while the posters were displayed provides support. However, more research would need to be done to further confirm our results. Longer time periods would need to be compared, and the project would need to be replicated in another dorm to provide added support that the posters were the variable affecting energy usage. Also, further research would have to be done to ascertain exactly which posters were making the most difference in terms of energy consumption (the ones reminding students to take the stairs, or turn off the lights, or take shorter showers, etc.). Our hypothesis also needs to be altered based on the results we have. Based on the data, it seems that the posters affect energy usage and result in a decrease in energy usage. Furthermore, the energy conserving habits last even after the posters are taken down. These results can be applied to many other situations, such as apartment buildings. From our experiment there is evidence that green movement posters do have an effect on energy conservation habits and the possibilities of where you can use this type of media is endless.

Conclusion
In conclusion, we found the experimental methods and procedures to be highly fair to have conducted the proposed experiment. Therefore, we can be sure that the resulting data/outcome is accurate and supports the hypothesis Emory University students were well educated enough to actively respond to the posters’ green encouragement. The information gained from this study is significant and can be used to create greener environments on college campuses and places around the world.

Methodology
We recreated sustainability-encouraging posters that were on display in Few and put them up in New Turman. Recreating the same posters provided a constant variable “a green movement” that eliminated the advantage of more-attention-grabbing sizes, colors, green phrases, etc. Then from the green screen in New Turman and Few we collected data on electricity usage (kWh/day), steam consumption (kilo-BTU/day), chilled water consumption (kilo-BTU/day), and all systems (kilo-BTU/day) for a period of two weeks each: before posters, with posters, and after posters. Because the visual media were already present in Few and New Turman, students would not experience their energy consumption while the posters were up. For Few, the data were used as the control to compare data from New Turman. We compared these results to determine an overall trend of the effects of green media and the length to which these effects lasted.

Discussion of Results
With a first look at our data, it appears that the numbers recorded by the green screen support our hypothesis and visual media encouraging the green movement do encourage students to be more sustainable. All the systems usage measurement provided by the green screen gives a generic reading of all the basic functions of the New Turman building. This measurement showed a mean difference of 3057.36 kilo-BTU between New Turman before the posters were displayed and the period while the posters were up. A difference this large could only have occurred 0.01% of the time by chance alone, and so it is safe to say that something other than chance is causing the differences to occur. When we took a more in depth look at the specific energy measurements from the green screen, we were able to pinpoint exactly what type of energy the New Turman residents were conserving and where the alternative energy usage was greatest. At Emory University, the resources available to promote green living are plentiful. There is no reason for students to be “environmentally unaware”.

This new term of “environmentally unaware” encompasses any action (or inaction) that consumes high amounts of energy. Most recently, Emory University has added three new green buildings: Few, Evans, and New Turman, each equipped with many energy efficient appliances to promote a green lifestyle. In New Turman, which would explain the continued decrease in resource usage while the posters were on display and the period of time after they came down.

Our next look at which specific energy features the New Turman residents had conserved versus Few residents. We found that although the difference in chilled water consumption was not statistically significant, both the difference in electricity usage and the difference in steamed water consumption was statistically significant. This shows that New Turman residents were careful about turning off lights, unplugging their electronics when done charging, and using the elevator less frequently which were all things that our posters advocated.

Lastly we compared data from New Turman from the week after the posters came down to the same week in Few. We found that overall energy usage was significantly less in New Turman than in Few, and that the difference in steamed water usage and the difference in chilled water consumption was statistically significant. New Turman was using more chilled water than Few in this period, which supports our hypothesis that the energy usage in New Turman is significantly lower than Few’s. It is possible that since the Few residents had been exposed to the posters since the beginning of the school year, they had become accustomed to the posters and stopped noticing them as much. In contrast, the posters were newly put up in New Turman, and perhaps, the residents took more notice of the posters and drastically decreased their energy consumption.

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Figure
Love the heat?
We need you

We are extremely encouraged by the green screen support our hypothesis and visual media encouraging the green movement do encourage students to be more sustainable. All the systems usage measurement provided by the green screen gives a generic reading of all the basic functions of the New Turman building. This measurement showed a mean difference of 3057.36 kilo-BTU between New Turman before the
The Effect of REM Sleep on the Critical Period in the Visual Cortex

Tania del Rivero

Creating a New Future
Obama Lifts the Ban on Stem Cell Research
An Editorial by Lauren Kurlander

O
n March 9, 2009, President Obama issued an execu-
tive order to reverse President Bush’s strict limitations
on stem cell research. President Obama has thrust
government support behind the research in hopes of
finding new treatments for serious diseases such as Parkinson’s and Alzheimer’s. By reissuing the funding of this research, President Obama stands by his pledge that “his administration will make sci-
cientic decisions based on facts, not ideology” (Stolberg NY Times, 3/9/09).

Although President Obama has opened the financial floodgates of the National Institutes of Health, the Dickey-Wicker amend-
ment of 1996 still bans scientists from manufacturing new stem cell
lines. Thus, all stem cell lines will continue to be the embryos re-
maining in private fertility clinics — still a heated debate of morality.

To quell the opponents of stem cell research, President Obama’s or-
der will also “give the National Institutes of Health 120 days to de-
velop ethical guidelines for the research” so that some caution tape
is set up for the anticipated boom in stem cell research (ABC News, 3/9/09).

Because the NIH grant application process can take as long as
nine months, the NIH is trying to “streamline the research process”
(ABC News, 3/9/09) by making grant money readily available. By
speeding up the grant processes, the NIH also hopes “to get money
from the stimulus out quickly” (ABC News, 3/9/09).

Revised by the new federal support, stem cell research is ex-
pected to open doors to many new possibilities. Here at Emory, stem cell research is a popular and progressing field. According to
Elizabeth Rogawski, a recent Emory College graduate who worked
at Emory’s Stem Cell Research lab, the latest research conducted
here intends to create IPS cells, or induced pluripotent stem cells.
These cells avoid the use of embryos while still maintaining embry-
nonic stem cell characteristics. The ability to manufacture stem cells
from adult cells would give a steady supply of stem cell lines to give
stem cell research another giant boost. Rogawski’s personal project
is involved with reprogramming human dermal fibroblasts to stem
cells. My particular goal is to use over-expression of microRNAs
to induce these cells to have the same characteristics as embryonic
stem cells. This would provide an alternate source for stem cells and
circumvent some of the moral issues with funding, etc.”

Ultimately, stem cell research is a critical area for the treatment of dis-
eses, and other researchers at Emory actually deal with this specifici-
cally, working to treat various diseases with stem cells, such as heart
disease. This is undoubtedly a thriving field of study, and thanks to
Obama, stem cell research will only increase in the future.

acknowledgements
My experiment is based on the work of James Shaffery and uses similar methods to
explore the same set of topics. I would like to thank my mentor, Bernardo Morales, for
his guidance in experimental design, as well as Carlos Rozas for his assistance in the pro-
cedure. I would also like to thank Kristen Frenzel for her suggestions. I would like to ac-
knowledge the University of Santiago Chile and the Institute for Study Abroad at Butler
University along with Emory University for providing me with resources and guidance.

Lauren Kurlander has transferred to Cornell University where she plans to major in bi psy-
ology. She is a resident of Manalapan, New Jersey and she hopes to pursue a career in neu-
rology.

abstract

The critical period for synaptic plasticity is a limited time period for learning dur-
ing which the brain must be exposed to certain stimuli. During this time, the brain is
more flexible and susceptible to change, but once the critical period closes, the stimuli no
longer have the same effect because permanent modifications have been made. Although
there is a difference in brain structure during and after the critical period, we have yet to
identify the environmental factors that contribute to its closing. Recent studies suggest
REM sleep plays a key role in this process by reducing the time period to induce synaptic
plasticity in the visual cortex. To test this hypothesis, a group of Sprague Dawley rats was
deprieved of REM sleep for one week at the end of the critical period, about 5 weeks post-
natal, using the “small-pedestals-over-water” method. A control group of Sprague Daw-
ley rats lived under similar conditions, but with necessary adjustments allowing them
to sleep. Slices of visual cortex were obtained, and Long Term Potentiation (LTP) was
induced to layers II/III in sleep- deprived and control rat brain slices. While LTP was
observed in rats that underwent REM sleep deprivation, in the control rats, there was
no significant change after high frequency stimulation. These findings suggest that REM
sleep accelerates the closing of the critical period by reducing synaptic plasticity in the
visual cortex in rats.

faculty mentor:

Dr. Bernardo Morales is a professor in the department of Chemistry and Biology at
the University of Santiago, Chile. He earned his doctorate at the University of Chile,
where he wrote his dissertation on “Inhibitory Responses Evoked by Odorants in Off-
cortex Neurons in Vertebrates”. Previously, he has worked as an investigator at the Depart-
ment of Neuroscience in the Zanvyl Krieger Mind/Brain Institute of Johns Hopkins Uni-
versity. He is currently Principle Investigator of a Neuroscience laboratory which focuses
on the cellular mechanisms behind learning and memory.

Synaptic Plasticity - the ability to alter the efficiency and structure of a synapse as a
result of electrical stimulation

Long Term Potentiation (LTP) - a model of synaptic
plasticity resulting in the strengthening of a synaptic
connection between two neurons after high frequen-
Cy stimulation
Introduction

During early childhood and through a short critical period, the cerebral cortical circuits display a high plasticity state that can be easily modified. The sensory experience is essential for the normal maturation of circuits in many regions of the cortex during these critical periods.

For example, children with cataracts lose vision in the affected eye unless they have a surgery before puberty. Another example of a process related to the critical period is the learning of a second language before puberty in order to gain complete fluency. Finally, a remarkable example of plasticity is the activation of the primary visual cortex of kittens that are reading in blind people who have lost their vision at an early age.

Most of our understanding of plasticity during the critical period derives from studies of ocular dominance (OD) in the visual cortex. OD is the relative responses of a neuron to visual stimuli coming in the eye of the right versus the left eye. Wiesel and Hubel did the first demonstration that monocular deprivation causes ocular dominance shift. [1] Numerous studies of deprivation have shown that OD shifts involve rearrangement of inputs from Lateral Genuis Nucleus (LGN) to layer IV and also from layer IV to layer III. Considerable progress has been made toward understanding the molecular and cellular basis of experience-dependent plasticity in cortex. It is now well established that cortical re-organizations are driven by changes in the patterns of activity induced by alterations in sensory experience. [2] The cellular mechanisms of this type of plasticity and how they come to be seen as a short critical period are poorly understood. Factors, such as the N-methyl-D-aspartate (NMDA) glutamate receptor, metabotropic glutamate receptors (mGluRs), neurotrophins, brain-derived neurotrophic factor (BDNF) and nerve growth factor (NGF) all have been implicated in the determination of the critical period. Rapid Eye Movement (REM) sleep has recently been implicated in this process as well.

Receiving the appropriate stimuli during the critical period is essential for normal development. Since this period of time is characterized by increased synaptic plasticity, only then are certain stimuli and experiences able to shape the brain by making the necessary synaptic modifications. Once the window for the critical period closes, the changes made during this time become permanent. For example, in an experiment conducted on kittens, one group was deprived of visual input in one eye throughout the critical period and became permanently blind in the light-deprived eye even though the eyes received normal visual input following the critical period. When tested at 4 years of age in one eye for part of the critical period was able to regain vision in that eye as long as they received visual input within the critical period. [3] Although the amount of visual input was the same in both eyes of kittens, the time during which the visual input was administered drastically changed the impact on synaptic connections.

This brings up the following question: What determines the length of the critical period? Previous studies have demonstrated the involvement of BDNF in the induction and consolidation of the time course of the critical period in visual cortex. [4, 5] Although environmental factors controlling the critical period are not well understood, one effect that has been shown to be REM sleep. REM sleep is a sleep stage that occurs every 90 minutes after the initial sleep and is characterized by Rapid Eye Movements (REM). This sleep stage has also been tied to memory consolidation, which involves permanent synaptic modifications. [6] In experiments done on kittens, monocular deprivation reduced the response to stimuli in both eyes. After sleeping 6 hours, this effect was enhanced and the kittens respond less to the stimuli which did not sleep during that time. The lack of response to stimuli in the kittens which did not sleep were more evident compared to the kittens which did sleep.

Experiments conducted by James Shaffer on the visual cortex of rats suggest that REM sleep deprivation is capable of maintaining synaptic plasticity beyond the 5 weeks. [7] This implies that REM sleep is essential for the normal maturation of circuits in the visual cortex and has the potential to promote the closing of the critical period.

A reliable model for testing synaptic plasticity in the brain is Long Term Memory (LTM), during Bruxall buffer at 4°C containing: 212.7 mM KCl, 1.25 mM NaH2PO4, 3 mM MgSO4, 1 mM CaCl2; 26 mM NaHCO3, and 10 mM glucose (pH 7.4 buffering with 95% O2 and 5% CO2). Eight slices were obtained for each group of rats. The slices were cut with a guillotine into a storage chamber containing artificial cerebrospinal fluid (ACSF) made of: 124 mM NaCl, 5 mM KCl, 1.25 mM NaH2PO4; 1 mM MgCl2; 26 mM NaHCO3, and 10 mM glucose (pH 7.4 buffering with 95% O2 and 5% CO2). The slices remained in the storage chamber for an hour at 32°C before electrophysiological recordings were executed. This investigation was performed following protocols approved by the Animal Care and Use Committee of the University of Santiago in Chile. Electrophysiological Recordings

Extracellular recordings for field excitatory postsynaptic potential (fEPSP) were made of a stimulus in the white matter of the brain sample and a recording pipette in the pyramidial cells of layers II/III within the cortex. Synaptic responses were evoked with 0.2 ms, 1 Hz and 0.75 mA stimuli. In the 3 week-old rats, the fEPSPs were identified using a bi-ionic stimulating electrode (HFC, 200 µm diameter). The white matter was stimulated with a low frequency stimulus of 1 Hz every 15 min until a 20 min baseline was collected. Tetanic stimulation was posed of 10 trains of 100 ms, 2 trains of 100 Hz for 5 seconds, was applied to the white matter to induce LTP.

Preliminary experiments were conducted in the laboratory to compare synaptic plasticity in rats during and after the critical period using LTP. These experiments aimed to find a detectable difference in the synaptic responses between mature and immature rats. Figure 2 shows the recordings of the fEPSPs in mV obtained in layers II/III of the rat visual cortex, induced by tetanic stimulation applied after the critical period.

In the 3 weeks-old rat (Fig. 2a), the single recordings of the fEPSPs clearly depict a greater amplitude in the fEPSP after the tetanic stimulus than in the fEPSP before stimulation. The amplitude of both the input was exposed to about 1.0 mV at the graph at the bottom, we can see this change in the amplitude after the tetanic stimulus is applied at 0 seconds. This increase in the fEPSP lasts for more than 30 min, indicating LTP was produced because the fEPSP before and after the tetanic stimulus is almost the same size. The increase in the amplitude of the fEPSP after tetanic stimulation is almost doubled from about 1.0 mV to 2.0 mV. In the 5 week-old rats (Fig. 2b), however, the amplitude of the fEPSP before and after the tetanic stimulus is almost the same, as the amplitude of the fEPSP after tetanic stimulation. This evidence shows that the capacity to induce LTP from the white matter declines with age and can be easily induced in young animals. With this information and considering previous studies, we can deduce that at 5 weeks there is no synaptic plasticity due to a closing of the minutes of sleep, which was not sufficient amount of time to reach the REM stage. The group of 28 day old control rats lived in pools with the same measurements and depth of water, with the exception that the platform measuring 26 cm in diameter that provided the rats with sufficient floor space for sleep.

Brain Dissection

At 35 days, the rats were anesthetized and decapitated using a guillotine to isolate the visual cortex. The necessary cuts were made to isolate the visual cortex. Then, using a vibratome (Campden Instrument), 300 to 400 µm thick brain slices were obtained in a storage chamber containing artificial cerebrospinal fluid (ACSF) made of: 124 mM NaCl, 5 mM KCl, 1.25 mM NaH2PO4; 1 mM MgCl2; 26 mM NaHCO3, and 10 mM glucose (pH 7.4 buffering with 95% O2 and 5% CO2). The slices remained in the storage chamber for an hour at 32°C before electrophysiological recordings were executed. This investigation was performed following protocols approved by the Animal Care and Use Committee of the University of Santiago in Chile. Electrophysiological Recordings

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Figure 1 - Dual extracellular field recording showing the stimulation pipettes on the white matter and recording pipettes on layer III/V

Visual Cortex (WM -> II/III)
The Unique Paths of Isaac Newton and G.W. Leibniz to the Calculus, With Shared yet Underappreciated Influence from Thomas Hobbes

faculty mentor:

Dr. Michele Benzi is a full professor in the Department of Mathematics and Computer Science. A native of Italy, she is a graduate of the University of Bologna and holds a PhD in Mathematics from North Carolina State University. His main research areas are numerical analysis and scientific computing. He is the recipient of several research grants from the National Science Foundation and serves on the editorial boards of some of the leading applied mathematics journals.

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Elizabeth Rogawski

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Critical changes occur in the brain which cause its maturation and critical period. The data in Figure 3 demonstrate that 5 week-old rats subjected to REM sleep deprivation were capable of generating LTP in response to tetanic stimulation applied to the white matter. The increase in the percentage of baseline response (another measure of EPSP amplitude) after tetanic stimulation at 0 seconds was increased on average 30% and lasted about 30 min. In contrast, rats with regular sleep cycles, as seen in the control rats, were incapable of producing LTP as expected based on the data from Figure 2. The EPSPs before and after the tetanic stimulation are almost identical in the control rats and the responses maintain the same amplitude. In comparing Figures 2 and 3, we can see there was not as much increase in the magnitude of the response in the LTP of the 5 week-old REM sleep-deprived rats in Figure 3 as in the 3 week-old rats in Figure 2. In the 3 week-old rats, the amplitude of the EPSPs was increased by 100%, from 1.0 mV to 2.0 mV, while in the 5 week-old REM sleep-deprived rats, the amplitude increase by approximately 30%, from 100% to 130%. However, the data clearly suggest that LTP was induced in the 5 week-old REM sleep-deprived rats because there was an unambiguous difference in the amplitude of the responses in this group of rats and the control rats. The amplitudes of the EPSPs were always larger in the REM sleep-deprived rats than the control rats after tetanic stimulus. In the REM sleep-deprived rats, the baseline response remained about 100% the entire time. The data in Figure 3 demonstrate that 5 week-old rats subjected to REM sleep deprivation retained synaptic plasticity in the visual cortex, suggesting that REM sleep influenced the amount of plasticity in the visual cortex. The most plausible explanation for the obtained results is that in the REM sleep-deprived rats, there was a prolongation of the critical period, which normally ends at 5 weeks.

Conclusion

It’s beneficial for us to learn more about the modulators of the critical period because this information can be utilized to manipulate its duration. In the critical period, many structural and functional changes occur in the brain which cause its maturation and limit its capacities by creating a fixed structure. Not only is it in our interest to identify these changes, but also to find out the mechanisms which provoke them. Previous studies by Shaffer & Roffwarg showed REM sleep deprivation had no effect on LTP regulation in mature rats since the critical period had already come to an end. The current study used immature rats to demonstrate that REM sleep is a key factor involved in the mechanisms that contribute to the closing of the critical period by reducing synaptic plasticity. This signifies that REM sleep deprivation can extend the critical period. Information such as this can be used to find out how we could have a more flexible brain for a longer period of time. If we can manipulate our critical period for learning, for example, we could learn a new language or math concepts with the same ability of a 12 year-old at age 30.

Works Cited


W.M. stimulation and Layer 2/3 recording

Figure 3 - Recordings of EPSPs in layers III of the visual cortex upon stimulating the white matter before (1) and after (2) tetanic stimulation in control rats (black) and rats deprived of REM sleep (blue) at 5 weeks of age.
A midwifet the advance of advances made in mathematics by a variety of geometers and philosophers in the seventeenth century. Isaac Newton (1642-1727) and Gottfried Wilhelm Leibniz (1646-1716) are disentangled from their contemporaries in both creating firm principles for the new field of calculus. Based on the new scientific methods developed by their predecessors, such as Galileo and Descartes, this new discipline is the result of their contributions to the study of the nature and relation to a broad array of problems. While Cavalieri, Torricelli, Wallis, Fermat, and others developed many basic concepts and ideas contributing to the establishment of a new discipline, Newton and Leibniz alone deserve to be named the creators of the calculus for their discoveries. At their time, mathematicians were focused on problems concerning the properties of curves, such as tangents, normals, lengths, areas, and volumes of quadratic surfaces. In their attempts, they considered both the sides and curvatures of revolution known as Gabriel’s Horn has an infinite surface area, but finite volume (Grattan-Guinness 227). John Wallis is known for the summation of infinite series by his method of arithmetic in- tended to expand function values. His method of summation was similar to the limit in describing his process, “it may be done as far as one likes until the difference between the greater and the smaller or finite series assigned is perceived.” Pierre de Fermat succeeds in finding centers of gravity for solids, maxima and minima of curves, and tangents of polynomials (Fer- mat 340). Each of these advances contributes to a growing base for the calculus. In the process of using infinitesimal quantities, and determines the proportion between them. While this method establishes a friendly shape” (Grattan-Guinness 227).

Cavaleri’s colleague, Evangelista Torricelli, extends the established rule of integration for y = x^n to include the case in which n ≥ 1 or is even negative. He also works with lengths of transcen- dents such as spirals, hyperbolas, and logarithmic spirals and the like. His method of revolution known as Gabriel’s Horn has an infinite surface area, but finite volume (Grattan-Guinness 227). John Wallis is known for the summation of infinite series by his method of arithmetic integration expanding function values. His method of summation was similar to the limit in describing his process, “it may be done as far as one likes until the difference between the greater and the smaller or finite series assigned is perceived.” Pierre de Fermat succeeds in finding centers of gravity for solids, maxima and minima of curves, and tangents of polynomials (Fermat 340). Each of these advances contributes to a growing base for the calculus. In the process of using infinitesimal quantities, and determines the proportion between them. While this method establishes a friendly shape” (Grattan-Guinness 227).

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Newton and Leibniz independently establish universal rules for the calculus, earning the status of the creators of this new field in mathematics. Instead of approaching specific problems as dis- tinct, both men seek to develop a method for the calculus that is applicable to all problems. The major insight of both men concerns the concept that differentiation is the inverse process of integration (Grattan-Guinness 272). When given a curve, he can find areas and volumes, and conversely from any areas or volumes, he can find the curves (Newton 366). In his letter to Henry Oldenburg in October of 1676, Newton cleverly hides his method. He states that when he integrates by adding bodies, when given derivatives, one can find the function (Newton 367). This notion today is essentially equivalent to the fundamental theo- rem of calculus which Newton later distinguished between the two methods. The methods of the two men will then be analyzed critically to reference between the two methods. The methods of the two men will then be analyzed critically to reference between the two methods. The methods of the two men will then be analyzed critically to reference between the two methods. The methods of the two men will then be analyzed critically to reference between the two methods. The methods of the two men will then be analyzed critically to reference between the two methods. The methods of the two men will then be analyzed critically to reference between the two methods.
Can You Get a PhD in Happiness?

An Interview with Corey Keyes, PhD

By Sammykta Mullangi

Corey Keyes, or as he is sometimes better known - Dr. Positive, is an Emory professor of sociology who has been studying social and psychological phenomena and “flourishing,” thereby pioneering the new field of positive psychology.

Sammykta: What is your definition of social well-being?

Dr. Keye: Social well-being is the ability to function well in your public life, in the specter that goes beyond the household, into the community, the workplace, and even into cities and the nation.

When we measure it, we don’t measure it as one thing. It actually comes in five different aspects or dimensions. So social well-being consists of a feeling of integration, a sense of contribution, that the things that you do on a daily basis matter to the world, a sense of acceptance of other people, a social well-being – we are part of units or groups that go beyond just being individuals and can grow. We honestly hope to believe that groups that we are part of, whether it is a state or nation, can grow. And the last one is social coherency, that the world around you, what’s happening in the society makes sense to you. So there are a lot of different ingredients that go into social well-being.

What is positive psychology?

Positive sociology or psychology is the study of human strength, resilience, and what makes for joyful living. Life is both suffering and joy. We’ve studied a lot of suffering, but we’ve not studied what makes for joyful living.

What is the laudate line?

Technically speaking, it’s the translation of non-linear dynamics into a simple formula, the ratio of positive to negative experiences required for you to flourish. It’s taken...
ing in an equation that was developed in non-linear dynamics to explain chaotic systems that create the butterfly effect – where one change expands, and why it keeps doing that. When you translate that into human terms, and into kids who are having negative experiences, the equation is translated as for every one negative experience you have, in order to maintain flourishing, you have to have three positive experiences to counteract it. The reason for that is, one-on-one, bad is always stronger than 1-to-3 good things. It will always lose to bad things in terms of our focus, our concentration, and what we remember. So in order to tip that into healthy balance, you need at least three more good things to have this healthy system that keeps expanding, growing, and staying resilient.

Does the magnitude of these events matter?

That’s a good question. They haven’t looked at that yet. But so far, they haven’t had to, because you just need three things of what would be considered positive experiences, positive ways of talking to people, positive emotions, for every one of your complaints. Intensity doesn’t matter, so far. But that’s a good question. To balance one slightly negative thing, do you only need two really good things, rather than just three? In terms of quality, if those three really are good things, you don’t need that third, but no, they haven’t looked at that.

What are the implications of your findings on society, governmental policy, and educational systems?

I’ve been thinking a lot about this because I’m now often invited to talk to the governmental officials who are interested in public health, particularly mental health. It turns out that we’ve only recently discovered that mental illness is a really serious public health issue. So everyone agrees on that but they don’t know how to solve the tide of rising mental illness. In terms of treatments, the treatment of illness is the way they go about that because we’ve been focusing on getting treatments, pills and therapies. The implication of my research is clear that you can treat everyone and you don’t have to treat everyone. In other words, you would still not necessarily have a mentally healthy population. The treatment of mental illness is only half the battle. And in fact, because mental health is more than the absence of mental illness, anything less than flourishing results in all kinds of losses – missed days of work, healthcare costs go up, resilience goes down, a whole host of problems that you need to be both promoting and preventing at the same time. You need to treat and protect. Treat mental illness and protect good mental health in the population at the same time. And so, we’re seeing a greater sense of purpose in life, a sense that what you can do now is of value to the world, that you are a part of our society, that you can have a sense of identity and belonging, that is, raise their levels of flourishing. You should leave here feeling even more confident in purpose, in life, a sense that you can do now is of value to the world, that you are a part of our society, that you can have a sense of identity and belonging, that is, raise their levels of flourishing. You should leave here feeling even more confident in purpose, in life, a sense that you can do now is of value to the world, that you are a part of our society, that you can have a sense of identity and belonging.

Are Americans in general susceptible to not flourishing? Because any country that goes through massive social change, cultural change, political change, traumatic change, it moves into a market-dominated culture where everything is monetized, right down to your time. Time is money. So how do you spend your time? When you look at the rates of mental illness by country, the U.S. leads the world to treat and protect. Treat mental illness and protect good mental health in the population at the same time. And so, we’re seeing a greater sense of purpose in life, a sense that you can do now is of value to the world, that you are a part of our society, that you can have a sense of identity and belonging, that is, raise their levels of flourishing. You should leave here feeling even more confident in purpose, in life, a sense that you can do now is of value to the world, that you are a part of our society, that you can have a sense of identity and belonging, that is, raise their levels of flourishing. You should leave here feeling even more confident in purpose, in life, a sense that you can do now is of value to the world, that you are a part of our society, that you can have a sense of identity and belonging.

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Metaphors are considered an essential part of language. They are vital to self expression because of their ability to communicate ideas beyond their literal meaning. The importance of metaphor comprehension goes beyond simply understanding a metaphor's literal meaning. Being able to understand a metaphor most likely implies a strong and solid grasp on the uses of non-literal language. This review aims to explore the theories behind metaphor comprehension through both a linguistic and biological perspective. The paper will outline what a metaphor is and how it has been defined, used and subdivided. Subsequently, this article will explore the general theories of metaphor comprehension, laying out the non-scientific approach to understanding how metaphors come to be understood. Lastly, this review will highlight the biological view of metaphor comprehension, underlining the search to attribute certain brain areas to metaphor comprehension.

Introduction

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Support & Refutation of Conceptual Metaphor Theory

Metaphors create dynamic and expansive opportunities in which to use language for self expression. There have been several interesting and often opposing theories as to how this linguistic tool is processed, as well as how it functions linguistically. Firstly, Lakoff and Johnson (1980) support the literary power behind metaphors by using the theory of the conceptual metaphor. The theory suggests that human experience shapes metaphor creation, use, and understanding. They argue that the concepts within a metaphor possess uniquely inherent properties. These intrinsic properties relate to physical sensory experiences, thus allowing an individual to comprehend them. Feldman, Lakoff, and Howell (2008, p. 4) highlight this approach with their reference to Lakoff's “Spatialization of Form” hypothesis, which implies that “a metaphorical mapping is constructed from the structure of physical space into that of a conceptual, mental space.”

Lakoff and Johnson (1980) specifically explore the use of conventional metaphors. An example of such a metaphor used by Lakoff and Johnson (1980) was “Argument is War.” They present the idea that the concept behind an argument is analogous to a battle. For example, one may be victorious in an argument just as easily as in a war. Although not all have experienced war, most have been involved in an argument and studied the history of wars, and thus may be able to understand the analogy. The conceptual metaphor theory is scrutinized for its explanation of how a metaphor is understood and reasoned (Keysar and Bly, 1999, p. 1563). Although Lakoff and Johnson (1980) develop a strong argument, many criticize this approach toward metaphor comprehension. Keysar and Bly (1999) argue, and others previously, that “while conceptual metaphors provide convenient means of expression, they do not constitute means of thinking” (Keysar and Bly, 1999, p. 1563). In the previous example, Lakoff and Johnson (1980) assume that the concept of war is well grasped by all. As Keysar and Bly (1999) argue, this may prove problematic and defeat the purpose of metaphor as a means of creative thinking. The idea of war has never been fought in a war. They believe that having actually fought in a war is irreplaceable. Therefore, without participating in war, a thorough and strong connection between the themes of argument and war could not be made.

Gregory L. Murphy (1997) also attempts to refute the legitimacy of the conceptual metaphor theory. He believes that ideas behind metaphors have not been sufficiently supported. One piece of evidence behind his reasoning is that there is a lack of nonmetaphoric hypotheses represented. Thus, there is no means for comparison to contrast ideas of how a metaphor may be processed differently than other phrase types. Murphy (1997) also highlights that this theory lacks biological support as it was developed by ex-
The right hemisphere is to possess a special cognitive function and is used to complement and contrast with the left hemisphere's abilities (Damasio, 1994). It is known that the right hemisphere plays a significant role in the processing of metaphorical language (Rinaldi et al., 2004). Additionally, the right hemisphere is known to have a special role in the processing of language (Damasio, 1994). Moreover, the right hemisphere is known to have a special role in the processing of language (Damasio, 1994). Furthermore, the right hemisphere is known to have a special role in the processing of language (Damasio, 1994).

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Two of the most comprehensively studied disorders are Asperger Syndrome (AS) and Autism Spectrum Disorder (ASD). Individuals with AS and ASD, however, often lack the interactive communicative skills to use their knowledge of language. They therefore

The use of metaphors in comprehending neurological function in brain-damaged patients with right hemisphere damage is challenging.
possess a deficit in pragmatic language use or comprehension. AS individuals have trouble with understanding non-literal linguistic phrases and interpreting a speaker's intentions by their choice of words. For example, patients with AS are often "overly literal in their language comprehension and have difficulty understanding narrative humor" (Martin & McDonald, 2004, p. 311). Thus, these mentally impaired patients are good test subjects because they provide the ideal window into contextual understanding of a metaphor is necessary to fully comprehend it.

Martin and McDonald (2004) explore the two predominant theories that attempt to explain where deficits in pragmatic language occur in AS patients. They compare the theory of Weak Central Coherence (WCC) and the Social Inference/Theory of Mind (TOM) (Martin & Caramazza, 2003). While the two theories appear similar, one is unable to use context to derive meaning. This would suggest a deficit in the contextual metaphor theory. For the WCC theory to hold true, low level pragmatic language processing must occur across several domains. In these individuals concentrate on minute pieces of information rather than a greater, cohered pattern of ideas. This would be caused by malfunctioning of the integrative central system within the brain (Martin & McDonald, 2004). WCC is necessary for a range of tasks from the comprehension of simple visual understandings to the understanding of pragmatics (Martin & McDonald, 2004).

In contrast, TOM indicates an ability to understand a speaker's intention and therefore to "form representations of other individuals' mental states, and, furthermore, to use these representations to understand, predict and judge others' utterances and behaviors" (Martin & McDonald, 2004, p. 312). Martin and McDonald (2004) highlight AS children's deficit in TOM by referring to Happe and Frith (2001). In Happe and Frith (2001), individuals diagnosed with autism were tested to see how well they could understand and process metaphors. The results indicate that the core of communication in society.

Impairments may stem from the inability to integrate metaphors with cognitive functions of the frontal cortex are compromised during this process. Overall, the ability to comprehend metaphors was not impaired in early or more developed cases of Alzheimer's as only four of the thirty-nine subjects were unable to comprehend figurative language. However, recent research has suggested that the left hemisphere attributed to metaphor and idiom comprehension is visual-spatial in nature. These mappings are grouped by the right hemisphere in general was identified (Chen et al., 2008). More specifically, there were significant activations of the left posterior middle temporal gyrus, left angular gyrus and left inferior frontal gyrus. In terms of motion metaphors, there is a posterior-anterior axis of increasing abstract processing through the lateral temporal cortex. The more literal, concrete motion language processing occurs in the posterior inferior temporal gyrus. The more abstract language activates the posterior middle temporal gyrus and even the superior temporal gyrus (Chen et al., 2008). These results can be interpreted in light of sensory-functional theory, proposing that "non-living things have some sensory-functional properties in terms of their functional properties" (Martin & Caramazza, 2003).

In effect, the concepts acquired through experiences are-ingrained within or near the sensory-motor area by their relevance to physical experience. Metaphors are expressions that include spatial concepts with both sensory-motor and abstract features. The research team believes that, "In predicate motion metaphors, for example, the non-literal core abstract conceptual features are highlighted to establish the meaning of the metaphor" (Chen et al., 2008, p. 7).

Lacey, Anderson, Stillia and Sathian (2008) corrected certain weaknesses of the cognitive depletion hypothesis. Chen et al. (2008) investigated the conceptual metaphor theory, but did not run a localizer task to identify motion-selective areas in their subjects. They simply looked at how the degree of abstraction of a motion metaphor causes activation of different anterior/posterior regions. Furthermore, several factors of the metaphors used in the Chen et al. (2008) paradigm were assessed including: word length, frequency, and concreteness. Chen et al. (2008), the frequency varied too greatly between the predicate metaphors, literal motion sentences and non-motive sentences. The study therefore lacked an important control variable. Lacey et al. (2008) addressed this issue by scheduling a task to localize visual, haptic, and bimodal texture-selective cortical areas in their participants. In a separate fMRI session, participants listened to sentences containing a texture metaphor and control sentences that contained non-motive sentences. Prior to running the task, participants pressed a button when each sentence was understood. The results showed that during the presentation of textual metaphor sentences compared to non-motive sentences, the participants showed increased activity in the supplementary motor area, bilateral OPI and left OP3, an area previously found to be texture-selective in touch (Silla & Sathian, 2008). However, neither the visual nor bimodal texture-selective areas were significantly activated during the manipulation and temporary storage of information and for that reason a central role is attributed to working memory (p. 8). Therefore, in order to quickly and efficiently comprehend uncon-

In previous research by Moscovitch and Umilta (1990) in which they attempted to determine the degree of neurological function and patients with a mild to moderate amount of illness were selected. (Papagno, 2001). Metaphors and idioms were employed to investigate the deficits in figural language. The patients were asked to translate the phrase to its corresponding literal meaning. The novel metaphors included: "I have eggs in my stomach" with a description of the content such as "This is what a girl said about her first day in school" (Dennis et al., 2001, p. 50). They were then asked to match the metaphorical phrase to its figurative meaning from a choice of four visual repre-
to show sensory-specific activity in the somatosensory cortex. These findings provide support for the idea that cognition is grounded in perception and that the understanding of metaphors stems from perception.

Conclusion

There have been several theories put forward and many unique subject groups used to analyze what is necessary to comprehend a metaphor. The conceptual metaphor theory emphasizes the importance of human experience and its ability to shape our understanding of language. It relies on the basic concept that in order to understand a metaphor one must call upon his or her physical perception and experiences. As discussed earlier, many of the right-brain damaged patients lose their ability to comprehend the context of metaphorical phrases as implied by the WCC theory and conceptual theory of metaphor processing. Although in some cases the theory mentioned above is well supported, it remains inconclusive whether metaphor comprehension may be attributed mainly to the understanding of a word's meaning and context and what that may imply.

Furthermore, Lacy et al. (2008) reinforce the use of physical perception by exploring sensory-specific metaphors in neuroimaging. The research team highlighted that the use of textual attributes allows for the activation of the texture-selective somatosensory cortex. This most likely occurs because texture is salient to touch. A specific somatosensory area of the cortex is recruited to assess the contextual relevance of the concepts within the metaphor. Therefore, the brain's inherent categorization through sensory mappings promotes this specific sensory activation.

There are several avenues to explore in order to further our understanding of metaphor processing. For example, future work may expand upon Lacy et al. studies by exploring the activation of different areas of the somatosensory cortex by various sensory-selective subjects. Further investigation into the ability of left-hemisphere brain damaged patients to understand metaphors should be pursued. Overall, a vast amount of research remains to be done on metaphor processing within the brain. This research is crucial for its contribution to the understanding of neural mechanisms behind language processing. Moreover, these studies may contribute to the expanding library of knowledge dealing with how information is integrated within the brain. Through the exploration of metaphor processing, we are moving along a path to a more extensive understanding of the neuronal mechanisms and regions of the brain attributed to language processing.

References


Introduction

In conducting our study, we sought to explore the validity behind one of the most prominent myths associated with college: the Freshman Fifteen. For many incoming freshmen, the prospect of entering a new, foreign environment, devoid of any parent oversight, can be both difficult and stressful. Regardless of the truth of the myth, the Freshman Fifteen can often feel like a looming possibility. Previous studies conducted over the past twenty years found that weight gain during the first semester of college is a real phenomenon, although subjects gained, on average, less than fifteen pounds. One such study found that college freshmen gain an average of 2.4 to 4.4 lb (680 to 1,020 g) during the first three months, certifying "all-you-can-eat" dining halls, snacking, and fast-food junk food as the primary contributors (Hodge, 1993). A similar study at Dartmouth College found that freshman gain an average of 3.5-4 pounds, an amount considerably greater than that observed in the general population, yet far short of the infamous fifteen (Holm-Denoma, 2008). Such studies served as a model for our investigation of college weight gain and a reference for the many factors that contribute to the freshman fifteen.

The objective of this study was to answer the central question: "Is the freshman fifteen a real phenomenon?" The study attempts to determine which lifestyle factors affect the "freshmen fifteen," as well as the impact of race and gender. It was hypothesized that freshmen at Emory gain on average five pounds in their first semester, contrary to the fabled "freshmen fifteen." The most significant factors affecting weight gain were predicted to be eating frequency and exercise frequency, although eating schedules and stress from the new environment may also play a minor role. Weight gain was thought to be independent of race or gender.

Participants

Eighty college freshmen at Emory participated in the study. The study included twenty students each from the dorms Complex, Evans, Few, and Harris. Subjects included a mix of males and females, various ethnicities, and people from different floors. All participants were selected at random.

Methods

Participants were asked to report their weight prior to starting college, or if unknown, the weight listed on their most recent driver's license. Participants were then weighed at the time they completed the survey as before college. Since coming to college, 18.8% of participants lost weight; the average weight loss of this group was 6.0 lb. Participants were also categorized by weight status according to BMI, a statistical measurement which compares a person's weight and height. It is calculated by taking an individual's body weight in kilograms and dividing by the square of their height in meters. A total of 2 (2.2%) of the 9 participants originally classified as underweight (BMI<18.5) in August were reclassified as normal in November (BMI≥18.5 and <25, respectively). In contrast, all 60 (100%) of participants originally classified as normal remained in the normal weight category. Of the participants classified as overweight in August, 1 (1.1%) lost sufficient weight to be reclassified as normal by February. The average BMI change over all survey years was an increase of 0.42. The average change in weight of those classified as underweight according to BMI was a gain of 3.8 lb. Of participants in the normal range of BMI, there was an average gain of 3.7 lb. The participants in the overweight category according to BMI on average lost 3.8 lb.

The data were analyzed using a Pearson Correlation, testing the strength of the relationship between two variables. Because a combination of many factors contribute to overall weight gain, a strong correlation was defined to be r > 0.1414 (R2 > .02), a moderate correlation between 0.1414 < r < 0.1414 (R2 < .02), and a poor correlation r < 0.1414 (R2 < .01). According to these standards, changes in sleep length, change in happiness, and number of meals at the DUC showed a strong correlation to weight change, while change in stress, change in number of meals, and snack amount exhibited a moderate correlation. The strongest correlation was between weight change and hours of sleep: people getting less sleep in college showed a significant correlation to weight gain during the study period. The average BMI change over all survey years was an increase of 0.42. The average change in weight of those classified as underweight according to BMI was a gain of 3.8 lb. Of participants in the normal range of BMI, there was an average gain of 3.7 lb. The participants in the overweight category according to BMI on average lost 3.8 lb.

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Table 1: Demographics

| Total Number of Participants = 80 |

<table>
<thead>
<tr>
<th>Age</th>
<th>Number of Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-19</td>
<td>58</td>
</tr>
<tr>
<td>20-21</td>
<td>22</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gender</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>46</td>
<td>34</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>White</th>
<th>Black</th>
<th>Asian</th>
<th>Hispanic</th>
</tr>
</thead>
<tbody>
<tr>
<td>49</td>
<td>8</td>
<td>21</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BMI (kg/m²)</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight (&lt; 18.5)</td>
<td>21.9 ± 2.92</td>
<td>21.8 ± 3.94</td>
</tr>
<tr>
<td>Normal (18.5-24.9)</td>
<td>21.0</td>
<td>21.0</td>
</tr>
<tr>
<td>Overweight (25-29.9)</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Obese (≥ 30)</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

| Percent underweight | 2.5% |
| Percent with BMI between 18.5 and 24.9 | 87.5% |
| Percent with BMI ≥25 | 10% |
| Students who exercise less than 4 times per week | 18.8% |
| Students who diet | 15.5% |

Table 2: Pearson Correlations

<table>
<thead>
<tr>
<th>Pearson Correlation (r)</th>
<th>Pearson Correlation</th>
<th>Relationship</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change in Average Weight</td>
<td>0.12</td>
<td>0.11</td>
</tr>
<tr>
<td>Change in BMI</td>
<td>0.20</td>
<td>0.14</td>
</tr>
<tr>
<td>Change in Weekly Sleep</td>
<td>0.05</td>
<td>-0.02</td>
</tr>
<tr>
<td>Change in Happiness</td>
<td>0.03</td>
<td>0.15</td>
</tr>
<tr>
<td>Change in Energy Intake</td>
<td>0.07</td>
<td>0.20</td>
</tr>
<tr>
<td>Amount of College Meals</td>
<td>0.01</td>
<td>0.18</td>
</tr>
<tr>
<td>Negative ECU Use</td>
<td>0.07</td>
<td>0.15</td>
</tr>
</tbody>
</table>

*Change in College eating on scale of 1-9 - high school eating on scale of 1-5

Table 3: No/Yes Correlation Analysis

<table>
<thead>
<tr>
<th>Weight Change</th>
<th>Same Weight Change</th>
<th>Weight Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>58.1%</td>
<td>27.9%</td>
</tr>
<tr>
<td>No</td>
<td>25.3%</td>
<td>30.5%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Equal Weight Intake</th>
<th>20.1%</th>
<th>17.4%</th>
<th>20.1%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>71.9%</td>
<td>71.9%</td>
<td>71.9%</td>
</tr>
<tr>
<td>No</td>
<td>28.1%</td>
<td>28.1%</td>
<td>28.1%</td>
</tr>
</tbody>
</table>

The questionnaire (Appendix 1) obtained detailed information about students' lifestyle related to their eating, sleeping and exercising habits during high school and the first semester of college. Students were also asked to complete a survey regarding their habits in high school and college. All data were entered into a spreadsheet in order to perform calculations including average weight gain, BMI, average change in BMI, and Pearson correlation. Graphs were constructed to visualize linear trends and statistical models; the relationship between a variable and weight gain, were used to augment the data analysis. An analysis of the yes/no questions was also performed by quantifying the percentage of respondents who gained, maintained, and lost weight based on their response to a particular yes/no question.

Survey

The questionnaire included detailed information about students' lifestyle related to their eating, sleeping and exercising habits during high school and the first semester of college. Students were also asked to complete a survey regarding their habits in high school and college. All data were entered into a spreadsheet in order to perform calculations including average weight gain, BMI, average change in BMI, and Pearson correlation. Graphs were constructed to visualize linear trends and statistical models; the relationship between a variable and weight gain, were used to augment the data analysis. An analysis of the yes/no questions was also performed by quantifying the percentage of respondents who gained, maintained, and lost weight based on their response to a particular yes/no question.

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to gain more weight. Several variables had no correlation to weight gain including residence hall, hours of exercise per week, and num-
ber of alcoholic beverages consumed per week.

Although the results were not analyzed using statisti-
cal methods, it is still possible to draw some conclusions from the
data by looking at the percentage of people in each category who
lost, maintained, and gained weight. When comparing individuals
who lost weight to those who gained weight, it appears that those
eating breakfast had no correlation to weight change. However,
when comparing those who gained weight to those who did not
gain weight (a group who lost and maintained their weight),
it becomes evident that breakfast does have an effect on
weight change: those who do not eat breakfast are 7.4% more
likely to gain weight. Consistent eating times appeared to have
no effect on weight change; those who ate at scheduled times gained
weight 71.9% of the time vs. 69.8% for those who did not have a
schedule. Intentionally dieting had a significant impact on weight
change: individuals who do not diet are 11.2% more likely to gain
weight. Health consciousness also showed a strong positive corre-
lation with weight gain: participants who described themselves as
health conscious were 14.4% more likely to gain weight.

Findings and Conclusions

This study examines the weight change of first-year college
students and explores demographic, nutritional, and lifestyle fac-
tors that may have contributed to weight change, and, with current
research, the results of our study indicate that freshman in college gain weight
during their first semester, although the average weight increase is
less than fifteen pounds. Our finding of a 2.85 lbs average gain is slightly
less than the results of other studies which reported average
weight gains of 4.4 lbs, 3.5-4.0 lbs, 5.0 lbs, and 5.0 lbs (Hodge,
increase of the average student was not significant enough to support the findings of Megel et al. (1994) and Levitsky et al.
(2004), such that the average weight increase upon entering col-
erge as a critical period for weight gain: An initial evaluation.
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### Survey

#### Background

<table>
<thead>
<tr>
<th>Age:</th>
<th>Height:</th>
<th>Sex:</th>
<th>Ethnicity:</th>
<th>Dorm/Floor:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Weight (lb):</th>
<th>Now</th>
<th>August, 2008</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**OR**

Change in weight since August 2008 (use + to indicate weight gain and – to indicate weight loss):

<table>
<thead>
<tr>
<th>Weight (lb):</th>
<th>Now</th>
<th>August, 2008</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Lifestyle

<table>
<thead>
<tr>
<th>Hours of sleep on an average weeknight?</th>
<th>College</th>
<th>High school</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hours of sleep per night on an average weekend?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of alcoholic beverages consumed in a given week?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Do you smoke? If so, how many cigarettes per day?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Average level of stress on a scale of 1-5, 1 indicating no stress and 5 indicating great stress?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Emotional state on a scale of 1-5, 1 being happy and 5 being sad</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

#### Diet and Eating Habits

<table>
<thead>
<tr>
<th>How many meals do you eat per day?</th>
<th>College</th>
<th>High school</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- At the DUC?
- At another campus dining facility?

<table>
<thead>
<tr>
<th>Do you eat breakfast?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>How many servings of fruits/veggies per day?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>How many snacks do you eat per day?</th>
<th>College</th>
<th>High school</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- What kind of snacks?

<table>
<thead>
<tr>
<th>What do you typically drink?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Do you eat at consistent times every day?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Do you keep food in your room? If so, what kind of food?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Do you purposely engage in dieting activities?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

#### Exercise

<table>
<thead>
<tr>
<th>How many hours do you exercise in a given week?</th>
<th>College</th>
<th>High school</th>
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<th>What type of exercise?</th>
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<table>
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<tr>
<th>How much time a day would you estimate you spend walking?</th>
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<th>Stairs or elevator?</th>
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#### Free Response

To what extent do you consider yourself to be health-conscious? Has this changed since coming to college?
Title: Freshman 15 in first year students at Emory

Principal Investigator: Diana Woodall, Rahul Varman, Joshua Katz, Jessica Preslar

Sponsor: ORDER class

Introduction and Purpose: You are invited to take part in a research study. The purpose of the study is to research the validity behind the common idea of the Freshman 15 – gaining 15 pounds in the first year of college. Although many students think and worry about this, the point of this experiment is to investigate if there is any support for this conception and determine if there are any trends in weight change. This study is being conducted for the ORDER class, a freshmen seminar at Emory focused on research.

Procedures: You are being asked to fill out this survey to provide information on weight, eating habits, exercise, and other lifestyle habits. This data will then be analyzed to see if freshmen do gain or lose a significant amount of weight and to look for any other trends that may emerge. There will be no further participation beyond the initial survey.

Risks, Discomforts, and Inconveniences: The only known risk to participation is possible breach in confidentiality or possible emotional discomfort at disclosing sensitive personal information. However, all possible precautions will be taken to minimize these risks. You may also choose to stop participating at any point if you become emotionally unsettled.

Benefits: This survey will not benefit you in any immediate way. The information gathered may be used to suggest behaviors or lifestyles that are associated with less weight gain.

Confidentiality: Your name will not be included anywhere in this experiment, associated with your survey or in any other form. The surveys that are collected will be kept by the researchers or the teachers of the ORDER class.

Contact Persons:
Jessica Preslar, researcher:
Email: jpresla@emory.edu
Emory IRB, for problems, questions, complaints, concerns or questions about your rights as a research participant:
Call toll-free at 1-800-503-9797 or (404) 712-0720; email irb@emory.edu; or write to the office at 1599 Clifton Road, Atlanta GA 30322.

It’s Your Choice: You are free to choose whether or not you want to take part in this study. You can change your mind and stop at any time without penalty. This decision will not adversely affect your relationship with the researchers or Emory. It will not affect any benefits you may receive outside of the research. It’s your choice.

Withdrawal: The lead researcher and/or sponsor may withdraw you from the study if they decide that it is in your best interest.
If you are willing to volunteer for this research, please sign below. You do not give up any rights by signing this form. You may keep a copy for your records.”

Subject’s name /Signature  Date  Time

Legally Authorized Representative (if required)  Date  Time

Person Obtaining Consent  Date  Time